Recess socialization and perceptions of school climate by body composition: Evidence from The Green Schoolyard Study in Little Rock, Arkansas

Recess socialization and perceptions of school climate by body composition: Evidence from The Green Schoolyard Study in Little Rock, Arkansas

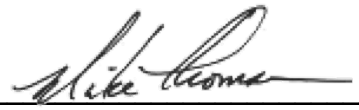
Abstract of thesis submitted in complete fulfillment of the requirements for the degree of Master of Sciences

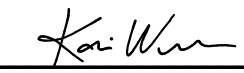
By

Deboleena Thakur
B. Pharma, Birla Institute of Technology, MESRA, Ranchi, India, 2017

2024, MS in Healthcare Data Analytics
University of Arkansas for Medical Sciences

This abstract is approved by:

Dr. Michael R. Thomsen, Ph.D. 

Dr. Kari A. Weber, Ph.D., MHS 

Abstract

Background: This study conducts a cross-sectional analysis using anthropometric data and observations from the System for Observing Children's Activity and Relationships during Play (SOCARP) on elementary school children in The Green Schoolyard Study in Little Rock, Arkansas. The aim is to understand how anthropometrics relate to recess behavior and children's perceptions of school social climate.

Methods: Selected elementary school children (n=162) from two community schools and two comparison schools underwent anthropometric measurements and completed school climate surveys. Associations between BMI categories, physical activity, and socialization skills observed via SOCARP were analyzed.

Results: The study included 162 participants (84 females, 78 males) from four elementary schools, with BMI categories as follows: Healthy Weight (50%), Overweight (18%), Obesity (19%), Severe Obesity (13%). Chi-square tests showed significant associations between BMI category and group dynamics but not with gender or age. No significant associations were found between BMI category and specific aspects of the school climate survey.

Conclusions: Children with severe obesity were observed to be more isolated during recess, engaging less in group activities and interactions. While stigmatization evidence was limited, sample size limitations may have impacted the analysis. Improvements in playground design may be one way enhance experiences for children with severe obesity and promote physical activity during elementary school.

Recess socialization and perceptions of school climate by body composition: Evidence from The Green Schoolyard Study in Little Rock, Arkansas

Recess socialization and perceptions of school climate by body composition: Evidence from The Green Schoolyard Study in Little Rock, Arkansas

A thesis submitted in complete fulfillment of the requirements for the degree of Master of Sciences

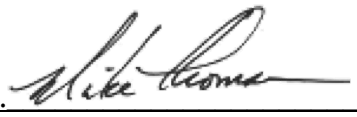
By

Deboleena Thakur
B. Pharma, Birla Institute of Technology, MESRA, Ranchi, India, 2017

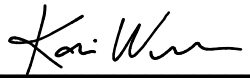
2024, MS in Healthcare Data Analytics
University of Arkansas for Medical Sciences

This thesis is approved for
recommendation to the Graduate Council

Major Professor:

Dr. Michael R. Thomsen, Ph.D. 

Dissertation Committee:

Dr. Kari A. Weber, Ph.D., MHS 

Acknowledgements

I am sincerely grateful to Dr. Michael R. Thomsen for providing me with the opportunity to work on the GSY Study and for his invaluable guidance, support, and expertise throughout this project. His insights and encouragement have been instrumental in shaping this thesis and enriching my overall learning experience. I would also like to express my heartfelt appreciation to Dr. Kari A. Weber for her valuable contributions as a co-reader. Her feedback and constructive criticism have significantly elevated the quality and depth of this work.

I extend my heartfelt gratitude to the GSY team- Dr. Matthew J. Barenie, Dr. Erin K. Howie Hickey, Mr. Chris M. Murphy, Ms. Ciara C. Jenkins, Ms. Amber R. Kaufman and Dr. Stephanie M. Lopez-Neyman, for their unwavering support and invaluable assistance throughout this study, as well as to all the participating schools whose collaboration was essential for the success of this research. Without their contributions, this study would not have been possible. Additionally, I want to express my appreciation to my thesis committee for dedicating their time and providing valuable feedback, which has greatly enriched the quality and depth of this work.

This research was supported by the National Institute on Minority Health and Health Disparities of the National Institutes of Health under award number R01MD018192. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. Funding sources had no role in the writing of this thesis.

Contents

Introduction:

Between 2017 and prior to the onset of the COVID-19 pandemic in 2020, of the 14.7 million children in the U.S., the prevalence of obesity was 19.7% (Stierman et al., 2021). Since then, the number of cases of childhood obesity has increased (Stierman et al., 2021). In 2020, Arkansas documented a 16% prevalence of childhood and adolescent obesity ranking it 15th out of the 50 states and the District of Columbia ("Curbing Childhood Obesity," n.d.)

Childhood obesity, and the occurrence of weight-based stigma, is one of the leading reasons for bullying and discrimination among school children which can start as early as in kindergarten. (Datar et al., 2004) Literature suggests that overweight and obesity in children has been linked to poor academic performance (Datar et al., 2004; Elish et al., 2023), psychological problems leading to behavioral issues like social isolation (Gunnarsdottir et al., 2012), low self-esteem (MacCann & Roberts, 2013), eating disorders (Pont et al., 2017), poor sleep quality due to strained breathing (Tan et al., 2014), and poor physical fitness due to lower physical activity (PA) (Donnelly et al., 2016) impacting overall quality of life. Obesity and related stigma may also impact socioeconomic development in the future (Elish et al., 2023).

Stigmas surrounding abnormal body composition, particularly in the context of overweight and obesity, can have profound effects on a child's physical and mental well-being. Weight-based teasing (WBT) is a prevalent form of stigma that has been linked to adverse physical outcomes such as increased adipose tissue gain among children and adolescents (Schvey et al., 2019). This teasing can contribute to psychological distress, body dissatisfaction, disordered eating behaviors, and a range of mental health issues.

Additionally, WBT may exacerbate existing weight-related health problems, creating a cycle of negative impacts on overall health. According to Haines et al. (2010), the relationship between WBT and health outcomes underscores the need for comprehensive interventions that address both the physical and psychosocial aspects of weight-related stigma (Haines et al., 2010; Schvey et al., 2019). These interventions should aim to reduce WBT and its detrimental effects on the child's health, emphasizing the importance of promoting a supportive and inclusive environment for all children regardless of their body composition.

Children spend a significant amount of time in school. To promote physical and mental development, schools in Arkansas are mandated by state legislation to have 40 minutes of recess daily (Barenie et al., 2023). Whereas the US Department of Human Services recommends 60 minutes of physical activities daily for better health outcomes (Loprinzi et al., 2012). Recess is known to play an important role in improving physical and cognitive development such as improving mobility and developing social skills in children (Prewitt et al., 2019). During recess children get to freely choose between structured and unstructured ways of playing and get 42% of the daily total physical activity, which is greater than their formal physical education class that only provides 32% of physical activity, or after-school programs and activities that only accounts for 26% of the total physical activity (Robert Wood Johnson Foundation, 2007). Since recess provides a more open setting for children to socialize, a variety of interactions can be observed including not only pro-social behavior like collaboration, sportsmanship, or leadership but also lead to anti-social behavior like physical and verbal conflicts, fights and even bullying on the play grounds during recess(O. S. Jarrett, 2002) which can make

it difficult for teachers to conduct normal recess schedules due to delays or cancellations (O. Jarrett & Waite-Stupiansky, 2009).

Through the Green Schoolyard Study, we were able to observe physical activity, assess school social climate, monitor air quality and assess environmental factors that may affect recess, make note of playground structures and equipment available, and observe physical and/or verbal interactions among the children on the school playgrounds during recess. For our study we used a method of conducting 'systematic observations research' or studies conducting observation around physical activity and surroundings called the System for Observing Children's Activity and Relationships during Play (SOCARP). There are other observation options such as the System for Observing Fitness Instruction Time (SOFIT), System for Observing Play and Leisure in Youth (SOPLAY), System for Observing Play and Active Recreation in Communities (SOPARC), Behaviors of Eating and Activity for Children's Health: Evaluation System (BEACHES), and System for Observing Physical Activity and Recreation in Natural Areas (SOPARNA). SOCARP is the ideal method for observing recess socialization for our study, where we look at social interactions on an individual level. SOCARP not only captures movement but also the activity type, activity levels, group size and positive or negative interactions (in physical or verbal form). Each observation can be validated by comparing the inter-coder values or by taking the means of the number of total observations per participant. (McKenzie, n.d.)

There are not many studies that have used the SOCARP method of observation to evaluate physical activity, play and social interactions. To date there are only seven studies published (April 2024) that address the use of SOCARP in their study, like the

development and validation of the SOCARP tool for studying physical activity and play behavior during recess by Ridgers, McKenzie, et al. (2010). Ridgers, Fairclough, et al. (2010) identified several factors influencing children's physical activity levels during recess, including gender, access to play equipment, temperature, and the size of the activity area. Wahl-Alexander & Morehead's (2020) research delved into children's physical activity levels, social play behavior, activity duration, and social interactions during unstructured periods, shedding light on important aspects of children's play habits. Coolkens et al. (2018) investigated the impact of supervised versus organized recess on children's participation, physical activity levels, play patterns, and social behaviors, contributing valuable insights to the discussion on effective recess management. Naish et al.'s community-based intervention, Play Hubs, implemented during the COVID-19 pandemic in Calgary, Canada, aimed to promote unstructured play among children by providing loose parts in parks, highlighting innovative strategies to encourage physical activity during challenging times. Pollard et al. (2012) conducted a study focusing on physical activity levels during school recess among British Pakistani girls aged 9-11 compared to White British girls, emphasizing the importance of addressing activity disparities among specific ethnic groups to enhance overall physical activity among schoolchildren. Zarrett et al. (2020) conducted a formative process evaluation of the Connect program, designed to foster a positive social climate for physical activity in after-school programs, highlighting the significance of formative evaluations in refining intervention strategies for maximum effectiveness.

Through this study we are aiming to find out any significant relationships between body composition, recess socialization, and perceptions of school climate, using

anthropometric, school climate survey responses and SOCARP observation data collected during May 2023 from the GSY Study (Barenie et al., 2024).

Objective:

The objective of this study was to investigate the relationship between children's social interactions during recess and their perceptions of the school social climate, particularly focusing on potential stigmatic behaviors related to body composition. The study delved into the intricate relationship between children's social interactions during recess and their perceptions of the school climate, specifically exploring how these dynamics vary based on body composition. The study utilized data from the assent sign-ups for the study participants and collected primary data on verbal and physical interactions among elementary school children (grades K to 5) during recess using the System for Observing Children’s Activity and Relationships during Play (SOCARP) method. Simultaneously, perceptions of the school social climate were assessed through a survey questionnaire consisting of 19 questions, completed by upper-grade students (grades 3 to 5). By comparing the responses in the school social climate survey with the SOCARP data, the study aimed to identify any correlations or markers that could shed light on how children's experiences during recess might influence their perceptions of the school environment. This investigation seeks to bridge the gap between observable social interactions during playtime and the subjective perceptions of the school climate, offering a comprehensive understanding of the factors influencing children's social experiences and well-being in school settings.

Methodology:

Study Sign-up Process

The Green Schoolyards initiative was supported by Cities Connecting Children to Nature (CCCN), an initiative of the National League of Cities and the Children & Nature Network, and implemented by the Little Rock School District and the city of Little Rock where the goal was to promote increased physical activities among community school children, especially in regions with lower socioeconomic status (SES) in the US, by improving the surrounding areas and introducing more green spaces. Around 27 cities participated in the Green Schoolyards Technical Assistance Cohort out of which only 10 cities were selected. Little Rock, Arkansas was one of them (Children and Nature Network, 2021). An evaluation of the Little Rock initiative is funded by the National Institutes of Health (NIH) through the National Institute on Minority and Health Disparities (NIMHD). Participating schools include two schools who will be undergoing green schoolyard improvements and two demographically-matched comparison schools. Each is a K-5 elementary school in the Little Rock School District. The Center for the Study of Obesity at the University of Arkansas for Medical Sciences (UAMS) applied for the NIMHD grant to conduct the research evaluation process for this initiative and was approved by the University of Arkansas for Medical Sciences Institutional Review Board (IRB protocol #274741). and Little Rock School District IRB to conduct the study in the four schools.

We distributed study flyers in school car rider lines after hours, obtained permission from the school principal to distribute study materials to classroom teachers for inclusion in take-home folders, and engaged in community school events to promote

the study while offering assistance at the events. Parents who signed up for the study were then contacted with information and a link to access the study. Upon signing up, each parent received a confirmation email outlining our plans to visit the school, ensuring they were aware of our upcoming visit. During our school visits, we met with the consented children, explained the study to them thoroughly, and ensured they understood it before asking if they were interested in participating. We emphasized that participation was voluntary. If a student chose to participate, we first obtained their assent, confirmed their personal details such as name, grade, age, and birth month, and then with the help of stadiometer we collected anthropometric data including height (in centimeters), a digital balance for the weight (in kilograms), and a digital measuring tape for the waist circumference (in inches) twice for accuracy (see Fig 1). For students in grades 3 to 5, they had the option to take the school social climate survey.

Fig 1. The stadiometer (Detecto™) used to check the child's height (in centimeters); Digital weighing scale (Tanita™) to measure the weight of the child (in kilogram); Digital measuring tape (Renpho™) used for measuring the waist circumference (in inches).

Additionally, we provided information about the accelerometer (Actigraph™ GT9X) (see Fig 2.) a non-invasive device which they wore around their waist for 7 days including while asleep. We also supplied an instruction sheet with a log for tracking each time the device was removed. To recognize their time and effort, we provided a monetary incentive and two tickets to local attractions (Little Rock Zoo or Museum of Discovery).

The School Social Climate Survey

To understand the school social climate, a survey questionnaire was designed using validated questions from the US Department of Education's National Center on Safe and Supportive Learning Environments to get a better understanding about the school environment, feelings of safety, recess experiences and expectations, play equipment provided, and environmental effects on play etc., that may affect the physical activity of children. The survey was conducted among the children in grades 3 to 5 who are believed to have a better ability to comprehend the questions than students in grade 2 and below (US Department of Education, 2024). The survey comprised a total of 19 questions that might take less than 10 minutes to complete. The study participants were assured by our team that their survey responses were strictly confidential and remained between the student and the approved study team members. The students were also given a choice between reading the questions themselves or get it dictated by the study team member assisting them in the process. While we checked that the survey was complete, no student was required to answer a question if they did not wish to do so.

Anthropometric Data Collection

For monitoring the physical activity of the participating students, the initial step was to create an anthropometric data sheet to understand the current body compositions like height (in centimeters), weight (in kilograms), and the waist circumference (in inches) of the participant. The height is collected using a stadiometer, the weight is used measured using a digital weighing scale, and the waist circumference was measured twice using a digital measuring tape for precision. Also, for conducting analysis and to link to our

records, each data sheet also comprises the student's Study ID, grade, sex, race, ethnicity, age, birth month, along with the section for accelerometer device number for monitoring the physical activity levels of the individual linked to their device and the choice of tickets (Little Rock Zoo or Museum of Discovery) they would like as a part of compensation for their participation in the study.

Fitting of the Accelerometer Device

The accelerometer (Actigraph™ GT9X) is a non-invasive device that is used in the study to monitor movement, activity levels and sleep. The device used in the study does not connect to the internet or cloud and the data stored within can only be accessed by the IRB approved study team members.

After collecting the anthropometric data, the child is fitted with the accelerometer device around their waist using an adjustable sized belt. Each device is set up to start tracking movement once it is 2:30pm and lasts indefinitely till its battery dies. Each device has a long battery life of almost two weeks but since we monitor the children for only 7 days, we collect the device from the student the following week in exchange for the rewards.

Fitting the accelerometers was an important part of the consent process and is thus reported as part of the methods of this thesis. However, that data being collected by the accelerometers will be analyzed as part of the larger four-year study and is not being analyzed and reported here.

Fig 2. The accelerometer device model (ActiGraph GT9X) that was used in the study.

SOCARP Data Collection

During the SOCARP data collection phase, we observed the selected population, who had consented by signing the assent form, during their recess period. To facilitate this, we utilized an in-house R-Shiny application (see Fig 3.) designed specifically for collecting SOCARP data. This tool recorded various parameters such as the participant's ID, Coder ID, Activity level, Activity type, Group size, and Interactions at 10-second intervals over a 1-minute period (resulting in 6 intervals). This method allowed us to track the child's movement and activity levels during the observation period, as well as observe their physical and verbal interactions with others during recess.

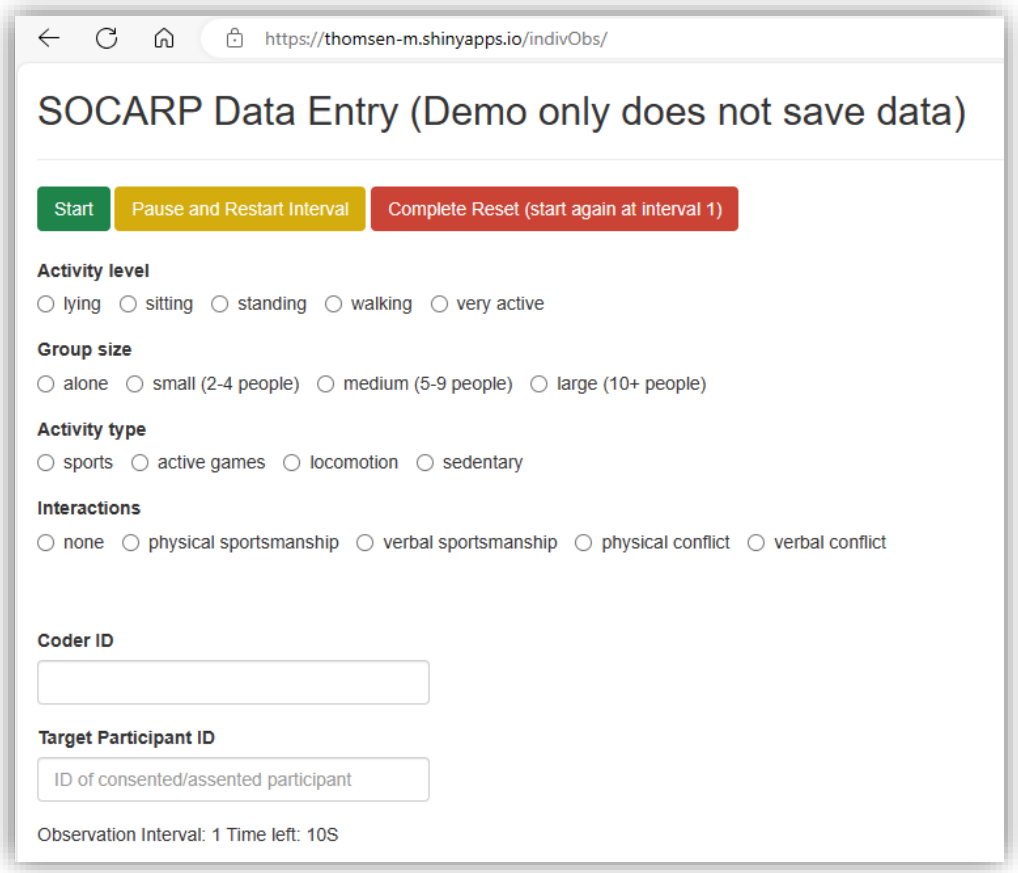


Fig 3.- The SOCARP R-Shiny application used for observing the physical activity and social interaction during recess. (Link to app: https://thomsen-m.shinyapps.io/indivObs/)

Analysis of the Study Data

A comprehensive cross-sectional analysis was conducted using the raw study data. For the analysis, the preferred choice of software, RStudio version R.4.3.1, was used. All required packages to support the statistical analysis and data visualization were installed. The raw data collected from the Green Schoolyard Study was uploaded from Research Electronic Data Capture portal (REDCap) and then processed to make it fit for analysis, followed by filtering out specific variables that are required for the project and all identifiers like name of the participant, resident address, and contact details, etc. were

removed as per the IRB protocols to maintain the anonymity of the study subjects. The data were further carefully studied for any possible human errors that were made during observation collection such as missing values due to short or unexpected interference during the recess period, duplicate data caused by accidental repeated entry, or due to server issues leading to multiple attempts to feed the same data, and incorrect data entry such as lack of uniformity in the format of coder initials entered, etc., were fixed to improve the data quality. The complete table of data was further filtered into smaller data frames by including specific filters which were used for analyzing the school social climate survey, the anthropometric data for body composition, and recess socialization data collected using SOCARP during observation collection for the study.

The responses from the school climate survey were plotted to get insight into the child's perspective of how they perceive the school, their teacher, the recess schedule, the playground area, and whether enough equipment is available to them. The data were visualized for each survey question using the *ggplot* function, and the responses were measured by age (approximately 4 to 11 years), gender (Male and Female), and by grades (3 to 5 grade).

Results:

Sample Data

The data collected through the assent sign-up process took place from May 2023 onward where a total of 243 records of study participants in total (as of 28 February 2024) were collected. The overall data is further filtered to information limited to the study identification number, the anthropometric data in metrics unit (height in centimeters,

weight in kilogram, and waist circumference in inches), survey responses that were answered by grades 3 to 5 in our four participating schools, school (names are concealed for data privacy reasons), gender, grades, and age in months. After removing missing data and fixing the errors, the new dataset has 162 observations out of which we have 84 Females (51.85%) and 78 Males (48.14%) participants in total from all four elementary schools enrolled in the study.

The data was further filtered by grade, gender, school, survey questions, body composition and systemic observation of study participants using SOCARP. By grades the data was divided into two groups- lower grade (K to 2) that had a total of 82 (50.62%) students comprising 44 Females (53.7%) and 38 Males (46.3%), and upper grade (3 to 5) having 80 (49.38%) students comprising 40 Females and 40 Males (50 % each) from all four participating schools. After that, school wise count (A= 28, B= 40, C= 50, D= 44) along with the percentage was checked (A= 17.28%, B= 24.69%, C= 30.86%, D= 27.16%) where school C had the highest participation (50 or 30.86%) among all four schools (Fig 4.).

After that we checked the total count and percentage of Males and Females participated in each school and the total Males and Females participating from each grade in all four schools (see Table 1 and 2.).

School	Gender	Count	Percentage (%)
A	Female	16	57.10
A	Male	12	42.90
B	Female	20	50.00
B	Male	20	50.00
C	Female	24	48.00
C	Male	26	52.00
D	Female	24	54.50

D	Male	20	45.50

Table 1: School-wise count and percentage of Males and Females

Grade	Gender	Count	Percentage (%)
1	Female	13	48.10
1	Male	14	51.90
2	Female	13	50.00
2	Male	13	50.00
3	Female	12	44.40
3	Male	15	55.60
4	Female	17	53.10
4	Male	15	46.90
5	Female	11	52.40
5	Male	10	47.60
K	Female	18	62.10
K	Male	11	37.90

Table 2: Grade-wise count and percentage of Males and Females from all the schools

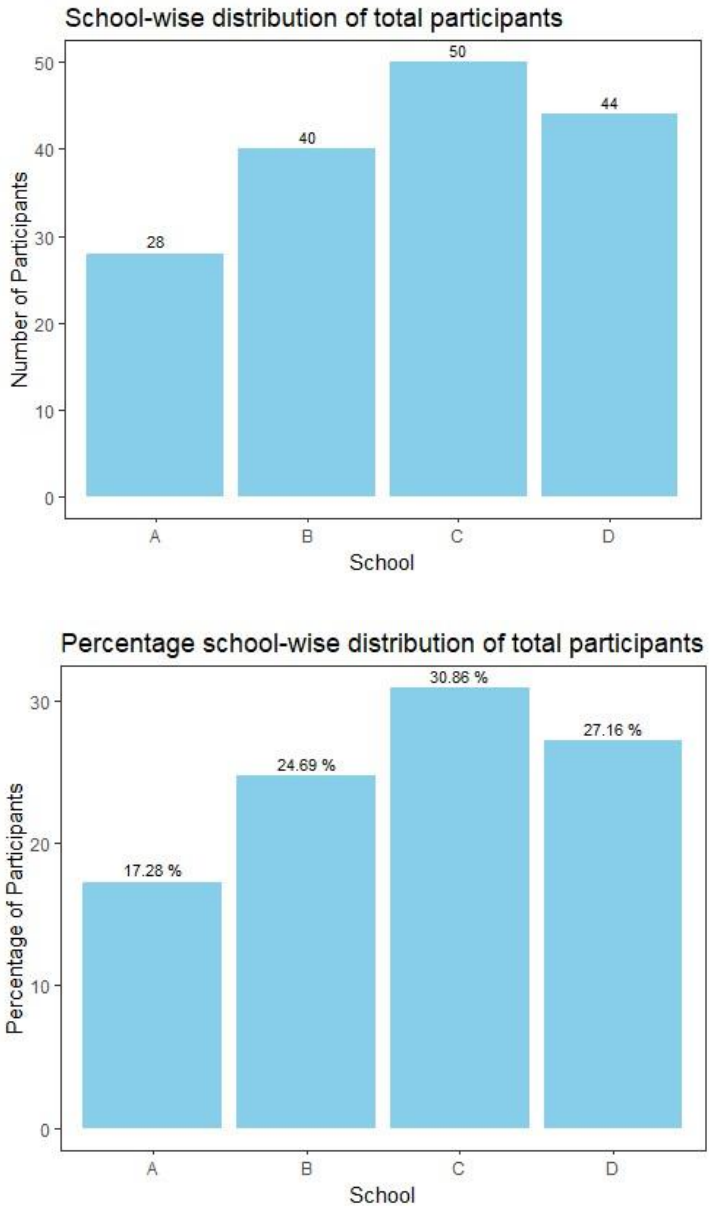


Fig 4.- Total number of students by count and percentage used in the study from each school.

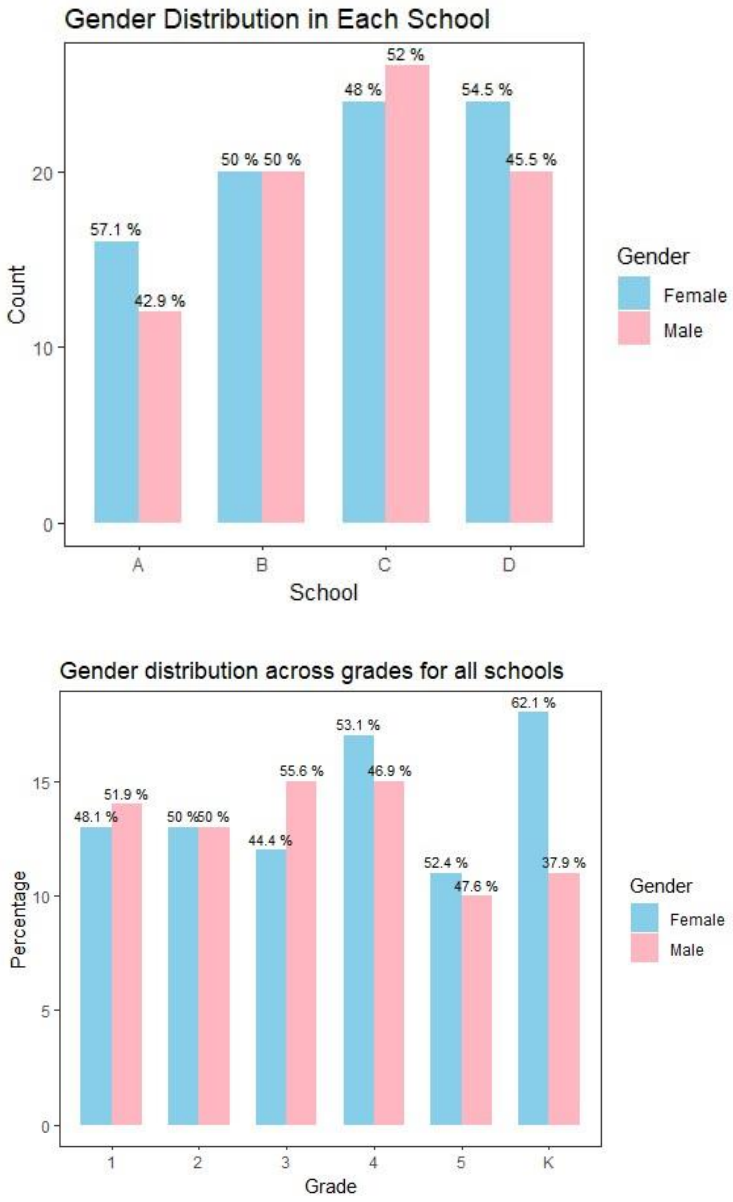


Fig 5.- Percentage school-wise distribution of students by their gender; Grade-wise (Kindergarten to 5) percentage distribution of participants used in the study from all the schools.

Survey Questions Data

Survey responses collected from the school climate surveys comprising upper grade students (3 to 5) from the four participating schools was further studied. The total population (N=80) was then calculated to check the count and percentage each response

(Strongly Agree=1, Agree=2, No opinion=3, Disagree=4, Strongly Disagree=5) by gender for each of the 19 survey questions (see Table 3. below).

Survey questions	Gender	1	2	3	4	5
Q1. At this school, boys and girls are treated equally well.	F	35.00	42.50	2.50	5.00	15.00
	M	41.03	33.33	7.69	10.26	7.69
Q2. My teachers care about me.	F	55.00	35.00	5.00	0.00	5.00
	M	61.54	23.08	10.26	5.13	0.00
Q3. It is easy to talk with teachers at this school.	F	37.50	37.50	10.00	10.00	5.00
	M	43.59	46.15	5.13	2.56	2.56
Q4. Students at this school get along well with each other.	F	2.50	20.00	22.50	35.00	20.00
	M	10.26	10.26	33.33	25.64	20.51
Q5. There are lots of chances for students at this school to get involved in sports, clubs, and other school activities outside of class.	F	50.00	32.50	12.50	0.00	5.00
	M	42.11	47.37	5.26	5.26	0.00
Q6. I am happy at this school.	F	50.00	37.50	5.00	5.00	2.50
	M	44.74	36.84	7.89	10.53	0.00
Q7. I feel like I have friends at this school.	F	57.50	32.50	5.00	2.50	2.50
	M	65.79	31.58	2.63	0.00	0.00
Q8. I feel safe at this school.	F	37.50	52.50	7.50	2.50	0.00
	M	45.95	35.14	10.81	2.70	5.41
Q9. I feel safe going to and from this school.	F	48.72	38.46	7.69	2.56	2.56
	M	43.24	40.54	5.41	8.11	2.70
Q10. The school grounds and playgrounds are kept clean and in working order	F	10.00	40.00	20.00	25.00	5.00
	M	35.14	27.03	10.81	13.51	13.51
Q11. The school grounds and playgrounds have many different things to play on (swings, slides, climbing).	F	45.00	40.00	0.00	12.50	2.50
	M	48.65	43.24	2.70	2.70	2.70
Q12. The school grounds and playgrounds have a lot of balls (soccer balls/basketballs), jump ropes, blocks and game equipment for us to play with.	F	35.00	35.00	12.50	12.50	5.00
	M	45.95	40.54	2.70	10.81	0.00
Q13. The school grounds and playgrounds have enough space for all activities we would like to play.	F	52.50	37.50	7.50	2.50	0.00
	M	54.05	35.14	5.41	2.70	2.70
Q14. At school, how much do you enjoy being active/playing at recess?	F	65.00	22.50	12.50		
	M	54.05	40.54	5.41		
	F	55.00	27.50	5.00	7.50	5.00

Q15. I would have more fun on the playground at recess if my friends were doing activities too.	M	59.46	29.73	8.11	2.70	0.00
Q16. At school, how much do you enjoy playing with sporting equipment (example: basketball or soccer)?	F	37.50	35.00	15.00	10.00	2.50
	M	42.11	42.11	2.63	10.53	2.63
Q17. At school, how much do you enjoy playing with playground equipment (example: jungle gym, slides, swings)?	F	47.50	45.00	5.00	2.50	
	M	52.63	42.11	0.00	5.26	
Q18. At school, how much do you enjoy playing on the grassy areas with more natural things such as trees, rocks, and garden area?	F	37.50	30.00	12.50	20.00	0.00
	M	34.21	44.74	2.63	10.53	7.89
Q19. After outside recess, I feel more energized to learn at school.	F	50.00	25.00	20.00	2.50	2.50
	M	39.47	34.21	10.53	13.16	2.63

Table 3. Percentage gender-based responses for Q1 to Q19 of the school climate survey, where 1= Strongly Agree, 2= Agree, 3= No opinion, 4= Disagree, and 5= Strongly Disagree

Anthropometric Data

The main dataset also includes anthropometric data such as height in centimeters, weight in kilograms, and waist circumference in inches. BMI was calculated for each participant using the standard formula of weight in kilograms divided by height in meters squared (kg/m^2). Additionally, LMS values were obtained from a CSV file provided by the CDC, which were then used to compute BMI Z-scores and P95 percentiles following the CDC growth chart guide The BMI values of participants were categorized based on WHO guidelines and CDC growth chart percentiles. Three participants were underweight; therefore, the decision was made to exclude three cases categorized as "Underweight" due to the small sample size in this category. Analyzing data with such a limited number of cases can present challenges in obtaining statistically significant results and meaningful insights. By removing these cases, we aimed to enhance the reliability and

robustness of our analysis, focusing on more substantial trends within the data. After this exclusion, the updated distribution of BMI categories in our dataset is as follows (see Fig. 6):

- Healthy Weight: 80 individuals (50%)
- Overweight: 28 individuals (18%)
- Obesity: 30 individuals (19%)
- Severe Obesity: 21 individuals (13%)

This adjustment allowed us to concentrate on more meaningful patterns and relationships within the data while ensuring the statistical integrity of our analysis.

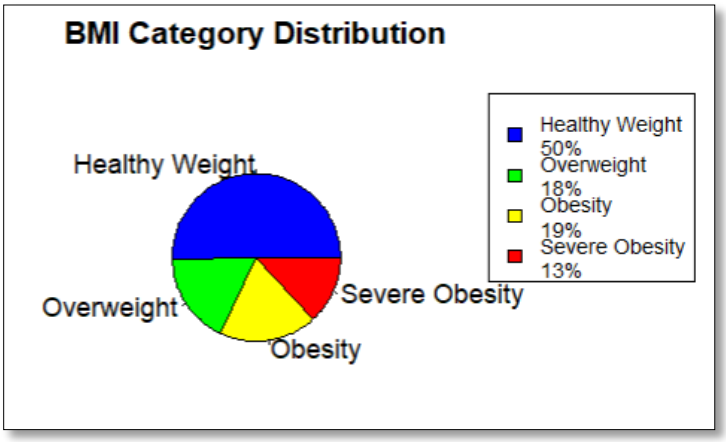


Fig 6. The percentage population distribution of participants in each BMI category.

After excluding the underweight population, we again checked the total participants from each school followed by the number and percentage of Females and Males in each school [A= 27 (M=12, F=15), B= 33 (M=16, F=18), C= 42 (M=20, F=22), D= 39 (M=18, F=21)] (see Fig 7.)

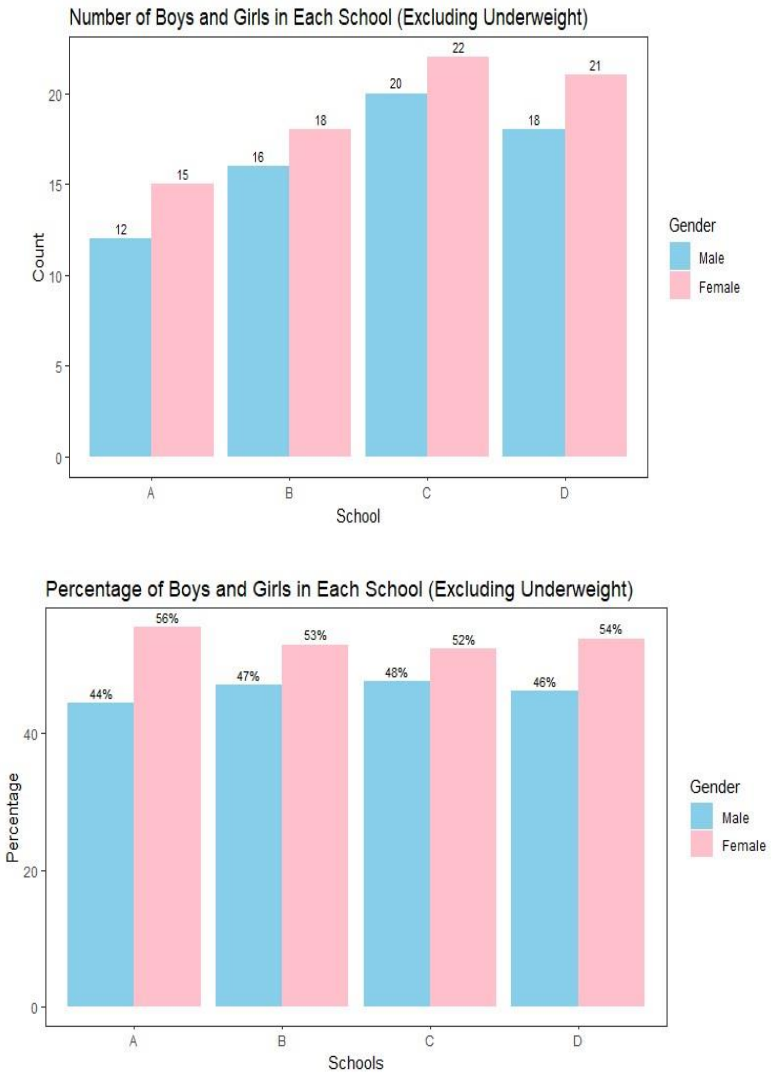


Fig 7. Number and percentage of boys and girls (excluding underweight population) in each school.

Next, we checked the total number and percentage of students falling under each of the BMI category by each school to understand the population belonging to healthy weight and unhealthy weight category (see Table 4 and Fig. 8).

BMI Category	School A	% A	School B	% B	School C	% C	School D	% D
Healthy Weight	14	52.00	18	53.00	22	49.00	19	48.00
Unhealthy Weight	13	48.00	16	47.00	23	51.00	21	52.00

Table 4. Number and percentage of participants falling in each of the BMI category by school.

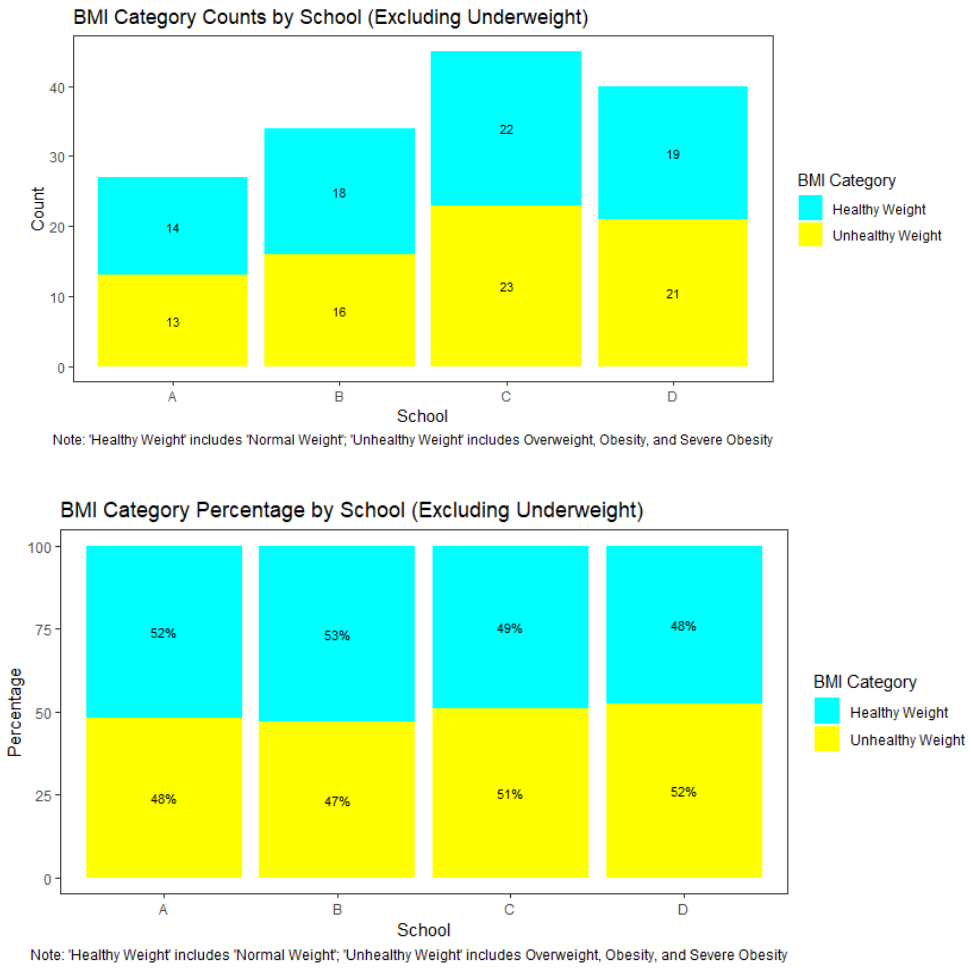


Fig 8. The total population count and percentage from each school segragated by their BMI category

Testing for Associations Using Chi Square Tests

Checking for any significant association between factors like Gender and Age to BMI Category analysis: The analysis of gender's relationship with BMI categories using Pearson's chi-squared test and Fisher's exact test did not find a significant association. The contingency table grouped Healthy Weight, Obesity, Overweight, and Severe Obesity counts by male (Gender = 1) and female (Gender = 2) participants. Pearson's chi-squared test resulted in a chi-squared statistic of 2.27 with 3 degrees of freedom, yielding a p-value of 0.5183. Similarly, Fisher's exact test gave a p-value of 0.5274. Both tests suggest that the observed BMI category distribution among genders did not differ significantly from chance. Thus, there's insufficient evidence to reject the null hypothesis of independence between gender and BMI categories in this dataset. Similarly, the analysis comparing age and BMI categories using Pearson's chi-squared test did not find a significant relationship. The contingency table showed counts for Healthy Weight, Obesity, Overweight, and Severe Obesity across different age groups ranging from 4 to 11 years. The chi-squared test resulted in a statistic of 22.886 with 24 degrees of freedom and a p-value of 0.5265, indicating no strong evidence to reject the null hypothesis of independence between age and BMI categories. Thus, age does not seem to be significantly associated with BMI category in this dataset.

SOCARP Data Analysis

The SOCARP dataset was analyzed, starting with data consolidation from multiple CSV files and standardizing variables like coder initials, student IDs, and categorical data for consistency. The data was carefully studied in R and further cleaned to ensure high-quality data. From our data, we found out that a total of 152 unique student IDs were

observed using SOCARP out of the total 162 students used in this study. The remaining 10 students were not observed as they left their respective school districts or were not available during the period of data collection. Furthermore, the SOCARP dataset and the "GSYData," comprising anthropometric data, were merged to analyze if there are any significant effects of body composition on physical activity and social interactions, providing comprehensive insights into children's behaviors. A Chi-square test was performed on the merged dataset combining SOCARP and survey data to assess the significance between two chosen categorical variables. Additionally, a cross-table analysis was conducted between BMI categories and SOCARP variables to determine their significance.

Chi Square Test Between Group Size and BMI Category. The Chi-square test between Group Size and BMI Category yielded a Pearson's chi-squared value of 201.85 with 12 degrees of freedom, resulting in a p-value of < 2.2e-16, indicating a highly significant relationship between these variables. Similarly, a Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates) produced a p-value of 0.0004998, further supporting the significant association between Group Size and BMI Category. These statistical tests revealed strong evidence of an association between body composition (BMI category) and group size among the observed participants, providing valuable insights into the interplay between physical characteristics and social dynamics during recess activities.

	Healthy Weight	Obesity	Overweight	Severe Obesity	Row total
not reported	88	30	19	29	166
Alone	451	114	152	154	871
Large	35	64	35	33	167
Medium	299	198	122	34	653
Small	1088	330	398	242	2058
column total	1961	736	726	492	3915

Table 5: Contingency table for Group size vs BMI category

Chi Square Test Between Activity Level and BMI Category. For this analysis, we combined the subcategories under Activity Level—lying, sitting, and standing—into one called "sedentary" because the number of instances was too small for significant results. The chi-square test conducted between Activity Level and BMI Category resulted in a Pearson's X-squared value of 70.194 with 9 degrees of freedom, indicating a highly significant association (p-value = 1.395e-11). Similarly, Fisher's exact test also showed a significant p-value of 0.0004998. These results suggest a strong relationship between children's activity levels and their BMI categories, emphasizing the importance of physical activity in influencing BMI outcomes among children.

	Healthy Weight	Obesity	Overweight	Severe Obesity	Row total
not reported	71	27	18	21	137
Sedentary	660	208	225	209	1302
very active	804	335	346	128	1613
Walking	426	166	137	134	863
column total	1961	736	726	492	3915

Table 6: Contingency table between Activity level and BMI category

Chi Square Test Between Activity Type and BMI Category. The chi-square test conducted between Activity Type and BMI Category resulted in a Pearson's X-squared value of 659.89 with 12 degrees of freedom, indicating an extremely significant association (p-value < 2.2e-16). Fisher's exact test also showed a highly significant p-value of 0.0004998. These results suggest a strong relationship between different types of activities and BMI categories among children, emphasizing the impact of various activities on BMI outcomes.

	Healthy Weight	**Obesity**	**Overweight**	**Severe Obesity**	**Row total**
not reported	111	44	26	36	217
Games	541	226	322	123	1212
Locomotion	794	152	216	168	1330
Sedentary	471	120	149	147	887
Sports	44	194	13	18	269
column total	1961	736	726	492	3915

Table 7: Contingency table between Activity type and BMI category

Chi square test between Interactions and BMI Category. The types of interactions, namely physC (physical conflict), physS (physical sportsmanship), verbC (verbal conflict), and verbS (verbal sportsmanship), were combined into broader categories of "conflict" and "sportsmanship" due to the limited number of instances in each subcategory. Combining these subcategories helps to ensure a more robust analysis by aggregating data into larger groups, thereby increasing the statistical power and reliability of the results. This approach is often taken in data analysis when the sample size for individual categories is too small to yield meaningful insights or statistical significance on its own. By consolidating these subcategories, we can still capture the essence of

physical and verbal interactions while avoiding potential issues associated with sparse data.

The chi-square test conducted between Interactions and BMI Category resulted in a Pearson's X-squared value of 39.046 with 9 degrees of freedom, indicating a significant association (p-value = 1.13e-05). Fisher's exact test also showed a highly significant p-value of 0.0004998. These results suggest that there is a statistically significant relationship between different types of interactions (none, conflict, sportsmanship) and BMI categories among children.

	Healthy Weight	**Obesity**	**Overweight**	**Severe Obesity**
not reported	188	64	62	56
None	719	265	256	221
Conflict	61	32	21	29
sportsmanship	993	375	387	186

Table 8: Contingency table between Interactions and the BMI category.

Testing for association between BMI category and the school social climate survey using Chi Square test

Ultimately, we explored the connection between BMI category and specific inquiries from the school's social climate survey using a Chi-Square test to investigate potential correlations. From the overall set of 19 questions, we focused on 11 that had a positive and negative response element to them, facilitating clearer interpretation of our analysis. The survey questions that were used were:

1. At this school, are boys and girls treated equally well?

2. Do my teachers care about me?
3. Is it easy to talk with teachers at this school?
4. Do students at this school get along well with each other?
5. Are there lots of chances for students at this school to get involved in sports, clubs, and other school activities outside of class?
6. Are you happy at this school?
7. Do you feel like you have friends at this school?
8. Do you feel safe at this school?
9. Do you feel safe going to and from this school?
10. Do the school grounds and playgrounds have enough space for all activities you would like to play?
11. After outside recess, do you feel more energized to learn at school?

Further, this involved conducting a data filtering process to concentrate on students in grades 3, 4, and 5 from the school social climate survey dataset. The selected questions pertained to various aspects of school experience, including teacher-student relationships, peer interactions, feelings of safety, and engagement in school activities. Answers to all school social climate questions are reported by gender in the appendix.

Chi Square Test Between BMI Category and Selected School Climate Survey Questions.

Q1) The Chi-square test was performed to analyze the association between BMI category and students' perceptions of gender equality at school. The contingency table revealed frequencies indicating the number of students falling under different BMI categories who either disagreed or agreed that boys and girls are treated equally well at school. The

results showed that among healthy-weight students, 8 disagreed and 26 agreed with the statement, while among unhealthy-weight students, 11 disagreed and 32 agreed. The Chi-square test statistic resulted in a value of 0 with a p-value of 1, suggesting no significant association between BMI category and this specific survey question. Similarly, the Fisher's Exact Test showed a p-value of 1, indicating no significant difference in the odds ratio between BMI categories regarding perceptions of gender equality at school.

	Disagree	**Agree**	**Row total**
Healthy Weight	8	26	34
Unhealthy Weight	11	32	43
Column total	19	58	77

Table 9: Contingency table between BMI category and survey Q1.

Q2) The chi-square test performed between BMI Category and the question "Do my teachers care about me?" indicates no significant association. In the contingency table, responses are evenly distributed across BMI categories, with 4 participants from the "Healthy Weight" category and 6 participants from the "Unhealthy Weight" category disagreeing, while 30 and 37 participants, respectively, agreed. Pearson's chi-squared test produced an X-squared value of 0.080495 with 2 degrees of freedom and a p-value of 0.9606, suggesting no significant relationship between BMI Category and this question. Similarly, Fisher's exact test resulted in a p-value of 1, further confirming that there is no significant association between these variables.

	Disagree	**Agree**	**Row total**
Healthy Weight	4	30	34
Unhealthy Weight	6	37	43
Column total	10	67	77

Table 10: Contingency table between BMI category and survey Q2.

Q3) The chi-square test conducted between BMI Category and the question "At this school, boys and girls are treated equally well" does not reveal a significant association. The contingency table shows a distribution of responses across BMI categories, with 8 participants from the "Healthy Weight" category and 11 participants from the "Unhealthy Weight" category disagreeing, while 26 and 32 participants, respectively, agreed. Pearson's chi-squared test with Yates' continuity correction resulted in an X-squared value of 0 with 1 degree of freedom and a p-value of 1, suggesting no significant relationship between BMI Category and this survey question. Similarly, Fisher's exact test yielded a p-value of 1, further supporting the conclusion that there is no significant association between these variables.

	Disagree	**Agree**	**Row total**
Healthy Weight	8	26	34
Unhealthy Weight	11	32	43
Column total	19	58	77

Table 11: Contingency table between BMI category and survey Q3.

Q4) The chi-square test conducted between BMI Category and the question "Do students at this school get along well with each other?" indicates no statistically significant association. The contingency table displays 28 participants in the "Healthy Weight" category and 33 participants in the "Unhealthy Weight" category disagreed, while 6 and 10 participants, respectively, agreed. Pearson's chi-squared test with Yates' continuity correction resulted in an X-squared value of 0.10211 with 1 degree of freedom and a p-value of 0.7493, suggesting no significant relationship between BMI Category and this

question. Additionally, Fisher's exact test yielded a p-value of 0.5855, supporting the conclusion that there is no significant association between these variables.

	Disagree	Agree	Row total
Healthy Weight	28	6	34
Unhealthy Weight	33	10	43
Column total	61	16	77

Table 12: Contingency table between BMI category and survey Q4.

Q5) The chi-square test conducted between BMI Category and the question "Are there lots of chances for students at this school to get involved in sports, clubs, and other school activities outside of class?" indicates no significant association. The contingency table demonstrates a similar pattern of responses across BMI categories, with 15 participants from the "Healthy Weight" category disagreeing and 8 agreeing, while 27 and 11 participants from the "Unhealthy Weight" category, respectively, provided the same responses. The Pearson's chi-squared test resulted in an X-squared value of 0.036756 with 1 degree of freedom and a p-value of 0.848, indicating no significant relationship between BMI Category and this question. Similarly, Fisher's exact test yielded a p-value of 0.7765, further supporting the conclusion that there is no significant association between these variables.

	Disagree	Agree	Row total
Healthy Weight	3	31	34
Unhealthy Weight	8	34	42
Column total	11	65	76

Table 13: Contingency table between BMI category and survey Q5.

Q6) The chi-square test conducted between BMI Category and the question "Students at this school get along well with each other" shows no significant association. The contingency table indicates a similar pattern of responses across BMI categories, with 28 participants from the "Healthy Weight" category disagreeing and 6 agreeing, while 11 and 4 participants from the "Obesity" category, respectively, provided the same responses. Likewise, 13 and 3 participants from the "Overweight" category, and 8 and 3 participants from the "Severe Obesity" category, respectively, agreed and disagreed.

The Pearson's chi-squared test resulted in an X-squared value of 0.8288 with 3 degrees of freedom and a p-value of 0.8426, indicating no significant relationship between BMI Category and this question. Fisher's exact test yielded a p-value of 1, further supporting the conclusion that there is no significant association between these variables.

	Disagree	**Agree**	**Row total**
Healthy Weight	3	30	33
Unhealthy Weight	9	34	43
Column total	12	64	76

Table 14: Contingency table between BMI category and survey Q6.

Q7) The chi-square test between BMI category and the feeling of having friends at school (survey Q7) yielded a Pearson's chi-squared value of 1.539 with 1 degree of freedom and a corresponding p-value of 0.2148. This result suggests that there is no significant association between BMI category and the feeling of having friends at school. Similarly, the Fisher's exact test produced a p-value of 0.1602, indicating no significant difference in the odds of feeling like having friends at school between different BMI categories. The contingency table shows that among those in the healthy weight category, 4 disagreed and 29 agreed with the statement, while in the unhealthy weight category, 1 disagreed

and 42 agreed. Overall, the statistical tests suggest that BMI category and the feeling of having friends at school are not strongly associated in this dataset.

	Disagree	Agree	Row total
Healthy Weight	4	29	33
Unhealthy Weight	1	42	43
Column total	5	71	76

Table 15: Contingency table between BMI category and survey Q7.

Q8) The Chi-square test between BMI category and feeling safe at school showed no statistically significant association (X-squared = 1.1914, df = 1, p-value = 0.275). Similarly, the Fisher's exact test also did not indicate a significant relationship (p-value = 0.1966). This suggests that there is no strong evidence to reject the null hypothesis, indicating that BMI category and feeling safe at school are not significantly associated in this dataset. The odds ratio estimated from Fisher's exact test is 2.53 (95% CI: 0.57 to 13.01), indicating a slight increase in the odds of feeling safe for the unhealthy weight group compared to the healthy weight group, but this difference is not statistically significant.

	Disagree	Agree	Row total
Healthy Weight	7	26	33
Unhealthy Weight	4	38	42
Column total	11	64	75

Table 16: Contingency table between BMI category and survey Q8.

Q9) The chi-square test conducted to analyze the relationship between BMI category and feeling safe while going to and from school (Q9 of the survey) resulted in a Pearson's chi-squared statistic of 1.0989 with 1 degree of freedom, yielding a corresponding p-value of

0.2945. This p-value suggests that there is insufficient evidence to reject the null hypothesis, indicating that there is no statistically significant association between BMI category and feeling safe during travel to and from school based on this dataset. Similarly, the Fisher's exact test also supports these findings, producing a p-value of 0.2013. This reinforces the notion that there is no substantial difference in the feeling of safety while commuting to and from school across different BMI categories. The odds ratio estimate from Fisher's exact test is 2.459354, indicating that the odds of feeling safe are approximately 2.46 times higher in the "Agree" category compared to the "Disagree" category, but this difference is not statistically significant at the conventional significance level of 0.05. Overall, based on these statistical analyses, it can be concluded that there is no strong evidence of a relationship between BMI category and feeling safe during travel to and from school in the surveyed population.

	Disagree	**Agree**	**Row total**
Healthy Weight	7	26	33
Unhealthy Weight	4	37	41
Column total	11	63	74

Table 17: Contingency table between BMI category and survey Q9.

Q10) The chi-square test examining the relationship between BMI category and students' perception of getting along well with each other at school (Q19 of the survey) did not reveal a statistically significant association (X-squared = 0.1386, df = 1, p-value = 0.7097). This result was corroborated by the Fisher's exact test, which also failed to show a significant relationship (p-value = 0.5806). These findings indicate that there is insufficient evidence to reject the null hypothesis, suggesting that BMI category and

students' perception of getting along well with each other are not significantly linked in this dataset. The odds ratio estimated from the Fisher's exact test is 1.45 (95% CI: 0.41 to 5.52), indicating a slight increase in the odds of positive perceptions for the Unhealthy Weight group compared to the Healthy Weight group, but this difference is not statistically significant.

	Disagree	**Agree**	**Row total**
Healthy Weight	3	30	33
Unhealthy Weight	5	37	42
Column total	8	67	75

Table 18: Contingency table between BMI category and survey Q13.

Q11) The chi-square test examining the relationship between BMI category and students' perception of getting along well with each other at school (Q19 of the survey) did not reveal a statistically significant association (X-squared = 0.1386, df = 1, p-value = 0.7097). This result was corroborated by the Fisher's exact test, which also failed to show a significant relationship (p-value = 0.5806). These findings indicate that there is insufficient evidence to reject the null hypothesis, suggesting that BMI category and students' perception of getting along well with each other are not significantly linked in this dataset. The odds ratio estimated from the Fisher's exact test is 1.45 (95% CI: 0.41 to 5.52), indicating a slight increase in the odds of positive perceptions for the Unhealthy Weight group compared to the Healthy Weight group, but this difference is not statistically significant.

	Disagree	Agree	Row total
Healthy Weight	28	6	34
Unhealthy Weight	32	10	42
Column total	60	16	76

Table 19: Contingency table between BMI category and survey Q19.

Conclusion

The key findings of this study arise from the play behaviors observed at recess using the playground observation protocol. There is evidence that children with severe obesity faced a greater degree of isolation on the playground, which is consistent with earlier findings on children with severe obesity being stigmatized (Gunnarsdottir et al., 2012; Pont et al., 2017). The results reported above show that children with severe obesity were playing alone (31.30%) more frequently at recess than other children. They were also less frequently observed playing games or active sports (28.65%). Fewer interactions (44.92%) of any type were recorded among children with severe obesity. Even so, children with severe obesity had a greater percentage of conflict interactions (5.89%) (verbal or physical) in comparison to children in other weight status categories.

There is less evidence of stigmatization from the survey responses, but this is likely due to a small sample size and the inability to discriminate between children falling into overweight, obese, and severe obese categories in the statistical analysis. As this study progresses, it is likely that patterns will emerge as sample size and statistical power improve. In this respect we suspect that the recess observation scans, which provide

strong evidence that children with severe obesity are isolated on the playground, are an early indicator of what will be found in the larger study.

The anthropometric measures showed that excess body weight is prevalent among this study population and that children with severe obesity accounted for a sizable portion of those with an unhealthy body weight. As the study moves forward, future work should address the role of playground improvements on enhancing recess experiences for children with severe obesity and in increasing physical activity to prevent children from developing severe obesity during elementary school. It will also be interesting to evaluation objectively measured physical activity by weight status with accelerometry data being collected as part of the study.

List of References

Barenie, M. J., Howie, E. K., Weber, K. A., Thakur, D., Murphy, C. M., & Thomsen, M. R. (2024). Where the children play: Gender gaps in recess physical activity by age and playground area. *Preventive Medicine Reports*, *41*, 102699. https://doi.org/10.1016/j.pmedr.2024.102699

Barenie, M. J., Howie, E. K., Weber, K. A., & Thomsen, M. R. (2023). Evaluation of the Little Rock Green Schoolyard initiative: A quasi-experimental study protocol. *BMC Public Health*, *23*, 1022. https://doi.org/10.1186/s12889-023-15891-6

Children and Nature Network. (2021, May). *Cities take the lead in transforming schoolyards with nature to help kids thrive*. Children & Nature Network. https://www.childrenandnature.org/resources/cities-take-the-lead-in-transforming-schoolyards-with-nature-to-help-kids-thrive/

Datar, A., Sturm, R., & Magnabosco, J. L. (2004). Childhood overweight and academic performance: National study of kindergartners and first-graders. *Obesity Research*, *12*(1), 58–68. https://doi.org/10.1038/oby.2004.9

Donnelly, J. E., Hillman, C. H., Castelli, D., Etnier, J. L., Lee, S., Tomporowski, P., Lambourne, K., & Szabo-Reed, A. N. (2016). Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. *Medicine and Science in Sports and Exercise*, *48*(6), 1197–1222. https://doi.org/10.1249/MSS.0000000000000901

Elish, P., Boedeker, P., Lash, T. L., & Gazmararian, J. (2023). Longitudinal weight status and academic achievement in elementary schoolchildren in the United States. *International Journal of Obesity (2005)*, 1–7. https://doi.org/10.1038/s41366-023-01309-1

Gunnarsdottir, T., Njardvik, U., Olafsdottir, A. S., Craighead, L. W., & Bjarnason, R. (2012). Teasing and social rejection among obese children enrolling in family-based behavioural treatment: Effects on psychological adjustment and academic competencies. *International Journal of Obesity*, *36*(1), 35–44. https://doi.org/10.1038/ijo.2011.181

Haines, J., Kleinman, K. P., Rifas-Shiman, S. L., Field, A. E., & Austin, S. B. (2010). Examination of shared risk and protective factors for overweight and disordered eating among adolescents. *Archives of Pediatrics & Adolescent Medicine*, *164*(4), 336–343. https://doi.org/10.1001/archpediatrics.2010.19

Jarrett, O. S. (2002). *Recess in Elementary School: What Does the Research Say? ERIC Digest*. ERIC Clearinghouse on Elementary and Early Childhood Education, Children's Research Center, University of Illinois, 51 Gerty Dr. https://files.eric.ed.gov/fulltext/ED466331.pdf

Jarrett, O., & Waite-Stupiansky, S. (2009). Recess—It's Indispensable! *Young Children*, *64*(5), 66–69.

Loprinzi, P. D., Cardinal, B. J., Loprinzi, K. L., & Lee, H. (2012). Benefits and Environmental Determinants of Physical Activity in Children and Adolescents. *Obesity Facts*, *5*(4), 597–610. https://doi.org/10.1159/000342684

MacCann, C., & Roberts, R. D. (2013). Just as smart but not as successful: Obese students obtain lower school grades but equivalent test scores to nonobese students. *International Journal of Obesity*, *37*(1), 40–46. https://doi.org/10.1038/ijo.2012.47

McKenzie, T. (n.d.). *Systemic Observation Research: Overview, Protocols, & Links*. Retrieved April 2, 2024, from https://thomckenzie.com/useful-tools/observation/

Pont, S. J., Puhl, R., Cook, S. R., Slusser, W., SECTION ON OBESITY, & THE OBESITY SOCIETY. (2017). Stigma Experienced by Children and Adolescents With Obesity. *Pediatrics*, *140*(6), e20173034. https://doi.org/10.1542/peds.2017-3034
Prewitt, S. L., Rosselli, C., & Rosselli, A. (2019). Physical Activity and Social Interactions of Rural Elementary Children during Recess. *Journal of Physical Activity Research*, *4*(2), 114–117. https://doi.org/10.12691/jpar-4-2-6

Ridgers, N. D., Stratton, G., & McKenzie, T. L. (2010). Reliability and validity of the System for Observing Children's Activity and Relationships during Play (SOCARP). *Journal of Physical Activity & Health*, *7*(1), 17–25. https://doi.org/10.1123/jpah.7.1.17

Robert Wood Johnson Foundation. (2007). *Recess Rules: Why the Undervalued Playtime May Be America's Best Investment for Healthy Kids and Healthy Schools* (p. 20) [Research]. Robert Wood Johnson Foundation. https://folio.iupui.edu/bitstream/handle/10244/583/sports4kidsrecessreport.pdf?sequence=2

Schvey, N. A., Marwitz, S. E., Mi, S. J., Galescu, O. A., Broadney, M. M., Young-Hyman, D., Brady, S. M., Reynolds, J. C., Tanofsky-Kraff, M., Yanovski, S. Z., & Yanovski, J. A. (2019). Weight-based teasing is associated with gain in BMI and fat mass among children and adolescents at-risk for obesity: A longitudinal study. *Pediatric Obesity*, *14*(10), e12538. https://doi.org/10.1111/ijpo.12538

Stierman, B., Afful, J., Carroll, M. D., Chen, T.-C., Davy, O., Fink, S., Fryar, C. D., Gu, Q., Hales, C. M., Hughes, J. P., Ostchega, Y., Storandt, R. J., & Akinbami, L. J. (2021). *National Health Statistics Reports, Number 158, June 14, 2021*. *158*, 20.

Tan, E., Healey, D., Schaughency, E., Dawes, P., & Galland, B. (2014). Neurobehavioural correlates in older children and adolescents with obesity and obstructive sleep apnoea. *Journal of Paediatrics and Child Health*, *50*(1), 16–23. https://doi.org/10.1111/jpc.12390

US Department of Education. (2024). *National Center on Safe Supportive Learning. Environments (NCSSLE)*. https://safesupportivelearning. ed.gov/

Appendix

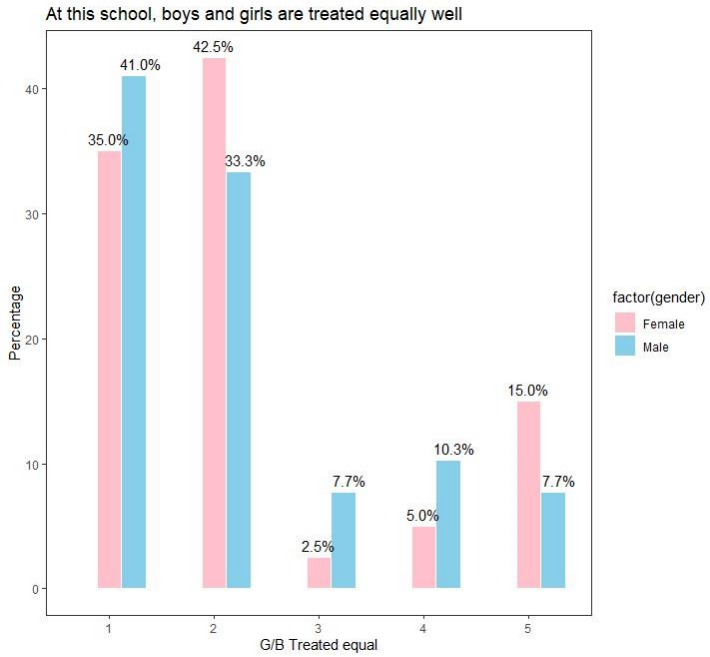


Fig. a1- Histogram plot between children's perception of being treated equally in school versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

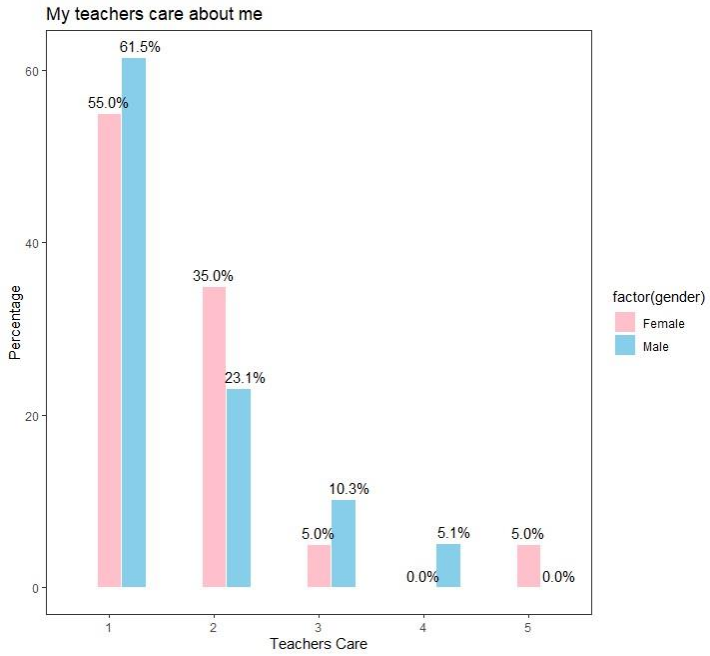


Fig. a2- Histogram plot between children's perception of whether their teachers care about them versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

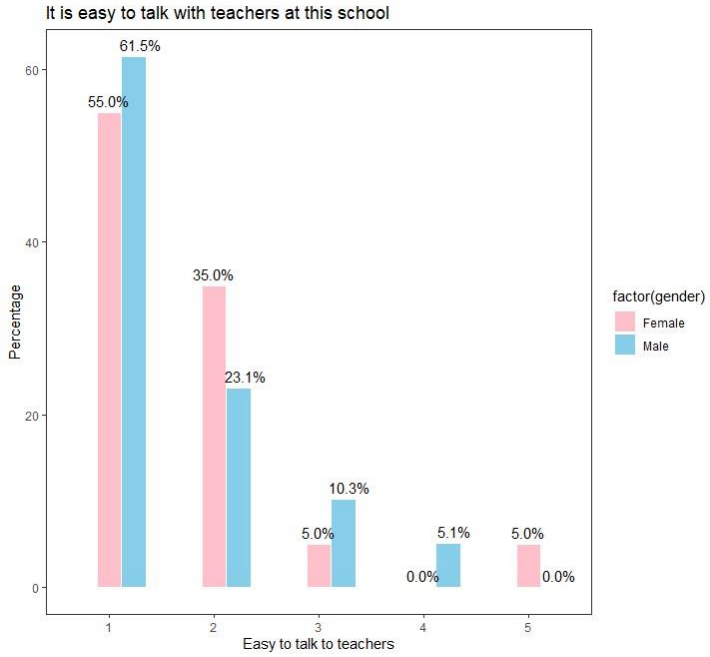


Fig. a3- Histogram plot between children's perception of whether it is easy to communicate with their teachers versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

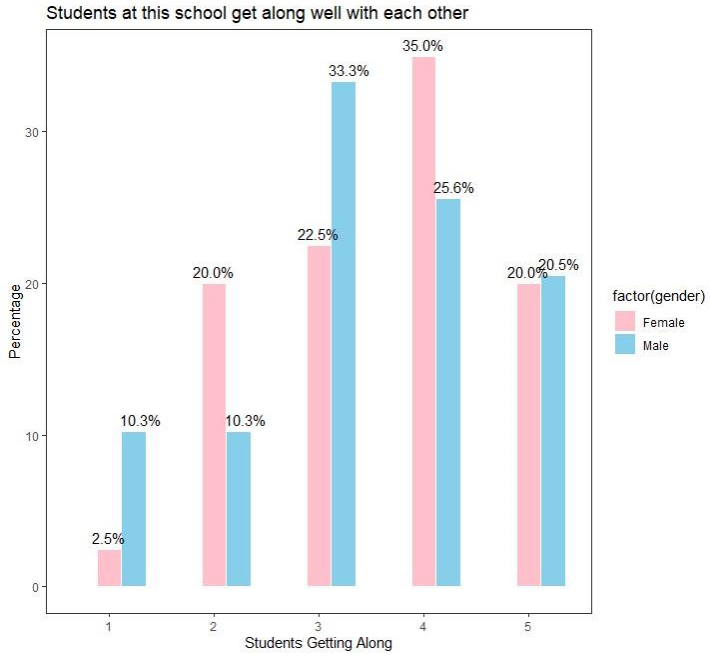


Fig. a4- Histogram plot between children's perception of whether students in the school get along with each other versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

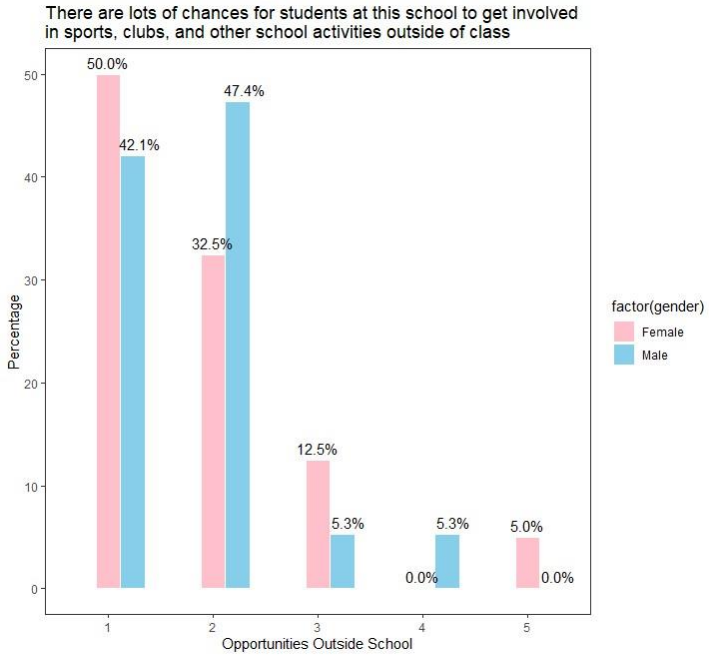


Fig. a5- Histogram plot between children's perception of whether students have sufficient opportunities for extracurricular activities outside of class versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

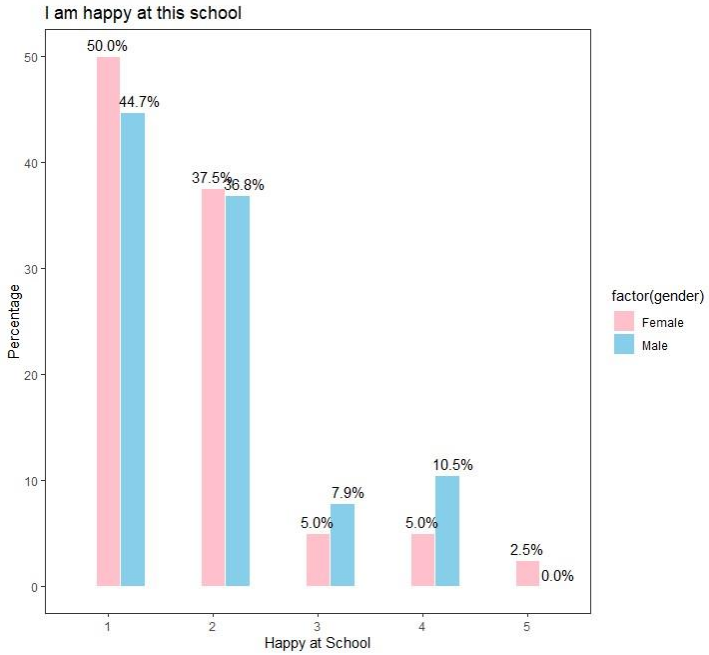


Fig. a6- Histogram plot to understand if the child is happy at the schools versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

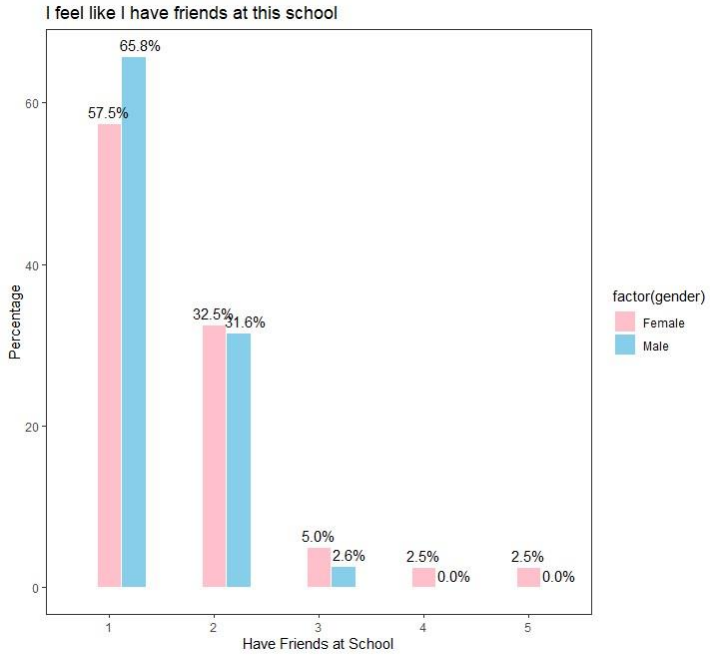


Fig. a7- Histogram plot to understand if the child feel they have friends in school versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

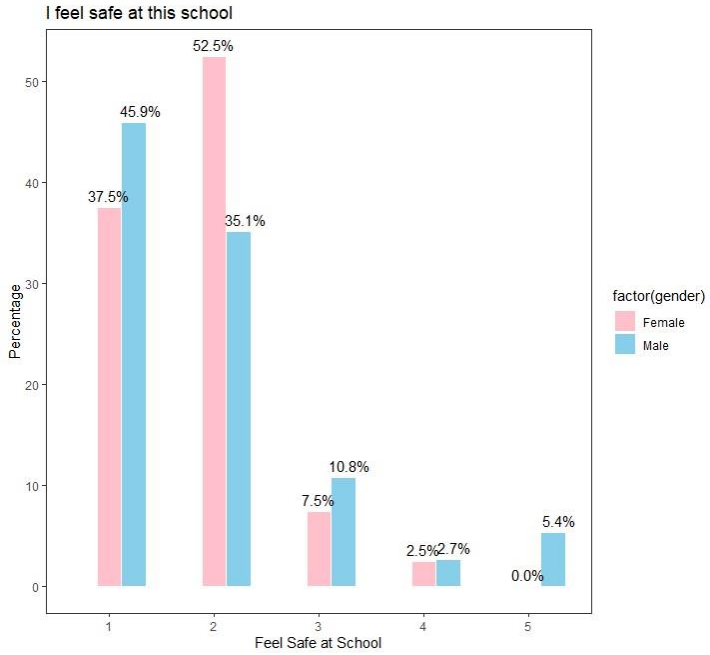


Fig. a8- Histogram plot to understand if the child feels safe at schools versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

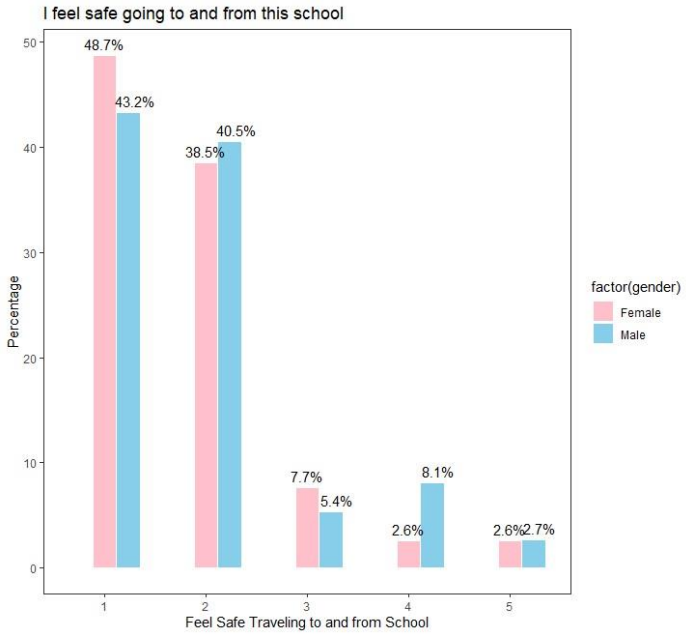


Fig. a9- Histogram plot to understand if the child feels safe travelling to and from schools versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

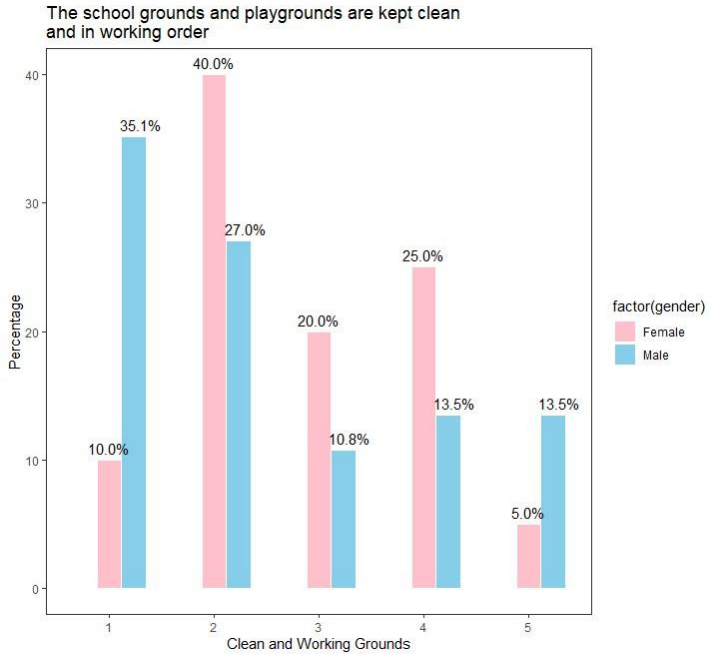


Fig. a10- Histogram plot to understand if the child finds the playground clean and in working condition versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

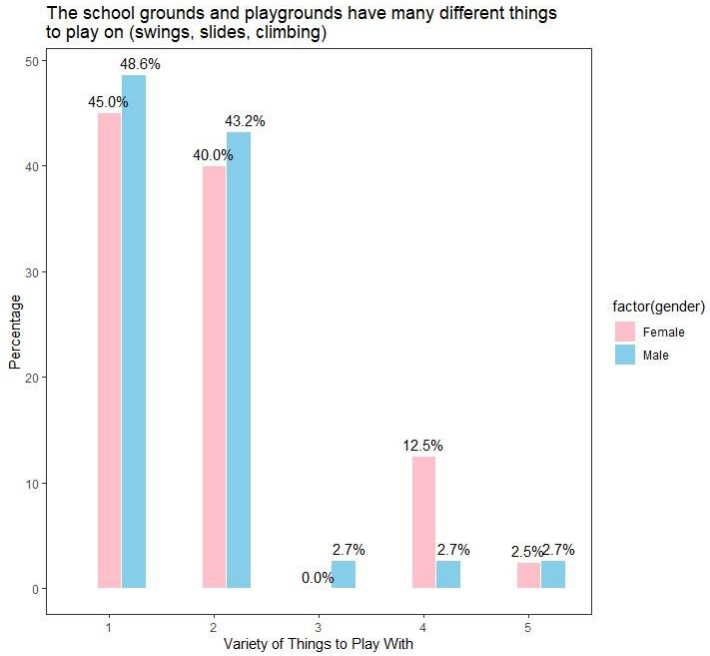


Fig. a11- Histogram plot to understand if the child feels there are variety of things to play with versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

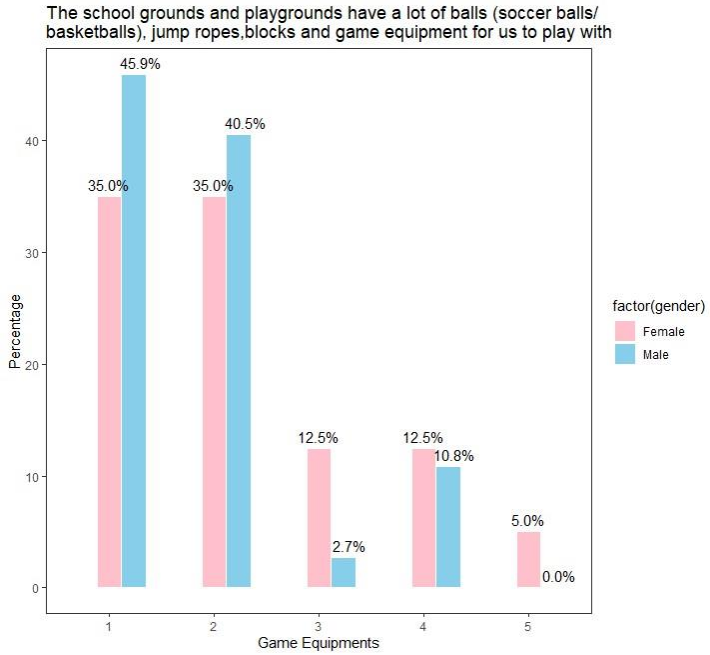


Fig. a12- Histogram plot to understand if the child feels there are enough game equipment available versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

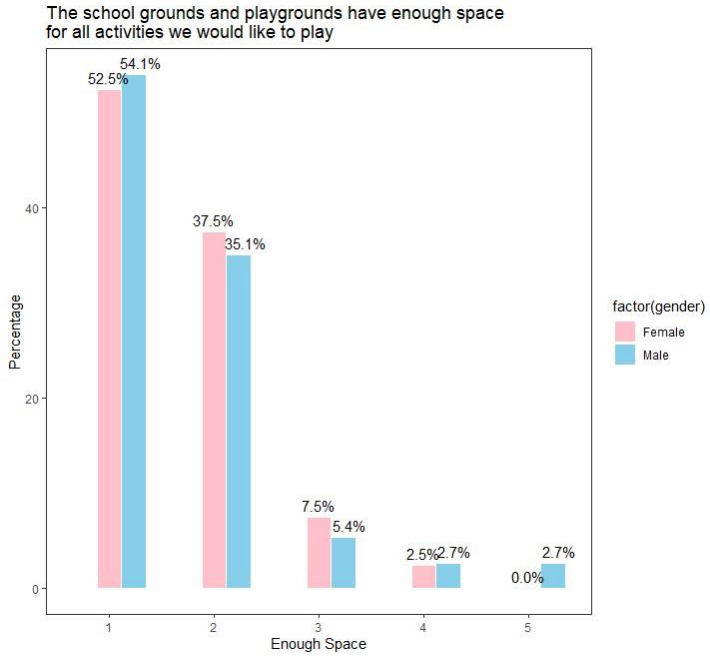


Fig. a13- Histogram plot to understand if the child feels the playground have enough space versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

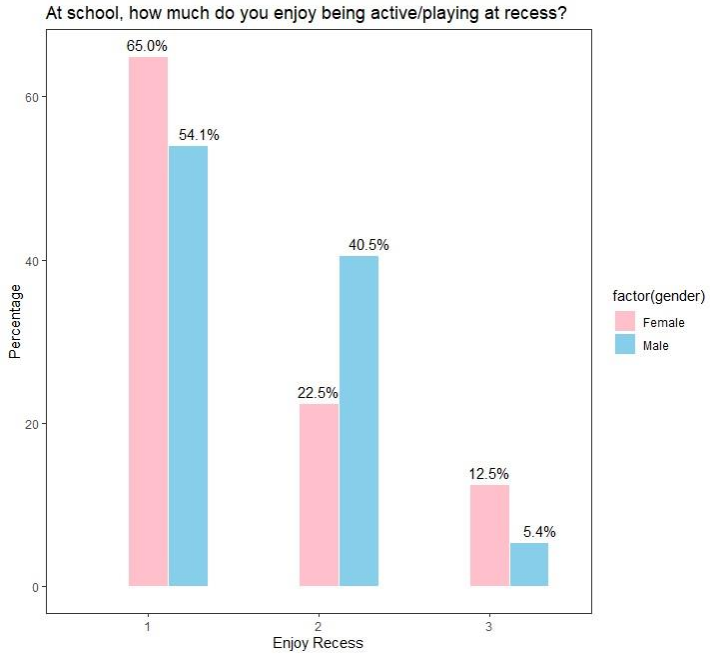


Fig. a14- Histogram plot to understand if the child enjoys recess versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

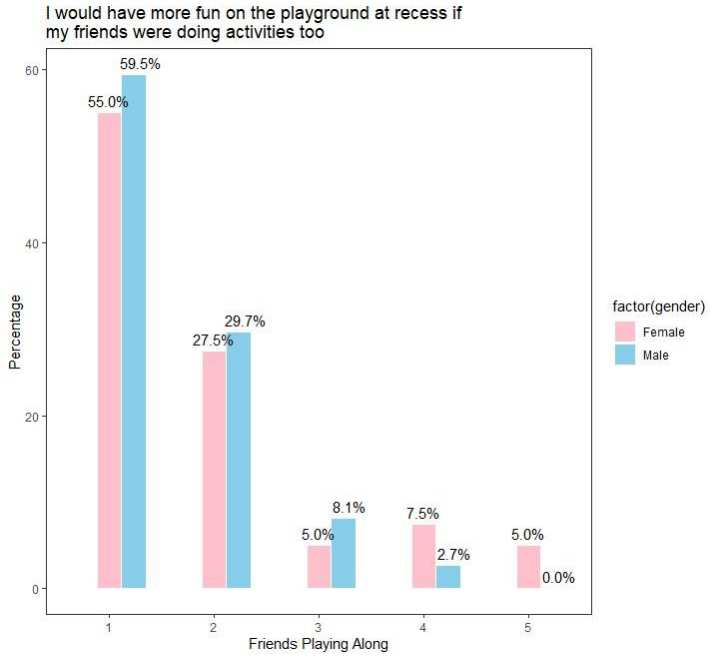


Fig. a15- Histogram plot to understand if the child would enjoy recess more if their friends played along versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

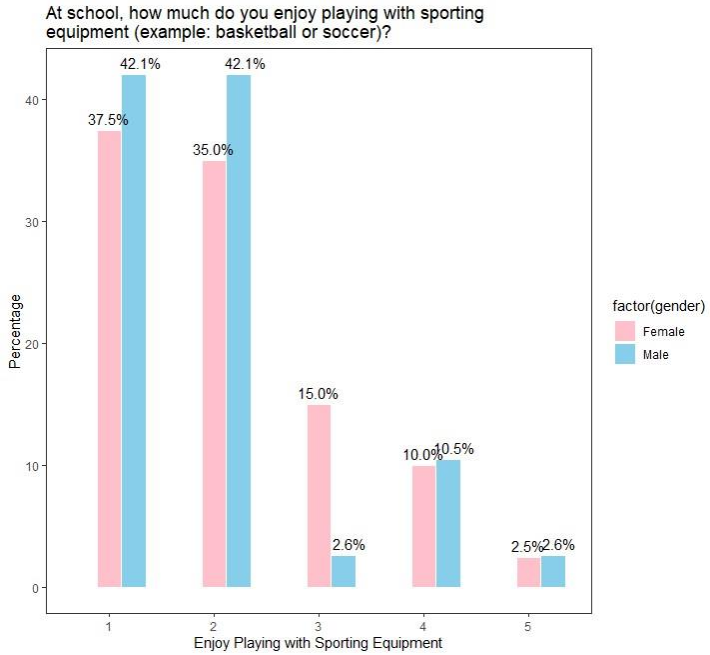


Fig. a16- Histogram plot to understand if the child enjoyed playing with sporting equipment versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

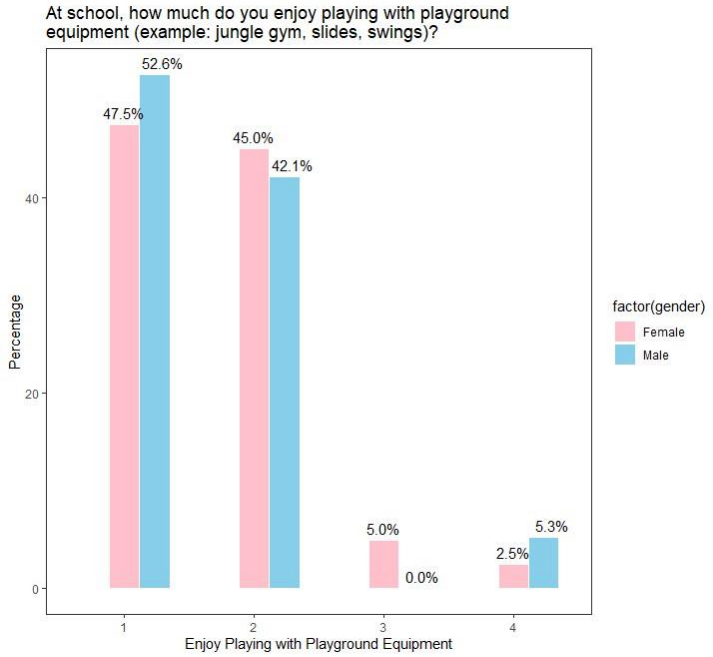


Fig. a17- Histogram plot to understand if the child enjoys playing with playground equipment versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

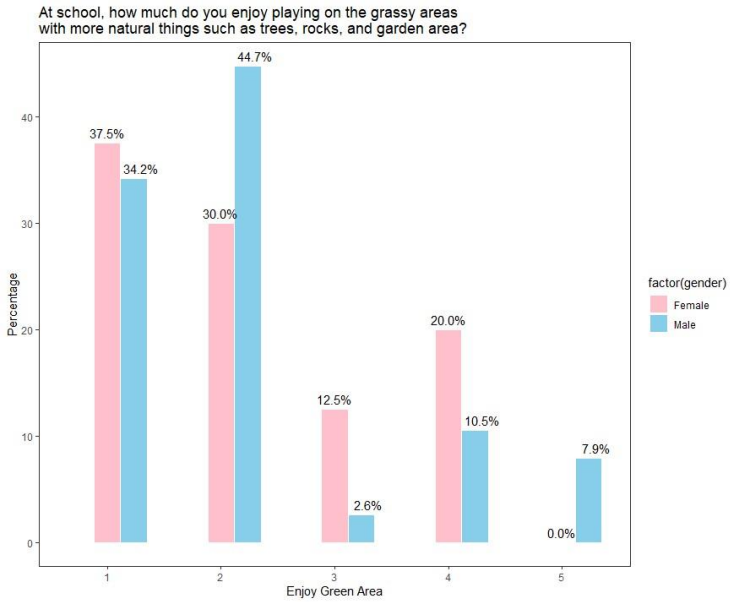


Fig. a18- Histogram plot to understand if the child enjoys green and natural spaces versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)

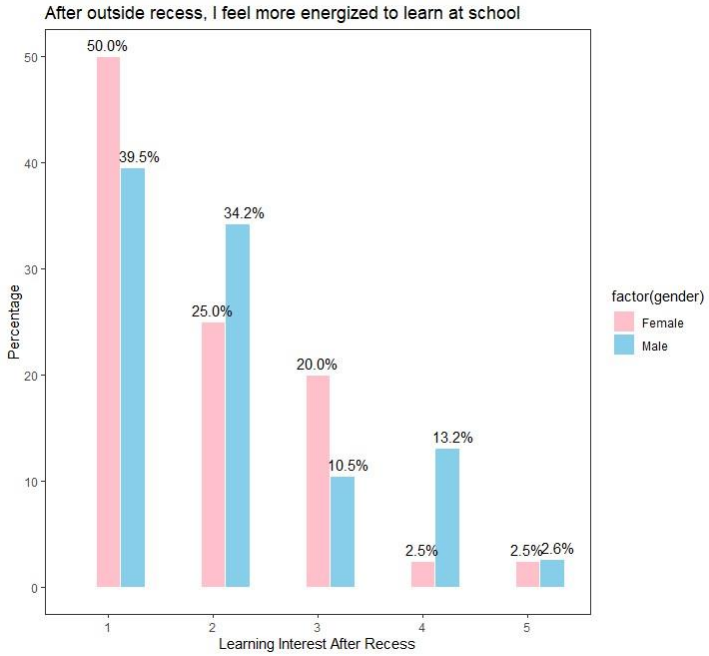


Fig. a19- Histogram plot to understand if the child feels more engaged after recess versus the percentage population of the respondents by gender. (1= Strongly Agree, 5=Strongly Disagree)