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EXERCISE SCIENCE

The Talk Test to Measure Exercise Intensity in Children

*Debra Sazama, Carl Foster, Cordial Gillette, Bryana Petersin,
Brandon VanGalen, Zack Beddoes, Kaylee Selden*

Abstract

The Talk Test (TT) is a measure of exercise intensity that has been used in a variety of populations. This study extends the use of the TT as a method to measure exercise intensity in prepubertal children. Healthy children performed an incremental exercise test and then either an interval-based exercise session on the treadmill or a 30-min free-play activity session in the gymnasium. The subject read a short (~100 word) passage and responded to “can you speak comfortably?” If the subject was able to speak comfortably, it was recorded as the positive (+) stage of the TT. If the individual was able to speak but with some difficulty, it was recorded as the equivocal stage (+/-). If the subject was unable to speak comfortably, it was recorded as the negative (-) stage. Ventilatory threshold (VT) was determined in the laboratory through respiratory gas exchange. During the interval-based activity and free-play session, the TT was used in the prediction of whether the subject was exercising at an intensity below or above their VT. Data analysis was performed with a chi-squared test for determining statistical significance. In both the interval-based exercise session and the free-play activity, the TT was effective at predicting whether the subject was exercising at an intensity below or above their VT. Correct predictions

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were made 73.3% of the time for the interval-based exercise group and 81.6% of the time for the free-play session. The TT appears to be a valid predictor of exercise intensity in prepubertal children participating in interval exercise or free play.

The American College of Sports Medicine (2018) and Centers for Disease Control and Prevention (2019) recommend children and adolescents, 6 to 17 years of age, perform at least 60 min of moderate- to vigorous-intensity physical activity (MVPA) each day. Moderate-intensity exercise is identified as an intensity level below the ventilatory threshold (VT) and vigorous exercise is usually identified as an intensity level above VT (Mezzani et al., 2012). VT, often referred to as anaerobic threshold in older literature, is the point during exercise when ventilation increases disproportionately to oxygen consumption (VO_2) and is a widely accepted marker of sustainable exercise intensity (Poole et al., 2020). In clinical or research settings, the availability of gas exchange equipment allows for objective variables to be recorded and exercise intensity determined. However, outside of these settings, objective measurement of intensity, together with anchoring maximal effort tests (e.g., VO_2 max test), is not widely available. Accordingly, subjective methods to determine and measure exercise intensity are needed.

One method to determine exercise intensity outside the clinical setting is the use of heart rate monitors. Armstrong and Bray (1991) used heart rate monitors to determine children's level of intensity during physical activity. To determine how long children were able to maintain vigorous activity, they recorded heart rate data at 5-, 10-, and 20-min intervals. Of the subjects, 84% sustained vigorous intensity for 5 min at least three times during the week, 18% sustained vigorous intensity for 10-min periods, and about 1.5% sustained vigorous intensity for the entire 20-min period at least three times during the week. Similarly, in preschool-aged children, 85% of the moderate- to vigorous-intensity activity episodes ranged from 5 to 10 min in length (Benham-Deal, 2005). Children's activity patterns are typically not continuous but are stochastic (e.g., stop and go) in nature. Although heart rate monitors can be used outside of a clinical setting to record data and provide immediate feedback to the user, they can be expensive. Further, an anchoring maximal effort exercise test to characterize intensity is necessary. Age-predicted equations

(i.e., $220 - \text{age}$) are of limited value on an individual basis because they can incorrectly estimate individual maximal heart rate (Tanaka et al., 2001) and do not consider other factors such as gender, resting heart rate, and body weight (Whaley et al., 1992).

Another method to determine exercise intensity is the use of the Rating of Perceived Exertion (RPE), which is a subjective measure of exercise intensity widely used in adults (Borg, 1998; Chen et al., 2002; Herman et al., 2006). An RPE of 13 is associated with an intensity of approximately 50% to 70% of $\text{VO}_2 \text{ max}$ and is generally a pleasant and effective intensity for training (Parfitt et al., 2012). RPE scales have been found to be effective in children as young as 9 to 10 years old (Mahon et al., 1997); however, the use of the original RPE scale to measure exercise intensity in children has limitations (Mahon et al., 2003; Utter et al., 2002). It is difficult for children under the age of 11 to use only words and numbers to represent their feelings (Utter et al., 2002). For children to identify how they are feeling while exercising, the Children's OMNI Scale of Perceived Exertion was created and includes pictures and language specific to children, for children to rate their perceived exertion (Robertson et al., 2001). Utter et al. (2002) presented a modified version of the Children's OMNI Scale, called the Children's OMNI Scale of Perceived Exertion for Walking and Running, which includes pictorial representations at different levels of exertion. The scale was used in children between the ages of 6 and 13 years old during graded exercise testing. The results demonstrated that the Children's OMNI Scale of RPE correlated with objective physiological intensity during walking and running (Utter et al., 2002).

A third method to measure exercise intensity outside of the research or clinical setting is the Talk Test (TT; Foster et al., 2018), which is a subjective method in which the researcher asks the question, "Are you able to speak comfortably?" immediately after the subject reads or verbalizes a short (~90 words) passage (Schroeder et al., 2017). A relationship has been shown between ventilatory threshold (VT) and the TT. The physiological mechanism driving the TT is the need to suppress breathing frequency (BF) to allow speech (Brawner et al., 2006; Creemers et al., 2017) at the point breathing frequency would normally increase (Poole et al., 2020), which results in retention of CO_2 . While exercising, individuals

must decrease their breathing frequency to produce speech. This is especially true at the intensity of the VT, when there is normally a substantial increase in breathing frequency. When an individual is exercising at a level above their VT, the conflict between these needs typically leads to a reduction in the perceived comfort of speaking (Brawner et al., 2006; Creemers et al., 2017).

There are three widely recognized stages of the TT (last positive, equivocal, and negative). When exercising in their last positive stage of the TT, a person is typically exercising at an intensity just below VT. For the moderate- and vigorous-exercise classification (Mezzani et al., 2012), exercising at the last positive stage of the TT is typically indicative of highest range of moderate exertion. When exercising in the equivocal stage of the TT, a person's intensity is very close to their VT, and when exercising at the negative stage of the TT, a person is almost always at an intensity above VT (Dehart-Beverley et al., 2000). At the lowest intensity associated with the negative stage of the Talk Test, a person is often near the second VT (e.g., respiratory compensation threshold), which is the second increase in ventilation that is disproportionate to VO_2 (Foster et al., 2018; Recalde et al., 2002; Rodríguez-Marroyo et al., 2013; & Woltmann et al., 2015). This point is generally considered the transition between the vigorous exercise-intensity domain and the severe exercise-intensity domain (Mezzani et al., 2012).

The TT has been used and found to be a useful way to approximate VT and guide exercise training intensity and in a variety of populations. The TT was used and found to be effective in approximating VT for individuals exercising on both cycle ergometer and treadmill (Persinger et al., 2004). Porcari et al. (2018) utilized percent heart rate reserve (%HRR) and the TT to guide exercise-training intensity in college-aged adults. Despite not needing the anchoring maximal exercise test, which is required in the %HRR method, the TT-based exercise prescription yielded the same results as %HRR relative to improving exercise capacity (Porcari et al., 2018). Thus, the TT can be utilized with healthy adults for prescribing exercise that is within appropriate parameters defined by the American College of Sports Medicine (Dehart-Beverley et al., 2000; Woltmann et al., 2015).

The TT has been used in adults (Dehart-Beverley et al., 2000; Foster et al., 2008) and athletes (Recalde et al., 2002; Rodríguez-

Marroyo et al., 2013; Woltmann et al., 2015) as an effective tool for determining exercise intensity. Foster et al. (2008) found that the TT is an appropriate measure of exercise intensity in adults during stochastic (e.g., interval) exercise. The TT has also been found to be an effective tool to measure exercise intensity in clinically stable cardiac patients (Voelker et al., 2002), in patients with myocardial ischemia (Cannon et al., 2004), with stable coronary artery disease (Brawner et al., 2006), following myocardial revascularization surgery (Zanettini et al., 2012), and for patients in outpatient cardiac rehabilitation programs (Foster et al., 2018; Krawczyk et al., 2017; Lyon et al., 2014).

The TT has been found to be an effective measure of exercise intensity in a variety of adult populations and is a well-accepted subjective measure of exercise intensity (Foster et al., 2018). The first time the TT was utilized in children, results were consistent with the TT response observed in adults during incremental exercise (Sazama et al., 2021). However, it has not been determined if the TT can be utilized to accurately determine exercise intensity during training and/or play in children. The purpose of this study was to determine if the TT can measure exercise intensity in children during interval-based training sessions and free-play sessions.

Method

Subjects

The subjects in this study were children 8 to 12 years of age ($N=18$). Table 1 shows descriptive characteristics. By parental report, all the children were prepubertal, although formal Tanner Staging was not completed. The University Institutional Review Board (20-BP-126 and 19-CF-445) approved the studies used in this data analysis. All subjects provided written assent, and parents/guardians provided written informed consent. Prior to participation, the children completed the Physical Activity Readiness Questionnaire (PAR-Q) and an Exercise History Questionnaire. This allowed for the identification of contraindications that could disqualify them from participating in the study.

Table 1*Descriptive Characteristics of Children (N = 18)*

Variable	Interval-based session (n = 10)		Free-play session (n = 8)	
	Girls (n = 5) <i>M ± SD</i>	Boys (n = 5) <i>M ± SD</i>	Girls (n = 2) <i>M ± SD</i>	Boys (n = 6) <i>M ± SD</i>
Age (years)	9.6 ± 0.55	10.6 ± 0.89	11 ± 0.0	10.3 ± 1.21
Height (cm)	136.6 ± 4.17	150.6 ± 10.31	147.4 ± 2.69	145.3 ± 8.11
Weight (kg)	32.4 ± 3.92	43.8 ± 8.02	41.8 ± 8.39	45.1 ± 11.89
VO ₂ max (mL*kg ⁻¹ *min ⁻¹)	41.3 ± 7.20	43.5 ± 1.53		
HRmax (b* min ⁻¹)	192.6 ± 11.93	180.2 ± 8.23	174 ± 8.49	181.7 ± 14.19

Protocol

Protocols included the subjects visiting the laboratory on 3 separate days. The first visit was an orientation and familiarization with the TT and the laboratory environment, which included the motorized treadmill and the gas-exchange equipment. During the first visit, subjects also completed a maximal TT, which was achieved via a modified Balke-type treadmill protocol that is widely used for graded exercise testing. During the first four minutes of the maximal test, the treadmill speed was gradually increased until subjects were walking at a comfortable pace. Following the initial 4 minutes, the grade of the treadmill was increased by 2% every 2 min while the speed remained constant. During the last 30 s of each 2-min stage, the subjects completed the TT by reading the “Pledge of Allegiance” three times (93 words) or a 100-word passage, which was selected as appropriate for their reading level and located on a cue card. After the passage was read, the subjects were asked, “Can you speak comfortably?” Answers that indicated the subject could speak comfortably (with a response of “yes”) were recorded as (+). The first point when the subject was uncertain about speaking comfortably (“yes, but”) was recorded as (+/-), and the first point when the subject was definitely not able to speak comfortably (“no”) was recorded as (-). Heart rate was measured with radio telemetry every 5 s (Polar Vantage XL, Polar USA, Lake Success, New York). The Children’s OMNI Scale of Perceived Exertion (Utter et al., 2002) was used in the measurement of RPE. Heart rate and RPE were documented in the last 10 s of each stage.

During the second visit, the subjects completed another maximal exercise test on a motorized treadmill. The maximal exercise test began with the subject completing a 2-min walking warm-up at 1.5 mph. In the first stage of the test, the speed of the treadmill was increased to 3 mph with a 0% grade. During the remainder of the test, speed remained constant while grade increased by 2% every 2 min until the subject indicated they could not continue. During the maximal exercise test, gas exchange was recorded through open-circuit spirometry (Moxus Metabolic Cart System, AEI Technologies, Pittsburgh, Pennsylvania), which was calibrated with a 3.0 L syringe and reference gas concentrations (~16% O₂ and ~5% CO₂ and room air). Gas-exchange data were integrated every 30 s.

The third visit consisted of the subjects completing an interval exercise test on the treadmill or a 30-min free-play session in a gymnasium. For the interval exercise test protocol, subjects began with a 2-min warm-up of walking on the treadmill at 1.5 mph with 0% grade. The TT was performed during the last 30 s of successive 2-min stages. The baseline exercise intensity was performed at a speed and grade that required approximately 30% VT (e.g., very light exercise). This baseline exercise intensity was calculated on the basis of their maximal exercise test. Subsequently, in 2-min stages, the grade was altered to a level predicted to be slightly below, equal to, or above their VT. Speed and grade were then lowered to the level that represented approximately 30% VT. At the end of each 2-min stage, the TT and RPE were performed and responses recorded. If the subject was unable to maintain the exercise protocol for 30 min, the speed and grade were adjusted for the subject to complete the protocol, with the addition of an extra-low intensity stage.

The 30-min free-play session consisted of the subjects engaging in activities of their choice in the university gymnasium. Prior to the free-play session, heart rate monitors (Interactive Health Technologies, LLC, Austin, TX) and wireless microphones were distributed to the subjects to wear. The microphones were clipped to each subject's shirt collar to record their responses to the TT and RPE. Following the free-play experience, the researcher listened to each participant's verbal responses and recorded a positive (+), equivocal (+/-) or negative (-) response for the TT and the number identified for RPE. The HR monitors recorded data every 5 s, and the data were later downloaded onto the IHT Spirit system. Due to COVID-19, ventilatory threshold was not able to be directly measured in the laboratory while the subjects engaged in the free-play session. Accordingly, HR at the last positive stage of the TT and at the first equivocal stage of the TT was recorded and used for analysis.

Activity zones were set up in the gym with basketballs and footballs in Zone 1, soccer balls and volleyballs in Zone 2, and jump ropes and frisbees in Zone 3. The equipment represented what might be available to children on a school playground at recess and provided the subjects choice of activities. Zoning playgrounds has been shown to increase physical activity during recess while allowing children freedom to make choices in which activities they want to

participate (Barnas & Ball, 2019). During the last thirty seconds of each 2-min stage, prompted by a whistle, the subjects repeated the “Pledge of Allegiance” three times and responded to “Can you speak comfortably?” with “yes”, “yes, but...”, or “no”. After the TT response, subjects were asked, “How hard do you feel you are working?” so their RPE could be determined. Four RPE posters were placed in the gymnasium and an additional poster was carried around by an investigator during the free-play session. This assisted the children in identifying their RPE.

Statistical Analysis

For both the interval-based data and the free-play data, statistical significance for predicted and observed TT responses was tested with a chi-squared test. A p value of < 0.05 was considered statistically significant.

Results

An analysis was performed on 18 (11 boys, 7 girls) children who performed the TT, a VO_2 max test, and either an interval-based TT or a free-play session TT. Thresholds used in this data analysis were expressed as $\% \text{VO}_2$ max at VT on the treadmill and the highest HR the participant achieved during the positive stage of the TT during free play. Predictions were made from the TT. From this, it was determined whether subjects were participating at an intensity above or below their VT. If a subject was working below VT, it was predicted they would be able to speak comfortably during the TT. If a subject was working above VT, it was predicted they would not be able to speak comfortably. Comparisons were made on the basis of predicted and observed TT responses for the interval-based session (Figure 1). Although the negative stage of the TT can be used to identify the respiratory compensation threshold, the focus of this study, on the basis of the moderate- versus vigorous-intensity domains, was limited to the positive and equivocal stages of the TT.

During the treadmill interval sessions, in 73.3% of the cases, the observation matched the prediction, indicating that participants were able to speak comfortably when exercising at an intensity below their VT or that participants were not able to speak comfortably when exercising above their VT. Individuals who were exercising at an intensity above their VT were predicted to not be able to speak

Figure 1

Expected Versus Observed Results of the Talk Test During Interval-Based Exercise

	Not predicted	Predicted
Observed	11	82
Not Observed	28	29
% Correct	73.3%	
% Incorrect	26.7%	

Note. The numbers represent subject responses.

comfortably. Individuals were predicted to speak comfortably when exercising at an intensity below their VT. In 71.8% of the 73.3% cases, participants who were predicted to not speak comfortably were in the negative stage of the TT and those who were predicted to speak comfortably were in the last positive stage of the TT. The chi-squared statistic for the interval-based session was 14.643, which reveals a statistically significant ($p < 0.05$) difference in the expected and observed values for the TT.

During the free-play session, in 81.6% of the cases, the observation matched the prediction, indicating that participants were able to speak comfortably when exercising at an intensity below their VT or that participants were not able to speak comfortably when exercising above their VT. Individuals who were exercising at an intensity above their VT were predicted to not be able to speak comfortably. Individuals were predicted to speak comfortably when exercising at an intensity below their VT (Figure 2). In 78% of the cases, participants were able to speak comfortably at an intensity below their predicted VT. Individuals playing at intensities above their VT were predicted to not speak comfortably. Of these cases, 90.0% were correct. The chi-squared statistic for the free-play session was 45.170, which reveals a statistically significant ($p < 0.05$) difference in the expected and observed values for the TT.

Figure 2

Expected Versus Observed Results of the Talk Test During Free Play

	Not Expected	Expected
Observed	3	71
Not Observed	27	19
% Correct	81.6%	
% Incorrect	18.3%	

Note. The numbers represent subject responses.

Figure 3 shows combined data for the interval and free-play session. Predicted TT responses were correct in 77.0% of the cases. In 76.1% of the cases, individuals were able to speak comfortably when exercising at an intensity below their measured or predicted VT. Individuals playing or exercising at intensities above their measured or predicted VT were predicted to not be able to speak comfortably. In 79.7% of these cases, the prediction was correct and participants were not able to speak comfortably.

Discussion

The purpose of these studies was to determine if the TT can measure exercise intensity in children during interval-based training sessions or free-play sessions. The findings indicate that the TT works as well in children as it does in adults (Foster et al., 2008, 2018) as a predictor of exercise intensity in relation to the VT. In particular, the TT is an effective tool to determine exercise intensity during incremental exercise in healthy adults (Dehart-Beverley et al., 2000), in incremental exercise in children (Sazama et al., 2021), and during stochastic exercise in adults (e.g., interval training; Foster et al., 2008). This data analysis reveals that the TT correctly predicts intensity levels of children during interval exercises 73.3% of the time. This number increases during free play to 81.6%. Another study that

Figure 3

Expected Versus Observed Talk Test Responses Combined for Interval Session and Free Play

	Not Expected	Expected
Observed	14	153
Not Observed	55	48
% Correct	77.0%	
% Incorrect	23.8%	

Note. The numbers represent subject responses.

compares 8- to 12-year-old correct prediction percentages to adult prediction percentages reveals similar results with correct predictions approximately 75% of the time for adult participants (Foster et al., 2008). Thus, the TT is as effective in predicting exercise intensity in children as it is in adults. Identifying the exercise intensities that correspond with VT and just above VT is important to maximize the health benefits gained from MVPA. Predicting VT is an important tool that ensures individuals are working at an appropriate intensity and that can be utilized in various settings. When children are aware of the intensity they should be working at, they can transfer that knowledge to various activity settings (e.g., recess, physical education class, before- and after-school programming) outside of a proctored setting. This is important for children to learn and understand because physically active lifestyles start to develop early in childhood and are then continued through their youth into adulthood (Telama et al., 2014). To date, there has been no valid and reliable tool to prescribe exercise intensity for children during natural exercise patterns or in a free-play setting, yet numerous organizations indicate that children should exercise daily at a moderate to vigorous level of intensity for 60 min or more. The results suggest that the TT may serve this function.

Future research should be conducted in a more natural play setting such as a gymnasium, playground, or park that allows observation of spontaneous stochastic play patterns in children. Further research should be conducted in a physical education class setting. Additional research could expand the age range of the children through observations of adolescents between the ages of 13 and 18. Data from the natural play setting should be compared to data obtained in the laboratory through the use of RPE, HR, and the TT.

Limitations

A special circumstance for this data analysis is that the free-play data does not contain VO_2 data due to the impact of COVID-19. The protocols for this data analysis are different in that the subjects engage in either free play in the gymnasium or interval testing on a treadmill. Additionally, due to the small sample size used in this data analysis, the generalizability of the results is low.

Practical Applications

These results are directly applicable to physical educators. Physical education has the potential to increase MVPA in children (Fairclough & Stratton, 2005; Meyer et al., 2011), but there has not been a child-friendly approach to prescribe exercise at or help children to identify if they are exercising at a moderate to vigorous level. The TT is an accurate and reliable tool to prescribe exercise intensity in children and can be successfully utilized by children to identify their exercise intensity. Results of this study indicate that if children are not able to speak comfortably while engaged in activity, they are working at or near a vigorous level of intensity. If children are still able speak comfortably (“yes”), they are working at a moderate level of intensity. In class, physical educators can ask students to engage in activity at a level at which they can “just barely” talk to a friend and know that they are engaging in a health-enhancing level of activity and working toward reaching their daily goal of 60 min of MVPA. Physical educators can also post the Children’s OMNI Scale of Perceived Exertion in their teaching space to help children identify their level of intensity.

Conclusion

The results from this data analysis show that when children are exercising or playing at an intensity below their VT, they are generally able to speak comfortably. This was shown in 76.1% of the cases from this data analysis. When children between the ages of 8 and 12 years old participate in exercise or free play, the TT appears to be a valid measure of exercise intensity, relative to the moderate-vigorous intensity domains. The data indicate that both children and adults can utilize the TT to assess intensity levels accurately. The TT is a useful method to determine exercise intensity because it is low cost, is easy to administer, and does not require a laboratory setting and equipment.

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INTRAMURAL SPORTS

A Qualitative Inquiry of Females' Experiences With a Novel High School Intramural Program

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Abstract

Adolescent females' disengagement from physical education, physical activity, and sport has been well documented. Participating in a quality intramural program could help to increase rates of adolescent females' engagement in physical activity at school. This study was conducted with female students in four high schools in south-central Canada. A school-specific organizing committee consisting of an outside expert, teacher-lead, and several female student-facilitators designed and implemented a new optional intramural program rooted in best practices to 483 female students. Semistructured focus group interviews were held with 25 student-facilitators before and after the intramural intervention. There was a noticeable reduction in the females' perceived barriers to being engaged in physical activity at school after the program intervention. Accommodating the intrapersonal, interpersonal, and environmental needs of adolescent females may help intramurals to counter the allure of more sedentary options at school.

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The developmental benefits of PA (PA) go beyond disease prevention, and many of the positive social, affective, and cognitive outcomes linked to PA are consistent with the overall aims and objectives of school-based education (Chen & Gu, 2018). In fact, publically funded schools are generally recognized as ideal sites to provide children and adolescents with regular, quality PA opportunities because, in most economically developed countries, children spend a large portion of their time attending school (Dwyer et al., 2008; Goudeau et al., 2014). It appears that adolescents (Statistics Canada, 2019), especially teenage females (Owen et al., 2017; A. Watson et al., 2015), are particularly at risk of disengagement from physical education, PA, and sport (Edwards et al. 2011; Lodewyk & Pybus, 2013).

Intramurals is a school-based intervention implemented during school hours that is designed in part to facilitate the quantity and quality of students' PA experiences is intramurals. A quality intramural program is a key component of a comprehensive school health initiative (Chen & Gu, 2018) and has several positive youth development outcomes (e.g., Webb & Forrester, 2015), including PA (Erwin et al., 2013). In spite of this, the proportion of schools offering intramural programs is approximately 79% in Canada with elementary schools and those in rural areas with smaller student populations less likely to do so (Canadian Fitness and Lifestyle Research Institute, 2016). This is relatively high compared to the level of 50% of schools in the United States offering intramural programs (Lee et al., 2007). Of Canadian schools, 81% offer interscholastic or between-school sports (extramurals) despite these having higher associated costs and resources (e.g., transportation, uniforms) than intramurals. These intrascholastic (extramural) programs also limit participation to fewer students to focus predominantly on the development of more elite athletes. For example, on average, 48.4% of students are likely to participate in intramurals compared to only 22.5% in interscholastic sports (Dwyer et al., 2008). While both intramurals and interscholastic sports (extramurals) serve important roles in the provision of school-based PA, there is more of an underlying aim in most intramural programs on being inclusive and ideally accessible to a wider range of students regardless of ability (Bocarro et al., 2014).

Despite the aim of intramural programming toward inclusive participation, males make up over 85% of the participants in more than half of the co-ed intramural sports offered by various middle schools in the United States, with only volleyball seeing relatively equal gender distribution and cheerleading being exclusively made up of female participants (Edwards et al., 2011). The reasons for this type of distribution could be, for example, the heightened feelings of intimidation sensed by females in intramurals with such a high proportion of male participants, particularly in females with lower skill ability and in the presence of bullying and male aggression (Holt et al., 2012). Another deterrent to adolescent females' participation in intramurals is the PA options being limited to only traditional sports-based activities. Such activities are overly repetitive and competitive and often require a high level of skill for confident participation (Bocarro et al., 2014; Byl, 2008; Hills et al., 2014; Holt et al., 2012; McCombe, 2010).

The social-ecological model (McLeroy et al., 1988) has helped shape understanding of many intrapersonal, interpersonal, and environmental factors related to females' PA participation, engagement, and retention; hence, it served as the theoretical framework for the study. Research using the framework has recommended a reduction in intrapersonal barriers in intramurals through, for example, the facilitation of optimal levels of perceived competence; interest in and value for the activities; and feelings of enjoyment, support, positive body image, and autonomy (Lodewyk & Pybus, 2013; Owen et al., 2017; Webb & Forrester, 2015). More specifically, adolescent females tend to dislike situations in which their individual physical performance is on public display. This tends to elicit corresponding fears of being scrutinized and compromised self-esteem and motivation (Lodewyk & Pybus, 2013; McCombe, 2008; Webb & Forrester, 2015). Another important choice for adolescent females is whether to participate in PA programming that is either coeducational (i.e., mixed gender; Morgan et al., 2019; Newton, 2010) or more gender segregated (Bocarro et al., 2014; Edwards et al., 2011; Kanters et al., 2008).

An important interpersonal recommendation for intramurals is providing opportunities for positive social interactions and feelings of belongingness (Artinger et al., 2006; Baghurst et al., 2014; Pantzer

et al., 2018). Others include offering cooperative physical activities that foster interpersonal skills while building positive relationships with teachers and other potential positive role models, and having students active in planning, implementing, and evaluating the program (Byl, 2008; A. Watson et al., 2015). In addition to these more psychosocial recommendations, since physical education teachers are often fitting leaders and role models in school PA programs such as intramurals due to their training, qualifications, and experiences (Goudeau et al., 2014; Morgan et al., 2019; Newton, 2010), their supervision and leadership in intramural programs could help to reduce the social hierarchies imposed by students in more unstructured PA settings that tend to marginalize certain students and relegate them to the sidelines as passive spectators (Pope & O’Sullivan, 2003).

Byl (2008) and McCombe (2010) provide environmental recommendations for intramurals such as structuring the program according to each school’s aims, time schedule, facilities, space, grade levels, staff supervisors, volunteers, and equipment. For example, gym space can be used more creatively with indoor and outdoor activities being run simultaneously. Other options include having less frequent sessions except for a longer duration of multisport activities and pickup or drop-in sessions, which may be appropriate during busy periods when participation numbers are lower. Organizing single-day events that take place during school hours to promote school spirit and active living across the entire school may also be useful. In addition to these suggestions, there may also be different facilitators and barriers to intramural participation in structured and unstructured environments and levels of competition. For example, adolescent females often prefer individual and group fitness and dance activities and having both a competitive division and a noncompetitive division to choose from in intramural sports (McCombe, 2008). They also enjoy an environment wherein their input and choices are welcomed and valued (Webb & Forrester, 2015) and where they are allowed to participate at their preferred intensity level (Lee et al., 2007).

An abundance of quantitative research evidence suggests that a school-based intramural program that emphasizes females’ engagement in its development and implementation can become “female-friendly” and successful in confronting and interrupting

practices that alienate many (Owen et al., 2017). For example, Baghurst et al. (2014) and Pantzer et al. (2018) recommend intramural programs that provide many diverse activity options (a variety of individual, team, small group, and larger group activities) that enable students to go beyond what they experience in their physical education classes and interscholastic (extramural) sports programs. The intramural program should also provide them with choices of activities (so they can select those they deem less threatening) while fostering greater autonomy, different social interactions, new relationships, and improved school connectedness. Calls have been made for more qualitative research into the effect of intramural programs on at-risk groups such as adolescent females (Bocarro et al., 2014; Owen et al., 2017). Hence, the two objectives of this study were to qualitatively increase understanding about (1) why there are lower levels of PA and sport participation among adolescent females (Edwards et al., 2011; Owen et al., 2017; A. Watson et al., 2015) and (2) how those factors might be impacted by a novel high school intramural program designed to apply many of the research-based recommendations provided earlier for increasing PA motivation and participation in adolescent females, especially at school.

Method

Participants and Procedure

A new 3-month intramural program was designed and implemented to support females to become more engaged in sport and PA especially during school. Participants included female students in four high schools (one Catholic and three public) within three school districts in or near a large city in south-central Canada. One school had close to 1,600 students in Grades 7 to 12 and was in the suburbs of a mid-sized city (population 500,000), whereas the other three schools were 40 to 60 km outside of that city. Two of these schools were in small towns (population 5,000 to 10,000) and had approximately 500 students (Grades 9 to 12 and 7 to 12), whereas the other was in a more populated urban city (population 30,000) and had about 850 students in Grades 9 to 12. During the school day, each of the four schools provided students a break for about 5 to 10 min between classes and two longer (20 to 25 min) breaks (recesses) wherein students had the time to eat and to do other things such

as socialize, use their cellphones, progress on their homework, or engage in some PA. Preliminary anecdotal evidence from researcher observations and conversations with each school's director of physical and health education revealed that students' PA during these extended "recess-lunch" breaks from school classes was often a "co-ed open gym" time consisting mainly of males participating while some females participated, others watched, and the majority chose to do other relatively sedentary things in other areas of the school. This typically occurred even though there were some other physically active options available such as traditional intramurals or occasional recreational activities. Each of the schools also offered a competitive after-school sports program for more skilled athletes.

Prior to the study beginning, ethics approval was received from the research ethics board of a university and of each school board. Consent was then attained from school principals, volunteering teacher-leads, and students and their parents through written correspondence. A physical and health education teacher in each school was recruited and equipped to serve as the staff liaison (teacher-lead) between the school, student-participants, intramural program, and the expert program facilitator and researchers in this study. The expert program facilitator and lead-teacher of the program at each school then explained and recruited female students to participate in the student-leadership training workshop and co-design the intramural program during a short (10 to 15 min) school assembly for females. A couple of weeks later, the facilitator and teacher-lead implemented the intramural leadership training workshop (developed by the expert program facilitator and her colleagues at a nationally recognized organization) during a regular school day with 47 volunteering females across all of the schools (see additional explanation in the Focus Group Interviews and The Intramural Program sections). Four hundred eighty-three students (75 to 180/school) then participated in the revised intramural program for approximately 3 months. A female graduate-student researcher attended the assemblies and training modules at each school and used approximately 5 min of each assembly to introduce and invite students to participate in the study, following a verbal script.

Focus Group Interviews

The female graduate-student researcher, who had previous training and experience conducting focus group interviews, conducted four preprogram focus group interviews (1/school) with a convenience sample of 30 consenting female students ($n = 5$ in Grade 7, 2 in Grade 8, 4 in Grade 9, 10 in Grade 10, 4 in Grade 11, and 5 in Grade 12) who were recommended to the researcher by the teacher-lead in each school because they were perceived to have lower participation and engagement in PA, especially at school. The aim of these initial focus group interviews was to better understand why many adolescent females were likely to have lower levels of PA and sport participation, especially at school. Each interview ranged in duration from 30 to 50 min and followed an interview guide consisting of seven questions. Sample questions included “What do you like/dislike about school recess/lunch break?” “What kind of physical activities do you typically do during recess/lunch break?” and, “What keeps you from being more physically active during recess/lunch break?”

In addition to serving as data to meet the first aim of study, this information was informally useful for those planning the subsequent school-specific intramural program intervention as most of these focus group interview participants also served in that capacity. For example, the interviewees likely applied some of what they learned in this focus group interview to their subsequent planning and implementation of the intramural program intervention. Each school’s new intramural program intervention had similar features (e.g., novelty, choice, interest, collaborative) while being tailored by their student and teacher-lead planning committee for the unique needs, setting, and interests of participants in each school.

After approximately 3 months of implementing the school-specific intramural program, a second (postprogram) focus group interview was conducted in each of the four schools. All of those who participated in the preprogram focus group interview were invited to participate in the postprogram focus group interview, and 22 did so. Three other students who were actively involved as participants and planners in the program also engaged in the postprogram focus group interviews, which resulted in a total of 25 postprogram focus group interviewees ($n = 5$ in Grade 7, 0 in Grade 8, 5 in Grade 9,

9 in Grade 10, 3 in Grade 11, and 3 in Grade 12). Compared to the preprogram focus group interviews, the second focus group interviews assessed the potential role of the new intramural program on participants' motivation, affect, and participation in intramurals, PA, and sports. Some of the guiding questions included "What did you like/dislike participating in during the new intramural program the past 10–12 weeks?" "Do you think your experience in it might change your motivation and participation in PA and/or sport? Why or why not?" and "How else should intramurals during school/recess be better structured to increase motivation and meaningful participation?"

The pre- and postprogram focus group interviews were held at an agreed-upon classroom and time such as a recess/lunch break in the school but not during regular class time. In accordance with school board policy, no incentives were offered to students to participate in the research except for a complimentary pizza lunch during the second focus group interview. Participants names were replaced with self-selected pseudonyms.

The Intramural Program

The aim of the intramural intervention was to support females to become more engaged in sport and PA, especially during school. The intramural intervention consisted of a school day of intramural leadership training, several peer-group planning sessions, and then organizing and participating in engaging activities. The optional one school-day intramural leadership training event was implemented wherein a school-specific team of diverse student volunteers received 1 hour of leadership training theory from the nonresearcher expert facilitator. This followed with application opportunities supported by the teacher-lead and nonresearcher expert facilitator wherein student-participants discussed and planned their school's novel intramural program intervention to be innovative, culturally competent, varied, and inclusive; to leverage the support and available resources; and to reflect many of the best practices reported earlier. For example, the following program development principles were emphasized: (1) engage school champions (teachers/adult allies) who are empathetic, confident, good communicators, fun, and engaging; (2) make positive group engagement and social interactions a priority; (3) use a play-based format (rather than drills,

activities with long wait times, or sports played by all of the formal rules); (4) focus on building confidence, not winning or competition; and (5) allow young people to co-design and be involved in shaping their own experiences. For example, most of the intramural leadership training student-participants became the lead decision makers and implementors of the intramural program intervention in their respective school.

Small peer-group intramural-program-planning sessions tailored to the specific interests and desires of the female participants in each school were held regularly and facilitated the implementation of the intramural intervention either before, after, and/or during breaks from school. Although the frequency and form of these meetings varied somewhat by school, there were typically a few weekly planning meetings lasting 20–30 min each prior to the onset of the new intramural program and then weekly meetings for the same duration once the program activities began. Meanwhile, the expert program facilitator continued to work with the teacher-lead and the team of female student volunteers in each school to support them with developing and implementing the planned program. Finally, a variety of desired, engaging, and novel physical activities (decided by each school's student-leader intramural-program-planning committee) with the necessary equipment were organized and implemented during these periods. Each school was provided with funds on the basis of need for the necessary equipment, facilities, and/or guest instructors for implementing a variety of novel activities including yoga, fitness (e.g., Bodypump) and strength training, low-organized games, martial arts, glow sports, Zumba, ringette, kickboxing, and bicycling. For example, one school went several times to a local kickboxing venue, where they received instruction from a specialist, whereas another school invited a guest instructor to the school for several martial arts sessions.

Data Analysis

The four preprogram and four postprogram focus group interviews conducted with students served as the primary data source for the research. Students' responses to the questions were audio-recorded with small audio-recorders placed on the table and then transferred to a computer to be replayed as needed and transcribed verbatim by the graduate-student researcher who conducted the

interviews. The second author then conducted an initial thematic analysis guided by Braun and Clarke's (2006) step-by-step approach. In Phase 1, each transcript was read and reread for familiarization. "Jotting" was used to note coder preliminary thoughts, ideas, concepts, and so forth in the margin of each transcript (Miles et al., 2014). In Phase 2, initial descriptive codes that highlighted factors influencing females' participation levels (pre- and postintervention) and perceptions of the program (postintervention) were generated (e.g., "broken equipment," "work," "relaxation," "role of adults"). Analytic memos—more extensive writing in separate documents—were also created. These helped capture the analytic process around each of these developing ideas and to help draw connections between different themes and concepts. Initial codes were revisited, some of which were changed or merged on subsequent rounds of coding (e.g., the codes "work" and "relaxation" were grouped and recoded as "other priorities"). In Phase 3, codes were collated into themes and (Phase 4) checked across the data set overall and against the codes that had been created. These themes were then defined and named including, for example, "the role of gender" and "time constraints." A portion of the data was then reanalyzed by the third author to ensure suitable consistency and rigor of coding.

In addition to themes being generated inductively, a secondary deductive analysis guided by the social-ecological model (McLeroy et al., 1988) was conducted. In this analysis, themes that were generated inductively were compared against and grouped within the intrapersonal, interpersonal, and environmental categories of the model. For instance, the role of gender was grouped within the intrapersonal category and time constraints were associated with scheduling issues and grouped within the environmental category. In addition, when analyzing postprogram focus group interview data, the coder also analyzed the data in relation to the codes/themes from the first interview to determine if participants' perspectives changed between the two interviews. For the reporting of results, School C was the Catholic school and Schools A, B, and D were the public schools.

Results

Preprogram Focus Group Interviews

The first research objective was to increase the depth of understanding about why a significant proportion of adolescent females tend to have lower levels of PA and sport participation overall and at school. Through the preprogram focus group interviews, we identified themes and subtheme factors (Table 1) in females' participation in PA, particularly during school recess and lunch times.

Intrapersonal

Gender. Gender was a prominent topic of discussion for the participants. First, participants suggested that males and females have variable preferences for PA and that females' preferences have often been neglected or overshadowed by the interests of males. For instance, females at School D noted that the males constantly played basketball in the gym at lunch, which made it challenging for females to play anything else. Females also expressed a general lack of support for PA and sport in the school. Taylor (School D) expressed, "The mentality of the athletic spaces in our school is masculine" and there's "not really anything female based." Females also felt that their school sports teams were undervalued because the males were more likely to win but that a greater level of support might help their teams become stronger. Females also felt they were not receiving the same support from teachers at school in the form of, for example, being able to spend time in the weight room with only females while receiving proper training on use of the equipment. Perhaps the most prominent gender-related factor influencing females' participation in PA was a general feeling of discomfort during participation in co-ed spaces. Females from all four schools repeatedly used words such as "intimidating," "uncomfortable," "lack of confidence," and "guy-dominant" to express their feelings toward shared PA spaces. Some of their lack of confidence came from feeling that the males "wouldn't be accepting" of females using the open gym time for their own interests. The most frequently suggested solution to this problem was the introduction of a females-only space. For example, Amy (School D) stated, "Then one side would be girls and the other side would be co-ed, because a lot of girls don't go because the guys are there. So, if we do that, maybe girls would get more physically active."

Table 1
Thematic Findings

Theme	Subtheme factors
Preprogram	
Intrapersonal	<ul style="list-style-type: none"> • Gender • Time constraints and competing interests (e.g., social media, grades, peer interactions) • Autonomy, choice, and affect (e.g., self-esteem and shame)
Interpersonal	<ul style="list-style-type: none"> • Friends/social interactions • Adult leaders
Environmental	<ul style="list-style-type: none"> • Scheduling, space, access, and amount of quality equipment • Adult leaders • Activity type, diversity, intensity, and structure
Postprogram	
Intrapersonal	<ul style="list-style-type: none"> • Gender • Time and situational constraints • Autonomy, choice, and increased comfort levels • Increased motor competence and confidence
Interpersonal	<ul style="list-style-type: none"> • Role of friends and adult leaders • Positive changes in others
Environmental	<ul style="list-style-type: none"> • Differences between older and younger students • Overall lack of participation • Frustration in the facilitation role • Positive affect associated with enjoyable activities of a moderate intensity • New, varied, and accessible activity choices

Time Constraints and Competing Interests. There was generally consensus that the lunch break was too short to provide for meaningful movement opportunities. For instance, females at one school suggested lunch is “so fast paced and rushed” (Vicky, School C). While some females suggested they would often eat their lunch during class to gain back time for more activity, others felt that shortening breaks between classes was a more feasible solution as it

would increase the time for the lunch break. The perceived shortness of lunch break led to females highlighting the need to prioritize to determine how they would spend their time. “For instance, Vicky (School C) commented, “I don’t really have time to, like, make plans to play sports, especially if you only have 40 minutes, when you want to eat, maybe do homework, study, see your friends.” Academic performance and the need to relax and socialize with friends was regularly prioritized above PA. For instance, Anne (School B) suggested, “If I am, like, behind on a few classes, I’ll definitely put that first and then go into the gym.” Lily (School A) added that as students progress through high school, it “gets a lot harder and there is a lot bigger load on [them], so its just nice to relax with [their] friends.” Having jobs with shifts from after school to late evening was also a factor because lunch hour is “one really free hour in the day where I can pick what I need to do” (Taylor, School D). There were also many other events such as clubs and practicing a musical instrument, which often resulted in one being “way too tired to go and to motivate [themselves] to participate in any of the physical activities at school” (Katt, School A).

Autonomy, Choice, and Affect. While females frequently cited feelings of self-consciousness when participating around males, there were also references to their self-esteem and self-worth more generally. Relevant perceived threats were feelings of intimidation, peer comparisons, and the feeling of being judged fueled by the “extremely public” nature of the intramural system, suggesting that females “don’t want other people seeing” (Vicky, School C). Females also expressed an interest in being provided with opportunities to exercise some autonomy, particularly opportunities to make choices for themselves, for example, “the choice [whether or not] to do sports” (Tori, School C), the choice “to do whatever you want in open gym” (Turbo, School B), and the choice to “go out and play field hockey during lunch and organize something” (Hailey, School B). They added that even overcoming these barriers would still not guarantee their participation in school-based PA “if [they] don’t want to do games or sports” (Kelly, School A).

Interpersonal

Friends and Social Interactions. Although mentioned earlier as a subtheme of time constraints, the theme outlined here highlights

that females would rather be participating in some form of PA but tend to feel uncomfortable doing so without their friends. When their friends choose not to participate, it inadvertently leads to the nonparticipation of the females themselves. For example, “None of my friends are really like into . . . physical activity . . . so it’s kind of hard when, like, the people around you aren’t interested” (Emma, School D). While females recognize this as a barrier to their PA participation, they also seem to resist seeing it as a “negative influence” of their friends (e.g., “When you’re playing sports, you want to do it with people you are comfortable with and that you know can do it with you” (Vicky, School C).

Adult Leaders. While this theme was mentioned less frequently than the previous three, several females spoke of the role of adults (most frequently teachers) in their PA participation. These perceived roles were often negative and frequently linked to the previous themes. For instance, the time constraints created by their short lunch break were exacerbated by teachers who refused to allow them to eat their lunch during class. Some also felt that teachers could better moderate females’ concerns by, for example, being more aware and proactive of them (“teachers need to push more to support females,” Amy, School A), helping to meet their desire for participating in unfamiliar PA options (“Ya, we have trouble finding teachers for new sports girls would like to play,” Rachel, School A), and teaching them how to do so (“But once again no one knows how to do it. No one steps forward to teach it,” Amy, School A).

Environmental

Scheduling, Space, Access, and Amount of Quality Equipment. The extent to which participants were willing and able to engage in movement activities at school was also dependent on access to equipment, space considerations, scheduling, communication, and weather. For example, it can be difficult to “get equipment and different things, to find it, to use it” (Amy, School A), especially during the winter months, and the amount and quality of the accessible equipment was often lacking. For example, Anna suggested, “A lot of the equipment that we use were men’s size, so some of us couldn’t go out because we did not have the right size . . . and some of them were a lot broken.” Some students acknowledged that “[they] have a lot of stuff, except for nobody knows how to play it, and sometimes there’s

not enough space or time to learn it” (Rachel, School A). Females also spoke of a lack of space being available for the types of PA they were interested in pursuing. During open gym times, the gymnasium often felt “crowded” and “cramped,” which left them fearful of injuries. Even if space was available, females were often “disappointed” at not being able to use that space. The lack of communication about existing PA options at school including intramurals was also a frustration for several. They expressed that these barriers could be reduced if some simple scheduling adjustments and communication patterns were implemented and if a few more teachers would be willing to monitor the additional space. Finally, some females felt that cold winter weather was a barrier to being physically active outdoors at school, whereas others cited the hot summer weather as more challenging.

Activity Type, Diversity, Intensity, and Structure. There was general consensus about the importance of offering a greater diversity of activity choices at school (“I just think if we introduce new sports to our school, I think more girls would maybe come at least try and see what it is,” Anne, School A). Some recommendations related to this were creating a second workout room to the current weight room and equipping it with cardio machines, adding a spin and yoga class, and allotting half of the gym (or adding another activity space) for alternative activities: “I think that if half the gym would be used for something else then I would definitely go . . . but, like, since the whole gym is used for all these guys playing basketball, I don’t think I would go do that” (Lily, School B). While the activity itself was problematic for some of the females, so was the level of intensity during the activities. Lily suggested that to ease that, one of the two gyms could be used for students wanting a “competitive” or “vigorous” activity, while the other could be used to “just kind of play around.” She continued, “A lot of girls would go to that one and have, like, maybe, like, a vote on what they want to do in that gym for that day or something.” Finally, for females in schools where PA opportunities consisted largely of unstructured open gyms, there was often a desire for a greater level of structure. For example, several females spoke of how “chaotic” open gym times could be: “Just having more of those kinds of activities with a bit more structure, maybe led by other students; it wouldn’t be, I guess, as like scary as maybe an open

gym or something led by a teacher” (Katt, School B). Conversely, in a few instances, for females in schools where an activity structure was in place, there was a desire for less structured activities. For example, Michelle (School C) suggested that when activities were too structured, they were not “fun” or “casual.”

Postprogram Focus Group Interviews

The second research objective was to assess the potential role of the ReBOOT Intramural program on participants’ motivation, affect, and participation in intramurals, PA, and sports. Results revealed similar themes, although there was more variation than the preprogram results by school and grade level given that the programs were developed separately by students in each school. Some of the factors that were either positive or inconsequential to one group of females may have been a troublesome issue to females in another school on the basis of the issues they faced in planning and running their own program. There was a consensus among the sample that the intramural program was generally positive.

Intrapersonal

Gender. Having previously expressed concerns over feeling uncomfortable participating with males, many of the females expressed feeling better about being separated from the males during the intramural intervention. For instance, Hobbs (School A) shared, “You weren’t with a bunch of boys who are always competitive about it . . . I liked that . . . cause whenever we play with boys, its just boys; the girls aren’t included.” Similarly, Tory (School C) felt that females hold different expectations for one another that set a different tone: “Because we’re all girls, we don’t expect each other to have certain athletic ability and feel judged going to these programs or sessions.” There were also instances when females felt the point of their request for the females-only activities and spaces was missed. For instance, Puff shared that, despite being provided with some introductory knowledge of how to use weight-lifting equipment, females were still required to use the equipment in the same room as the males and this was uncomfortable and led to the thought, “Should I be here? Do I fit in?”

While several females spoke positively of the implementation of females-only spaces and activities, there were others who expressed

a strong preference to participate with the males, and even some who felt it was “wrong” to exclude them. For instance, Rachel (School A) suggested she “kind of [felt bad]” about the separation of boys and girls” and that she “love[s] playing sports with guys. They’re competitive, they’re hilarious . . . it’s just a lot more fun.” She goes on to suggest that more of the older students would likely attend if there was consistently a co-ed option that involved the same activity being offered in the females-only space. Similarly, Leah (School A) suggested that, despite the offer of a females-only option, “a lot of girls went in the co-ed side of the gym . . . they would rather be doing it with boys, as well as girls.” Micky asserted that, despite her preference for activities in a co-ed setting, she viewed the separation as a “good idea” but “just to start it off to make girls more comfortable.” The females also perceived that the males were similarly unhappy about the females-only activities when it meant having to give up space, particularly when space was taken but very few females showed up.

Time and Situational Constraints. Females in School B felt that splitting their lunch period into two separate sections (one for eating and one for playing) helped them achieve a balance. Anna stated, “So I think it was a good amount of time, like for intramurals and then, like, you still had time with your friends.” Females at other schools expressed being able to manage their priorities in other ways because the activities were freely accessible to all students and they could bring friends and feel as though they had plenty of time with them. The females in this study were generally more positive about the situational constraints to participation after the intramural intervention than before it. For example, they valued having the finances to purchase new equipment, visit community facilities such as a women-only fitness center), and pay instructors such as a boxer or a yoga leader to visit the school. Females in School B felt that the communication issues previously present were a nonissue during the implementation of their program given their efforts to use several strategies (e.g., morning announcements, video announcements, posters, banners) to advertise the program. Katt (School A) suggested that “everyone in the school [knew] that these things [were] happening” and that a failure to attend was based on choice, not a lack of awareness of available opportunities. Similarly, earlier space concerns were greatly improved with the addition of females-

only spaces that offered “a safe space for girls to play sports” (Hobbs, School A) and left the environment feeling “a lot less chaotic” (Rolo, School B).

The issue of time management and prioritization was still problematic for females in relation to their workload, particularly for older students. When asked why their friends did not often attend the intramural activities, students from School A suggested it was because of the heavy workload in upper grades. Other related reasons for lack of participation were needing time to eat, needing time to catch up on social media, taking part in alternative or extracurricular pursuits, and not wanting to waste their lunch time if intramurals was not organized or fun. For example, Rolo (School B) stated, “It was kind of annoying for me having to wait for a bunch of other people to show up when I had taken a bunch of time out of my lunch break.” Negative postprogram situational constraints included the lack of some desired equipment (e.g., outdoor equipment) despite having purchased some new equipment. How to effectively announce and promote the program events was a major source of contention between those who participated in planning the program events and those who did not. While this created very evident tension, School A seemed to avoid this by agreeing that announcing something just prior to the activity and maintaining a public calendar outlining the events were highly effective modes of communication.

Autonomy, Choice, and Increased Comfort Levels. Activities offered through the intramural intervention often provided females with a stronger sense of autonomy than their former lunchtime PA programs, especially by providing them valued choices of “a variety of different activities that the girls could do, because you’d see different girls going to different ones depending on what they enjoyed doing” (Leah, School A). Hailey (School B), who was part of the group facilitating the program at her school, shared that they had started “going in and talking to more girls” and asking the females “what they [wanted] to play,” changes that she felt were helping to improve the program. Despite this, some of the females expressed the need for continued improvement in this area and several were also conscious of the logistical concerns associated with this level of autonomy. For example, Katt (School A) stated, “Those things [offering a wider range of options] would be nice, just the problem would

be organizing it, because then you would require more teacher supervision, and you would require more student volunteers.” The new format of the activities also helped females who previously felt intimidated to feel more comfortable participating. For instance, Anna shared, “Most who went to intramurals wouldn’t like, like judgmental at all, everyone was, like, welcoming and, like, you felt comfortable and stuff.”

Increased Motor Competence and Confidence. For some females, the environment fostered through the intramural intervention provided them with the opportunity to develop the skills they needed to feel more confident participating in PA both at school and for the long term. For example, Jessica suggested that the development gained from participating in the program surpassed mere physical skills and provided her with a sense of empowerment: “If I actually had time to go and, like, to be in a boxing session after school, I would honestly go, because I think it helps with your person, like, your person inside, and makes you powerful.”

Interpersonal

The Role of Friends and Adult Leaders. The role of friends seemed to shift postprogram wherein females who participated in and planned the programs began to encourage their friends to participate with them, although some of them continued to experience resistance from friends. For instance, Turbo (School B) tried to persuade friends to come, yet they often did not because they were not “really into that kind of stuff.” Others were, however, able to persuade friends who previously would not attend to participate and some believed that their participation led to others wanting to join: “When I go out, some of my friends will start coming in too, and so I am able to keep up with my friends” (Hailey, School B). While females previously perceived a lack of support from adults, this was hardly evident in the postprogram data. Females from School A suggested that they had more support from administrators and a few of their teachers, which increased their participation.

Positive Changes in Others. One of the topics females spoke most positively about was having the opportunity to see positive changes in others on the basis of their engagement in the program. For instance, Sam (School A) noted, “I enjoyed seeing more girls coming out as we did them . . . they were all smiling, and I like when

people enjoy themselves.” Amy (School B) added, “We got to see a change in girls’ PA, so I have been seeing a lot of different females coming out.” Hailey (School B) shared that, while the program had little effect of her PA participation given that she was already active, of the females who did participate, she had “never seen them play sports before.” Jessica (School C) supported this: “A lot of girls I never actually saw at any school sports, and in phys ed class they would hate playing sports... seeing them come together was actually fun, and it made me happy.” Many of the females shared this feeling of satisfaction and enjoyment in perceiving positive changes in others during the program.

Environmental

Differences Between Older and Younger Students. Females who were part of facilitating the programs and those who simply attended noticed a disproportionate number of younger students participating and a striking absence of students in Grades 11 and 12. For example, females in School A noted that “there [weren’t] as many older girls” (Lolo) and that it was “really hard to get Grade 11 and Grade 12 students to do anything” (Leah, School B). Rachel (School B) suggested that students in the upper grades have “a lot of work” and are “really focused,” although Leah (School B) cautioned that older high school females did participate but preferred co-ed options so it would be best to avoid the females-only activities that are part of the program. One female (Jessica, School C) asserted that the best solution is to overlook those senior students and focus on younger students who are interested in participating.

Perceived Overall Lack of Participation. The females—especially those who did want to participate or who invested time into planning the programs—were disappointed and frustrated by what they perceived to be a general lack of participation from the majority of females in the school despite the initial momentum of the new intramural program. For example, Anne (School B) shared that her greatest dislike about the program was that “there wasn’t a lot of participation” and Micky (School C) was “upset that there weren’t too many girls—not as many as she had hoped would come.” For example, Leah (School A) expressed that the girls had “[taken] half the gym and then hardly anybody [was] showing up . . . so this

one side of the gym [was] packed full, and then the other side of the gym there [were] like three or four people playing.” The perceived lack of participation was similarly frustrating for students who gave up a portion of their lunch break to participate only to “wait for about 10 to 15 minutes for other people [who] took a lot longer to show up” (Rolo, School B). The females believed that this would likely be improved if the program was of value or worth to students. For instance, Katt (School A) asserted that “if people can see . . . just how fun and easy it could be, it would probably change motivation to do it.” These suggestions were linked to the perception that those students who attended were often not the females they felt most needed to be there: “I think that a lot of the people who did end up coming out were people who would already participate in like PA, which is kind of unfortunate” (Emma, School D).

Frustration in the Facilitation Role. Many of the females who participated in the focus group interviews were a part of the planning and facilitation process of the programs. They shared several frustrations about serving in this role. First, they seemed to struggle to see themselves as facilitators and participants simultaneously because if they were “supervising,” they could not fully participate in the program. Sam (School B) suggested that they avoided participating to avoid “crowding” and because “the females who supervise are more likely females that normally do sports . . . so kind of making females that don’t play sports more invited and feeling more comfortable there.” Second, they felt a lack of ability to motivate students to participate even if they signed up to do so. This was evident in Amy’s (School D) comment:

So I, like, sent out all the emails to the females like who were participating . . . and then the day comes and no one shows up, and then who’s the one who has to chase them? Me. So I have to go classroom to classroom for those females, and that’s very frustrating.

Third, frustration also resulted from fellow planning committee members failing to fulfill their responsibility, which often resulted in more tasks being piled on a smaller number of student-facilitators who were often left feeling “practically alone” (Amy, School D).

Sam (School B) noted that the committee that started with approximately 20 people dwindled to “the same four people setting up every time.” Perhaps more frustrating, these absent committee members expressed a complaint that the females who usually did the set up were “not doing it properly or . . . should do it differently or . . . should communicate it more” (Sam, School B). The final source of frustration for program student-facilitators came from program participants who shared their complaints. For instance, Hailey (School B) pointed out that while “very few people [help] out . . . a lot of people [complain].” Despite these feelings of frustration, females from School B acknowledged that this was their “first time for running” the program, as a largely student-led initiative, and that they were “learning stuff along the way” (Hailey, School B).

Positive Affect Associated With Enjoyable Activities of a Moderate Intensity. The sample also spoke of the nature of the available activities as an influential factor in their positive movement experiences in the form of having fun (e.g., “I felt happy because of how much fun I was having,” Dopy, School B). They valued being able to just relax and play. For example, Anna (School A) expressed, “Like when we were little kids, so it brought back the past and we got to laugh; it was super fun.” Emma (School D) added, “It wasn’t like too intense or anything, so it was good; it was fun.” The affirming atmosphere provided a positive alternative and often helped motivate friends to participate.

New, Varied, and Accessible Activity Choices. One of the elements of the newly implemented intramural program that females spoke most favorably about was the inclusion of a variety of novel activities from which they could choose, including those relative to physical education. For example, Rachel (School B) stated,

I definitely liked the newer sports that we don’t play in gym, like the martial arts and the glow games . . . because a bunch of people came out, and the martial arts was just fun because it is not something that you do it in gym for some reason.

Vicky (School C) added,

It showed the girls that they can have fun doing physical things that we forgot we liked to do . . . I think the program doing different things really, really shows you that you can

have fun working out, and it doesn't have to be like the status quo stuff we do at school.

Similarly, Rolo (School B) felt that being involved in activities that she had not previously experienced “opened up [her] mindset . . . to some other options.” For some, being involved in the intramural program provided them opportunities to engage in physical activities that were previously inaccessible. For instance, Dopy (School B) expressed, “Well, I don't get to do a lot of sports because some sports we can't afford, so if I can do them at school, then I like this.”

Discussion

This study qualitatively increases understanding about why there are lower levels of PA and sport participation among adolescent females particularly during the time spent at school and how those factors might be impacted by a high school intramural program. One general intrapersonal findings about PA and intramurals at school prior to the intramural program is that females feel more needs to be done to recognize their needs and preferences for some different types and intensities (i.e., the freedom to choose how hard to exert oneself) of physical activities than those of males, to reduce feelings of discomfort and self-consciousness. Females also have an interest in being provided with opportunities to exercise some autonomy, particularly in being given opportunities to make choices for themselves. These findings generally corroborate the research reported earlier on intrapersonal factors of females' school-based PA including intramurals (Bocarro et al., 2014; Edwards et al., 2011; Holt et al., 2012; Morgan et al., 2019; Owen et al., 2017; A. Watson et al., 2015) and provide a necessary frame of reference for the post-program results.

These intrapersonal concerns may largely dissipate after an intramural program, with many females preferring more physical activities away from males, along with a variety of novel activities such as yoga, Zumba and Bodypump fitness, weight training, low-organized games, martial arts, glow sports, ringette, kickboxing, and bicycling. Females also feel more comfortable (less intimidated) and autonomous during intramural programs. Because adolescent females are often highly influenced by their peers to participate in activities that are deemed “gender appropriate”—and often associate PA

with sport, competition, and skill (Edwards et al., 2011)—redefining social views of PA and gender to include a wide array of activities can encourage safe and confident female participation (A. Watson et al., 2015). However, some females have a strong preference to participate with the males, even viewing it as “wrong” to exclude them given that females-only spaces are often not well attended. Hence, it may be useful to provide mixed-gender and females/males-only PA and sport options during intramurals while providing a variety of physical activities, venues, and instructors/leaders that will interest more students and motivate more to participate.

The preprogram results pertaining to the interpersonal socio-ecological realm reveal that females often feel uncomfortable participating without their friends and that they often have negative views about the role of teachers in facilitating PA through more exclusively co-ed and traditional sport-based intramurals. After the new more comprehensive and student-centered intramural program, there appears to be a noticeable improvement in how the females feel socially and about their teacher-leaders involved in the program. For example, after such a program, females may more intentionally encourage their friends to participate with them despite their resistance and the perceived lack of teacher support may disappear. Females may also have more personal satisfaction from seeing new participants in intramurals and the positive changes in others.

These interpersonal results signal the importance of positive social interactions, feelings of connectedness with peers and friends (Artinger et al., 2006; Baghurst et al., 2014; Pantzer et al., 2018), and effective adult leaders and mentors in adolescent females’ PA settings (Goudeau et al., 2014; Morgan et al., 2019; Newton, 2010). To illustrate, a pertinent finding of the study is that females who participate regularly in an intramural program may want others to also reap the rewards that they experienced. This provides support for assertions about the importance of helping females to realize the value of being physically active through intramurals (Webb & Forrester, 2015). The study also reveals especially low participation rates in the senior grades in a program designed to support female participation in PA. More of these females may participate if more opportunities for co-ed activities are offered. Some research signals that older females prefer co-ed PA, in comparison to their younger counterparts

(Morgan et al., 2019; Newton, 2010), and that female athletes intrinsically value both females-only and co-ed recreational basketball intramurals (Baghurst et al., 2014). Research needs to clarify these discrepancies by grade and ability in females.

Females part of the planning and facilitation committee for the intramural intervention in each school are generally positive about it and feel their experience can improve in time if they persevere. This corroborates research (e.g., Pantzer et al., 2018; D. Watson et al., 2000) generally showing that empowering students to serve as valued stakeholders involved in creating effective and inclusive policies, programs, and environments is vital to success. This is most likely because participatory approaches to program development can promote students' feelings of autonomy, enjoyment, engagement, and participation in the PA experiences. The SASFE features of autonomy-supportive teaching (Supportive, Active, Autonomous, Fair, Enjoyable) by Lubans et al. (2017) seem to closely align to these findings.

While many of these positive outcomes from serving as student-leaders appear evident in this study, student-facilitators may also have several frustrations about serving in such a role (e.g., less personal participation, feelings of inadequacy to motivate others, and experiencing some contention and alienation). This reinforces the need for adequate teacher and peer supports during the program. A study of adolescent females' experiences in a more traditional sports-focused intramural program by A. Watson et al. (2015; also see Newton, 2010) also highlights the importance of regular positive mentoring interactions between female student participants and student and teacher leader-role models as a means of promoting an active and healthy lifestyle at school.

While some of the initial time and environmental concerns are still evident after the program (e.g., not wanting to waste their lunchtime if intramural events are not organized or fun; the lack of some desired equipment for outdoor activities), a program designed to support female participation in PA can resolve some of these (e.g., females-only spaces, accessible activities, split lunches). Such a program can also reduce preprogram communication frustrations (e.g., being unaware of scheduling adjustments and existing PA options at school). Females also have a general appreciation for offerings such

as more alternative (less traditional sports), diverse, and moderate-intensity intramural activity choices with some additional options for the degree of structure (i.e., free-play or taught) depending on one's preference. One implication of this is that students should be afforded the opportunity to provide input on the types of activities offered as part of an intramural program, which can, if enacted, increase enjoyment and motivation (Webb & Forrester, 2015). Welcoming student input can also lead to higher levels of participation and engagement (Edwards et al., 2011; D. Watson et al., 2000), along with deeper learning and intention of students to continue to participate in PA (Kanters et al., 2008).

It is also important to note the variations in the results by school. Some of the factors that are either positive or inconsequential to one group of females may be a troublesome issue to females in another school on the basis of issues during planning and running their own program. This signals the need for a delivery approach that best suits each school's physical and cultural environment including the school schedule; number of student participants; volunteers and supervisors; and access to available funds, facilities, and equipment. With this in mind, the transferability of these findings is limited to similar settings (e.g., demographics, budget, facilities, equipment, incentives, mentors, and instructors). Also, we acknowledge that this study of adolescent females does not fully address the spectrum of what constitutes "male" or "female" (Kirk, 2003) and caution against any overgeneralizing of the results by gender. Finally, it is prudent to acknowledge that the funding provided for equipment, guest instruction, and some use of community venues in this study may have prompted some students to elevate their affirmations of the program. Moreover, the limited 3-month duration and variable event schedule of the program might have diminished its potential effect.

In conclusion, this study answers calls in the literature for qualitative research into the effect of intramural programs with adolescent females (Bocarro et al., 2014; Owen et al., 2017) and provides important new and specific information about the personal, social, and environmental complexities in intramural programming for this population. Most notably, this study shows a noticeable reduction in the females' perceived barriers to being engaged in PA at school after a program designed to encourage females to participate in

PA. Of specific importance, the intramural program needs tailored to each school culture through recruiting, training, empowering, and supporting student-volunteers who collectively (and following consultation with peers) decide on and administer the program. Other implications include addressing females' specific needs for socioemotional acceptance and comfort; positive social engagement with friends; time, space, and equipment for all seasons; teacher guidance; support; some basic instruction; intensity level options; and a variety of engaging and novel activities from which to choose, including whether to participate with males. Accommodating many of these needs in adolescent females can foster the enjoyment, value, and motivation for PA through intramurals and counter the allure of options that are more sedentary while enhancing the effectiveness of a multicomponent Comprehensive School Physical Activity Program (Owen et al., 2017).

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MOTOR LEARNING

Anthropometric Variables and Visual Reaction: A Relationship Study on Volleyball Players

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Abstract

Volleyball is a competitive sport and the main goal is to win or defeat other teams. The purpose of the study was to investigate the relation between selected anthropometric variables and reaction time of volleyball players. Fourteen district-level volleyball players from Bolpur, Birbhum, and West Bengal were selected as subjects. The age of the subjects was 19 to 25 years. Anthropometric segments (i.e., height, weight, arm length, leg length, BMI, and reaction time) were the variables of the study. Pearson product–moment correlation coefficient was used to find out the relationship. The level of significance was set at 0.05. There is a positive relationship between reaction time and weight, arm length, leg length, and BMI, but there is a negative relationship between height and reaction time of volleyball players.

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Volleyball is one of the most popular sports in the world. In 1895, Willam G. Morgan started the game of volleyball and he named it “Mintonette” for business people. Later, Professor Alfered Halstead, seeing the nature of the game, suggested that the name “Mintonette” be replaced with “Volleyball.”

Afterward, in the year 1947, the Fédération Internationale de Volleyball was established as the international controlling federation of the game, followed by different national federations formed to control the game nationally. In India, the Volleyball Federation of India was established in the year 1951.

Volleyball then developed rapidly around the world. In 1949, the volleyball world championships was launched. In 1964, volleyball was introduced in the Olympics for first time in Tokyo.

From the era of inception to the present era, the game has changed. It was started as a outdoor game but became a specialized indoor game. Initially, it was started as a recreation game but is now a specialized sports in which every player plays a specific roll in specialized positions such as spiker, setter, and libero.

Currently, volleyball is a competitive sport and the main goal is to win or defeat other teams, which requires a high level of performance and sound tactical system. A high level of performance demands a high level of physical fitness, power, mental alertness, reaction time, and anthropometric characteristic and a good level of co-coordinative abilities and various other factors.

Anthropometric measurements are a series of quantitative measurements of the muscle, bone, and adipose tissue used in the assessment of body composition. The core elements of anthropometry are height, weight, body mass index (BMI), body circumferences (waist, hip, and limbs), and skinfold thickness. Additionally, anthropometric measurements can be used as a baseline for physical fitness and as a method of tracking the progress of fitness (Casadei & Kiel, 2020).

Reaction time is the time interval between the application of a stimulus and the appearance of appropriate voluntary response by a subject. It involves stimulus processing, decision making, and response programming. Reaction time can be altered by a number of factors both physiological and pharmacological (Nene et al., 2011).

Seeing the basic demand of the present volleyball, we formulated this study with the basic intention to find whether any relationship exists between selected anthropometric characteristics and reaction time.

Method

Design of the Study

Purposive design was used by which the volleyball players were selected as subjects for the this study.

Selection of Subjects

The study was conducted on 14 district-level male volleyball players from the age category of 19 to 25 years. All the players were from Bolpur, Birbhum, and West Bengal, India. Before the start of the test, the participants were informed about the aim of the study and also told the details of the procedures of the test.

Selection of Variables

Anthropometric variables of height, weight, arm length, leg length, BMI, and reaction time were the variables of the study. Data were collected on two alternative days. On first day, data were collected on reaction time. On the next day, data were collected on selected anthropometric variables.

Criterion Measure

Height was measured with a stadiometer in meters. Weight was measured with a weight machine in kilograms. Arm length was measured with a measuring tape in centimeters. Leg length was measured with a measuring tape in centimeters. BMI was measured with weight in kilograms divided by height in meters squared. Reaction time was measured with an audio visual reaction timer in seconds.

Statistical Procedure

For the purpose of understanding the relationship between reaction time and selected anthropometric variables, Pearson product-moment correlation coefficient was used. The level of significance was set at 0.05.

Results

Table 1 shows the descriptive statistics of selected anthropometric segments and reaction time. Table 2 shows a clear relationship between reaction time and height ($r = -0.07$), reaction time and weight ($r = 0.20$), reaction time and arm length ($r = 0.01$), reaction time and leg length ($r = 0.08$), reaction time and BMI ($r = 0.22$). Figure 1 shows a graphical presentation of the relationship between selected anthropometric segments and reaction time.

Table 1

Mean and Standard Deviation of Selected Anthropometric Segments and Reaction Time

Variables	<i>M</i>	<i>SD</i>
Height	1.73	0.05
Weight	65.07	6.45
Arm length	77.36	3.65
Leg length	94.21	5.94
BMI	21.67	2.23
Reaction time	0.31	0.08

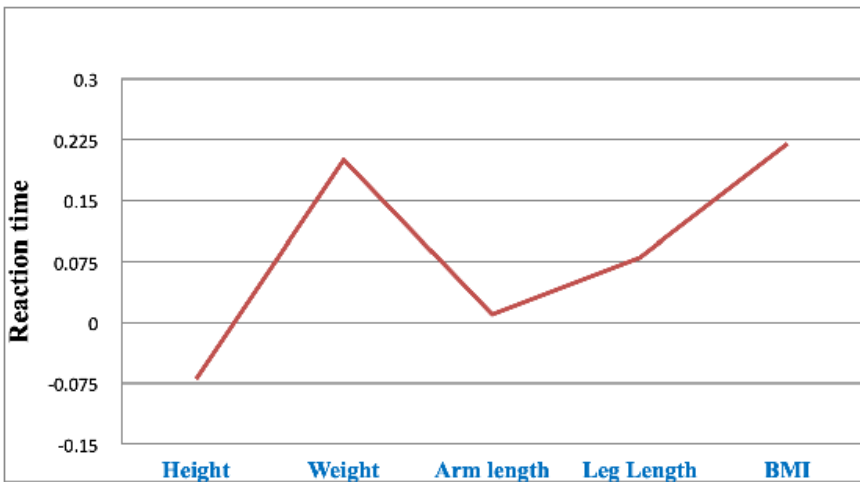
Table 2

Pearson Product-Moment Correlation Coefficients Between Selected Anthropometric Segments and Reaction Time of Volleyball Players

Anthropometric variable	<i>N</i>	Correlation coefficient
		<i>r</i>
Height	14	-0.07
Weight	14	0.2
Arm Length	14	0.01
Leg Length	14	0.08
BMI	14	0.22

Figure 1

Graphical Presentation of the Relationship Between Selected Anthropometric Segments and Reaction Time



Discussion

The results reveal a positive relationship between reaction time and selected anthropometric segments (i.e. weight, arm length, leg length, and BMI) and a negative relationship between reaction time and height.

This may be because reaction time is a co-coordinative component of performance-related physical fitness. In case of reaction time with an adequate stimulus, muscles are excited and excited muscles contract. This is immediately followed by relaxation. The general anthropometrical measures are dependent upon the genetic factor and may also depend on the nature of the activity, the training age of the player, and the position played in volleyball. We selected the volleyball players from the district level. The players had received proper training and had practiced the game on regular basis under proper guidance. This may be the reasons for such a result.

The results of the study are also supported by another study. The Sudheer et al. (2017) study reveals a positive relationship between BMI and visual reaction time. The probable reason for this positive correlation between BMI and visual reaction time is that elevations of BMI can lead to pathophysiologic changes such as vascular

changes, impaired insulin regulation, systemic inflammation, and reduced cardiovascular fitness, which can impact cognitive functioning, thereby slowing the processing capability and leading to a longer reaction time (Sudheer et al., 2017).

Conclusion

This study reveals positive relationships between reaction time and weight of district-level male volleyball players, between reaction time and arm length of district-level male volleyball players, between reaction time and leg length of district-level male volleyball players, and between reaction time and BMI of district-level male volleyball players. It also shows an inverse relationship between height and reaction time of district-level male volleyball.

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PEDAGOGY

The Acute and Chronic Effects of GoNoodle Brain Breaks on Reading Fluency Among Elementary School Children

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Abstract

There is growing evidence that increased physical fitness and physical activity (PA) rates are positively associated with academic achievement. Recent efforts toward Comprehensive School Physical Activity Programs (CSPAP) include the use of PA breaks during academic learning activities. This study examined the acute and chronic effects of PA breaks (via GoNoodle) on the reading fluency of 384 elementary school children. Reading scores (words per minute, reading accuracy, and words retold) increased significantly in certain chronic and acute conditions. Findings provide additional support of the growing body of research for the use of PA for enhancing academic achievement, specifically reading fluency.

In the era of the high-stakes testing across the education landscape, teachers are looking for any advantage to help their students succeed. One foundational area of particular interest that affects all other learning is the attainment of reading skills (literacy). Reading fluency (i.e., reading quickly, accurately, and with proper expression) gained national prominence when it was included in the Reading

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First guidelines of the No Child Left Behind Act of 2001 with a major emphasis on fluency *instruction* and *assessment* (Cunningham, 2001; National Reading Panel, 2000).

Not surprisingly, reading skills (i.e., reading with greater fluency, accuracy, and comprehension) increase when students read more. Children who are skilled readers read in greater volume and gain more enjoyment than less skilled readers (Clarke et al., 2013). They possess faster phonological processing for letter-sound application and self-testing that provides them with growth in vocabulary and comprehension (Clarke et al., 2013; McGill-Franzen et al., 2002).

Literacy deficiencies, on the other hand, are usually addressed through specific interventional strategies (most often workbooks and flashcards, ghost reading, etc., as remediation activities). Critics of these strategies argue that removing students in need of literacy intervention has the unfortunate result of these students reading thousands fewer words than proficient readers or those in teacher-led reading groups (Allington & Gabriel, 2012; Neuman & Celano, 2001; Serafini, 2010), thus, inadvertently, widening the reading gap. Not surprisingly, teachers are open to additional interventional strategies including the judicious use of physical activity (PA).

Physical Activity Trends and Academic Achievement

The connection between physical education outcomes (PA rates, fitness, etc.) and academic achievement has long been suspected but has received serious study only relatively recently. The inclusion of PA breaks throughout the academic day is an idea that is a part of a larger approach to increase health-enhancing PA referred to as the whole child, whole school approach. Operationalizing the goals of the whole child, whole school approach has led to the creation of the Comprehensive School Physical Activity Program (CSPAP). A CSPAP is a multidimensional structure that strives to maximize the school environmental effects on student PA rates. The five dimensions of a CSPAP, thought to make a positive contribution to children's overall PA rates, include (a) staff involvement, (b) PA during school (e.g., classroom activity breaks such as GoNoodle), (c) physical education, (d) PA before and after school, and (e) family and community engagement. In regard to PA, there are several products designed for movement integration in the classroom, including GoNoodle videos (see Dugger et al., 2020, for a comparison

of the functionality, utility, and appeal of these products). GoNoodle videos are avatar-led, set to music, last 5 to 10 min, and incorporate a variety of PA patterns. They also incorporate a variety of integrated academic learning content (Dugger et al., 2020). In this study, we used the free, online version of GoNoodle PA breaks (<https://www.gonoodle.com/>) to assess their possible effects on reading fluency.

Concurrent to the pursuit of a variety of interventional strategies designed to increase academic achievement, including reading fluency, the effects of infusing PA have also been explored. Over the past 15 years or so, a growing body of evidence has shown a positive relationship of PA rates and fitness scores to school attendance and academic achievement (Beddoes et al., 2020; Castelli et al., 2014; Castelli et al., 2007; Castelli et al., 2011; Chomitz et al., 2009; Grissom, 2004; Kamijo et al., 2014; Rasberry et al., 2011; Welk et al., 2010).

Other research has also suggested that the inclusion of PA breaks in a classroom setting or used during academic lessons has increased the overall rate of academic engagement within that classroom (Erwin et al., 2011), particularly when the teacher models and participates (Ernst & Pangrazi, 1999). Also, children have been observed to demonstrate on-task behavior during academic tasks following PA breaks (Grieco et al., 2009; Mahar et al., 2006). Further, evidence has revealed an increase in math test scores for eighth-grade students who have been exposed to a moderate-to-vigorous bout of PA (MVPA), compared to a nonactive group.

The possible effects of PA as an academic interventional strategy have produced a variety of examinations whose collective findings have been considered in three published systematic reviews and meta-analyses of the literature (Norris et al., 2015; Owen et al., 2016; Watson et al., 2017). Due to space considerations, we provide only a brief overview of their findings, recommendations, and conclusions and refer the reader to the papers referenced herein for complete details.

These analyses considered the results of some 88 studies examining the basic question of the effects or relationship of PA on indices of school engagement such as academic achievement (e.g., standardized test scores), classroom behavior, and cognitive function (Watson et al., 2017) or more general indices of school engagement (behavior,

emotions, and cognition; Hillman et al., 2011; Owen et al., 2016). An additional major purpose of many of the papers included in these systematic reviews was the degree to which PA breaks contributed to overall PA levels of children and adolescents. However, exploring the measurement, the amount, quality, or intensity of the PA during these breaks is not central to this study's research question but is for use as a manipulation check only.

A variety of research designs (e.g., cross-sectional, interventional, quasi-experimental, experimental) were employed, each with its strengths and weaknesses noted in the systematic reviews. Many of these studies reported having to operate within constraints common to working within the public school setting. Admitting to their respective limitations, the various authors urged caution in the interpretation of their singular results, something common to any study. However, the value of these meta-analyses is that the limitations of a single study begin to give way to a preponderance of evidence across the entirety of the extant literature.

Watson et al. (2017) further drew a distinction between the types of PA breaks as (a) *active breaks* with no intended connection to academic content, (b) *curriculum focused* with an intentional connection to academic content, and (c) *physically active lessons* wherein PA is fully integrated into subjects other than PE. The intervention type of our study falls primarily under the active break category where the form of physical activities has no overt connection or alignment to any academic subject matter. Any connections that may have occurred were coincidental.

The question of the acute and chronic effects of PA breaks was also examined in these analyses. Notably, there seems to be a consistently stronger acute effect raising the possibility of reactivity (novelty) and the question of exercise intensity (Owen et al., 2016). Conclusions from these studies include (a) PA breaks during class time, of moderate to vigorous intensity, seem to have small to moderate immediate effects and small chronic effects and (b) more pronounced effects associated with greater PA intensity (Egger et al., 2019; Schmidt et al., 2016). The mechanism by which an exercise intensity effect occurs deserves further inquiry.

Yet, there are other dimensions of PA, besides quantity or intensity, that also merit examination. For example, Uhrich and Swalm

(2007) explored a bimanual, cross-hemispheric motor task (cup stacking) over a 5-week period and found positive improvements in reading comprehension.

While most reading fluency studies examine the effects of instructional strategies (workbooks and flashcards, ghost reading, etc.), this study focuses on whether PA breaks might also have a positive effect on the specific academic outcome of reading fluency. If so, it may be that PA breaks present teachers with an additional effective strategy to increase reading fluency while helping children and adolescents achieve PA recommendations. Therefore, this study assesses the acute (immediate) and chronic (long-term) effects of PA breaks via GoNoodle on indices of reading fluency.

Method

Participants and Setting

Participants ($n = 384$, 208 males, 176 females) were members of 16 second-grade ($n = 8$) and third-grade ($n = 8$) intact classes ($r_{\text{class size}} = 20\text{--}30$) in four elementary schools located in the Intermountain West. School demographics were 70% White, 28% Hispanic, and 2% other ethnicities (Asian, Black, Pacific Islander) with 50% of the students receiving free or reduced lunch. All procedures received university and district IRB approval before the study began. Parental consent and student assent forms were signed and returned prior to data collection. All classrooms were configured with individual student desks arranged in rows, groups of four, or partners, including a large carpeted space sufficient to accomplish PA breaks.

Research Design

Researchers were granted access to the end-of-year DIBELS (version: Next; Good & Kaminski, 2002) scores for each of the 16 intact classes that were assigned to one of four distinct treatment groups in a 2 acute (with or without immediate PA break) \times 2 chronic (with or without a history of daily PA breaks), quasi-experimental, factorial design (Figure 1). Each group was represented by two second-grade and two third-grade classes. Dependent variables of interest included measures of reading fluency (WPM, RA, and WR) and PA rates (via steps per minute pedometry). Of primacy in this

Figure 1

Research Design: 2 Acute (With or Without Immediate PA Break) × 2 Chronic (With or Without a History of Daily PA Breaks), Quasi-Experimental, Factorial Design Matrix

	Acute PA: Participated in a GoNoodle PA break activity just prior to taking DIBELS assessment	No-Acute PA: Did not participate in a GoNoodle PA break activity just prior to taking DIBELS assessment
Chronic PA: Daily GoNoodle PA break activities during school year	Group A: Both chronic and acute PA breaks Grades 2 and 3 (<i>n</i> = 96)	Group B: Chronic PA breaks only Grades 2 and 3 (<i>n</i> = 96)
No Chronic PA: No GoNoodle PA break activities during school year	Group C: Acute PA break only Grades 2 and 3 (<i>n</i> = 72)	Group D: No chronic and no acute PA breaks Grades 2 and 3 (<i>n</i> = 120)

Note. Factorial design for 2 (chronic) × 2 (acute) treatment conditions. Each cell had two second-grade and two third-grade classes.

study were *both* the acute (immediate) and chronic (history of daily PA breaks), as compared to no-acute or no-chronic, use of PA breaks on reading fluency.

Instruments

As a result, federal grant monies funded the development and testing of valid and reliable literacy assessment tools designed to measure literacy constructs (e.g., phonemic awareness, phonics, fluency, vocabulary, and comprehension). One approved and widely adopted reading fluency assessment program is the Dynamic Indicators of Basic Early Literacy (DIBELS; Good & Kaminski, 2002). The DIBELS consists of several subtests that measure phonemic awareness, phonics, and oral reading fluency (ORF). Embedded in the

ORF is a comprehension measure via the Retelling Fluency (RTF) as measured by the number of words retold (WR). The DIBELS also measures reading accuracy (RA) and fluency via words per minute (WPM). The DIBELS has gained widespread use in the United States as a measure of early reading skills and, coincidentally, is required statewide, independent of this study. The DIBELS (including its subtests to measure WPM, RA, and WR), has been found to be valid and reliable (Martin & Shapiro, 2011). The DIBELS is quick and efficient (1–3 min/student) to administer and can identify students in need of remediation. Free for educational use, the DIBELS materials are available for download (Acadience, 2021; Serafini, 2010). In the subject district, reading fluency proctors administer DIBELS three times yearly (beginning, middle, and end of year) to identify at-risk students for reading difficulties. For the purposes of this study, access was granted only to the end-of-year DIBELS assessment scores.

This study used the World-Class Instructional Design and Assessment (WIDA; <https://wida.wisc.edu/resources>), a language proficiency test for English as a second language (ESL) that assesses ability to read in English (Solano Flores, 2016), to assess if ESL student reading fluency scores were affected by ESL status as a possible confounder variable. The WIDA is required statewide for all ESL students on a yearly basis.

Students were instructed on the use of uniaxial Walk 4 Life pedometers (model LS 2525). The pedometers were worn and recorded steps per minute during GoNoodle PA breaks. Total steps were recorded, and steps per minute were calculated. Pedometry was used only as a measure of total steps taken during the GoNoodle activities and not as a measure of exercise intensity (i.e., MVPA) or its contribution to individual PA levels.

Procedures

All teachers and district DIBELS test proctors attended a training meeting, which helped ensure fidelity across the study. Data were collected by classroom teachers (pedometer step counts, PA breaks weekly frequency) and district personnel (DIBELS, WIDA).

Classes in Groups A and B engaged in the free, online GoNoodle exercise program for 10 to 12 min/day for the entire school year. GoNoodle videos were selected from three categories (Kids Bop, Moose Tube, and Fresh Start Fitness) that (a) achieved time

requirements and (b) contained music with 120 to 160 musical beats per minute (Brewer et al., 2016) for better MVPA rates. The primary investigator checked in with teachers weekly to assess the degree of compliance and reported a high degree of fidelity in Groups A and B. Classes in Groups C and D did not engage in the GoNoodle exercise program. Thus, Groups A and B were considered to have a “chronic history” of brain break use in the classroom, whereas Groups C and D were not. Similarly, Groups A and C experienced acute use of GoNoodle PA breaks. Classes in Group D experienced neither chronic nor acute PA breaks and acted as controls.

Data Collection

On the day of DIBELS testing, Groups A and B participated in an online GoNoodle activity projected on the front wall. Immediately prior to the activity, students were prompted to reset their pedometer. Following the activity students recorded their step counts, which were then collected by the teacher and entered into a data sheet. Groups B (chronic) and D (no chronic) had neither an acute GoNoodle PA break nor donned a pedometer. Student in Groups A and D participated in regularly scheduled classroom activities.

All four groups were escorted to the media center, where they were allowed to sit quietly for 2 to 3 min before DIBELS assessment administered by trained and certified district proctors. All participants from Groups A and C (acute PA break) received DIBELS testing within 30 min of the cessation of the GoNoodle PA break.

Data Analysis

All statistical procedures were completed through IBM SPSS (version 25) software. Descriptive statistics (means, standard deviations, etc.) were calculated for all response variables (Table 1). Pedometer counts were used as a manipulation check that the PA breaks were equally administered (i.e., if class average step counts did not differ across groups). Although not central to the research question, an estimate of MVPA via steps per minute (Graser et al., 2011) was calculated and reported. WIDA scores were examined for any preexisting or ancillary ESL conditions as potential covariates. Socioeconomic status via free and reduced (FRL) lunch data was examined as a possible confounding variable. Gender differences were also examined (Table 2). Through correlational analysis, the

relationships among variables of interest were examined (Table 3). Univariate and multivariate normality as well as multicollinearity were examined via appropriate tests.

A two-way factorial MANOVA analysis was conducted for WPM, RA, and WR. Follow-up post hoc examinations were conducted for assessment of any gender or between-group differences. Main effects for chronic and acute use of PA breaks as well as their interaction were examined and compared across treatment groups. Specifically, comparisons were examined for Group A (both chronic and acute PA breaks) compared to Group B (chronic PA breaks only), Group C (acute PA breaks only), and Group D (control: neither chronic nor acute PA breaks). With multiple pairwise comparisons, effects sizes via Cohen's *d* were calculated for noted group differences. Where applicable, partial eta-squared was also calculated for main and gender effects.

Results

Table 1 shows descriptive statistics for selected dependent variables by treatment group. For the entire population considered ($n = 384$), participant DIBELS reading scores averaged (a) $M_{\text{WPM}} = 86.6$ ($SD = 31.2$), (b) $M_{\text{RA}} = 2.92$ ($SD = 1.1$), and (c) $M_{\text{WR}} = 32.9$ ($SD = 18.8$). Overall gender differences (Table 2) revealed that boys scored significantly higher on all three fluency indices, WPM: $F(1, 383) = 38.4$, $p < .001$; RA: $F(1, 383) = 17.2$, $p < .001$; and WR: $F(1, 383) = 50.2$, $p < .001$. These findings were similar to those by Watson et al. (2019). No significant gender-by-group interaction effects were noted.

The WIDA score for ability to read in English was $M_{\text{WIDA}} = 3.5$ and was not significantly different across treatment groups, indicating no preexisting differences in English reading ability between groups. The mean for socioeconomic status (FRL) was 1.54 ($SD = .50$) and did not differ significantly across groups, indicating no preexisting socioeconomic differences between groups.

Mean step count (for Groups A and C only) was 99.2 ($SD = 42.1$), suggesting low to moderate PA rates (Graser et al., 2011) and was nonsignificant across groups. In other words, PA rates during the GoNoodle activity breaks were essentially the same; the chronic group was no more active than the acute group. Two conclusions can be drawn from this: (a) the acute group did not experience a temporary bout of reactivity to the GoNoodle activity and (b) the

Table 1

Means and Standard Deviations Across Words per Minute, Accuracy, and Words Retold by Condition

Chronic use of brain breaks	Acute use of brain breaks	Group	N	Words per minute		Accuracy		Words retold	
				M	SD	M	SD	M	SD
Chronic	Acute	A	96	92.63	30.78	3.16	.99	37.41	19.19
	No Acute	B	96	87.20	31.14	2.98	1.05	29.39	16.71
	Total		192	89.92	31.00	3.06	1.02	33.40	18.39
No Chronic	Acute	C	72	87.96	32.19	3.04	1.03	36.61	19.64
	No Acute	D	120	80.51	30.25	2.63	1.10	30.03	18.52
	Total		192	83.30	31.16	2.78	1.09	32.49	19.17

Table 2

Means, Standard Deviations, and Eta-Squared for Measures of Reading Fluency by Gender

Measure of reading fluency	Gender	<i>N</i>	<i>M</i>	<i>SD</i>	η^2
Words per minute	Male	208	95.19***	28.50	--
	Female	176	76.50	31.27	--
	Total	384	86.61	31.19	.093
Reading accuracy	Male	208	3.12***	1.03	--
	Female	176	2.69	1.06	--
	Total	384	2.92	1.06	.044
Words retold	Male	208	38.70***	18.15	--
	Female	176	26.15	17.17	--
	Total	384	32.94	18.76	.12

Note. Boys demonstrated significantly higher reading fluency on all three measures.

*** $p < .001$.

manipulation produced a similar total-steps response in each of the classes and may serve as a simple check.

Bivariate correlations (Table 3) revealed relationships among selected variables were in the anticipated direction. There were significant, positive correlations between FRL status and reading fluency scores—students not on FRL demonstrated a small to moderate relationship to fluency scores (Table 3). Further, DIBELS fluency and WIDA scores demonstrated strong, positive correlations (Table 3).

Univariate normality indices for WPM, RA, and WR were in acceptable ranges ($r_{\text{skewness}} = -.52-.04$, $r_{\text{kurtosis}} = -1.0 - -.44$). There was, however, a violation of the assumption of multivariate normality via a significant Shapiro–Wilk (SW) test ($SW_{\text{WPM}} = .98$, $p < .001$; $SW_{\text{RA}} = .83$, $p < .001$; $SW_{\text{WR}} = .98$, $p < .001$). Further, an indirect test of multivariate normality was conducted through a Mahalanobis d of 11.46, with a three-variable, critical value of 16.27, which provided indirect support for multivariate normality. Last, Box’s test of equality of covariance matrices was nonsignificant, indicating an adjusted p value was not necessary. Levene’s test of equality of error variances was also nonsignificant. Nonetheless, in consideration of a

Table 3

Correlations of Measures of Reading Fluency, Free or Reduced Lunch, and WIDA Scores

Variable	Free or reduced lunch	WPM	Accuracy	WR	WIDA
Free or reduced lunch		.34**	.14**	.22**	.35**
WPM			.52**	.67**	.87**
Accuracy				.50**	.60**
WR					.81**
WIDA					

Note. WIDA = World-Class Instructional Design and Assessment; WPM = words per minute; WR = words retold.

* $p < .05$. ** $p < .01$. *** $p < .001$.

significant Shapiro–Wilk test, a Pillai’s trace (PT) adjusted value was used hereafter in the factorial MANOVA omnibus test.

Significant main effects for group ($PT_{WR} = .10, p < .001; d = .21, \eta^2 = .034$) and gender ($PT_{Gender} = .13, p < .001, d = .63, \eta^2 = .13$) were noted, allowing for follow-up comparisons via Tukey’s HSD. No significant interaction (Group \times Gender) effects were noted. Significant gender effects were noted with boys scoring higher than girls on WPM, $F(1, 376) = 38.73, p < .001$; RA, $F(1, 376) = 17.22, p < .001$; and WR, $F(1, 376) = 50.22, p < .001$. Small to medium effect sizes (i.e., small = .2, medium = .5, and large = .8) were noted via Cohen’s d (Cohen, 1990) and are indicated in text where appropriate.

Words Per Minute (WPM)

Group A ($M_{WR} = 92.63$) scored significantly higher than Group D ($M_{WR} = 80.51$; Tukey, $p = .003; d = .38$) on WPM. Group C ($M_{WR} = 87.96$) scored significantly higher than Group D ($M_{WR} = 80.51$; Tukey, $p = .048; d = .24$) on WPM. Thus, there was a significant acute main effect (Groups A and C vs. Group D) of GoNoodle PA breaks on WPM. However, no chronic main effect (Group B vs. Group D) was noted, suggesting that increases in WPM were primarily affected by an immediate bout of PA but not a cumulative effect.

Reading Accuracy (RA)

Group D ($M_{RA} = 2.63$) scored significantly lower on RA than Group A ($M_{RA} = 3.16$; Tukey, $p < .001$; $d = .50$), Group B ($M_{RA} = 2.98$; Tukey, $p = .007$; $d = .32$), and Group C ($M_{RA} = 3.04$; Tukey, $p = .001$; $d = .38$). Thus, there were both chronic and acute effects associated with GoNoodle PA breaks on RA.

Words Retold (WR)

Group A ($M_{WR} = 37.41$) scored higher on WR than Group B ($M_{WR} = 29.39$; Tukey, $p = .008$; $d = .46$) and Group D ($M_{WR} = 30.03$; Tukey, $p = .001$; $d = .39$). Group C ($M_{WR} = 36.61$) also scored significantly higher on WR than Group B ($M_{WR} = 29.39$; Tukey, $p = .01$; $d = .40$). Group C ($M_{WR} = 36.61$) scored significantly higher on WR than Group D ($M_{WR} = 30.03$; Tukey, $p = .001$; $d = .35$). Once again, there was a pronounced acute main effect on WR.

Discussion

The purpose of this study was to examine the possible effects of PA breaks via GoNoodle on indices of reading fluency (WPM, RA, and WR) as measured within the DIBELS reading assessment tools. Following recommendations of previous works, we employed an intervention design with a control group over an entire school year, and used standardized, valid, and reliable measures (DIBELS, and WIDA). We sought to isolate the effects of PA on a single academic outcome, reading fluency, as opposed to more generalized measures of school performance.

While many teachers are beginning to recognize the value of PA for increasing school engagement (Barney & Deutsch, 2009; Owen et al., 2016), there may be much more to it than the ambiguous pursuit of *burning off excess energy*. Indeed, the results of this research suggest that increases specifically in reading fluency also seem possible. A single bout of exercise, for example, can improve the automation of some aspects of cognition (Audiffern et al., 2008; Hagervost et al., 1996; McMorris & Graydon, 1997) such as reaction time, speed of information processing, and higher-order cognition (planning, scheduling, inhibition, and working memory; Kramer et al., 1999; Owen et al., 2016). It is also noteworthy the gender effect

favors the males. For them, exercise seems a more especially effective intervention.

Further, while reading fluency, in and of itself, is a desirable outcome, it may also be a critical gateway to comprehension. Increased reading fluency may free mental processes toward achieving deeper levels of meaningfulness. Wolf and Katzir-Cohen (2001) describe a process that moves readers from reading accuracy to reading with greater ease and speed and to ever-increasing success. Thus, it is understandable that teachers would welcome any variety of strategies that achieve increased reading fluency, including the possible contribution of PA breaks.

Acute Effects of Physical Activity Breaks in the Classroom

The results reveal that the most pronounced effects of PA breaks occur immediately following bouts of PA on measures of reading fluency. This finding aligns with those in studies summarized in Owen et al. (2016). There also appears to be more of a cognitive benefit than previously recognized (Hillman et al., 2011). This finding also supports research (Phillips et al., 2014) examining the effects of single-bout PA but does so with a shorter activity episode via GoNoodle activity breaks and with a lower PA rate with young children. However, some evidence suggests that some acute bouts of PA may or may not have an effect on cognition (van den Berg et al., 2016). Further, PA breaks may not be any more effective than sedentary breaks, and there is a need for more research in that area (Owen et al., 2016). While the relative merit of PA breaks versus sedentary breaks is an interesting question, if the only valued outcomes were academic, social, or emotional, we believe that the contributions of PA have merit of their own. A suggestion from Ratey and Loehr (2011), with which we agree, is the need for ongoing research to further clarify the beneficial effects of PA on school engagement; cognition; and specific, foundational academic outcomes such as reading fluency.

Chronic Effects of Physical Activity Breaks in the Classroom

While it is gratifying to see that acute PA bouts have an immediate effect on reading scores, it is also important to consider the possibility that there might be a cumulative effect from the chronic

use of PA breaks. Results of this study reveal children who take part in chronic and acute PA breaks may have better reading fluency than children who do not take part in such PA breaks. Though it is possible that the acute factor may account for the largest part of the variance, a chronic effect appears to exist to some degree in this study. This leads us to conclude that there may be academic value in the consistent practice of including PA breaks in the classroom. Additionally, as physical educators, we fully support the contribution such PA breaks make to the overall accumulation of healthful exercise habits that may extend in the critical years of adolescence in which PA declines (Blaes et al., 2011).

Limitations

Results and inferences of this paper extend only to second- and third-grade students and only in DIBELS testing at the end of the school year. We suggest a follow-up study that (a) tracks reading fluency pre-, mid-, and postyear to assess if there is a tipping point for chronic effects and (b) to test the effects of PA on reading fluency (amid all academic pursuits) through sixth grade or perhaps beyond. While it is encouraging to see chronic effects, they were weaker than we would have hoped for. This may not be surprising given ingrained characteristics of any kind are more stable and much more difficult to move in a given direction. While not of primacy in this study, there were no strict controls for the amount of MVPA during the PA breaks, rather just a simple use of GoNoodle products. Future studies can look at the dose-response, perhaps using heart rate telemetry.

As is underscored in the systematic reviews cited herein, there have been many different research designs employed to examine this or similar questions. Each, including this study, has its strengths and its weaknesses. With a quasi-experimental design, this study lacked full randomization at the student level given the children were members of intact classes—a common problem for field-based research in the public school setting. We were further given access only to the end-of-year DIBELS scores. Having access to the pre-, mid-, and posttest scores would have been ideal. Therefore, we recommend additional research in this area seek to include measures from throughout the year to assess the within-group differences as well as the between-group differences. While we did have a control group,

its comparative value must only be acknowledged with respect to the end-of-year DIBELS assessment.

Conclusion

Though the effects sizes were small to medium, we view the results of this study as encouraging. Reading fluency comprises a complex set of skills and to find a link between it and PA is noteworthy. It supports similar findings cited earlier in this paper—academic activities seem to benefit from PA. PA, we know, affects the health of children and the question of whether “healthy kids learn better” seems to be gaining traction in today’s educational landscape. Although the results of this study may support this proposition, they do so only tangentially. We encourage additional research that investigates the connections between PA, health indices, and academic performance.

As the weight of evidence of the mind–body link continues to mount, perhaps educators, school administration, and parents should reconsider the long-held position that PA takes valuable academic learning time away from kids (Owen et al., 2016). Physical education, classroom activity breaks, before- and after-school PA programs, and community outreach (all components of a CSPAP) probably make a more significant contribution to academic achievement than is realized or accepted. Making a place for PA seems to hold merit for educating the whole child.

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PEDAGOGY

Examination of the Body Language Competencies of Physical Education Teachers

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Abstract

In this research, the objective was to examine the body language competency levels of physical education teachers (PETs) and their body language competencies according to gender, participation in an effective communication skills course, service year, and doing sports. Furthermore, it also included opinions of PETs about their actions in solving the disciplinary problems arising from students according to their participation status in an effective communication skills course. A quantitative design was used in the research. Three hundred forty-seven PETs from various cities around Turkey participated in this study voluntarily. The Body Language Scale was used in the research. The scale was delivered to the teachers via Google Forms. The research found PETs' body language competencies to be at an intermediate level. Moreover, there was no difference in the body language competencies of the PETs in terms of gender. The PETs whose service year was between 6 and 10 cared about their clothing more, and the teachers who attended an effective communication skills course and who regularly exercised paid more attention to their gestures and mimic, postures, and clothing. In addition to these results, it was observed that the teachers who attended an effective communication skills course did not display conducts such as shouting or physical contact while dealing with disciplinary problems. On the basis of the results, it can be inferred that teachers who attend an effective communication skills course will have

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higher levels of body language competencies. Therefore, it is thought that it is important for PETs to attend trainings that include effective communication skills.

People are in need of communication to sustain their lives, to interact with their environment, and to express themselves. People communicate with each other at every stage of their lives. So, wherever people are, there is always communication and this forms an inseparable part of human beings (Cuceloğlu, 2017). Communication has an important place in education and training life as in all other areas of life because education is one of the areas covering the communication processes. As well, education processes entail an effective use of communication. Therefore, it can be stated that teachers should have effective communication skills in the education process. An effective use of body language, which is a communication tool, in the education process can help students better understand their teachers. In this respect, the main purpose of this research was to find out to what degree physical education teachers (PET) use body language for effective communication.

Communication is the process of exchanging information between two or more parties and conveying information, ideas, messages, and facts between senders and receivers (Rickheit & Strohner, 2008). Another definition, communication is the transmission of feelings and ideas to others, on the basis of mutual speech and listening, verbally or with body language (Hogan & Speakman, 2012). Communication occurs as verbal or nonverbal. Verbal communication is the use of sounds and tongue to send and receive various messages. Verbal communication acts as the primary means of expressing ideas and thoughts between two or more people. However, oral communication alone is not sufficient for individuals to convey their ideas and thoughts. Although oral communication is the primary means of expression, nonverbal communication—also called body language—can affect the way a message is perceived and understood (Meriem, 2017). Body language, which is a form of nonverbal communication, is an effective approach for strengthening expressions in communication. Body language is a type of communication that includes features of place and time, clothing, or color codes and in which emotions are reflected on the body (Gunes, 2011).

Visual messages are prominent in body language. For this reason, a message delivered through body language is more effective than a message delivered verbally or audibly. Therefore, body language is a communication tool whose reliability is considerably strong. People use gestures, mimics, and movements of face, eyes, hands, arms, and body in their relationships with one another. These movements are important means of communication even though they refer to different expressions from society to society.

Through body language, it is possible for a person to leave a positive impression on others, understand the other person better, and communicate more effectively (Erol & Erol, 2015). The messages conveyed through body language hold 55% share of the communication that people establish with their environment. Thus, people realize most of their everyday communication by means of body language (Dutta, 2011). As body language constitutes an important part of proper and effective communication (Dogan, 2020), it helps to improve the quality of the learning–teaching process and students’ behaviors. Teaching and learning processes require the use of both verbal communication and nonverbal communication. Facial expressions, gestures, and body movements, which are elements of body language, contain various messages that affect teaching and learning processes (Meriem, 2017). It is important for teachers to use body language correctly and effectively so that students understand and accept the message given in the teaching process because students are influenced by the personality, attitudes, and actions of their teachers as well as their knowledge (Erkan & Avci, 2014). The useful evaluation of these effects is thought to be largely related to the quality of the communication between teachers and students (Bolat, 1996). In physical education (PE) classes, which are among classes in which nonverbal communication is used most frequently, it is important for teachers to use their body language effectively in terms of making students acquire successful communication skills. PETs play an important role in the personal and social development of students as teachers of other branches do.

The communication style of a teacher during the process of teaching a PE class helps students learn more naturally, more creatively, and more independently. The fact that more than half of the communications in PE classes are realized through nonverbal

communication encourages nonverbal behavior in PE (Jovanović & Zdravković, 2017). For this reason, PETs should have communicative and orientational features besides having aesthetic values such as a harmonic body structure and anthropometric and motoric features because PETs can build closer relationships with their students on an individual or a group basis during education processes (Gentiana, 2014). Considering that body language is a type of expression used in effective communication, it can be said that this type of communication is an inseparable part of PE (Dobrescu, 2014). Besides PETs creating a workload for students, body language promotes PE as a mutual action by which students gain experience and understand the necessity, advantages, and conditions of teamwork. Communication through body language helps students understand the message intended during an education process clearly, accept it, and act accordingly. As good critics and observers, students recognize the signals that teachers convey through their body language actions, they realize teachers' postures, and they come up with conclusions on what teachers think about a subject from their body language. For this reason, PETs should be able to make very good use of facial expressions, body movements, postures, intonations, and variants of proxemics (indoor space behaviors) that can reflect body language in communication effectively (Zovanovic & Zdravkovic, 2017). They should predict what type of reaction that students might give as a response to the teacher's actions; should make students feel their status as teacher via body language; should use their gestures and mimics effectively; and should be patient, smiling, understanding, kind, trustworthy, and full of energy (Çalışkan & Yesil, 2005). During the education process of the students, it is important for PETs to perceive body language approaches and provide feedback in a desirable way. This situation puts forward that the body language is an important mean for students to communicate effectively and successfully.

This research focused on the body language competencies of PETs. In this research, the body language competencies of PETs were analyzed according to the variants of gender, their participation status in an effective communication skills course, service year, and doing sports. In addition to this, this study researched the way PETs used their body language competencies in solving disciplinary problems. The results were expected to encourage trainers to attend

activities such as seminars, courses, and events intended to improve body language and effective communication skills.

Method

Research Model

In this study, a quantitative design was used. Quantitative design is a type of research that makes observations possible through objectification of experienced events and phenomena that can be measured and expressed numerically (Buyukozturk et al., 2016). In the study, PETs body language competency levels and their body language competencies were examined according to gender, participation in an effective communication skills course, service year, and doing sports. Furthermore, the behaviors that PETs showed while solving disciplinary problems were determined according to their participation status in an effective communication skills course.

Research Group

The research group consisted of PETs who were working in various regions and cities of Turkey in the spring term of the 2019–2020 academic year. Three hundred forty-seven PETs participated in the research voluntarily ($M_{\text{age}} = 37.93 \pm 10.13$). Table 1 shows the demographic information of the participant PETs.

Of the PETs, 167(48.1%) were males and 180 (51.9%) were females; 257 (74.1%) had not attended a body language course and 90 (25.4%) had attended an effective communication skills course; and 91 (26.2%) had 1 to 5 years of service, 91 (26.2%) had 6 to 10, 71 (20.5%) had 11 to 15, and 94 (27.1%) had 16 or more. Additionally, 85 PETs (24.5%) did sports regularly, 71 (20.5%) did sports frequently, and 191 (55%) did sports from time to time.

Data Collection Tool

The Body Language Scale used for the research was developed by Tok and Temel (2014). The scale consists of 23 items and has a 5-point Likert-type structure. The scale has three subdimensions: gesture and mimic, posture, and clothing. Example items include “I teach effectively by using my gestures” for the gesture and mimic subdimension, “I exhibit a confident stance” for the posture subdimension, and “I pay attention to the harmony in my clothes” for

Table 1*Demographic Information of the Participant Physical Education Teachers*

Value	Level	n	%
Gender	Male	167	48.1
	Female	180	51.9
Participation in an effective communication skills course	No	257	74.1
	Yes	90	25.9
Service year	1 to 5 years	91	26.2
	6 to 10 years	91	26.2
	11 to 15 years	71	20.5
	16 and years	94	27.1
Doing sports	Regular	85	24.5
	Frequently	71	20.5
	From time to time	191	55.0
Total		347	100

the clothing subdimension. The internal consistency coefficient of the scale was calculated as .87, for the first subdimension as .86, for the second subdimension as .67, and for the third subdimension as .61. For this study, the internal consistency coefficient of the scale was calculated as .74, for the first subdimension as .69, for the second subdimension as .75, and for the third subdimension as .60.

Data Collection Process

The PETs were included in the study through an open sampling procedure (Strauss & Corbin, 2015), which is a convenience sampling in which everyone meeting the inclusion criteria and expressing their interest participates. An electronic scale via Google Forms was applied to the teachers who were willing to participate via email groups, social media accounts, and personal media accounts. The scale, which provided a confirmation form before the start of the research, included the aim of the study, amount of time to participate, inclusion criteria of the study, and participants' right of withdrawal. The PETs who accepted the inclusion criteria continued the scale. The data collected were transferred to SPSS 23.0.

Data Analysis

The study performed the data analysis as follows: frequency and percentage for descriptive statistic; variance analysis (one-way ANOVA and independent sample *t* test) for comparison of the mean scores in unrelated measures related to gender, participation in effective communication skills courses, service year, and doing sports; and the Tukey test for determining the groups of significant difference. Chi-squared analysis was also used in comparison of PETs' behaviors in solving disciplinary problems arising from the student according to their participation status of effective communication skills courses.

Before parametric tests were used in the study, skewness and kurtosis values, histogram and scatter graphics, and the variance equation of the groups (Levene *F* test) were used for normality assumptions. When the histogram and scatter graphics were examined, the curve showed a symmetrical distribution and the skewness-kurtosis values were between -1.5 and $+1.5$ (Tabachnick & Fidell, 2013). As a result of the analysis, the data showed normal distribution and the group variances were equal. According to the results, the data set was suitable for parametric tests.

Findings

The findings included body language competency levels of the PETs and conditions about the competency of body language in terms of gender, participating in an effective communication skills course, service year, and doing sports. Furthermore, some findings related to the behaviors of PETs in solving disciplinary problems according to their participation status in an effective communication skills course. Table 2 shows the body language competency levels of the PETs.

The body language competency levels of the PETs in the subdimensions of gesture and mimic ($1.94 \pm .68$), posture ($2.22 \pm .71$), clothing ($2.44 \pm .88$), and total ($2.10 \pm .63$) were at an intermediate level. Table 3 shows the *t*-test results of the PETs' body language competencies by gender.

No significant difference was found in the body language competencies of PETs by gender ($p > .05$). Table 4 includes the *t*-test results

Table 2*The Body Language Competency Levels of the Physical Education Teachers*

Subdimension	<i>N</i>	\bar{X}	<i>SS</i>	Min	Max
Gesture and mimic	347	1.94	.68	1.00	4.00
Posture	347	2.22	.71	1.00	4.00
Clothing	347	2.44	.88	1.00	4.00
Total	347	2.10	.63	1.00	4.00

Table 3*t Test Results of Body Language Competencies of the Physical Education Teachers by Gender*

Subdimension	Gender	<i>N</i>	\bar{X}	<i>SS</i>	<i>t</i>	<i>p</i>
Gesture and mimic	Male	167	15.62	5.53	.1522	.880
	Female	180	15.53	5.50		
Posture	Male	167	11.16	3.43	.189	.850
	Female	180	11.08	3.71		
Clothing	Male	167	4.91	1.83	.171	.865
	Female	180	4.87	1.70		

* $p < .05$.

of the body language competencies of the PETs according to their participation status in an effective communication skills course.

Significant differences were found in the body language competencies of the PETs in the subdimensions of gesture and mimic, posture, and clothing according to whether they had participated in an effective communication skills course. A significant difference was found in favor of Yes (having taken an effective communication skills course) in gesture and mimic ($t = -2.362$; $p < .05$), posture ($t = -3.476$; $p < .05$), and clothing ($t = -3.350$; $p < .05$) subdimensions. Table 5 presents one-way ANOVA results of the body language competencies of the PETs according to years of service.

A significant difference was found in the subdimension of clothing, $F(3, 343) = 2.469$, $p < .05$, of the body language competencies of the PETs by service year. No significant difference was found in the subdimensions of gesture and mimic, $F(3, 343) = 1.140$, $p > .05$, and posture, $F(3, 343) = .658$, $p > .05$.

Table 4

t Test Results of the Physical Education Teachers' Body Language Competencies According to Their Participation Status in an Effective Communication Skills Course

Subdimension	Effective communication skills course	N	\bar{X}	SS	t	p
Gesture and mimic	Yes	257	15.17	5.37	-2.362	.01*
	No	90	16.75	5.75		
Posture	Yes	257	10.73	3.54	-3.476	.00*
	No	90	12.23	3.44		
Clothing	Yes	257	4.70	1.76	-3.350	.00*
	No	90	5.42	1.67		

* $p < .05$.

A multiple comparison test (post hoc) found a significant difference between 11 to 15 years (\bar{X} = 4.47) and 6 to 10 years (\bar{X} = 5.23) in favor of 6 to 10 years in the clothing subdimension. Table 6 shows the one-way ANOVA results of the body language competencies of the PETs by doing sports.

According to the status of doing sports, a significant difference was found in the body language competencies of the PETs in the subdimensions of gestures and mimics, $F(2, 344) = 8.277, p < .05$; posture, $F(2, 344) = 6.543, p < .05$; and clothing, $F(2, 344) = 4.754, p < .05$. The multiple comparison test (post hoc) detected significant differences in the subdimension of gesture and mimic between from time to time and regularly in favor of doing sports regularly; in the subdimension of posture between from time to time and regularly in favor of doing sports regularly; and in the subdimension of clothing between from time to time and regularly in favor of doing sports regularly. Table 7 presents the chi-squared test results for the actions of PETs in solving the disciplinary problems that arise from students according to their participation status in an effective communication skills course.

The opinions of the PETs on the actions they put forward to solve the disciplinary problems that arise from students are given. A significant difference was found in the comparison made according to their participation status in an effective communication skills course,

Table 5
One-Way ANOVA Results of the Body Language Competencies of the Physical Education Teachers by Service Year

Subdimension	Service year	<i>n</i>	\bar{X}	<i>SS</i>	<i>SD</i>	<i>F</i>	<i>p</i>	Tukey
Clothing	1 to 5 year(s)	91	4.92	1.77	3	2.469	.04*	11-15 < 6-10
	6 to 10 years	91	5.23	1.68	343			
	11 to 15 years	71	4.47	1.92	346			
	16 or more years	94	4.85	1.67				

* $p < .05$.

Table 6

One-Way ANOVA Results of the Body Language Competencies of the Physical Education Teachers by Doing Sports

Subdimension	Doing sports	<i>n</i>	\bar{X}	<i>SS</i>	<i>SD</i>	<i>F</i>	<i>p</i>	Tukey
Gesture and mimic	Regularly	85	16.44	5.91	2	8.277	.00*	From time to time < Regularly
	Frequently	71	17.32	5.42	344			
	From time to time	191	14.54	5.14	346			
Posture	Regularly	85	12.04	3.25	2	6.543	.00*	From time to time < Regularly
	Frequently	71	11.64	3.97	344			
	From time to time	191	10.51	3.45	346			
Clothing	Regularly	85	5.29	1.65	2	4.754	.00*	From time to time < Regularly
	Frequently	71	5.09	1.96	344			
	From time to time	191	4.63	1.70	346			

* $p < .05$.

$\chi^2(2) = 9.636, p < .05$. It was found that the PETs who participated in an effective communication skills course did not engage in the actions of shouting and physical contact (0.0%) to solve a disciplinary problem, but rather they tried to explain the situation with their gaze (62.2%) and talking (37.8%). It was found that the PETs who had not participated in an effective communication skills course did not get physical contact (0.0%) and they explained the situation with their gaze (68.5%), talking (25.3%), and shouting (6.2%).

Discussion and Conclusion

Teachers' body language actions are important for effective and successful communication. Nonverbal communication affects teaching intimacy and teaching efficiency and creates a positive environment (Panagiotis & Vasiliki, 2021). Thanks to the role teachers play in the teaching and learning process, some researchers focus on identifying teachers' styles, mistakes, and deficiencies in their body language actions and finding solutions (Çalışkan & Yesil, 2005; Habaci et al., 2013). When it comes to physical education and sports, teachers' use of verbal and nonverbal communication methods is important in terms of better expressing feelings, thoughts, and identity related to movement (Mukhopadhyay, 2020). The results of this study reveal much about PETs' body language competencies. These include that gender does not affect PETs' body language competencies, that PETs with 6 to 10 years of service pay more attention to their clothing, and those who take effective communication skills courses and do sports regularly pay more attention to their gestures and mimic, posture, and clothing. Moreover, teachers who participate in an effective communication skills course do not exhibit actions of yelling and physical contact while solving disciplinary problems. Finally, teachers who participate in an effective communication skills course use their body language competencies more effectively.

This research also reveals intermediate body language competency levels for PETs in the subdimensions of gesture and mimic, posture, clothing, and total. According to this result, it can be said that PETs put effort in using body language actions. In terms of the body language actions of teachers in a classroom, their gaze, posture, behaviors in indoor spaces, gestures, and mimic are important for revealing many actions that teachers should do through nonverbal communication (Ozbent, 2007). Therefore, the results of this

Table 7

Opinions of the Physical Education Teachers About Their Actions in Solving the Disciplinary Problems That Arise From Students According to Their Participation Status in an Effective Communication Skills Course

Actions of the PETs /values	No n (%)	Yes n (%)	Total n (%)	df	χ^2	p
My gaze would be enough	176 (68.5)	56 (62.2)	232 (66.9)			
I would scold the student by shouting	16 (6.2)	0 (0.0)	16 (4.6)			
I would try to explain the situation by talking	65 (25.3)	16 (37.8)	99 (28.5)	2	9.636	.00*
I would try to scare the students by physical contact	0 (0.0)	0 (0.0)	0 (0.0)			

* $p < .001$.

research reveal that PETs should use body language more often and more effectively in the teaching–learning process. Moreover, receiving training on effective communication skills may also contribute to the teaching–learning process.

In this research, the results show gender does not affect PETs' body language competencies. Accordingly, it can be said that male and female teachers have similar approaches about body language usage competencies. In addition to this result, it can be stated that the curriculum and rules applied in educational institutions limit the distinction of male and female teachers in terms of using body language. However, gender is an important factor affecting body language. Due to biological differences based on gender, males and females have unique behavioral patterns. For example, the walking and sitting styles of males are different than that of females. Males always seem to be strong and in protective position compared to females. They do not express their feelings openly, and they act sharper, harder, and with less emotion. As a result of these, there are differences between male and female body language. However, the results from this research do not match with the expectations. Similar to the findings of this research, the findings of Chaudhry and Arif (2012), Yalman and Hamidi (2014), and Gulec and Temel (2015) show no significant difference in the style of body language used by prospective teachers in terms of gender. Unlike the findings of this research, the findings of Hall (2006) and Tunceli (2013) reveal that female teachers have better communication skills than male teachers. On the other hand, a study by Pop and Zamfir (2020) shows that despite the stereotype that women communicate better, men read body language better and are more sensitive to nonverbal cues.

In this research, the results reveal that an effective communication skills course affects PETs' the body language competencies in gesture and mimic, posture, and clothing. Accordingly, it can be said that teachers who participate in an effective communication skills course put more importance on having a good disposition, a respectful posture, and an exemplary outlook for their students as a requirement of having good communication skills. Gestures, hand, and arm movements give clues about the inner appearances, understandings, persuasiveness, and mental states of individuals (Baltaş

& Baltaş, 2004). Effective nonverbal communication in the teaching process is supportive for teachers and positively affects students' performance (Nuraeni & Wahab, 2020). The external appearance of the teacher affects the students (Aytekin & Ates, 2020). According to Laminack and Long (1985), for students, a good PET has the qualities of having a decent temperament and being flexible, fair, respectful, reputable, determined, diplomatic, disciplined, patient, cheerful, understanding, emotional, gentle, sincere, attentive, positive and impressive, happy, and well-dressed. Students want PETs to smile at all students, to display a comfortable body position while talking to students, to use various vocal expressions, and to make eye contact while addressing students (Sztejnberg & Jasinski, 2020). Teachers who use gestures and facial expressions effectively, make eye contact, teach the lesson standing, and use the classroom environment effectively leave a positive image on students (Gokceli, 2013). According to the result of this research, it is important for PETs to attend an effective communication skills course and attending such a course increases the body language competencies of teachers who attend.

Because of the significant difference in the body language competencies of the PETs in terms of clothing by service year, it can be said that the teachers who have 6 to 10 service years in their profession pay more attention to their clothing in their body language competencies than do teachers who have 11 to 15 service years in their profession. In addition to this result, it can be said that the clothing style of teachers who have 11 to 15 service years affects them in negative ways such as monotony in the profession, decreased motivation, and exhaustion. The age factor affects the way of communication. As the age progresses, verbal messages are used more than bodily messages (Millî Eğitim Bakanlığı, 2011). Accordingly, it can be said that as the service years of teachers increase, they put their outlook of body language into the background and tend to use verbal messages more. Teacher clothing plays an important role in pedagogical communication (Aytekin & Ates, 2020). It is an important tool that reflects the personality and social status of teachers (Kaşhem, 2019). The teacher being an example with clothes creates a positive image on the students (Kaşhem, 2019). On the subject, similar results in terms of service years come from Tepeli and Ari (2011), but the results from Bozkurt (2004) show no significant difference between teachers' clothing and service years.

While fulfilling their responsibilities, PETs should set a good example for their students in many aspects including their sportswear (Gullu & Arslan, 2014). For this reason, it can be said that it is important for PETs to wear appropriate, clean, and neat clothes to set a good example for their students, and it will be useful for any teacher to be sensitive about this issue regardless of their service years. The results of this research reveal that PETs who do sports regularly have higher body language competencies. Accordingly, it can be stated that teachers care about sports because regular sports activities provide them with decent physical appearances and positive images. Physical appearance is one of the issues that people care about most. Physical appearance often takes precedence over actions and achievements of an individual. The effect of regular sports activities for an individual in achieving an ideal body structure is undeniable. An ideal physical structure gained through regular sports activities is also an indicator of being healthy (Cusumano & Thompson, 1997). In addition to providing individuals with the opportunity to live in a healthy way, physical activities have positive effects on the development of personal and social characteristics of individuals (Ozturk, 1998). The physical appearance of PETs affects the participation of students in physical activities, and students participate more in physical activities in lessons with PETs who have a fit appearance (McKown et al., 2019).

Body presentation is not just a reflection of the clothing style. It is also the manifestation of the will, intention, and feelings of an individual (Ozaltin, 2003). From this perspective, it can be said that teachers who do sports regularly are examples of healthy individuals for both students and society. Thus, PETs should think about the ideals that support their own embodiment, professional identity, and practice (Schubring et al., 2021). A good physical appearance of a PET while teaching increases the field-specific teaching success (Tamer & Pular, 2001). This situation reveals that teachers put importance in doing sports regularly as it improves their self-confidence and provides a positive body image while they communicate with students. In addition to the anthropometric features of individuals (age, height, and weight), health status and physical appearance constitute behaviors that control self-worth and skills, and all of these are reflected in their social relationships. Prospective PETs who do sports

actively have high physical self-perceptions (Pehlivan, 2010), and individuals who do sports have more positive body perceptions than those who do not (Zekioglu, 2003).

In this research, the results reveal that PETs who participate in an effective communication skills course do not engage in actions of shouting and physical contact for solving disciplinary problems and they try to explain the situation with their gaze and by talking. On the other hand, PETs who do not participate in an effective communication skills course do not use physical contact but explain the situation with their gaze and by talking and shouting. It is noteworthy that the participant teachers who participated in an effective communication skills course did not communicate by shouting. In general, it can be said that teachers mostly choose nonverbal warning methods when dealing with the undesirable actions of the students. Considering that PE classes are mostly held at school gardens or sports fields, it can be assumed that PETs prefer to use this form of warning against undesirable student actions. The preference of communication approach can be explained by the way a class is taught. It can be said that play-based activities being performed frequently in PE classes and students being allowed to move freely during PE classes prevent undesirable student actions from reaching serious stages. Thus, undesirable student actions observed during classes are mostly mild and manageable (Korkmaz et al., 2007). From another perspective, students want PETs who do not shout at them, do not scold them when they make mistakes, and do not get angry (Avsar & Saglam, 2008; Sekerci, 2019). It can be said that the warning style of the participant teachers in this research is compatible with the expectations of the students. Other research reveals that teachers warn their students by making eye contact and give their reactions to their students by making eye contact (Yilmaz, 2008). PETs also use a verbal warning method frequently against undesirable student actions during PE classes (Erdem, 2016). In this research, the participant teachers used similar warning methods. In this respect, it can be said that PETs use verbal and nonverbal warning methods against undesirable student actions. Moreover, it is a positive behavior for teachers who participate in an effective communication skills course to avoid warnings by shouting or intimidating students by physical contact. That the participant teachers did not prefer such methods

against undesirable student actions shows that they adopt positive behavioral patterns. Therefore, it can be said that participating in an effective communication skills course contributes positively to the way teachers warn students.

Limitations

This research has some limitations. First of all, the data obtained in the research consists of evaluations based on the individual perceptions of the participant teachers about themselves. In addition to this, the research sample consists only of PETs. Future studies can conduct a comparison study by creating a data group with teachers of different branches.

Suggestions

The results of the research reveal body language competencies of the PETs in the teaching process to be at an intermediate level. However, teachers who participate in an effective communication skills course have higher body language competencies. Today, it is important to train teachers to use body language effectively. This skill can be taught by experts through teaching activities oriented at the effective use of body language for the prospective teachers during their candidacy process. Moreover, classes and activities that enable prospective teachers to develop their communication skills should be provided. This will allow them to become experienced in effective communication.

On the other hand, the results of the research reveal that PETs who participate in an effective communication skills course do not yell or use physical contact while solving disciplinary problems. Therefore, in-service activities, classes, and informative activities oriented at the use of effective communication skills and body language can be organized for teachers on duty.

It is known that regular sports have effects on individuals such as being healthy and fit, increasing self-esteem, and allowing for socialization. According to the results of the research, PETs who take effective communication skills courses and do sports regularly pay more attention to their gestures and mimic, posture, and clothing. Therefore, in addition to taking effective communication skills courses, PETs should also be encouraged to do sports regularly, and a suitable environment and time should be provided for this.

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PHYSICAL FITNESS



Classifying High School Students' Health-Related Physical Fitness Report Cards With Data Mining

Hande Busra Eren and Gokhan Caliskan

Abstract

In this study, classifications were made from the data obtained from the Health-Related Physical Fitness Report cards and BMIs of students through data mining methods, artificial neural networks, and decision trees models. Then the classification performances of both models were compared. The body weight and height measurements of the students in the Health-Related Physical Fitness Report were formulated, and their BMI classification was made. In addition, it was investigated whether other parameters such as shuttle, push-up, and sit-and-stretch flexibility test values had an effect on BMI classification. The study group comprised 1,050 secondary school students studying in the Cihanbeyli district of Konya in 2017. In conclusion, it was determined that artificial neural networks had more correct classifications than decision trees analysis. In the Health-Related Physical Fitness Report, shuttle and push-up stood out among the variables affecting BMI classification.

In the developing and globalizing world, great advances have been made in information technologies. In parallel with this development, storing every desired data has caused billions of bytes of data to be accumulated in electronic media in a very short time. New mechanisms have emerged that meet the requirements of today

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and go beyond data collection. From the aggregated data accumulated in the databases, the need to access meaningful information was felt, and the process of accessing the gold data from raw data was initiated. This process is called “data mining.” Data mining is the process of discovering interesting models and information from a large amount of data in databases, enabling automatic retrieval of previously unknown, hidden, meaningful, and useful patterns from large-scale databases (Sever & Oğuz 2002).

Data mining has been successfully applied in the field of educational sciences, as well as in many sectors such as health, economy, and telecommunications for years. Data mining in the field of education is known as educational data mining. The increasing use of technology in education systems has led to the storage of large amounts of student data. This has increased the importance of the use of educational data mining to improve teaching and learning processes (Algarni, 2016). Research using educational data mining has aimed to receive feedback from students about lessons, to determine the factors that affect their success and increase student achievement, to identify deficiencies in the content of education, and to create a more effective education process. In addition, research has aimed to guide students according to their needs and abilities and to offer teaching styles with customizable curricula by clustering students with similar profiles (Algarni, 2016; Altun et al., 2019; Aybek, 2016; J. Chen et al., 2014; Demiralay et al., 2017; Çırak & Çokluk, 2013; Romero & Ventura, 2007). The use of educational data mining has provided benefits to teachers and managers in many branches, as well as to physical education and sports teachers in their lessons.

The literature has included studies on the use of educational data mining in physical education and sports lessons. These studies have explored detailed information from the sports performance data of students, have determined the variables that affect their physical performance, have mentored students by creating prediction models, and have predicted the number of future athletes (Atasoy et al., 2017; Fan et al., 2019; Pan, 2019; Wang, 2020; Zhu, 2018). Moreover, the parameters affecting students’ physical fitness measurements have been determined through data mining methods (Rani et al., 2012); footballers have been classified according to their physical condition through cluster analysis, a data mining method (Jiang et al., 2018);

and future obesity situations have been predicted through data mining methods, students' existing BMI, and physical fitness measurement data (YoussefAgha et al., 2013).

One of the objectives of the Republic of Turkiye Ministry of National Education, physical education and sports course is to enable students to adopt these skills by improving their movement, knowledge, and skills through physical activity (Republic of Turkiye Ministry of National Education, 2018). It is known that individuals who regularly perform physical activity are less sick, have higher energy, and feel stronger psychologically (Corbin & Pangrazi, 1993). Individuals who are not physically active enough are known to face health problems such as obesity, high blood pressure, diabetes, and joint disorders (Chinn & Rona, 2001; Doinne et al., 2000).

Countries have been developing policies to solve these problems, which have reached a level that threatens individuals of all ages and has led to serious health expenditures and loss of labor. Schools are the most suitable places to find solutions to social problems because they are the places where children and adolescents spend most of their time. The physical education and sports course, which is an integral part of education programs, is the only class in which students can be physically active. Therefore, it provides an important opportunity to produce solutions to health problems that may occur due to a lack of physical activity (McGinnis et al., 1991). In this context, the *Health-Related Physical Fitness Report* is included in the curriculum of Physical Education and Sports (Republic of Turkiye Ministry of National Education, 2017). The purpose of the *Health-Related Physical Fitness Report* is to develop the knowledge, skills, and attitudes required to lead a healthy lifestyle, by creating the skills necessary for individuals to participate in physical activities (Republic of Turkiye Ministry of National Education, 2017). In this context, height, weight, push-ups, sit-ups, and sit-and-reach flexibility test (right and left) measurements of the students are taken twice a year, at the beginning (September 15–October 15) and end (April 15–May 15) of the academic year. With these measurements, the students are classified as underweight, normal weight, overweight, or obese according to the World Health Organization classifications of BMI. Students and their parents can access the measurement results from the relevant module in the e-school system (Republic

of Türkiye Ministry of National Education, 2017). According to the *Health-Related Physical Fitness Report* published by the Republic of Türkiye Ministry of Health in 2018, 16.5% of male students in secondary education are overweight and 6.8% are obese; 13.5% of female students are overweight and 4.3% are obese. Determining the parameters affecting BMI classification plays an important role in reducing the proportion of students classified outside the “normal weight” category in the BMI classification of the *Health-Related Physical Fitness Report*. However, it is necessary to provide the most accurate estimation and classification for this purpose. Artificial neural networks determine the information they receive from the given examples, which constitute the experiences of their own information processes and, thus, in which classification the student belongs (Öztemel, 2012). Another widely preferred classification model with easy installation and interpretation is the decision trees method, which is easy to adapt to databases (Kuyucu, 2012).

The literature review found a limited number of studies that use data mining, especially in physical education and sports. For this reason, it is thought that this study will contribute to the field. In this context, it will be in the community’s best interest for physical education and sports to better tackle obesity in students.

For this reason, data mining is an important issue for which to discover and apply new methods that will enable existing programs to better serve their intended goals. It is desired that students meet the classification of “normal weight” rather than “obese.” The main purpose of the *Health-Related Physical Fitness Report* is to raise awareness among individuals. Besides revealing which of the *Health-Related Physical Fitness Report* parameters are effective in BMI classification, the use of data mining methods will provide physical education and sports teachers with valuable information about reducing obesity. In this context, the general aim of this study was to classify the measurement data of the students’ *Health-Related Physical Fitness Report* through the methods of artificial neural networks and decision trees and to compare their classification performance. In addition, the BMI classification in the study came from the body weight and height measurements of the students in the *Health-Related Physical Fitness Report*. The study investigated whether sit-ups, push-ups, and sit-and-reach flexibility test values

affected this BMI classification. In this context, answers to these questions were sought:

1. What accuracy rate does the model, obtained by artificial neural network analysis, have in classifying students in the classification of the *Health-Related Physical Fitness Report*?
2. What accuracy rate does the model, obtained by decision trees analysis, have in classifying students in the classification of the *Health-Related Physical Fitness Report*?
3. What are the results regarding the comparison of the general correct classification rates of artificial neural networks and decision trees methods according to the classification of students in the *Health-Related Physical Fitness Report*?
4. What is the importance of independent variables in the BMI classification of the *Health-Related Physical Fitness Report*?

Method

Participants

One thousand fifty students (460 [43.8%] females, 590 [56.2%] males) studying at secondary schools in the Cihanbeyli district of Konya were included. An appropriate sampling method was used. Table 1 shows the class levels of the students in the study.

Data Collection Tools

Data on the *Health-Related Physical Fitness Report* were obtained from the Republic of Türkiye Ministry of National Education e-school system database. For the data to be used in the research process, ethical principles to be followed during the use of data were determined and permission was obtained from the Konya Provincial Directorate of National Education for research. After all the permissions were completed, data from each student's *Health-Related Physical Fitness Report* were obtained via e-school. Table 2 shows the variables used in the research as a data collection tool and included in the *Health-Related Physical Fitness Report*.

Table 1
Class Levels of the Students in the Study

Students	Grade				Total
	9	10	11	12	
N	380	272	255	143	1050
%	36.1	25.9	24.3	13.7	100

Table 2
Health-Related Physical Fitness Report Variables

Independent variable	Tests
Anthropometric measurements	Weight Height
Muscle endurance	Push-ups Sit-ups
Flexibility	Sit-and-reach flexibility test (right) Sit-and-reach flexibility test (left)

In addition, BMI classification according to the World Health Organization was made for the variables in the *Health-Related Physical Fitness Report*. Students were classified as underweight, normal weight, overweight, or obese.

Statistical Analysis

Artificial neural network analysis and decision trees analysis were used in the data analysis. BMI classification was determined as a dependent variable for decision trees analysis and as an output variable for artificial neural network analysis. The variables of height, weight, push-ups, sit-ups, and sit-and-reach flexibility test (right and left) were included as independent variables for decision trees analysis and as input variables for artificial neural network analysis.

CHAID analysis method was used for decision trees analysis, and multilayer perceptron method was used for artificial neural networks. The data were tested with different algorithms in SPSS 23 software. The model with the highest accuracy was chosen.

Artificial Neural Networks

Artificial neural networks are computer systems that have emerged as a result of the artificial simulation efforts of the human brain, and the ability to create, derive, and discover new information spontaneously through learning, one of the features of the brain (Kantardzic, 2011). They give easier and more accurate results in predicting nonlinear problems in comparison to traditional analysis methods. They consist of artificial cells that are hierarchically linked at the same time and can operate in parallel with each other. The main task of an artificial neural network is to produce an output set that can correspond to an input set shown to it. To do this, the artificial neural network is trained with examples of the same event, and the learning of the network is provided. In this way, the network is given the ability to generalize. It generates its own output values in the face of similar events with its generalization capability. This situation provides the most effective benefit in decision-making processes when there is limited information about the situations but there are examples (Öztemel, 2012). Artificial neural networks consist of many layers and many artificial neural cells. They have three parts: input layer, hidden layer, and output layer. Input variables that enter from the input layer pass through here and come to the hidden layer and are then passed to the output layer (Silahtaroglu, 2013). There are many artificial neural network structures in the literature, one of which is the multilayer perceptron networks used in this study.

Multilayer perceptron networks have a feed-forward network structure and use the method of teacher learning. Their operating principles are based on reconnecting weights until the mean of error squared is minimized. This is called the “generalized delta rule” (Haykin, 2009).

Decision Trees

On the basis of historical data, decision trees decide which classes the new data belong to by establishing certain rules. Many approaches are used in decision trees, and CHAID is the most widely used approach among them.

CHAID (chi-squared automatic interaction detection) analysis was developed by Kaas in 1980. One advantage of CHAID analysis is

that it can work with categorical and continuous variables (Mattison, 1997). In CHAID analysis, there is one dependent (predicted) variable and multiple independent variables (predictor). In this analysis method, all independent variables are compared and the variable that best describes the dependent variable is determined. Then, the data set is divided into nodes, that is, subgroups according to the independent variable that best describes the dependent variable. Nodes continue to create new nodes for other significant independent variables (Avşar & Yalçın, 2015).

Results

Artificial Neural Network Analysis

Table 3 presents the data on students' *Health-Related Physical Fitness Report* classified with the artificial neural network. The artificial neural network model correctly classified the students in the underweight category at 92.9%, the normal weight category at 95.9%, and the overweight category at 100%. Students in Class 1, 2, and 3 obesity categories could not be classified correctly. Total correct classification rate of the training set was 91.5%.

The test set was correct for 91.8% of students in the underweight category, 95.1% of students in the normal weight category, and 95.4% of students in the overweight category. Students in Class 1, 2 and 3 obesity categories could not be classified correctly. The total correct classification rate of the test set was 90.6%.

The training data set was used in the training of the network, and the test data set was used in the measurement of the performance of the training data set. When the findings of the test data set were examined to measure the performance of the training application, on the test data set, the training application performed well with a high correct classification rate.

Table 4 shows the findings regarding the importance order and percentages of the independent variables according to the classification status of the students from the *Health-Related Physical Fitness Report*.

Table 3
Classification Table Resulted From Artificial Neural Network Analysis

World Health Organization's BMI classification categories	Training dataset			Test dataset		
	Correct	Incorrect	Correct classification %	Correct	Incorrect	Correct classification %
Underweight	65	5	92.9	78	7	91.8
Normal weight	301	13	95.9	352	18	95.1
Overweight	76	0	100	83	4	95.4
Class 1 obesity	0	19	0	0	19	0
Class 2 obesity	0	3	0	0	4	0
Class 3 obesity	0	1	0	0	1	0
Total	442	41	91.5	513	532	90.6

Table 4

Artificial Neural Network Analysis Percentage of Importance of Independent Variables

Independent variable	Importance	Normalized importance %
Body Mass Index	0.244	100
Weight	0.240	98.1
Push-ups	0.109	44.5
Height	0.096	39.4
Sit-ups	0.093	38.2
Age	0.090	36.7
Sit and reach flexibility test (left)	0.051	21
Sit and reach flexibility test (right)	0.042	17.2
Sex	0.035	14.4

The most important variable determining the classification was body mass index (100%), followed by weight (98.1%) and push-ups (44.5%). These were followed by variables such as height (39.4%), sit-ups (38.2%), age (36.7%), sit-and-reach flexibility test (left; 21%), sit-and-reach flexibility test (right; 17.2%), and sex (14.4%).

Decision Trees Analysis

Table 5 shows the results of the classification made with the decision trees model. Correct classification was done for 77.4% of students in the underweight category, 90.9% of students in the normal weight category, 79.1% of students in the overweight category, and 31.6% of students in the Class 1 obesity category. Students in Class 2 and 3 obesity categories could not be classified correctly. The total correct classification rate of the test set was 84.2%.

Table 5
Classification Table Resulted From CHAID Analysis

Observed	Classification						Correct classification %
	Estimation						
	Underweight	Normal weight	Overweight	Class 1 obesity	Class 2 obesity	Class 3 obesity	
Underweight	120	35	0	0	0	0	77.4
Normal weigh	34	622	28	0	0	0	90.9
Overweight	0	33	129	1	0	0	79.1
Class 1 obesity	0	0	26	12	0	0	31.6
Class 2 obesity	0	0	4	3	0	0	0
Class 3 obesity	0	0	2	0	0	0	0
Correct Classification %	14.7	65.8	18	1.5	0	0	84.2

Comparison of Artificial Neural Network Analysis and Decision Trees Analysis

The performances of artificial neural network analysis and CHAID analysis methods were compared through classification tables of both methods. As a result of artificial neural network analysis, separate classification tables for the test data set and the training data set were created. The average of these two tables was calculated for the general accuracy classification. Table 6 shows the comparative correct classification percentages obtained through artificial neural network and CHAID analyses.

The artificial neural network analysis achieved the highest classification success in terms of the overweight category at 97.7%, whereas the CHAID analysis achieved the highest classification success in terms of the normal weight category at 90.9%.

The artificial neural network analysis made the most accurate classification for students in the underweight, normal weight, and overweight categories, whereas the CHAID analysis made the most correct classification for students in the Class 1 obesity category. The overall correct classification rates were 91.1% for artificial neural network analysis and 84.2% for CHAID analysis.

Table 6
Artificial Neural Networks and CHAID Analyses Classification Percentage Comparison

Observed	Estimation	
	Artificial neural networks	CHAID
	%	%
Underweight	92.4	77.4
Normal weight	96	90.9
Overweight	97.7	79.1
Class 1 obesity	0	31.6
Class 2 obesity	0	0
Class 3 obesity	0	0
Total correct classification %	91.1	84.2

Discussion

“If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.”

—Sun Tzu Wu, *The Art of War*, 450 BC

Meaningful information can be obtained from various data during the education and training process. In this way, educators can get to know themselves, the methods they use, and their students better. Thus, they have the opportunity to produce more effective solutions to their problems. Educators are always striving to get better. One method that provides an advantage to overcome their difficulties is data mining, with data being “the new oil of the digital economy” (Wired, 2014).

With the 84.2% success rate in classifying students according to *Health-Related Physical Fitness Report* measurements and the 91.1% correct classification with the artificial neural network analysis in this study, the artificial neural network analysis, compared to the CHAID analysis, is clearly better at predicting BMI category of students. It is thought that the primary factor in this success of artificial neural networks is to carry out a training process using data and to try to reduce the error rate by constantly renewing itself after this process. Other studies show similar results. The Tosun (2007) study reveals artificial neural network analysis better classifies student achievement than does a decision trees analysis. The Toprak (2017), which classifies students according to their PISA test mathematics achievements, reveals artificial neural networks are better than decision trees and discrimination analysis methods. These studies and other studies in the literature show that artificial neural networks can be used in classification problems in the field of education (Algarni, 2016; Altun et al., 2019; Aybek, 2016; J. Chen et al., 2014; Çırak & Çokluk, 2013; Demiralay et al., 2017; Romero & Ventura, 2012). However, the CHAID analysis also classifies at a high level of accuracy. With the advantage of CHAID analysis, students with similar physical characteristics can organize activities to be included in the same group. Thus, it is possible for the students in the obese category

to be included in the normal weight category more systematically and quickly.

The two most important variables that predict *Health-Related Physical Fitness Report* classification among the independent variables in the study are body mass index and body weight. This is due to the World Health Organization's classification of BMI with the Body Weight / (Height*Height) formula. In addition, it is an expected result that the BMI variable calculated from the ratio of the two is among the important variables. It is known that as the number of sit-up and push-up repetitions increases, individuals are more likely to be classified in the normal weight category, and that as the number of repetitions decreases, they are more likely to be classified in a category other than the normal weight category (X. Chen et al., 2020). In the literature, many studies emphasize that individuals in the obese category have significantly lower number of sit-up and push-up repetitions than do their healthy peers (X. Chen et al., 2020; Deforche et al., 2003; İskenderoğlu, 2020; Kamuk, 2019; Kim et al., 2005; Mak et al., 2010; Orjan et al., 2005; Tulum, 2002). In this context, our study shows consistent results with studies on similar age groups in the literature.

Considering these results, it is thought that the possibility of classification of students as normal weight in the *Health-Related Physical Fitness Report* classification increases with the fact that physical education and sports teachers have more room for sit-up and push-up exercises in the classroom and extracurricular activities. In addition, there are studies in the literature on the variables affecting classification by artificial neural network analysis. For example, the Ivankovic et al. (2010) study using artificial neural network analysis to determine the levels at which certain variables affect the wins of the teams in the Serbian Basketball League points to some variables (i.e., numbers from the painted area) bringing teams closer to winning. In this sense, it can be said that artificial neural network analysis is a successful method in determining the degree to which variables affect classification.

The multilayer perceptron model created with artificial neural networks makes the most accurate classification in BMI classification in the overweight and normal weight categories. The normal weight category with the most agglomeration is expected to be highly

accurate. However, the highest estimation of the overweight category is the most striking result of artificial neural network analysis. This shows that the classification performance is higher for students in the overweight category than in the other categories. For this reason, the model established with artificial neural network analysis chooses the students in the overweight category better and gives better results in its classification. It is, however, possible to say that the CHAID analysis gives better results, especially in the classification of students in the normal weight category. The artificial neural network analysis fails to correctly classify Class 1, 2 and 3 obesity categories, whereas the CHAID analysis fails to do so for Class 2 and 3 obesity categories. This may happen because these categories contain fewer samples.

In light of these results, imagine a student who has a body weight of 73 kg, height of 135 cm, 3 push-ups, 2 sit-ups, 18 cm sit-and-reach flexibility (right) test, and 17 cm sit-and-reach flexibility (left) test. Artificial neural networks is used in predicting which BMI classification this student will belong to in the future. As a result of the analysis made with variable values added to the data set, this student is assigned to the “overweight” class. The probability of this estimate being correct is 91%. Of the parameters that will allow the obesity level to be brought to the normal weight level, shuttle and push-ups can have an important effect in lowering this level normally for this student, who is predicted to be in the overweight category.

For the generalization of the findings within the scope of this research, further studies with larger samples are recommended. However, this study is thought to be an example for the use of data mining methods in the process of physical education and sports education research. On the other hand, in terms of parameters that influence students' *Health-Related Physical Fitness Report*, researchers must consider BMI classification. With more importance given to these parameters in the classroom and extracurricular activities, more students can be included in the normal weight category in BMI classification.

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YOU AND THE LAW

What Types of Risks Cannot Be Waived by the School?

Thomas H. Sawyer and Tonya L. Sawyer

In American society today, it has become common for an individual to think about suing then trying to negotiate a peaceful settlement without lawyers, courts, and judges. Over the past 20 years, the field of personal injury litigation has grown rapidly and expanded into physical activity and sport. Private entities have been hit hard with lawsuits that have most often focused on negligence issues and product liability. Governmental agencies, such as schools, have often been protected by governmental immunity. However, there are certain types of risks that cannot be waived because they are considered to be a crucial part of a school's duty to keep students safe from harm. This article discusses a few of those types that should be considered nonwaivable.

Known Defects in Equipment and Facilities

If a student is injured because a piece of equipment or part of a facility is defective or broken, and the school or a school employee knew of that defect, the school could be held liable for the injuries and resulting damages from the injury.

Examples

A weight machine breaks and the coach keeps forgetting to put a sign on it that it is out of order or to remove it from the area entirely. A student athlete uses the machine to work out. A pulley breaks and

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drops weights on the student, whose arm breaks. The school may be liable because the coach was aware of the issue and did nothing about it.

The pool operator is aware and does not tell the instructors before the class begins that a chlorination pump is releasing too much chlorine into the pool. The students begin complaining about eyes burning and itchy skin to the instructors.

Even unknown exercise and sporting equipment may allow parents to file a product liability lawsuit. Product manufacturers, distributors, and retailers are strictly liable for any injuries caused by product defects. Product liability lawsuits include defects in

- manufacturing,
- design,
- installation, and
- warning signage.

The swim team has new diving boards installed. A swimmer gets up to dive off the board, which breaks on the first bounce. The swimmer falls and is cut severely on the edge of the broken board. The diving board manufacturer and/or company that sold the diving board may be liable for damages. The company and/or persons who installed the diving board may be liable, too.

Improper Inspection and/or Maintenance of Indoor Facilities or Outdoor Facilities such as Fields, Courts, Courses, or Track

If the school knows of a dangerous condition on one of its indoor or outdoor facilities, it may be liable.

Examples

There is no fence in front of the baseball or softball dugouts as highly recommended by the rule book in each sport. A player on the visiting baseball team is hit by a line drive foul ball in the dugout. Every other school in the conference has an 8-foot fence in front of its dugouts. The player who was hit was accustomed to having a fence for protection.

The stair treads on the wooden bleachers for the track need repaired but have not been inspected prior to the first home meet. Mrs. James, an older mother of a track player, climbs up the old stairs and falls through the rotted stair halfway up to the top row. The bleachers were scheduled to be inspected the following week and new bleachers installed over the summer.

There had been heavy rain for 2 days prior to the soccer match. Water had pooled on the sideline near the corner of the field. Because of the heavy rain, a hole had been created by heavy traffic. A player from the visiting team ran down the sideline while chasing a ball and fell in the hole and broke his ankle. If the groundskeeper or coach or official had inspected the field prior to the game and filled the hole with a clay-sand mixture and warned both teams of the hazard, this would not have happened.

Inadequate Supervision and Inspection of the Playing Area

If a coach or other instructor fails to properly oversee the students under their care and oversight would have prevented that injury, the school may be held liable for the student's injuries. The level of supervision required depends on the dangerousness of the activity and the age of the students involved.

Examples

To work on her shoulder strength for wrestling, Susan is told to use the new weight machine the school recently purchased. The new weight machine has an extensive training manual on how to safely use the machine. Susan is not instructed how to use it and not told to review the manual, and the coach does not supervise her at any time while she is using it.

Susan damages her rotator cuff because she attempted too much weight when using the unfamiliar machine. If she had been supervised and instructed on the proper use of the machine, she would not likely have been hurt. The school could be liable because she was not adequately instructed and was left unsupervised.

John went into the weight room to use the free weights. He was lifting alone. He did not inspect the area where he was working or

the apparatus/machines he would be using. Even though there are signs that instruct users to rack the weights after each use and put on collars while lifting, very few do. He began lifting and doing a bench press without collars secured. His right arm was unable to keep up with his left and the weights slid off the right side, then the bar flew to the left and the weights fell off the left side with the bar and collar hitting John in the head, knocking him unconscious. Luckily, an attendant was able to come to his assistance. If he had followed the signs, this could have been avoided.

Learn-to-Swim by 10 Classes was being held by the local school district in the school district's central pool that services the schools in the district. During the 9 o'clock session with the first-grade classes from XYZ Elementary School, the students were broken down into eight subsections of 10 students, with one instructor and one lifeguard watching all the students. In one subsection, a 6-year-old female slipped off the instruction pad behind the instructor and the lifeguard watching the area of the pool was distracted and did not see the student in distress. The student went under the water for a third time and did not come back up. When the instructor took head count, the little girl was not to be found on the surface. The supervision plan had failed. She had drowned.

Coach and Staff Negligence

Negligence on the part of a coach or other staff can be a basis for filing a personal injury lawsuit to recover damages on a student's behalf. This could result from lack of certification, improper training techniques, overstretching or overexerting a student, or other conduct outside the scope of the staff member's training and experience which causes injury.

Examples

Coach Jensen forces his football team to run wind sprints nonstop for 1 hour. It is 95 degrees outside. Students have asked for water, but the coach tells them not until they're done with the workout. Two students collapse from heat exhaustion and possible heat stroke, requiring medical treatment. The coach's extreme training measures and failure to ensure proper hydration subjects the school to liability.

Athletic Director Smith has a contract with XYZ University to provide athletic training services for all home contests for football but not for away contests. A football player at an away game received a serious head injury and was knocked unconscious. The coaching staff was unable to perform the state-required concussion protocol and the team did not have an athletic trainer with them. The player was taken to a local hospital for observation and returned home on the team bus with a head trauma and no medical assistance.

A background check was not required for the recently hired girls' gymnastics coach. Later, two of the gymnasts complained of sexual assaults by the newly hired coach. During the investigation, it was found he was released from his former position as gymnastics coach in another state because of accusations of sexual harassment.

Intentional Harm

If a coach, teacher, or supervisor hits a student or throws something at a student, that individual may be liable for intentional harm caused by assault or battery.

Examples

Coach Smiley coaches the school soccer team. None of the students are doing the drills he assigned and are just playing around. Coach Smiley is frustrated and kicks a ball hard at a student. The ball hits the student in the face, breaking the student's tooth. Coach Smiley could be liable for assault and battery for intentionally putting the student in harm's way and causing an injury.

Coach George, a high school wrestling coach, who is a former high school and college wrestler, likes to demonstrate moves on his wrestlers. He is skilled, experienced, and strong. He likes to wrestle with them as well. He has a big ego and challenges them often. One day at practice, one of his wrestlers challenges him to a 6-minute match. Coach George is 20 pounds heavier than the student wrestler. Three minutes into the match, the student athlete screams and a loud snap is heard in the room. Everything goes silent. Coach yells, "Go get the trainer now!" The student athlete is crying and holding his shoulder and arm. He has a dislocated shoulder and broken arm.

This is a perfect example of a “mismatch” and how not to protect student athletes.

Swim Coach Rabbit forces one of his sprinters to jump off the 3-meter diving board because the sprinter was not making his times consistently in practice. The sprinter who is afraid of heights suffers a broken arm because he does not know how to enter the water from that height.

Closing Remarks

The areas and examples in this article make it easy for the reader to see how a school district, which is generally shielded by governmental immunity as a governmental agency, can be held liable for negligence in a personal injury case. The district may attempt to plead governmental immunity, but in these specific areas they most often will fail to prevail. As an athletic administrator and/or coach, you need to be very aware of your liability related to negligence in these areas and understand that you may not be shielded by governmental immunity.

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