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Point of View

You and the Law

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AUTISM SPECTRUM DISORDER

Fine and Gross Motor Competence in Children With Autism Spectrum Disorder

Ting Liu, Jaclyn Capistran, Sayed ElGarhy

Abstract

Autism spectrum disorder (ASD) is characterized by challenges with social communication and the display of restrictive and repetitive behaviors. Research has also shown that children with ASD are behind their typically developing peers in motor skill competence. However, limited studies have used the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) to assess motor competence of children with ASD. The purpose of this study was to fill the gap and comprehensively examine the fine and gross motor competence of children with ASD. Fifty-three children with ASD between the ages of 7 to 14 participated in the study. This study used the BOT-2 to comprehensively assess the children's fine and gross motor competence. The children with ASD were significantly delayed in all fine and gross motor subtests (i.e., fine motor precision, fine motor integration, manual dexterity, upper-limb coordination, bilateral coordination, balance, running speed, and strength and agility) compared to their typically developing peers. The children with ASD were impaired on all fine and gross motor composites of the BOT-2, with all scoring in the well below average category of the BOT-2. Incorporating fine and gross motor skill practice into the

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therapy treatments and daily activities of children with ASD is recommended for improvement of their social interaction, communication, and reduction in repetitive behaviors in school and physical activity participation.

Autism spectrum disorder (ASD) is often diagnosed in early childhood and affects 1 in 68 children in the United States (Autism Speaks, n.d.; Centers for Disease Control and Prevention, n.d.). Children with ASD are reported to display difficulties in social interaction, communication, and restrictive and repetitive behaviors (American Psychiatric Association, n.d.; Myers & Plauché, 2007). In addition, research has suggested that children with ASD are impaired in motor competence, which refers to the ability of performing fine and gross motor skills according to chronological age (Ayers et al., 2016; Green et al., 2009; Leary & Hill, 1996; Macdonald et al., 2011; Pan & Frey, 2006). Delays in fine and gross motor skills for children with ASD may lead to poor motor coordination, impaired postural control, and balance deficits (Provost et al., 2007; Smith, 2004; Staples & Reid, 2010). Children with ASD are either excluded or not interested in participating in sports and physical activities that require developed fine and gross motor skills, because of their motor delays. For example, Liu and Breslin (2013) used the Movement Assessment Battery for Children-2 (Henderson et al., 2007) to examine the fine and gross motor performance between children with ASD and typically developing children. They found that out of 30 children with ASD, 77% demonstrated significant motor delays and 3% were at risk for motor delays, whereas 100% of typically developing peers showed no movement difficulties. Similarly, Green et al. (2009) concluded that 79% of 101 children with ASD demonstrated definite movement problems, while about 10% demonstrated borderline problems when assessed with the Movement Assessment Battery for Children (Henderson & Sugden, 1992). Researchers have also reported that children with ASD have greater impairments in object manipulation skills such as throwing, catching, and balance in Movement Assessment Battery for Children-2 because of the lack of visual feedback (Ament et al., 2015; Green et al., 2002; Whyatt & Craig, 2012). Similarly, Whyatt and Craig (2012, 2013) also reported that motor deficits in children with ASD were likely due to difficulty with visual, spatial, and temporal characteristics of an action.

Fine motor skill competence can affect children's academic success, communication, and complex motor skill development. Macdonald et al. (2014) concluded that children with ASD's fine motor skill development was about 9.5 months behind their chronological age, suggesting that children with ASD were more delayed on fine motor proficiency compared to their typically developing peers. Delays in fine motor skills are crucial for children with ASD because it most notably affects their handwriting, which can lead to difficulties in academic performance at school (Liu et al., 2016). The immature pencil grasp also makes a child with ASD often feel uncomfortable and show noticeable difficulties in handwriting. Alaniz et al. (2015) found that grip strength correlates with handwriting legibility and children with ASD showed weaker grip strength than typically developing children. Broun (2009) explained that having to engage in handwriting is the most serious impediment to academic achievement for students with ASD, as they typically experience hypotonia, which is the impairment in the ability to execute skilled movements. Difficulties in handwriting can also affect classroom behavior because of the stress from the expectation of written output and from the frustration encountered when children with ASD cannot communicate effectively through their handwriting. Johnson et al. (2015) suggested that difficulties in handwriting for children with ASD are due to fine motor, attention, memory, and linguistic demands that are required during writing. MacDonald et al. (2013) suggested that teaching fundamental motor skills to children with ASD may help in creating an environment for practicing social skills during play, which may lead to positive social interaction with peers and adults. Being proficient in performing motor skills is important because it affects some of the aspects that are typical characteristics of children with ASD, including communication, academic achievement, and social interaction.

In addition to fine motor development, gross motor competence is important for children with ASD because children who have a high proficiency in gross motor skill performance are more likely to be physically active and participate in sports and physical activity. Delays in gross motor skill performance may have a negative impact on balance, social interaction, and motivation to participate in physical activities for children with ASD (Baranek,

2002; Bhat et al., 2011; Liu & Breslin, 2013). Ozonoff et al. (2008) suggested that motor deficits are crucial characteristics in children with ASD, besides social interaction and communication delays. Ming et al. (2007) concluded that hypotonia and apraxia were the main deficits that caused children with ASD to show impairment in gross motor performance. Staples and Reid (2010) used the Test of Gross Motor Development-2 (Ulrich, 2000) to assess the gross motor performance of children with ASD and their typically developing peers. The children with ASD performed gross motor skills at a level equivalent to the typically developing peers half their age. Mache and Todd (2016) found that children with ASD scored an average of 28.6 points lower than their typically developing peers on the Test of Gross Motor Development-3 (Ulrich, 2013). Macdonald et al. (2014) similarly reported that children with ASD were 6.4 months behind their chronological age on gross motor skill development, based on the Mullen Scales of Early Learning (Mullen, 1995). In addition, Van Damme et al. (2015) used the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2; Bruininks & Bruininks, 2005) to examine the detailed motor profiles of children with different psychiatric disorders. They identified ASD as the most significant predictor for low BOT-2 composite scores. Pan (2014) studied 31 adolescents with ASD and 31 adolescents without ASD aged 10 to 17 years old, using the BOT-2. The children with ASD scored lower on all motor subtests compared to the adolescents without ASD. Pan also reported significant positive correlation between total motor composite and all physical fitness components in adolescents with ASD. These findings suggest that besides fine motor delays, children with ASD are delayed in gross motor proficiency.

Both fine and gross motor competence are important for the motor competence of children with ASD. However, limited research has comprehensively examined both fine motor skill competence and gross motor skill competence in children with ASD. The BOT-2 has been identified as a comprehensive tool in motor competence assessment. Therefore, the purpose of this study was to fill this gap in research and examine the fine and gross motor competence of children with ASD, using the BOT-2. The BOT-2 is a comprehensive measurement of fine and gross motor proficiency and examines four fine and gross motor composites: fine manual control, manual

coordination, body coordination, and strength and agility. Other instruments such as the Movement Assessment Battery for Children-2, which is considered a screening tool for motor competence that assesses limited fine and gross motor tasks, and the Test of Gross Motor Development-2, which only assesses gross motor skill performance for a small age range of children 3 to 10 years old, made it clear that the BOT-2 was the best fit as it allows for a detailed examination of the child's motor competence. The Movement Assessment Battery for Children-2 also tends to make it more difficult to identify the impairments in motor development, listing only one to two motor tasks under each motor subtest, which may not provide enough information for a true representation of the child's fine or gross motor skill competence (Staples, 2013). This study hypothesized that children with ASD would show significant delays in fine and gross motor competence on the BOT-2 compared to their typically developing peers.

Method

Participants

Fifty-three children with ASD participated in the study. They were between the ages of 7 and 14 years old (48 male, 5 female). ASD is 4.5 times more likely to occur in males than in females (Autism Speaks, n.d.; Centers for Disease Control and Prevention, n.d.); therefore, this study has an unbalanced number of male and female participants. Children were included in the study if they had (1) an ASD diagnosis, (2) the capability to understand directions given by the test administrator, and (3) the ability to perform the fine and gross motor tasks as instructed. Children who could not follow instructions and complete all motor tasks were excluded from the study. Consent forms were obtained from parents before their child's participation in the study. This study was approved by the Institutional Review Board.

Instrument

The BOT-2 (Bruininks & Bruininks, 2005) is a comprehensive assessment tool that measures both fine motor competence and gross motor competence for children between the ages of 4 and 21 years. This study used the BOT-2 Short Form measures to represent

four motor composites: *fine manual control*, which had the subtests of fine motor precision and fine motor integration; *manual coordination*, which had the subtests of manual dexterity and upper-limb coordination; *body coordination*, which had the subtests of bilateral coordination and balance; and *strength and agility*, which had the subtests of running speed and agility and strength. The BOT-2 standard scores were determined based on the participant's level of proficiency on each subtest. A child may be classified as *well-above average* if the standard score range is 70 or greater, *above average* if the standard score range is between 60 and 69, *average* if the standard score range is between 41 and 59, *below average* if the standard score range is between 31 and 40, or *well-below average* if the standard score range is 30 or less.

Procedures

The BOT-2 was administered in a quiet classroom with minimum distractions at a local elementary school by Jaclyn Capistran and Sayed ElGarhy. Prior to the test administration, Capistran and ElGarhy received extensive training on administering the BOT-2 tests. General administration directions were taught in a half-day workshop by Ting Liu. Capistran and ElGarhy took a training workshop to familiarize themselves with the BOT-2 testing kit. Each then practiced by going over possible administration scenarios, such as how to verbally instruct children with difficult behavior or how to take scores of a noncompliant child. They then tested two children while being observed by Liu. Feedback was given when administration deviated from standardization. Capistran and ElGarhy were considered proficient on assessing the BOT-2 once they reached 90% agreement with Liu. They proceeded to test for data collection under the supervision of Liu. The interrater reliability was high (98%) between Liu and Capistran and ElGarhy. All participants received verbal instructions and a visual demonstration of each task prior to their motor performance. The participants were given a practice

trial, and if they did not perform the skill correctly, additional instruction and demonstration was provided. All children completed the four subtests in the BOT-2 assessment.

Data Analysis

Descriptive statistical analysis was used to examine children's fine and gross motor competence on the BOT-2 test. Raw scores were converted to the standard scores and a total score using the norm tables in the BOT-2 manual. Standard scores were used to describe each child's level of competence on each subtest. A single sample *t* test was used to compare the mean of children with ASD's performance scores to the mean of the BOT-2 norms. Results were considered significant if the alpha level was less than .05.

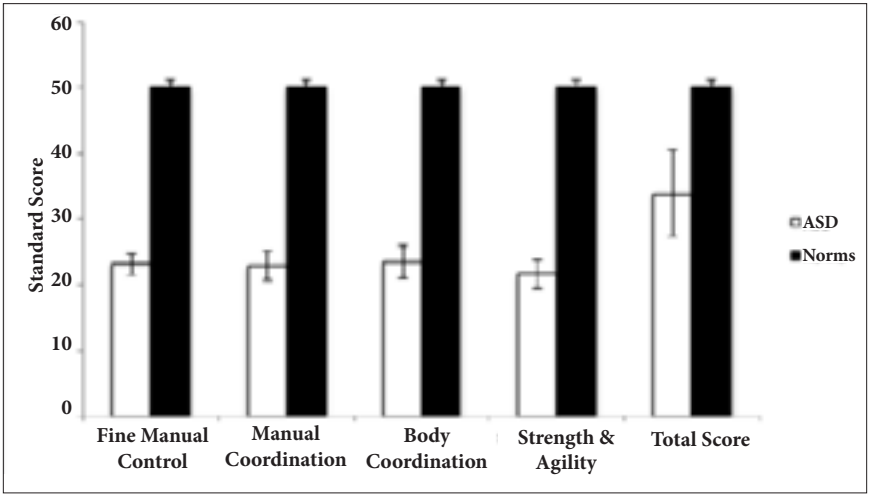
Results

The descriptive analysis showed that 24.5% of the children with ASD scored *well below average* on BOT-2, 66% scored *below average*, and only about 9.5% of the children were classified as *average*. Specifically, 90.5% children with ASD scored in the *well below average* and *below average* classification of the BOT-2.

A single-sample *t* test analyzed children with ASD's BOT-2 standard scores in comparison to their age-matched normative mean. A significant difference was found between children with ASD and the norms, $t(52) = -17.944$, $p < .01$. Children with ASD's standard score mean of 33.85 ($SD = 6.553$) was significantly lower than the normative mean of 50. Single-sample *t* tests were also used in the analysis of children's motor competence on each of the motor composites. Significant delays were found on fine manual control, $t(52) = -120.451$, $p < .01$; manual coordination, $t(52) = -90.996$, $p < .01$; body coordination, $t(52) = -75.616$, $p < .01$; and strength and agility, $t(52) = -96.463$, $p < .01$. These results, compared to the normative data (Figure 1), suggest that children with ASD perform much lower on fine and gross motor skills.

Figure 1

Children With ASD Scored Significantly Lower Than Their Typically Developing Peers on All Four Motor Composites of the Bruininks-Oseretsky Test of Motor Proficiency-2



Discussion

The purpose of this study was to comprehensively evaluate the fine and gross motor skill competence of children with ASD, using the BOT-2. The hypothesis that children with ASD would score significantly lower on fine and gross motor skill competence in comparison to the BOT-2 norms was supported in this study. About 90.5% of children with ASD were classified as either in the *below average* or *well below average* categories, indicating that children with ASD were delayed in fine and gross motor competence. These findings were in line with research stating that motor impairments were common in children with ASD (Dewey et al., 2007). The participants were delayed in all four subtests of fine manual control, manual coordination, body coordination, and strength and agility (Figure 1), with the total score mean being 13.85 points below the norm and standard deviation being 3.45 points below the norm (Table 1). This was consistent with the results of Hilton et al. (2014), who found that children with ASD showed motor impairment in BOT-2 on all four subtests. In addition, the finding that the strength and agility of children with ASD was scored the lowest of all four subtests was similar to Mattard-Labrecque et al.'s (2013) study results that children

with ASD and attention deficit hyperactivity disorder showed poorer strength and agility in the BOT-2 than children with attention deficit hyperactivity disorder alone.

Table 1
Mean and Standard Deviation of the Standard Scores in Each Subtest and Total Score of Children With ASD (N = 53)

Subtest	*M*	*SD*
Fine manual control	23.11	1.63
Manual coordination	22.98	2.16
Body coordination	23.47	2.55
Strength and agility	21.64	2.14
Total Score	91.17	6.48

The findings of this study are important because delays in fine and gross motor skill competence could affect children's academic success, communication, complex motor skill development, physical activity participation, sports performance, and social interaction. Delays in fine motor competence may affect the handwriting legibility, pencil control, and communication of children with ASD (Broun, 2009). Delays in gross motor competence affect physical activity and sports performance because children with ASD are less proficient in balance, body coordination, and strength and agility, which then leads to a lack of motivation to participate and has a negative impact on social interaction (Baranek, 2002; Bhat et al., 2011; Liu & Breslin, 2013).

This study adds new and valuable findings to the literature because it includes detailed results on the fine and gross motor performance in fine manual control, manual coordination, body coordination, and strength and agility of children with ASD. The BOT-2 was useful in providing a comprehensive understanding and specific details on both fine motor competence and gross motor competence in children with ASD. For example, handwriting legibility and finger and pencil control were observed with the drawing of lines through crooked paths in the fine motor precision subtest and with the copying of shapes in the fine motor integration subtest, which are essential aspects of academic success. Specific gross motor

skills such as the ability to balance by walking forward on a straight line and the ability to dribble a ball with alternating hands could be a determining factor of the reason children with ASD do not participate in physical activity or sports. The findings of this study were also in line with Pan's (2014) results, suggesting that children with ASD generally show a great delay in the motor composite of strength and agility.

Future studies may consider implementing fine and gross motor interventions on children with ASD. Many researchers have reported that utilization of interventions may improve the fine and gross motor competence of children with ASD. Wuang et al. (2010) found that after a 40-week horseback riding program, the children with ASD showed significant improvement on bilateral coordination, based on the Bruininks-Oseretsky Test of Motor Proficiency (Bruininks, 1978). In addition, Srinivasan et al. (2015) implemented a rhythmic and robotic intervention to assess the motor competence of children with ASD, using the BOT-2. They found that after an 8-week training, the rhythm and robot groups who engaged in whole-body gross and fine motor games to the beat of music improved on body coordination, while the comparison groups who were engaged in sedentary fine motor imitation activities improved on the fine manual control composite of the BOT-2. These results suggest that interventions have positive impacts on the motor competence of children with ASD. Furthermore, the children's physical activity participation and the characteristics of academic performance were not collected in this study, which may help better explain the connections of motor competence to school success. Future research may collect this information to have a better understanding of the relationship between motor delays and academic performance.

In summary, this study indicates that children with ASD have definite movement impairments in fine and gross motor skill competence on the BOT-2 compared to their typically developing peers. It is recommended that researchers and educators incorporate fine and gross motor skills in their training programs, interventions, or curriculum to enhance the motor competence of children with ASD. Adding fine and gross motor skills to the daily activities of children with ASD may improve their academic success, communication, physical activity participation, and social interaction.

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FACILITY PLANNING AND DESIGN

Strength and Conditioning Facilities in Texas High Schools: A Quantitative Analysis

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Abstract

The health and athletic performance benefits of strength training for adolescents have increased the demand for the development and use of strength and conditioning facilities (SCFs) within the high school setting. Despite the growing prevalence of these facilities, research on high school SCFs is limited. Therefore, the purpose of this study was to investigate the space, equipment, usage, and staffing patterns of SCFs in the state of Texas. This examination provided descriptive data on SCFs' space, equipment, usage, and staffing patterns based upon the state athletic governing body's six-tier classification level. Significant differences in SCFs' size and available equipment were determined; as well, facility usage for athletics (99.2%), physical education (24.5%), and community (30.6%) was determined. These results are indicative of the need for additional research on high school SCFs for the establishment of better school standards and best practices.

The benefits of strength training for adolescents on both athletic performance (Harries et al., 2012) and general health (Smith et al., 2014) have been well documented. As such, the demand for strength and conditioning facilities (SCFs) as part of a high school campus has increased. SCFs are now considered an integral part of a high

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school for their use in physical education, athletics, and community outreach (Duehring & Ebben, 2010). Despite the documented importance of strength training on the high school population and the prevalence of SCFs as part of a high school's built environment, there has been very little research on high school SCFs. Initial examinations of all high school indoor physical activity spaces for physical education and athletics, including SCFs as a component, were conducted by Petersen (1997) in New Mexico and Indiana (Petersen, 2007, 2013). Specific examination of interscholastic SCFs was conducted by Petersen and Judge (2008) within Indiana high schools. The methodologies of these initial studies were based upon pioneering research of physical education and SCFs in the collegiate setting (Sapora & Kenney, 1961; Strand, 1988; Walker, 1989). The early studies of high school SCFs highlighted the need for descriptive, quantitative research of SCFs throughout the country (Petersen & Judge, 2008). An initial study sampling high school strength and conditioning coaches across the nation also included a brief facility component focused upon facility size in combination with school and athlete populations (Duehring & Ebben, 2010). Therefore, this study sought to address this need by examining the SCFs within Texas high schools.

The state of Texas provides an outstanding opportunity to expand the study of high school SCFs for a number of reasons. First, the most recent reporting of the National Federation of State High School Associations (NFHS, 2019) has indicated that Texas has the greatest number of total participants in interscholastic athletics with 825,925 participants in the 2018–2019 school year. The state also has the highest level of football participation both in the number of schools and in the total participants including 1,317 high schools with 165,641 athletes in 11-player football and an additional 197 schools with 3,647 athletes in 6-player football (NFHS, 2019). The large number of high schools in Texas, combined with the great breadth of school enrollment size and high levels of sport participation in general and football in particular participation, contributes to a setting where strength training would be emphasized. Therefore, the purpose of this study was to investigate the space, equipment, usage, and staffing patterns of SCFs in the state of Texas.

Three research questions guided this study of Texas high school SFCs:

- RQ1: How does school size or classification affect the prevalence and size of SCFs?
- RQ2: How does school classification affect the types of equipment found in the SCFs?
- RQ3: How does school classification affect the usage and staffing of the SCFs?

Method

Experimental Design

This investigation used a descriptive survey study design. The use of an online survey instrument allowed for the collection of data from the population sample of Texas high school athletic directors. The survey provided insight into the the space, equipment, usage, and staffing patterns of SCFs in a large state in the Southwestern United States. These data allow for a better understanding of these important facilities for the establishment of better school standards and best practices.

Procedures

A 72-item survey instrument was developed for the collection of data on the SCFs in high schools throughout the state of Texas. This instrument was developed through the modification of the instrument used by Petersen and Judge (2008) to collect data on SCFs in Indiana high schools. All modifications made to the original instrument were clerical changes, necessary to address differences in demographics and terminology between the two states. The survey instrument was formatted for distribution through the Qualtrics online survey platform. A recruitment email containing information about the study and a link to the survey was sent to the athletic director of every high school in the state of Texas. The athletic directors were directed to either complete the survey themselves or to forward the survey to their strength and conditioning coach for completion. Before completing the survey, the subjects were informed of the purpose and the associated risks and benefits of the investigation. Participants meeting all inclusion criteria gave their informed consent in accordance with the Declaration of Helsinki. For an im-

provement in response rates, follow-up emails were sent 3 weeks and 6 weeks following the initial contact. The survey instrument and research protocols were approved by the university Institutional Review Board.

Statistical Analyses

SPSS 24.0 was used for all descriptive, chi-square, and ANOVA statistical analyses with a significance level established at .05 for all analyses. All post hoc pairwise analyses were Bonferroni corrected from multiple comparisons when more than two groups were compared.

Results

This study provides important baseline descriptive data for practitioners in sport that can be used to improve SCFs and enhance the delivery of strength and conditioning services to athletes and physical education students in the high school setting. A total of 1,499 public and private high schools were identified in the state of Texas. Of these schools, 1,451 had valid email addresses listed for the athletic director. Sixty-nine nonduplicated email addresses were nondeliverable. From this pool of 1,382 schools contacted for this study, 245 surveys were completed, for a response rate of 17.7%. These schools included public institutions governed by the University Interscholastic League (UIL) as the statewide association for interscholastic athletics as well as private high schools with membership in either the Texas Association of Private and Parochial Schools (TAPPS) or the Texas Christian Athletic League (T-CAL). The respondents were balanced among the six UIL enrollment classifications and the private school category as 8.6% 1A, 12.7% 2A, 13.1% 3A, 16.7% 4A, 14.7% 5A, and 18.4% 6A, and 15.9% were private schools.

Facility Size

A total of 229 (93.5%) schools indicated the presence of a dedicated SCF within their school's physical plant. These dedicated facilities ranged in size from 200 sq ft to 30,000 sq ft with an overall mean of 3,461 sq ft (SD ± 3,779). Table 1 shows a comparison of the mean square footage of the SCFs by school classification. An ANOVA revealed a significant difference in facility size among the seven classifications, $F(6, 228) = 8.313$, $p < .001$. Tukey post hoc testing revealed

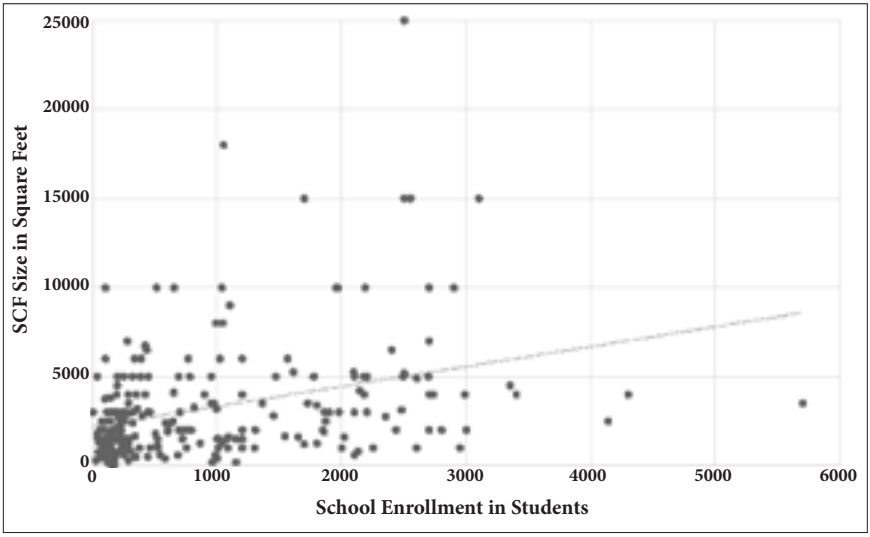
Table 1
Mean Strength and Conditioning Facility Size in Square Feet by Classification

1A $n = 21$	2A $n = 31$	3A $n = 32$	4A $n = 41$	5A $n = 36$	6A $n = 45$	Private $n = 39$	Combined $N = 245$
1416	2766	2615	3548	3814	6359	1775	3461

that the UIL 6A schools had SCFs that were significantly larger than each of the other classifications; however, no other differences between classification levels were statistically significant.

In addition to the comparison of mean facility size for enrollment classification, the relationship between school enrollment and the size of the SCF was assessed via a Pearson correlation coefficient analysis. There was a significant positive correlation ($r = .337$, $p < .001$) between these two variables, indicating the linear relationship between the school's student enrollment and the size of the SCF measured in square footage, and Figure 1 illustrates this relationship including the data points along with a line of best fit.

Figure 1
Scatterplot of School Enrollment and Strength and Conditioning Facility Size



An analysis of the space allocation within the SCFs for free weights, weight machines, and cardio equipment revealed mean percentages of 81.5% of the facility allocated to free weights, 13.0% allocated to weight machines, and 2.9% allocated to cardio equipment. The only significant difference found among the school classifications was in the space allocated to free weights, $F(6, 238) = 5.048$, $p < .001$. A Tukey post hoc analysis revealed that private schools allocated significantly less space to free weights than every UIL classification except for 2A schools.

Free Weights

Two hundred forty-two of the 245 schools indicated the presence and use of free weights within their SCF (98.8%). The key elements of free weight use analyzed in this study were the use of bench press, squat, and power clean stations as well as the use of dumbbells. Table 2 shows a comparison of the mean availability of each of these elements by school classification. The mean values for number of each station, the high and low weight ranges of the dumbbells, and the total number of Olympic bars were compared via ANOVA. Significant differences were found among the classifications in the number of bench press stations, $F(6, 238) = 16.781$, $p < .001$; squat stations, $F(6, 238) = 7.986$, $p < .001$; power clean stations, $F(6, 238) = 18.225$, $p < .001$; Olympic bars, $F(6, 238) = 20.025$, $p < .001$; and high range, $F(6, 238) = 7.510$, $p < .001$, and low range, $F(6, 238) = 2.467$, $p = .025$, of dumbbell weights. Tukey post hoc tests revealed several significant differences among classifications, summarized in Table 2. The most notable differences include 6A schools having more power clean stations than did every other classification and more bench press stations and Olympic bars than did every other classification, except 5A. It is also notable that 1A and private classifications had significantly fewer of each free weight station type than 5A and 6A schools.

Table 2
Free Weight Equipment Mean Comparisons

Equipment	1A $n = 21$	2A $n = 31$	3A $n = 32$	4A $n = 41$	5A $n = 36$	6A $n = 45$	Private $n = 39$	Combined $N = 245$
Bench press stations	4.0 $_{4,5,6}$	8.0 $_{5,6}$	7.9 $_{5,6}$	10.0 $_{1,6,7}$	12.2 $_{1,2,3,7}$	15.1 $_{1,2,3,4,7}$	5.4 $_{4,5,6}$	9.5
Squat stations	3.8 $_{2,5,6}$	11.1 $_{1}$	7.9 $_{6}$	10.4	13.1 $_{1,7}$	15.3 $_{1,3,7}$	5.2 $_{5,6}$	10.1
Power clean stations	3.1 $_{4,5,6}$	7.7 $_{6}$	7.6 $_{6}$	9.3 $_{1,6,7}$	11.3 $_{1,6,7}$	15.2 $_{1,2,3,4,5,7}$	4.8 $_{4,5,6}$	9.0
Olympic bars	9.1 $_{3,4,5,6}$	18.4 $_{5,6}$	18.6 $_{1,5,6}$	21.7 $_{1,6,7}$	28.1 $_{1,2,3,7}$	33.2 $_{1,2,3,4,7}$	12.0 $_{4,5,6}$	21.3
Dumbbell sets	2.5	2.4	3.3	3.7	2.2	2.4	1.9	2.6
Dumbbell low weight	6.9	8.5	6.7	9.0 $_{7}$	8.9	8.0	5.5 $_{4}$	7.7
Dumbbell high weight	60.0 $_{2,3,4,5,6}$	92.3 $_{1}$	85.6 $_{1,4}$	107.0 $_{1,3,7}$	91.8 $_{1}$	92.1 $_{1}$	77.3 $_{4}$	88.6

[1] Significantly different from 1A schools, $p < .05$
[2] Significantly different from 2A schools, $p < .05$
[3] Significantly different from 3A schools, $p < .05$
[4] Significantly different from 4A schools, $p < .05$
[5] Significantly different from 5A schools, $p < .05$
[6] Significantly different from 6A schools, $p < .05$
[7] Significantly different from private schools, $p < .05$

Selectorized Weight Machines

Of the 245 schools from which data were collected, 81 (33.1%) reported the use of selectorized, or pin select, weight machines in their SCFs. Broken down by classification, 4.8% of 1A schools, 25.8% of 2A schools, 25.0% of 3A schools, 19.5% of 4A schools, 36.1% of 5A schools, 46.7% of 6A schools, and 56.4% of private schools used selectorized weight machines. An ANOVA found these differences to be significant, $F(6, 238) = 4.750$, $p < .001$, and a Tukey post hoc analysis revealed significant differences between 1A schools and both 6A and private schools as well as between 4A schools and private schools. Lat pull down (26.9%), leg curl (20.4%), leg extension (19.2%), tricep extension (18.4%), and cable row (16.3%) were the selectorized machines found most frequently within the SCFs. Significant differences were found among classifications for the prevalence of lat pull down, $F(6, 238) = 4.351$, $p < .001$; tricep extension, $F(6, 238) = 3.837$, $p = .001$; and seated military press machines, $F(6, 238) = 2.395$, $p = .029$. Table 3 shows a complete summary of selectorized equipment allocations.

Plate-Loaded Machines

Plate-loaded weight equipment, commonly associated with the Hammer Strength brand name, was found in 146 out of 245 (59.6%) schools from which data were collected. Plate-loaded equipment was present in 57.1% of 1A schools, 58.1% of 2A schools, 53.1% of 3A schools, 61.0% of 4A schools, 58.3% of 5A schools, 75.6% of 6A schools, and 48.7% of private schools. ANOVA analyses revealed no significant differences among classifications in the presence of plate-loaded equipment nor for the presence of any specific piece of plate-loaded equipment. Leg press (36.7%), leg extension (35.5%), leg curl (34.7%), and lat pull down machines (29.4%) were the most common pieces of plate-loaded equipment found in these high school SCFs. Table 4 shows a comprehensive breakdown of the plate-loaded equipment in these SCFs.

Table 3
Selectorized Weight Machine Prevalence

Weight machine	1A *n* = 21	2A *n* = 31	3A *n* = 32	4A *n* = 41	5A *n* = 36	6A *n* = 45	Private *n* = 39	Combined *N* = 245
Lat pull down	4.8% [7]	12.9% [7]	15.6% [7]	19.5% [7]	36.1%	35.6%	48.7% [1,2,3,4]	26.9%
Cable row	4.8%	6.5%	15.6%	9.8%	22.2%	22.2%	25.6%	16.3%
Low row	4.8%	3.2%	9.4%	9.8%	13.9%	15.6%	20.5%	11.8%
Pec dec	0%	6.5%	6.3%	7.3%	5.6%	13.3%	5.1%	6.9%
Tricep extension	4.8% [7]	6.5% [7]	12.5%	7.3% [7]	30.6%	22.2%	35.9% [1,2,4]	18.4%
Leg extension	0%	9.7%	18.8%	19.5%	25.0%	22.2%	28.2%	19.2%
Leg curl	0%	12.9%	18.8%	19.5%	27.8%	24.4%	28.2%	20.4%
Leg press	0%	9.7%	12.5%	9.8%	22.2%	20.0%	28.2%	15.9%
Adductor	4.8%	3.2%	3.1%	0%	2.8%	4.4%	7.7%	3.7%
Abductor	4.8%	6.5%	0%	0%	2.8%	4.4%	7.7%	3.7%
4-Way hip	0%	3.2%	0%	2.4%	2.8%	4.4%	7.7%	3.3%
Seated calf	0%	0%	6.3%	0%	2.8%	4.4%	10.3%	3.7%
Standing calf	4.8%	3.2%	6.3%	4.9%	2.8%	4.4%	12.8%	5.7%
Military press	0%	6.5%	0% [7]	9.8%	5.6%	6.7%	20.5% [3]	7.8%
Lateral raise	0%	0%	3.1%	4.9%	5.6%	2.2%	10.3%	4.1%
Abdominal crunch	4.8%	6.5%	3.1%	2.4%	11.1%	13.3%	15.4%	8.6%
Back hyperextension	0%	3.2%	9.4%	9.8%	8.3%	22.2%	10.3%	10.2%
Rotary torso	0%	0%	3.1%	2.4%	0%	2.2%	2.6%	1.6%

[1] Significantly different from 1A schools, $p < .05$
[2] Significantly different from 2A schools, $p < .05$
[3] Significantly different from 3A schools, $p < .05$
[4] Significantly different from 4A schools, $p < .05$
[5] Significantly different from 5A schools, $p < .05$
[6] Significantly different from 6A schools, $p < .05$
[7] Significantly different from private schools, $p < .05$

Table 4
Plate-Loaded Weight Machine Prevalence

Plate-loaded weight machine	1A *n* = 21	2A *n* = 31	3A *n* = 32	4A *n* = 41	5A *n* = 36	6A *n* = 45	Private *n* = 39	Combined *N* = 245
Flat bench	9.5%	9.7%	12.5%	17.1%	13.9%	17.8%	12.8%	13.9%
Close grip bench	4.8%	3.2%	6.3%	9.8%	5.6%	6.7%	0%	5.3%
Incline bench	14.3%	12.9%	12.5%	14.6%	16.7%	24.4%	15.4%	16.3%
Military press	4.8%	6.5%	9.4%	9.8%	13.9%	17.8%	12.8%	11.4%
Lat pull down	38.1%	35.5%	31.3%	26.8%	44.4%	26.7%	10.3%	29.4%
Low row	19.0%	12.9%	9.4%	9.8%	22.2%	13.3%	5.1%	12.7%
T-bar row	9.5%	9.7%	6.3%	12.2%	13.9%	6.7%	2.6%	8.6%
4-way neck	4.8%	22.6%	6.3%	14.6%	25.0%	22.2%	12.8%	16.3%
Shoulder shrug	4.8%	3.2%	3.1%	9.8%	5.6%	6.7%	7.7%	6.1%
Leg extension	47.6%	41.9%	37.5%	29.3%	41.7%	40.0%	17.9%	35.5%
Leg curl	42.9%	41.9%	37.5%	24.4%	41.7%	44.4%	15.4%	34.7%
Leg press	28.6%	41.9%	40.6%	36.6%	27.8%	44.4%	33.3%	36.7%
Squat	28.6%	9.7%	15.6%	17.1%	22.2%	17.8%	10.3%	16.7%
Seated calf	9.5%	3.2%	6.3%	4.9%	11.1%	4.4%	5.1%	6.1%
Standing calf	0%	0%	9.4%	4.9%	8.3%	4.4%	7.7%	5.3%
Bicep curl	4.8%	0%	9.4%	7.3%	11.1%	6.7%	2.6%	6.1%
Tricep extension	14.3%	0%	9.4%	4.9%	16.7%	15.6%	5.1%	9.4%

Cardio Equipment

Cardiovascular exercise equipment was present in 89 of 245 (36.3%) SCFs. This was broken down by classification as 14.3% of 1A schools, 29.0% of 2A schools, 31.3% of 3A schools, 36.6% of 4A schools, 41.7% of 5A schools, 42.2% of 6A schools, and 46.2% of private schools using cardio equipment in their SCFs. ANOVA analyses revealed no significant differences among classifications in the presence of cardio equipment nor for the presence of any specific piece of cardio equipment. Exercise bikes (standard, recumbent, or spin; 32.2%), treadmills (21.2%), and elliptical machines (20.8%) were the most prevalent pieces of cardio equipment in SCFs. Table 5 contains a complete summary of the cardio equipment available in the SCFs.

Facility Use

In addition to the space and equipment allocations in SCFs, this study also examined different uses of these facilities. Nearly all of the SCFs (99.2%) were used by athletic teams, with the most prevalent use coming from football (98.4%), boys' track and field (92.2%), boys' basketball (88.6%), and baseball (82.9%). Table 6 provides a summary of usage by team and gender for each enrollment category as well as for the sport team as a whole. Just below half (44.9%) of the SCFs were operated coeducationally, while 55.1% of these facilities had males and females train separately. Weight training classes for physical education credit were offered in 24.5% of the SCFs during the school day, and 13.1% of these SCFs were utilized for student-athletes weight training sessions before or after school hours. SCFs were available for use by community members at 30.6% of the schools, and of these facilities open for community use, 2.8% charged a fee for access and use for the community members.

Facility Staffing

The final aspect of the high school SCFs examined in this study was the staffing patterns for the facilities. A dedicated strength and conditioning coach was employed at 37.1% of the schools in this study, and 94.5% of these coaches were employed by the school in a full-time position. There was no significant difference among classifications in the prevalence of a dedicated strength and conditioning coach. ANOVA analyses comparing the full- and part-time staffing

Table 5
Cardio Equipment Prevalence

Cardio equipment	1A *n* = 21	2A *n* = 31	3A *n* = 32	4A *n* = 41	5A *n* = 36	6A *n* = 45	Private *n* = 39	Combined *N* = 245
Treadmills	0%	12.9%	15.6%	26.8%	19.4%	31.1%	28.2%	21.2%
Stair stepper	0%	3.2%	0%	4.9%	8.3%	8.9%	7.7%	5.3%
Elliptical	4.8%	19.4%	15.6%	22.0%	27.8%	22.2%	25.6%	20.8%
Bike	14.3%	29.0%	25.0%	29.3%	33.3%	42.2%	41.0%	32.2%
Norditrack	0%	0%	3.1%	0%	2.8%	0%	0%	0.8%

Table 6
Sport Team Usage of Strength and Conditioning Facility by Percentage

Team	1A *n* = 21	2A *n* = 31	3A *n* = 32	4A *n* = 41	5A *n* = 36	6A *n* = 45	Private *n* = 39	Combined *N* = 245
Baseball	42.9%	83.4%	96.9%	100%	88.9%	88.9%	61.5%	82.9%
Basketball (boys)	95.2%	90.3%	100%	95.1%	80.6%	84.4%	79.5%	88.6%
Basketball (girls)	81.0%	83.9%	96.9%	80.5%	80.6%	73.3%	41.0%	80.0%
Cheerleading	9.5%	19.4%	6.7%	17.1%	8.3%	11.1%	15.4%	12.7%
Cross country (boys)	61.9%	58.1%	62.5%	46.3%	50.0%	53.3%	33.3%	51.0%
Cross country (girls)	57.1%	67.7%	62.5%	46.3%	47.2%	87.5%	25.6%	49.0%
Football	100%	96.8%	100%	100%	100%	100%	92.3%	98.4%
Golf (boys)	61.9%	38.7%	46.9%	24.4%	13.9%	20.0%	15.4%	26.5%
Golf (girls)	38.1%	35.5%	46.9%	22.0%	16.7%	17.8%	10.3%	24.9%
Softball	9.5%	67.7%	90.6%	75.6%	83.3%	77.8%	35.9%	66.1%
Swim & dive (boys)	0.0%	0.0%	0.0%	4.9%	16.7%	28.9%	2.6%	9.0%
Swim & dive (girls)	0.0%	0.0%	0.0%	4.9%	16.7%	26.7%	5.1%	9.0%
Tennis (boys)	42.9%	19.4%	37.5%	43.9%	27.8%	26.7%	5.1%	28.2%
Tennis (girls)	38.1%	19.4%	37.5%	43.9%	25.0%	24.4%	5.1%	26.9%
Track & field (boys)	100%	100%	93.4%	95.1%	83.3%	88.9%	89.7%	92.2%
Track & field (girls)	95.2%	80.6%	87.5%	75.6%	69.4%	82.2%	82.1%	80.8%
Volleyball (girls)	38.1%	51.6%	87.5%	78.0%	75.0%	82.2%	71.8%	71.8%
Wrestling (boys)	0.0%	3.2%	3.1%	12.2%	27.8%	60.0%	12.8%	20.0%
Wrestling (girls)	0.0%	0.0%	0.0%	4.9%	16.7%	28.9%	2.6%	9.0%

patterns for the school year and the summer revealed only one significant difference. The 5A schools used significantly higher numbers of full-time staff members during the summer than 1A schools, $F(6, 238) = 2.530$, $p = .022$. Table 7 shows a complete summary of the staffing patterns by classification.

Discussion

The results of this study demonstrate from RQ1 that there are both significant differences of SCF size based upon school enrollment categories as well as a significant positive correlation between school enrollment and SCF size. The results of this study show several notable differences and several similarities from the prior study of Indiana high school SCFs (Petersen & Judge, 2008). The SCFs in Texas were on average about 600 sq ft larger than those in Indiana; however, as in Indiana, in Texas the largest classification of schools had significantly larger SCFs than any other classification. This relationship between enrollment and space also aligns with findings of studies examining collegiate SCFs (Sapora & Kenney, 1961; Strand, 1988; Walker, 1989). With the trend of a positive relationship between enrollment and SCF size being well established in the literature, future research should begin to quantify this relationship. This would allow for evidence-based recommendations for the appropriate space needed for an SCF based upon either current school enrollment or anticipated school enrollment to be used within the facility planning processes.

The types and amounts of equipment within SCFs were assessed within RQ2 of this study, and numerous differences were identified by school classification in relation to the equipment for free weight training as well as for the use of selectorized equipment and cardio equipment. While the number of significant differences in equipment by enrollment classification was most prominent for free weight equipment, this finding may be in relation to the greater emphasis on training with free weights within this state. One of the notable differences between the SCFs of Texas and the SCFs of Indiana is in the equipment selection. While the availability of free weights was extremely common in both studies, 99.1% in Indiana and 98.8% in Texas, the availability of selectorized weight machines (90.7% Indiana to 33.1% Texas), plate-loaded machines (75.9% Indiana to 59.6% Texas), and cardio equipment (64.8% Indiana to 36.3% Texas)

Table 7
Strength and Conditioning Facility Staffing Patterns

Staffing	1A *n* = 21	2A *n* = 31	3A *n* = 32	4A *n* = 41	5A *n* = 36	6A *n* = 45	Private *n* = 39	Combined *N* = 245
Dedicated strength coach	33.3%	32.3%	34.4%	39.0%	38.9%	37.8%	41.0%	37.1%
Strength coach full-time employee	100%	100%	100%	100%	100%	100%	68.8%	94.5%
Strength coach other coaching duties	100%	100%	90.9%	93.8%	85.7%	88.2%	75.0%	89.0%
Full-time staff school year (*m*)	1.19	3.81	5.84	3.59	5.64	4.29	1.72	3.84
Part-time staff school year (*m*)	1.00	0.10	0.41	1.41	0.44	0.58	1.69	0.83
Full-time staff summer (*m*)	0.57	2.48	1.44	3.17	4.75	2.42	1.41	2.45
Part-time staff summer (*m*)	1.10	0.65	1.47	2.24	2.22	2.53	1.49	1.77

was much higher in the Indiana study than in the Texas study. There are a couple of possible explanations for these differences. First, there has been a shift in training techniques since the Indiana study was completed in 2008. Training with free weights has a great deal of physiological benefit and perhaps strength and conditioning coaches and athletic directors are beginning to view these benefits as outweighing the safety benefits associated with weight machines. This finding highlights the need for longitudinal research on SCFs. Without tracking the data over time, it is difficult to identify trends in the industry and to determine possible underlying causes.

A second possible explanation for the differences in the equipment selection is the differences in the usage of the facilities. The Indiana study found that 90.7% of schools used their SCF for weight training classes for physical education credit, compared to just 24.5% of schools in the Texas study. This is likely due to the "athletic period" concept that is common in Texas. Many Texas high school students receive physical education credit for participation in athletics and use the SCF during an "athletic period" with their athletic team rather than in a general physical education class for credit. With such a smaller number of nonathlete students using the SCF in Texas, schools may be likely to equip their SCF with athletic performance in mind rather than physical education.

The final research question (RQ3) addressed the facility staffing and facility usage. The National Strength and Conditioning Association (NSCA) makes several staffing recommendations in their Strength and Conditioning Professional Standards and Guidelines (Waller et al., 2009). These recommendations include having a strength and conditioning practitioner with an applicable college degree to lead the program. This practitioner should develop a team to instruct and monitor the strength and conditioning program. Additionally, the NSCA recommends a professional-to-participant ratio of no greater than 1:15 for high school athletes. Despite these recommendations, only 37.1% of schools in this study reported having a dedicated strength and conditioning coach and there was only one statistically significant difference in the number of staff members employed among classifications. The presence of a dedicated strength and conditioning coach to lead the program is an apparent area of need for Texas high schools. The relatively steady

number of SCF staff across classifications is also concerning. While it is possible that these numbers are similar due to larger schools using staggered schedules for student-athletes to train, the schools with larger enrollments should seek to have larger numbers of staff supervising their SCFs to provide the appropriate levels of supervision.

Limitations

This study is not without limitations. A larger sample would have served to increase the statistical power for this research. We theorize that the limited response rate may be due to the following factors: (a) we failed to include a follow-up email reminder after the initial invitation, (b) strength coaches may not have had sufficient time to complete the survey, and (c) numerous institutions were lacking a dedicated SCF or were without full- or part-time strength and conditioning staffing. This descriptive study did not include important qualitative aspects such as dialogue with Texas high school strength and conditioning coaches about the status of SCFs or with patrons about their attitudes toward use of the facility. Giving voice to the viewpoints expressed in the survey data could have added depth to the results. The discussion of the study, therefore, was limited to issues potentially surrounding the quantitative descriptive data collected.

Conclusions and Directions for Future Research

SFCs are a common part of the built environment at the majority of Texas high schools. While nearly all high schools in the state have an SCF, only about a quarter of these schools are using these facilities for physical education and many schools are lagging behind industry standards for staffing these facilities. As such, areas for additional research specifically within Texas high schools should include

1. an analysis of strength training use in the physical education curriculum,
2. an analysis of strength and conditioning staff training and development, and
3. an analysis of funding levels and mechanisms for strength and conditioning staff.

Additional research on high school SCFs outside of Texas is also encouraged and should include

1. an expansion of descriptive, quantitative research on high school SCFs throughout the nation;
2. meta-analyses of different state studies on high school SCFs to help determine industry standards for space, equipment, and staffing; and
3. longitudinal research on high school SCFs to identify trends and track changes in the field.

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FITNESS

Associations of Physical Fitness and Academic Achievement Among Illinois High School Students

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Abstract

The health benefits of physical activity are empirically supported and well accepted. However, the relationship between physical activity, physical fitness, and academic performance remains to be clearly established. The purpose of this study was to identify the relationship between physical fitness and academic achievement among a sample of Illinois high school students. Analyses were based on the 2016–2017 school year Archival Fitnessgram physical fitness test scores and cumulative GPAs of ninth- through twelfth-grade students (N = 371). Pearson correlation assessed the relationship between physical fitness and academic performance. Multiple linear regression predicted students' academic achievement. There was a positive association between total fitness and academic achievement, although not statistically significant, r (369) = .002, p = .49. The regression prediction model was statistically significant (p < .001) and accounted for approximately 25% of the variance in academic achievement (R^2 = .256, adjusted R^2 = .246). Academic achievement was predicted by total number of absences and gender, and to a lesser extent by socioeconomic status, the curl-up, and ethnicity. The findings of this study suggest a positive association between physical fitness and academic achievement. These results are potentially relevant to the development of future education policies. Thus, policy makers, school administrators, and educators must use the knowledge gained in this study, along with existing research, as

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evidence to emphasize the importance of the fitness–academic link, to further support the need for quality physical education curriculum and mandated physical fitness testing.

During the last 4 decades, the prevalence of diseases associated with childhood obesity impacting physical and emotional well-being has reached epidemic proportions, with lack of physical activity being a significant contributor (Ogden et al., 2012). Although the benefits of physical activity are well documented, the Centers for Disease Control and Prevention (CDC, 2016a) has estimated that 65% of adolescents do not get the recommended amount of physical activity each day. Furthermore, only 27.1% of high school students meet current recommendations for physical activity and only 29.8% attend physical education classes daily (CDC, 2016b; Kann et al., 2016).

Schools serve as the perfect venue to provide daily physical activity; however, physical education has been substantially reduced in schools across the United States. This reduction and elimination of physical education comes in response to both budgetary concerns and increased pressure for academic accountability (Coe et al., 2006; Trost, 2009). Many state legislators and school administrators have questioned the value of physical education and claimed that time devoted to physical education detracts from academic performance; however, research has refuted this notion (CDC, 2011).

Given the increased rates of childhood obesity and its associated health implications, coupled with the increased pressure among school administrators to improve student academic performance, a number of studies have assessed the relationship between physical activity and academic achievement. However, the relationship between standardized fitness assessments, such as the Fitnessgram, and academic achievement among high school students has received less attention (Bass et al., 2013). Of those studies, many have been inconclusive in recognizing the fitness–academic link with regard to absenteeism and sociodemographic variables that may influence the relationship (Blom et al., 2011). The purpose of this study was to quantify the cross-sectional association between academic achievement (GPA) and measures of physical fitness (Fitnessgram), including the potential for confounding variables such as gender,

ethnicity, and socioeconomic status among a sample of Illinois high school students.

Method

Participants

Participants for the study included ninth- through twelfth-grade students (N = 371) from a rural Illinois high school who were enrolled in physical education class and completed the Fitnessgram physical fitness test during the 2016–2017 school year. Archival Fitnessgram physical fitness test scores, cumulative GPAs, and additional socio-demographic data (including age, grade level, gender, ethnicity, socioeconomic status, and absenteeism records) were utilized in the assessment of student fitness and academic performance.

Measuring Instruments

Physical fitness was measured with four independent fitness tests from the Fitnessgram developed by the Cooper Institute. The Fitnessgram includes a battery of fitness tests that measure the various components of physical fitness necessary for good health, including aerobic capacity, body composition, muscular strength, endurance, and flexibility (Plowman et al., 2013). The Fitnessgram uses criterion-referenced standards to measure the fitness level of students and is intended to be administered during school-based physical education programs (Meredith & Welk, 2010; Plowman et al., 2013). Criterion-referenced standards are used as opposed to percentile norms because they are based on individual levels of good health specific to gender and age (Plowman et al., 2013). The use of health-related criteria emphasizes personal fitness for health rather than setting goals based on performance (Meredith & Welk, 2010). The Fitnessgram classifies fitness levels using two primary zones called the Healthy Fitness Zone (HFZ) and the Needs Improvement Zone (NIZ). The HFZ determines the level of fitness required for a low risk of future health problems, and students scoring in the NIZ are potentially at risk for future health problems (Plowman et al., 2013). A participant's score on each fitness test determines if the participant is in the HFZ or NIZ based on their gender and age. The goal of the Fitnessgram is for students to achieve the HFZ in

as many assessment areas as possible. For the purpose of this study, participants were categorized as HFZ or NIZ for each fitness test and for the combination of three of the fitness tests (PACER, 90-degree push-up, and curl-up). The Back Saver Sit and Reach was not included in the total fitness score because only sophomores completed the assessment. In addition, data on body composition were not collected at the selected school and were, therefore, not available for this study. The Illinois State Board of Education mandates that all fitness tests be conducted all 4 years of high school, with the exception of the Back Saver Sit and Reach (Illinois State Board of Education, 2017a). The Fitnessgram has been established as both valid and reliable and is commonly used throughout the United States as part of physical education curriculums (Plowman et al., 2013).

Academic achievement was measured through student cumulative GPAs. GPAs were calculated by teachers in the selected school and were determined from students' cumulative scores from the final quarter of the 2016–2017 school year. Numerical values were assigned to letter grades such as 4 (A), 3 (B), 2 (C), 1 (D), 0 (F) and the total number of points were added and divided by the number of classes for the GPA. GPAs were matched with the students' Fitnessgram scores and information was then de-identified. We acknowledge the lack of reliability and validity of using GPA as a measure of academic achievement. Although use of standardized test scores may be a more likely choice for measuring academic achievement, GPA data are readily available for all students. Furthermore, the use of high school GPA has proven to be more predictive of students' success in English and Math college courses, as opposed to the use of their scores on standardized tests (Hodara & Cox, 2016).

Additional archival sociodemographic data including age, grade level, gender, ethnicity, socioeconomic status, and absenteeism records were retrieved by the selected school's principal. These data were then matched with respective students' Fitnessgram scores and GPAs and then de-identified before being reported.

Data Analysis

Data were analyzed with SPSS 22. We categorized and coded the participants as fit or not fit based on their achievement of the HFZ for individual fitness tests and total fitness. Pearson's product-moment correlation determined the relationship between physical fitness and academic achievement. Multiple linear regression analysis predicted GPA based on the combined effects of all independent variables.

Results

Characteristics of the Study Population

The population at the selected high school consisted of 1,051 students (n_{9th} = 304, n_{10th} = 261, n_{11th} = 214, and n_{12th} = 272), with males representing 52% of the population. Caucasian students represented 57% of the population; Hispanic, 34%; African American, 4%; multiracial, 3%; American Indian, 0.4%; and Asian, 0.4%. Average daily attendance rate was 91% (Illinois State Board of Education, 2017b) and approximately 47% of the population received free or reduced lunch (Illinois State Board of Education, 2017b).

Characteristics of the Sample Pool

The sample pool consisted of all ninth- through twelfth-grade students who participated in the battery of Fitnessgram physical fitness tests during their physical education class in Spring 2017 and also had an up-to-date cumulative GPA. The sample is believed to be representative of the ninth- through twelfth-grade student population at the selected school based on comparable percentages of their demographic information, including gender, ethnicity, and socioeconomic status.

Table 1 shows the descriptive statistics for the categorical demographic variables used in this study. Table 2 reports the descriptive statistics for the continuous demographic variables used in this study, along with GPA and the mean and standard deviations for each individual fitness test. Table 3 reports the number of students who reached the HFZ for each individual fitness test.

Table 1
Summary of Categorical Demographic Information

Variable	Frequency	%
Sex		
Male	220	59.3
Female	151	40.7
Year in school		
9	114	31.0
10	130	35.0
11	81	21.8
12	46	12.4
Race/ethnicity		
Caucasian	205	55.3
Hispanic	136	36.7
Black	10	2.7
Multiracial	12	3.2
Asian	4	1.1
American Indian	2	0.5
Socioeconomic status		
Free/reduced lunch	207	55.8
Paid lunch	164	44.2

Table 2
Summary of Continuous Demographic Information

Variable	Range	*M*	*SD*	Skewness	Kurtosis
Age	14–19	16.05	1.16	-.232	- .478
Absences	0–60.5	10.18	9.72	1.898	4.742
Total fitness	3–6	4.90	0.82	-.349	-.440
PACER	0–63	33.45	13.61	-.064	-1.174
Push-up	0–40	16.22	8.62	.404	.096
Curl-up	6–80	54.90	24.67	-.099	-.591
Sit & reach	4.25–12.0	10.28	1.94	-1.201	.954
GPA	0.56–4.0	2.46	0.76	-.099	-.591

Table 3
Summary of Fitnessgram Data

Test	No. completed	No. reached HFZ	No. reached HFZ
PACER	371	118	32
Push-up	371	247	67
Curl-up	371	337	91
Sit & reach	101	71	70

The prediction model for GPA based on the combined effects of all independent variables (total fitness, individual components of fitness, gender, ethnicity, grade level, socioeconomic status, and number of absences) was statistically significant ($p < .001$) and accounted for approximately 25% of the variance of GPA ($R^2 = .256$, adjusted $R^2 = .246$). GPA was partially predicted by total number of absences and gender (females reporting higher GPA), and to a lesser extent by socioeconomic status, the curl-up, and ethnicity (Caucasians and Asians reporting higher GPA). Table 4 shows the raw and standardized regression coefficients of the predictors together with their correlations with GPA, along with their squared semipartial correlations.

Table 4
Stepwise Regression Analysis Predicting GPA

Model	B	*SE* B	B	*r*	Sr^2
Constant	2.486	.109			
Absences	-.027	.004	-.342	-.373	
Gender	.429	.072	.278	.235	.062
Socioeconomic status	-.267	.070	-.175	-.220	.028
Curl-up	.004	.001	.139	.099	.019
Ethnicity	.662	.333	.091	.119	.008

Note. The dependent variable is GPA. $R^2 = .256$, adjusted $R^2 = .246$. Sr^2 is the squared semipartial correlation.

Discussion

A number of studies have provided evidence that physical fitness is positively associated with academic achievement (Blom et al., 2011; Castelli et al., 2007; Chomitz et al., 2009; Fedewa & Ahn, 2011; Hillman et al., 2009; Van Dusen et al., 2011). Results from this study are consistent with these findings, although no statistically significant relationship was found in this study. One plausible explanation for this is that athletes at the selected school are allowed to waive out of physical education courses during their junior and senior years. Research indicates that athletes typically have a higher GPA than nonathletes, are more physically fit, and have less total school absences (Lumpkin & Favor, 2012). Hence, theoretically, the students who would achieve the highest level of fitness and academic achievement may have been left out of the study, contributing to the nonsignificance of the relationship.

Within the few studies that have been conducted regarding associations between muscular strength, endurance, and academic achievement, positive associations were found between abdominal strength (utilizing the curl-up test) and academics. However, associations were weakened after controlling for potential covariates, such as age and socioeconomic status (Chu et al., 2016). The results of this study confirm findings from previous studies, as a positive association was found between the curl-up and GPA, after controlling for confounding variables.

When determining if the aforementioned sociocultural variables, along with total physical fitness scores, were significant predictors of GPA, this study found that the combination of these variables accounted for 24% of the variance in GPA. Although a definitive explanation for the variance in GPA cannot be provided, it is well documented that both lower socioeconomic levels and higher total absences are independently associated with lower academic achievement, thus providing a plausible explanation as to why these variables significantly contributed to the model (Castelli et al., 2007). These results further justify the need for investigation of all factors that influence academic achievement, including physical fitness.

Limitations

The main limitation of this study is that it was undertaken with a convenience sample and this may limit its generalizability across the population. Furthermore, although the physical education teachers at the selected school were certified and trained to conduct and collect data for the Fitnessgram physical fitness tests, the reliability of the data collection was unknown. Consequently, systematic bias may be compromised because of inconsistent data quality. The final limitation is that, as previously noted, junior and senior athletes at the selected school were allowed to waive out of physical education courses. Athletes typically have a higher GPA than nonathletes, are more physically fit, and have less total school absences (Lumpkin & Favor, 2012); therefore, the students who would achieve the highest level of fitness and academic achievement may have been left out of the study.

Implications for School Health and Physical Education

The results of this work carry implications for research, policy, and health and physical educators. For researchers, further examination longitudinally into the relationship between physical fitness and academic achievement for grades K–12 is recommended. In addition, the influence of confounding variables such as gender, ethnicity, socioeconomic status, and absenteeism rates needs to be further explored because the literature surrounding this is limited and contradicting. For health and physical education policy makers, advocating for common physical education guidelines and policies across all states is necessary. This includes the development and implementation of nationwide physical fitness testing procedures and guidelines for fitness testing and reporting requirements for individual, as opposed to aggregate, level data so that students' health and academics can be monitored longitudinally. For health and physical educators, the potential impact of physical fitness on academic performance should be considered when developing curriculum and allocating funds from legislation, such as the Every Student Succeeds Act, to hire additional certified physical education teachers, build necessary and appropriate physical education facilities, purchase physical education equipment, and properly schedule physical education classes. Physical education requirements are strongest for

elementary students; however, the association of fitness with academic achievement among high school students was identified in this paper. Given these findings, significant efforts should be made toward the sustainment of an effective physical education curriculum during high school.

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PEDAGOGY

Effects of a Content Knowledge Intervention on Instruction and Learning: A Pilot Study

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Abstract

The purpose of this pilot study was to examine the effects of improving a physical education teacher's content knowledge and, in turn, the teacher's instructional effectiveness and student learning in an upper elementary physical education setting. Four classes were randomly assigned to either a comparison condition (n_{4th} = 9 students; n_{5th} = 17) or an intervention condition (n_{4th} = 7; n_{5th} = 10). The teacher taught both conditions. The teacher first taught two classes in the comparison condition in a manner that he had taught for the past five years. Following the completion of the teaching, he received a content knowledge workshop. After the workshop, the teacher taught two classes in the intervention condition. Assessment of the teacher following the workshop showed that he obtained higher content knowledge scores than prior to the workshop. These improvements in content knowledge positively impacted his enacted teaching with more appropriate task selection and better instruction. Student learning also significantly improved in the intervention condition, not in the comparison condition, from pre- to posttest. The findings of this study extend the research demonstrating the effectiveness of improving the content knowledge of teachers in

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impacting student learning, in this case in the upper elementary grade band.

Improving a teacher's pedagogical content knowledge (PCK) is central to enhancing the quality of instruction and student learning (Shulman, 1987; Ward & Ayvazo, 2016). PCK is typically conceptualized as including five areas of knowledge: students, content, context, pedagogy, and curriculum (Ward & Ayvazo, 2016). Lack of content knowledge is often argued as a significant weakness in the PCK of teachers (Hastie & Vlaisavljevic; 1999; Ingersoll et al., 2014; Tsangaridou, 2002). Yet, despite this, a number of studies have demonstrated that improving the content knowledge of teachers leads to improved student learning and that this can be done in a time-efficient manner (Iserbyt et al., 2017; Kim, 2016; Kim et al., 2018; Ward & Ayvazo, 2016).

Ball et al. (2008) defined two categories of content knowledge: common content knowledge (CCK) and specialized content knowledge (SCK). Ward (2009) further refined these categories for physical education defining CCK as knowledge of rules, etiquette, and safety, techniques, and tactics of sports, and SCK as knowledge related to content representations, instructional tasks, and student's error detection. The National Standards for initial licensure in physical education recognize the importance of teachers being able to develop strong content knowledge with two substandards. Standard 1.a states, "Describe and apply CCK for teaching PreK–12 physical education" and Standard 1.b states, "Describe and apply SCK for teaching PreK–12 physical education" (SHAPE America, 2017).

Studies have demonstrated support for the importance of CCK and SCK regarding PCK (Iserbyt et al., 2017; Sinelnikov et al., 2015; Ward et al., 2015). Experimental studies have shown that improvements in content knowledge and, in particular, SCK have positively impacted teacher instruction, including task selection (e.g., sequences of tasks and appropriateness of tasks) and instruction (e.g., task presentation and feedback), which resulted in better student learning outcomes (Iserbyt et al., 2017; Sinelnikov et al., 2015; Ward et al., 2015).

However, there are at least two critical gaps in this line of research. The first is that prior intervention studies that focused on

improving the PCK of teachers did not evaluate the teachers' CCK and SCK prior to and following the content knowledge workshop using knowledge tests (Iserbyt et al., 2017; Sinelnikov et al., 2015; Ward et al., 2015). In these studies, a workshop to train teachers to deliver specific CCK and SCK to a particular grade level and content area was implemented. Researchers then investigated if the content taught in the workshop appeared in the instruction of teachers in subsequent lessons. However, none of these studies documented whether the intervention brought changes in a teacher's understanding of the content (i.e., CCK and SCK). Thus, inferences between the outcomes of the workshop and the teacher's ability to apply the knowledge in practice can be questioned because there is no direct measure of the impact of the workshop as an intervention.

A second gap in the literature is that the majority of studies in this line of content knowledge intervention studies were conducted in secondary physical education settings (Iserbyt et al., 2017; Sinelnikov et al., 2015; Ward et al., 2015). Only one study has been conducted in a lower elementary context (Chang, 2014), and there are no studies in upper elementary settings. Examining the impact of improving a teacher's content knowledge and the subsequent results on student learning in an upper elementary context is essential considering the uniqueness of this age group for psychomotor learning. From a developmental perspective, upper elementary school students are in the transitional motor skill phase (Goodway et al., 2019). This stage is a critical stepping stone to lead learners' motor skill performance from isolated and decontextualized environments to the more dynamic and context-specific environments that are inherent in sports and games (Belka, 2004; Goodway et al., 2019). If we, as teachers, fail to assist children in this transitional motor skill phase, children may experience failure in sport-specific skills and could drop out of engaging in sports or physical activity (Belka, 2004; Goodway et al., 2019).

Rink's (2012) four-stage games model provides a promising framework to teach children who are in the transitional phase of motor development. In Stage 1, the focus is on attaining individual skills and developing the ability to control an object. Stage 2 focuses on using skills in combination with each other and relating movement to others in cooperative ways. In Stage 3, basic offensive and

defensive strategies are introduced, and in Stage 4, the focus is on modified games with changes in the rules, boundaries, and number of players, leading to playing of the full game. Among the four stages, Stages 2 and 3 are especially important to provide children who are in the transitional motor skill phase step-by-step development of their skills (Rink, 2012). However, at present, no research has examined the efficacy of Rink's stages of game development.

In addition to Rink's (2012) stages of game development, the concept of content development is critical in providing students step-by-step learning experiences. Content development is defined as sequencing movement tasks in a manner that has the potential to facilitate learning (Rink, 2012). The assumption underpinning the concept of content development is that beginning levels of the skills need to be mastered before more complex versions of those skills can be learned. Based on this assumption, Rink conceptualized content development tasks with having four functions: informing, extending, refining, and applying. An *informing* task is the first task in a sequence to teach specific content. An *extending* task increases or decreases the complexity of the task relative to a previous task. A *refining* task focuses on the quality of the performance such as improving the technique. An *applying* task has two different functions: to assess a student's ability or to apply their performance in a context such as a game. All tasks in the development are referenced relative to the initial informing task.

This study aims to address two gaps in the literature (i.e., the lack of content knowledge experimental study in upper elementary contexts and evidence in support of Rink's stages of game development). The purpose of this pilot study was to examine the effects of improving the tennis content knowledge of a teacher on his CCK and SCK and on his instruction and student learning in an upper elementary physical education setting. Three research questions guided the study: (a) What is the impact of a content knowledge intervention consisting of a content knowledge workshop and accompanying knowledge packet on a teacher's CCK and SCK? (b) What are the differences in the teacher's PCK (i.e., task selections and instruction) between the comparison and the intervention conditions? and (c) What are the differences in students' tennis skill performance

between the comparison and intervention tennis units? This study serves as a pilot study to ensure the feasibility of the study approach.

Method

Settings

The institutional review board of the university approved the study, the teacher consented to the study, and parental permission and assent were secured from the children. The study was conducted in an elementary school with one physical education teacher and four classes of students in a suburban, Midwestern city in the United States. Students typically received physical education twice a week for 30 min in each lesson. Tennis was selected as the content area because tennis is a common lifelong physical activity (SHAPE America, 2014) and is a new content area that has increasingly been introduced in elementary school contexts, in this study the fourth and fifth grades (United States Tennis Association [USTA], 2016).

Participants

Teacher

The teacher was male and had been teaching physical education in elementary school for 19 years. While he had little to no experience in playing tennis, he had taught tennis in elementary schools for 5 years. He had participated in a professional development training session from the USTA prior to teaching tennis in his physical education classes. He rated his confidence level of teaching tennis as 4 on a scale of 1 (*low*) through 5 (*high*).

Students

Forty-three students from two classes in fourth grade and two classes in fifth grade participated in the study. One class from each grade was randomly assigned to the comparison condition (n = 26; n_{4th} = 9 [girls = 3]; n_{5th} = 17 [girls = 10]) and the intervention condition (n = 17; n_{4th} = 7 [girls = 2]; n_{5th} = 10 [girls = 3]).

Study Design and Procedures

An experimental research design with a comparison condition and an intervention condition with students nested within intact classes (n = 4) was used to drive the study. The same teacher taught

both conditions. The teacher first taught the comparison condition in a manner that he "typically" teaches. The pretest of students' tennis skill performance was conducted prior to the first day of the unit (2 days prior in both classes), and the posttest was executed after the last day of the unit (12 days [fourth grade] and 5 days [fifth grade] after the unit completion). Then the teacher received a content knowledge workshop. Prior to and following the 2-hr training, the teacher spent 30 min completing the pre- and posttests (a total 1 hr of testing). The pretest was conducted at the beginning of the training and the posttest was conducted once all the content had been covered. Emi Tsuda was present in all the classes taught by the teacher. The data of task selection and instruction were collected during the teacher's enacted teaching in the 3-day tennis unit. A video camera was not utilized to record classes, because not all the students in the class provided permission to participate in the study. The teacher wore a wireless microphone to record his voice. Voice-recording started when the teacher began a lesson and finished when all the students were out of the gymnasium. After all the procedures were completed, interobserver agreements were established for all the variables with the exclusion of two components of instruction: clarity of task presentation and demonstration. Following the workshop, the teacher taught the intervention condition to the two classes. As with the comparison condition, the pretest of students' tennis skill performance was conducted prior to the first day of the unit (8 days [fourth grade] and 5 days [fifth grade] prior), and the posttest was executed after the last day of the unit (7 days after in both classes).

To address the issue of teacher knowledge gains, this study was conceptualized in terms of two levels of analysis. The first level focused on the pre-to-post learning gains that occurred from the content knowledge intervention designed to improve the teacher's CCK and SCK. The second level was a comparison of teacher instructional behavior and student learning that occurred in the comparison and the intervention conditions. Table 1 indicates the summary of the independent and dependent variables of the study, along with the timelines.

Table 1
Timeline, and Independent and Dependent Variables of the Study

Timeline	1	2	
comparison condition 3-day tennis unit	**The CK intervention**	**Intervention condition 3-day tennis unit**	**3**
Level 1 analyses			
IV	–	The CK workshop using the knowledge packet	–
DV	–	The teacher's CCK and SCK across the CK intervention	–
Level 2 analyses			
IV	The teacher's task selection and instruction	–	The teacher's task selection and instruction
DV	Student skill learning	–	Student skill learning

Note. IV = independent variable; DV = dependent variable.

Level 1 Analysis: A Content Knowledge Intervention

Independent Variables

The Level 1 analysis looked at the impact of the upper elementary tennis content knowledge intervention on the teacher's CCK and SCK. The intervention consisted of the content knowledge workshop and upper elementary tennis knowledge packet. During the workshop, the teacher was actively led through the knowledge packet content, which ensured his understanding.

The Upper Elementary Tennis Knowledge Packet. A knowledge packet is a body of knowledge that defines and explicitly de-

scribes the content to be taught to a specific grade level (Ward et al., 2015). The knowledge packet in this study was designed for a physical education teacher with some experience in teaching tennis to Grades 4 to 5 students (Tsuda et al., 2018). The knowledge packet was underpinned by two premises. The concept of content development (Rink, 2012) and the stages of game development (Rink, 2012), both discussed in the introduction. There were five components in the knowledge packet: (a) introduction, (b) equipment modification, (c) concepts of task development, (d) content map, and (e) task description (Ward et al., 2015). The content validity of the knowledge packet was secured through two steps. First, a tennis expert developed the knowledge packet in alignment with recommendations provided by the International Tennis Federation (ITF, 2007) and the National Standards for K–12 Physical Education (SHAPE America, 2014). Second, another tennis expert checked the content, and revisions were made based on feedback.

The Content Knowledge Workshop. The content knowledge workshop aimed to prepare the teacher to implement the tasks in the knowledge packet. The training lasted 2 hr and was completed within a day. Four goals of the workshop were that the teacher (a) knows the basic rules, critical elements of techniques, and tactics needed to teach upper elementary tennis (CCK); (b) can perform the tennis skills to teach upper elementary tennis (CCK); (c) knows and can deliver the tasks and task progressions in the knowledge packet (SCK); and (d) can detect errors of students and correct them (SCK). During the workshop, the teacher completed pretests (30 min); Tsuda introduced and explained the rationales of the knowledge packet (20 min); Tsuda explained equipment, rules, techniques, and tactics of tennis (20 min); Tsuda explained and practiced the tasks on a content map (70 min); the teacher completed the posttest (30 min); and the teacher created a block plan (10 min). The total time for the workshop was 2 hr. Treatment integrity was secured through a rehearsal of the workshop and use of a checklist during the workshop that ensured all the elements were covered. Table 2 illustrates the contents, timeline, and pedagogy of the content knowledge workshop.

Dependent Variables for the Workshop

The teacher's content knowledge changes were evaluated through four tests: (a) rules, techniques, and tactics (CCK); (b) skill performance (CCK); (c) knowledge of task sequences (SCK); and (d) knowledge of student errors (SCK). The teacher took the tests before and after the content knowledge workshop.

Knowledge of Rules, Techniques, and Tactics. The teacher completed 15 open-ended questions examining knowledge of rules, techniques, and tactics in tennis. The questions were aligned with the knowledge packet. Each question was valued 1 point, with a total of 15 points. Content validity was established in two ways. First, a tennis expert developed the test based on the National Standards (SHAPE America, 2014), tennis textbooks (Brown, 1989; Bollettieri, 2001), and ITF (2007) and USTA (2016) guidelines. Second, two graduate students with experience in tennis and in developing similar tests checked the content and clarity of the test. Based on their feedback, refinements were made on two questions for clarity.

Skill Performance. A tennis skills test to evaluate the teacher's tennis performance was created. This same assessment was used in the measurement of students' tennis skill performance with the assumption that a teacher needs to be able to perform skills at a minimum of the level that is going to be taught. The test was also developed to meet the expected learning outcomes identified in the grade level outcomes in the National Standards (SHAPE America, 2014). The stages of game development (Rink, 2012) underpinned the test. The test included three tasks (Stage 1 to 3 tasks) for both forehand and backhand. There were three trials for each task: a practice trial and two coded trials. Each task had two to seven technical criteria, with a 1 representing when a criterion was present and 0 representing when a criterion was absent. This assessment was scored between 0 and 60 points. The test used the developmentally appropriate equipment (i.e., a red ball, a 25-in. racquet, and a quarter size of the full-size tennis court). Content validity of the test was secured in three ways: First, a tennis expert developed the test referring to preexisting assessments (Brown, 1989; Strand & Wilson, 1993; Ulrich, 2016), and second, another tennis expert checked the content and clarity of the test. Third, a pilot test was conducted with six elementary school students.

Table 2
The Contents, Timeline, and Pedagogy of the Content Knowledge Workshop

Time	Topic	Content	Pedagogy
30 min	Pretest	• The test for the knowledge of rules, techniques, and tactics • The test for the knowledge of tasks • The test for the knowledge of student errors • The test for the skill performance	N/A
20 min	Introduction & rationales of the knowledge packet	• Organization of the knowledge packet • Grade level outcomes of striking with a short-handled implement in the National Standards in the upper elementary age band • Two underlying concepts of the knowledge packet (i.e., the stages of game development & the concept of content development) • The four goals of the teacher training	Tsuda verbally explained the content to the teacher in a conversational style. Tsuda frequently asked the teacher if he had a question. However, the teacher did not ask any questions, because he had no problem of understanding of the content.
20 min	Equipment, rules, techniques, and tactics	• Equipment: racquet, court, ball sizes • Rule: one bounce, name of the lines, and on the line still counts • Techniques: forehand and backhand (four critical elements) • Techniques: footwork (four critical elements) • Tactics: ready position, aim weakness, open court, and cross-court rally	Tsuda explained the content and demonstrated the skills to the teacher. After that, Tsuda and the teacher practiced each skill together. The researcher asked questions of the teacher to check for understanding (e.g., "Could you tell me what the critical elements for forehand ground stroke are?").

Table 2 (cont.)

Time	Topic	Content	Pedagogy
70 min	Content map & tasks	• Overall picture of the content map • Tasks 1–14 including the five components of the task: (a) purpose of task as related to aspects of skilled performance, (b) task description, (c) equipment needed, (d) teaching cues, and (e) student common errors	The researcher explained the content. Emi Tsuda explained the contents in a conversational style. Tsuda and the teacher practiced the task together. Tsuda frequently asked the teacher if he understood the task. During the practice, Tsuda and the teacher also discussed the best way to implement each task in the context considering a size of the gym and a number of the students in his class.
30 min	Posttest	• The test for the knowledge of rules, techniques, and tactics • The test for the knowledge of tasks • The test for the knowledge of student errors • The test for the skill performance	N/A
10 min	Block plan	• Create a block plan	The teacher was asked to write a block plan. After that, Tsuda asked the rationale to the teacher, and feedback was provided based on his comments.

Knowledge of Tasks and Task Sequences. A content map to assess knowledge of tasks and task sequences was used (Ward et al., 2017). A content map is a graphic organizer of SCK that defines the content to be taught and has been established as a valid and reliable tool for measuring SCK. In this study, the focused content was forehand and backhand groundstrokes and footwork of tennis. Tsuda coded the content map in three aspects: (a) Rink's (2012) content development categories (the depth of the content development was calculated by the formula [E + R + A] / I; Ward et al., 2017), (b) Rink's four stages of game development, and (c) appropriateness of task sequences (see Table 3 for definitions).

Table 3
The Definitions of the Categories for Task Selection

Category	Definition
	Alignment With Content Map
Aligned with the CM	A task matched with the task on the CM.
A goal of the task was consistent with the CM	A primary goal of the task was consistent with a task on the CM, but a different task was implemented.
Not aligned with the CM	A task was not on the CM.
	Content Development
Informing	The first task in a sequence to teach specific content.
Extending	A task increases or decreases the complexity of the task relative to a previous task.
Refining	A task focuses on the quality of the performance such as improving the technique.
Applying	An applying task can be used to assess a student's ability or to apply their performance in a context such as a game.

Table 3 (cont.)

Category	Definition
	Stages of Game Development
Stage 1	Focus on the ability to control the object or body which also includes the changes from stationary to moving objects/moving receivers.
Stage 2	Skills are combined; rules that limit the way an action can be performed are emphasized; skills are practiced in cooperative relationships.
Stage 3	The focus is removed from the execution of the skill to simple offensive and defensive roles with the use of the skill.
Stage 4	Complex game play. For most games, Stage 4 begins when offensive and defensive players become specialized.
	Appropriateness of Task Sequences
Appropriate	The task progression from one task to another was characterized by small step-by-step instructional progressions.
Inappropriate	The task progression from one task to another was not characterized by a small step-by-step progress, not a big step up from a prior task.

Note. CM = content map.

Knowledge of Common Errors of Students. The teacher's understanding of potential student errors and how to correct those errors was assessed through a test with 10 open-questions that was developed and implemented based upon the knowledge packet. Each question consisted of two parts: to detect an error and to correct it. A total score for this assessment was 20, and each answer was scored as 1 point (10 questions × 2 parts = 20 points). Tsuda secured content validity in three ways: First, a tennis expert developed the test based on the knowledge packet, which had previously been validated. Second, two graduate students checked the content and clarity of the test. Third, based on their suggestions, refinements were made on three scenarios in the test for clarity.

Level 2 Analysis: A 3-Day Tennis Unit

Independent Variables

The independent variable of the tennis unit was the teacher's PCK (task selection and instruction), and the dependent variable was students' learning. The teacher taught a 3-day tennis unit for both the comparison condition and the intervention condition. In the instruction of the comparison condition, the teacher was asked to teach the tennis unit in the way he had typically taught in the past. The teacher determined what tasks to do and how to instruct lessons. The intervention condition consisted of the same teacher being asked to teach another 3-day tennis unit to two classes, using the knowledge learned through the knowledge packet and the content knowledge workshop. All the lessons in both the comparison condition and the intervention condition were video recorded. The teacher's PCK was coded and the differences were compared between the comparison condition and the intervention condition through the video data. Tables 3 and 4 demonstrate the definitions of a criterion for each subelement for task selection and for the instruction of the teacher, respectively.

Table 4
The Definitions of Categories for Instruction

Category	Definition
	Clarity of Instruction
Clear	A teacher described the task clearly, and little confusion is seen among students.
Unclear	A teacher did not describe the task clearly and students were confused with what they were expected to do.
	Demonstration
Complete demonstration	A correct complete model of the desired movement and that movement met all the critical elements of Stage 1 and 2 tasks.
Incomplete and/or incorrect demonstration	An incorrect model of task performance by using incorrect critical elements and/or partial elements of the whole demonstration.

Table 4 (cont.)

Category	Definition
	Cues
Accurate and appropriate	All cues presented were correct and appropriate.
Accurate but inappropriate	All cues presented were correct but were inappropriate.
Feedback	
Congruent feedback	A cue provided was congruent with a student's error.
Incongruent feedback	A cue provided was not congruent with a student's error.

Dependent Variable

Students' tennis skill performance was assessed through the same instrument that assessed the teacher's tennis skill performance. All performances of the tennis skill test were video recorded. Students were assessed in groups of one to three students, depending on the availability of students and time.

Coder Training and Interobserver Agreement

Coder training was conducted in three steps for analysis of the tests measuring the teacher's CCK, SCK, PCK, and the students' learning. First, Tsuda explained the definitions of each variable. Second, two graduate students coded and analyzed 10% of the data together until reaching 100% of the agreement with Tsuda. When disagreement occurred among the graduate students, they discussed until 100% of the agreement was secured. Third, the graduate students analyzed another 10% of the data independently until they acquired a 95% agreement with Tsuda. After the completion of the training, the graduate students analyzed 100% of the teacher's CCK and SCK data because there was only one teacher's data, and the interobserver agreement was 95%–100% across four tests. For the teacher's PCK data (instruction and task analysis), 33% of the data were analyzed by the graduate students. The result of the agreement

was 91.07% for task selection and 92.50% for instruction. For the students' performance, the graduate students analyzed 33% of the data, and the interobserver agreement was 94.10%.

Data Analysis

The teacher's variables (CCK, SCK, and PCK) were analyzed through descriptive statistics because there was data for only one teacher. For the student variable, nonparametric statistics were used because the data did not meet the assumptions of parametric statistics. The Mann–Whitney U test analyzed the mean scores of the pretest of tennis skill performance between the comparison condition and the intervention condition. Two Wilcoxon signed-rank tests were used in the examination of the differences between student tennis skill performance scores pretest and student tennis skill performance scores posttest for each condition. Effect sizes were calculated with the formula $r =$ (Rosenthal, 1991; $r = .10$ [small], $r = .30$ [medium], and $r = .50$ [large]). SPSS 22 was used in the analysis of the data.

Results

Level 1 Analysis: The Content Knowledge Intervention

Table 5 illustrates the results of the pre- and posttests of the teacher's CCK and SCK and detailed analyses of the content map written by the teacher. Overall, the teacher improved both CCK and SCK after receiving the workshop. Specifically, the teacher improved his skill performance and the knowledge of student errors.

Level 2 Analysis: The 3-Day Tennis Unit

The Teacher's PCK

Table 6 shows the results of the teacher's task selection and instruction in the two conditions. The teacher used more (a) tasks from the knowledge packet, (b) appropriate task sequences, (c) extension tasks, and (d) Stage 2 and 3 tasks after the workshop in the intervention condition than in the comparison condition. Regarding instruction, the teacher demonstrated more complete demonstrations, accurate

Table 5
The Results of Common Content Knowledge (CCK) and Specialized Content Knowledge (SCK) on the Pre- and Posttest of the Teacher

Test content	Test (total score)	Pretest (% correct)				Posttest (% correct)			
CCK	Rules, techniques, and tactics (15)	14 (93.3%)				14 (93.3%)			
	Skill performance (60)	38 (63.3%)				57 (95%)			
SCK	Content development (the index score)	5.33 (N/A)				6 (N/A)			
	Student errors (20)	11 (55%)				17 (85%)			
	Detailed analyses of content development on the content map								
Content development	Task development	***I***	***E***	***R***	***A***	***I***	***E***	***R***	***A***
		3	16	0	0	3	17	0	1
	Task sequences	***Appropriate***		***Inappropriate***		***Appropriate***		***Inappropriate***	
		11		5		13		7	
	Stages of game development	***1***	***2***	***3***	***4***	***1***	***2***	***3***	***4***
		17	2	0	0	13	7	1	0

Note. The score in the parentheses is the total score of the assessment; I = informing; E = extending; R = refining; A = applying; N/A = not applicable.

Table 6

The Mean of Teacher's Task Selection in the Comparison and Intervention Conditions in the 3-Day Unit

Task selection														
	Alignment			Task sequences		Content development				Index score	Stages of game development			
Class	A	C	N	A	IA	Informing	Extending	Refining	Applying		1	2	3	4
Comparison	4.17 (4-4.5)	0.83 (0.5-1)	1.83 (0-3.5)	4.17 (3-4.5)	1.67 (1-2.5)	1.17 (1-1)	4.67 (3-5.5)	0.83 (0-2)	0.33 (0-1)	5.12	6.00 (2.5-8.5)	0.5 (0-1.5)	0.00 (0)	0.33 (0-1)
Experiment	7.83 (6.5-9)	0.67 (0-1.5)	0.00 (0)	6.83 (5.5-8)	0.33 (0-1)	1.33 (1.5-3.5)	4.67 (3.5-6.5)	0.83 (0-1.5)	1.67 (1-2)	5.39	4.66 (2-7.5)	2.50 (2-3)	0.83 (0-1.5)	0.50 (0-1.5)

Instruction											
	Clarity		Demonstration			Cues				Feedback	
Class	Clear	Unclear	CD	ID	ND	AA	AI	IA	N	Congruent	Incongruent
Comparison	7.16 (5-8.5)	0 (0)	4.16 (2.5-5)	1.50 (0-2.5)	1.16 (0-2.5)	2.83 (0-5)	0 (0)	0 (0)	4.00 (3.5-5)	5.83 (5-8)	0 (0)
Experiment	8.5 (6.5-10.5)	0 (0)	6.17 (2-9.5)	0.67 (0.5-1)	1.50 (0-3.5)	5.67 (4.5-7.5)	0 (0)	0 (0)	2.83 (2-3.5)	10.66 (9.5-12.5)	0 (0)

Note. Task selection (A = aligned with the content map; C = a goal of the task is consistent; N = not aligned with the content map; A = appropriate; IA = inappropriate). Instruction (CD = complete demonstration; ID = incomplete demonstration; ND = no demonstration; AA = accurate and appropriate; AI = accurate but inappropriate; IA = inaccurate; N = not given).

and appropriate cues, and congruent feedback in the intervention condition than in the comparison condition.

Student Learning

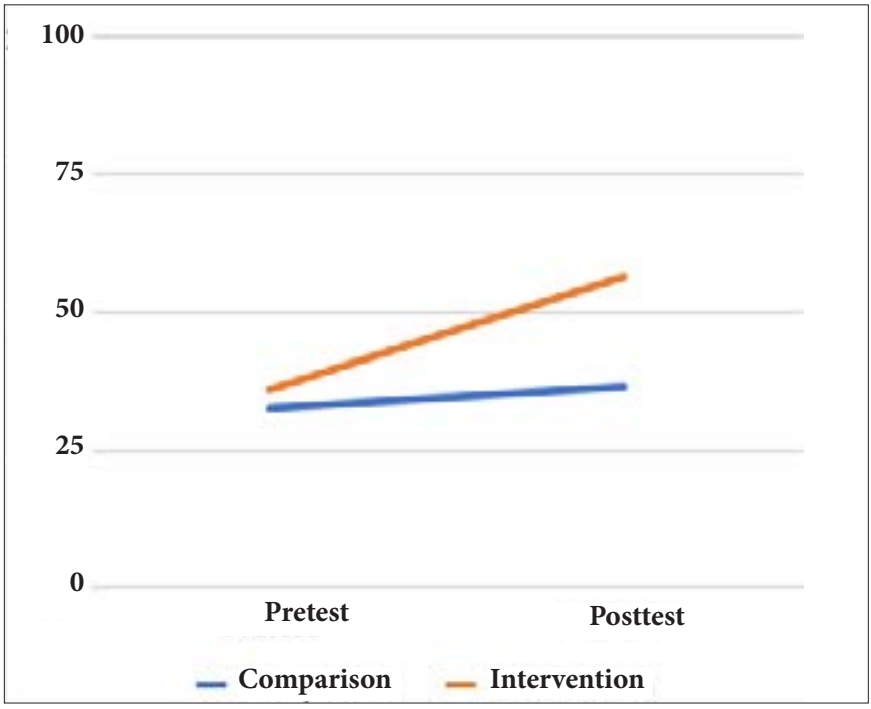
Figure 1 shows the results of the pre- and posttest student performance tennis skills test of the students in the two conditions. There were no statistically significant differences at the pretest between the comparison condition (M = 19.61, SD = 6.90) and the intervention condition (M = 21.63, SD = 9.22; U = 168.00 [Z = -.73], p = .46, r = -.11). No statistically significant change from the pre- to posttest was observed in the comparison condition (Z = -1.01, p = .30, r = -.19; M = 21.96, SD = 9.90). In the intervention condition, there was a statistically significant difference from the pre- to posttest (Z = -3.23, p = .001, r = -.83; M = 33.86, SD = 4.73) for student performance on the tennis skills test.

Discussion

The Intervention Was Effective in Improving the Teacher's Content Knowledge

The teacher improved his CCK and SCK after the intervention, in comparison to the pretest results, with the exception of CCK in rules, techniques, and tactics. The lack of improvement in rules, techniques, and tactics of CCK may have been due to ceiling effects because the teacher scored high on the pretest (14 out of 15 points) and little room was left for improvement. The teacher's skill test score changed from 63% to 95%, which indicates that although limited time (10 min) was allocated to practice tennis skills in the workshop, the teacher already had the skill set to further advance his performance in tennis needed to teach upper elementary students. Regarding SCK, the teacher developed more appropriate task sequences in the content map with the use of more Stage 2 and 3 tasks in Rink's (2012) stages of game development. The teacher's knowledge of student errors also enhanced after the intervention. Overall, the results of the Level 1 analyses showed that the content knowledge intervention was effective in improving the teacher's CCK and SCK. The findings provided the first evidence of the teacher's CCK and SCK changes that were measured.

Figure 1
Changes in Percentage From Pre- to Posttest in the Student Tennis Skill Performance Test in the Comparison and Intervention Conditions



Strengths of the content knowledge intervention were that the training covered all the elements of the knowledge packet and Tsuda went over every task by practicing and discussing how to best implement each task with the teacher. During that time, cues and student common errors were also provided to the teacher. A weakness of the content knowledge intervention was that the knowledge packet was given to the teacher right before the content knowledge workshop. It is suggested that in future interventions, teachers be given the knowledge packet beforehand so that they have some time to study it and the workshop time can be used in the most meaningful way.

Positive Changes in the Teacher's Enacted Teaching and Student Learning

Changes in Enacted Teaching

The teacher's task selection was better in the intervention condition than in the comparison condition. The teacher's task selection in the intervention condition was characterized by the use of more appropriate task sequences in Stages 1 to 3 of game development (Rink, 2012), while the teacher primarily utilized Stage 1 tasks in the comparison condition. The use of Stage 2 and 3 tasks in the intervention condition created a more continuous task progression toward more game-like contexts (Belka, 2004). Similarly, the teacher's quality of the instruction component of PCK was higher in the intervention condition than in the comparison condition. The teacher provided more complete demonstrations, more accurate and appropriate cues, and more congruent feedback; no differences were observed in the clarity of the task presentation because the teacher demonstrated clear task presentation 100% of the time in both conditions. The results from this study support other research with mostly older grade levels (Kim et al., 2018) and suggest that the teacher's changes in CCK and SCK after the content knowledge intervention were successfully translated into the teacher's actual teaching, PCK.

In those prior experimental studies, continuous coaching was provided to teachers after an intervention. In an attempt to have more social validity mirroring the real conditions of teachers, this study did not give follow-up feedback to the teacher. This study produced the first evidence that if the intervention was successful in changing a teacher's CCK and SCK, then a teacher can also improve their PCK without further support, which is more ecologically feasible in a real-life context and allows for the implementation of the intervention in a larger scale.

Changes in Student Learning

At the pretest, no statistically significant differences were detected between the two conditions in students' skill levels, indicating that the students from the two conditions were at a similar skill level prior to the tennis unit. In the comparison condition, there were no significant score changes from the pre- to posttest. This may be due to the biased use of Stage 1 tasks, which provided few opportunities

for students to learn critical elements of the forehand and backhand and practice those skills in more dynamic and game-like contexts, which are expected learning outcomes in fourth and fifth grades (SHAPE America, 2014).

In contrast, a statistically significant change from the pre- to posttest in tennis skill scores occurred in the intervention condition. Greater use of Stage 2 and 3 tasks in Rink's stages of game development, and appropriate sequences of those tasks to provide the students step-by-step learning experiences as discussed, which was the most notable differences in the two conditions, may have accounted for these results. Collectively, the changes seen among students were consistent with those in prior studies that have used similar content knowledge interventions to improve PCK of teachers and that resulted in subsequent improvement in student learning (Iserbyt et al., 2017; Sinelnikov et al., 2015; Ward et al., 2015).

Limitations

This study has four major limitations. First, while the CCK and SCK (excluding a content map) assessments were content validated, they were not validated through construct validity. Construct validity could not be secured because there are no other extant tests of CCK and SCK with which to compare the results. Future studies might use CCK and SCK tests validated by a Rasch analysis. Second, while this was a pilot study, the sample size for both the teacher analysis and the student analysis was small. Future studies can use larger sample sizes to enhance the generalizability of the study. Third, the use of a more extended unit (5 to 10 days) could promote greater student learning. While the 3-day unit may be ecologically valid, it is too short to assist students in learning more advanced content (i.e., Stage 3 tasks), as even the students in the intervention condition were only able to achieve 60% of the test score on average. Last, this study did not explore the retention of the intervention effect of the teacher's instruction. Future studies can analyze teachers' instruction after 6 months or longer to see if teachers still teach in the way that theytaught the intervention condition.

Conclusion

This study provides the first evidence in the line of content knowledge intervention studies in an upper elementary context. The

results demonstrate that the intervention is sufficient in developing teacher CCK and SCK, which can improve a teacher's PCK and correspondingly students' learning. Also, the study produces the first evidence of the efficacy of the framework of Rink's stages of game development. The use of Stage 2 and 3 tasks can assist students in meeting the expected learning outcomes in upper elementary levels.

Based on the findings, there are three recommendations for pre- and in-service teacher education programs. First, teacher education programs should focus on developing teachers' CCK and SCK, which could produce corresponding improvements to PCK. This is especially important because recent studies have found that K–12 physical education and extracurricular experiences spend too little time developing CCK and SCK (Tsuda et al., 2019; Ward et al., 2017). Second, teacher education programs should utilize instructional materials such as a knowledge packet to help teachers learn the appropriate content. Having this type of packet enables teachers to implement developmentally and principally appropriate tasks right away. Finally, teacher education programs should utilize evidence-based approaches to prepare teachers on how to teach games. Rink's (2012) stages of game development are one such approach that helps teachers to develop appropriate tasks and task sequences that produce student learning outcomes. In conclusion, the pilot study was successful in demonstrating the appropriateness of the research design and approaches for conducting a larger scale study.

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PEDAGOGY

Parent Perceptions of a College Physical Education Program for Homeschool Students

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Abstract

Although the number of homeschool students in the United States has increased to approximately 2 million K–12 students as of spring 2010, there has been limited research on homeschool families and physical education. In particular, investigations of parent perceptions of homeschool physical education programs are lacking. The purpose of this study was to examine the parent perceptions of a college physical education program for homeschool children. Participants included 11 female parents of a child or children enrolled in the homeschool physical education program for 6 weeks. Data were collected through focus group interviews with the 11 parents placed in one of three groups based on the age of their participant(s). In addition, observational field notes were taken before, during, and after each homeschool physical education session. Data were inductively analyzed for themes through constant comparison of raw data. Methodological and investigator triangulation and member checking were utilized and supported trustworthiness. Five main themes emerged from the data from the parent perceptions of physical education and benefits of participating in physical education. For physical education, homeschool parents described a developmentally appropriate curriculum. Further, the theme of negative physical education experiences describes poor physical activity experiences that have influenced parent perceptions of physical education. Homeschool parents recognized multiple benefits of

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physical education in relation to their children and to the family. At the student participation level, the theme of affective learning describes the social-emotional development experienced by the homeschool children through the physical education program. The theme of student exposure describes other participant benefits of a physical education program. Finally, the theme of impact on family describes the benefits associated with physical education taking place outside of the college physical education program.

The number of homeschool students in the United States has continued to increase in the last decade. As of 2016, an estimated 2.3 million children have been homeschooled, up from approximately 2 million K–12 students in spring 2010 (Ray, 2016). Homeschooling has become more accepted across demographic groups and for children with varying needs (Tingstrom, 2016). An estimated 32% of homeschool students belong to minority groups (Noel et al., 2013).

Parents decide to homeschool their children for a variety of reasons (Wachob, 2015). The ability to individualize the curriculum and learning environment for each child while using nontraditional pedagogical approaches were the most common reasons for the decision to homeschool (Ray, 2016). According to the 2016 National Household Education Surveys Program, 80% of parents with homeschool students indicated a concern about the environment of traditional schools (e.g., safety, drugs, or negative peer pressure) as a reason for homeschooling. Whether the reason for selecting homeschooling involves dissatisfaction with public school education, a desire to integrate religious instruction, or concerns for the public school environment, the outcomes of homeschooling students have been impressive. Homeschool students, irrespective of parental education or income, outperform public school students on standardized tests (Ray, 2016). Individuals who have been homeschooled are also likely to engage in community service and activism and to adopt parental values.

Regardless of the schooling environment, increases in learning and academic success have been linked to parental involvement (Anderson & Minke, 2007; Green & Walker, 2007; Na, 2015). Parental involvement not only benefits students academically but has also been tied to physical activity participation (Leung et al., 2017; Lim & Biddle, 2012; Zecevic et al., 2010). When parents indicate enjoyment

and support children in physical activity, children are more likely to be physically active (Zecevic et al., 2010). However, physical activity participation and fitness levels of homeschool children may be low despite positive parental attitudes toward fitness (McKethan et al., 2010; Swenson et al., 2016).

Homeschool children and families have been described as an "understudied population" (Swenson et al., 2016, Future Research Direction section, para. 1). Parents of homeschool children are heavily involved with daily decision-making about education, including time spent in physical education (PE). Further research on homeschool parent perceptions of PE is warranted. Homeschool parent perceptions may influence support, including logistical support via driving children to programming and providing necessary resources, which influences participation (Myrold & Ullrich-French, 2017).

Parents may rely on personal childhood experiences and anecdotal commentary from children because of lack of firsthand experience with current PE programs (Sheehy, 2011). Thus, perceptions of PE may be inaccurate, incomplete, and inclusive of assumptions, with parents placing an emphasis on play rather than learning (Na, 2015). Although parents may perceive PE as less beneficial than participation in youth sport (Na, 2015; Neely & Holt, 2014), they have recognized the importance of some outcome goals for the PE curriculum. Na (2015) mentioned parent-identified goals in PE such as learning life skills, having time to play, and health promotion. The findings of Sheehy (1993) and Na (2015) demonstrate parent perceptions of current PE practices. Exposing parents more directly to current K–12 PE practices may be beneficial in addressing misperceptions and in shifting toward more positive perceptions of PE (Sheehy, 2011). Given the role of parents in parent teacher associations and local government, K–12 policies and funding for PE can be negatively affected and the content may be further marginalized without a greater understanding and appreciation of PE (Sheehy, 2011). Investigation of parent perceptions of a college PE program for homeschool children may allow researchers to make recommendations that support the advocacy of PE.

In a push to promote quality PE, legislation has been written to define and recommend policies regarding PE (An Act to Promote Quality Physical Education, 2017; Every Student Succeeds Act, 2015).

Senate Bill 297 (An Act to Promote Quality Physical Education, 2017) includes mandates for PE for all grades to be taught by certified physical educators and for PE to focus on "physical competence, health-related fitness and enjoyment of physical activity" (p. 3). Parents of homeschool students have reportedly attempted to meet physical activity demands through a variety of programming such as local recreation programs, church programs, or home-designed programs (McKethan et al., 2000). Although state and national legislation has set expectations for quality PE in public schools, the requirements for the homeschool population have not been defined.

Some colleges and universities with PE teacher education (PETE) programs have begun to offer PE programs for homeschool children (Everhart, 1998; Everhart & McKethan, 2004; Kane, 2016; Swenson et al., 2016; Tingstrom, 2016; Wachob, 2015). The benefits of such programs are multifaceted in nature: PETE programs gain exposure in the community, preservice teachers develop teaching skills and an understanding of varied needs of children, and homeschool children have access to quality PE and may increase physical activity participation (Everhart, 1998; Everhart & McKethan, 2004; Swenson et al., 2016; Tingstrom, 2016; Wachob, 2015). Parents have reported the experience as valuable for the children in engaging within the community and for psychomotor and affective development and lifelong physical fitness (Everhart, 1998; Tingstrom, 2016). While parents of students in public school have limited opportunities to learn about K–12 PE programs, parents who enroll their homeschool children in college PE programs often directly observe lessons and engage in subsequent dialogue with children. Given the opportunity to observe and discuss, parents of homeschool children may be in a better position than parents of children in public school to provide a more accurate and in-depth assessment of PE curricula and instructional strategies.

As the practice of homeschooling in the United States increases, coupled with faulty perceptions of PE among public school parents, research needs to focus on better understanding perceptions of parents who observe a college PE program for homeschool children. The unique perspective of homeschool parents may provide insight into parent expectations and perceptions of PE, given more knowledge and experience. In particular, an instrumental case

study design would be appropriate for the investigation of such a unique situation. Instrumental case study design can provide meaning and understanding of a phenomenon within a bounded system (Merriam, 2009). An instrumental case study allows for exploration of a topic, with the case used as a secondary interest in refining a theory (Baxter & Jack, 2008). Observations and detailed logs allow for further understand of individuals and the overarching theory.

The purpose of this study was to examine the perceptions of homeschool parents pertaining to PE and a homeschool PE program facilitated at a college. The research questions that guided the study included What are the perceptions of PE from the perspective of a homeschool parent? What benefits do parents perceive for their children in participating in a college PE program?

Method

Participants and Setting

Participants in this study were 16 parents sending their children to a PE program for homeschool students at a local college in Western Massachusetts. The college PE program for homeschool students, being offered by a college with a PETE program, was in its fifth year of existence. Parents transported their children to the classes and remained in the fieldhouse where they could utilize the indoor track, socialize with other parents, and observe the PE classes.

Families that were homeschooling children in the surrounding area were invited to enroll children to engage in a weekly 70-min PE lesson. Lessons were planned and taught by preservice teachers (PSTs) based on a curriculum developed by the program directors, including the department chair, faculty, and graduate teaching fellows. All PSTs were enrolled in the PETE program. Some PSTs were teaching the homeschool children within lab sessions for elementary and secondary methods courses, while others were gaining teaching experience through work study. The ratio of homeschool student to PSTs averaged out to be 23:2 per age group.

The homeschool children were separated into three groups by age, with each group being taught in a separate space the size of an official basketball court. Curriculum content for the 5–7 and 8–11 age groups consists of a Skill Themes and Movement Concepts approach, as well as cooperative games and rhythmic activities. The

12-and-up group receives instruction in team, dual, and individual sports. The PSTs prepare and implement content into 6-week units. The college PE program for homeschool students runs for 12 weeks each semester.

Data Collection

Data collection methods included observation and focus group interviews. Field notes based on observations in relation to behaviors and interactions of participants and their children, the setting, and documents were recorded at six sessions. Field notes supplemented the focus group interviews and used for triangulation of data from other sources. Focus groups were organized by the age groups of the children (5–7, 8–11, 12 and up). Questions used for the focus group interviews were modified from the Sheehy (1993) case study. Prevalidation of questions was performed, followed by bracketing.

Data Analyses and Trustworthiness

Data analyses commenced with verbatim transcription of field notes and focus group interviews. Pseudonyms were inserted for all individuals, places, and institutions. The 11 parents were assigned to one of three focus groups. Participants were all female. Data were inductively analyzed for themes through constant comparison of raw data (Strauss & Corbin, 1986). Methodological and investigator triangulation and member checking were utilized and supported trustworthiness. The research questions were addressed through methodological triangulation with data collected via observations and focus group interviews. Investigator triangulation involved independent analyses of the data by Steven W. Groccia, Michelle E. Moosbrugger, and Kevin M. Mirando followed by discussion and further analyses. For member checking, participants were provided transcripts of the focus group interviews and were requested to review and report any discrepancies or additions.

Results

Five main themes emerged from the data for homeschool parent perceptions of PE and benefits of participating in PE. For PE, homeschool parents described a developmentally appropriate curriculum. Further, the theme of negative physical education experiences describes poor physical activity experiences that have influenced

parent perceptions of PE. Homeschool parents recognized multiple benefits of PE in relation to their children and to the family. At the student participation level, the theme of affective learning describes the social-emotional development experienced by the homeschool children through the PE program. The theme of student exposure describes other participant benefits of a PE program. Finally, the theme of impact on family describes the benefits associated with PE taking place outside of the college PE program. Direct quotations are provided for each category and show the interrelatedness among categories.

A Developmentally Appropriate Curriculum

When discussing PE, all participants associated specific activities with positive experiences from PE. Fitness, motor skills, and sport skills were described as central to PE. Movement and exposure to a variety of activities were purposefully selected and implemented within the program, which ties to the desired outcome of lifelong healthful physical activity of both the parent and the college PE program. A mother with two children in the oldest age group (12 and older) described PE:

> Physical education to me is being physically fit in the sense that the body is healthy, the heart is healthy, the muscles are able to do everyday tasks and maybe a little beyond that. Um, flexibility is there so they don't get hurt doing everyday things, and again, a little over that. . . . mental health as well to me. I feel that physical fitness helps you mentally, so I feel like those just work together.

Another mother of two students in the oldest age group, but from a different focus group interview, echoed educating for lifelong physical activity:

> [The college physical education program does] very well in this class not just teaching sports and teaching competition or engaging competition but really teaching the healthy part of being physically active. . . . Because it is being physically active and being healthy, and even healthy competition is a very necessary life skill that I believe is too often overlooked.

Parents with homeschool children in the younger age groups also recognized the PE curriculum. A mother with a child in each of the college program's three age groups described the developmentally appropriate curriculum:

> I think one of the things that I like is breaking down the skills, like you do here, but you know when they go play a sport, it's a sport, it's a game, it's how to play it. But, breaking it down into throwing a ball, and kicking in those smaller gross motor skills that then build up to the game or to the bigger sports.

Homeschool children in the college PE program were exposed to a variety of motor skill, sport skill, and physical activity opportunities through the curriculum. Parents viewed the PE curriculum as a means of promoting healthy behaviors in their homeschool children, and child participation in the college PE program was key to the development of the skills necessary for lifelong physical activity.

Negative Physical Education Experiences

The focus group participants desired for their children to live healthy lives and believed purposeful PE to be one way of working toward lifelong physical activity. The homeschool parents were clear on what they felt "purposeful" PE was, but they often contrasted the desired outcomes with negative PE experiences. A mother with two children in the youngest age group recalled,

> I think when I was in PE it was all about, like, dodgeball, and the one activity we're doing today. And I didn't really think about [physical education] in terms of, like, my life. And I think one of the things that I would like to see in phys. ed, and I think you do a good job here, is teaching them that it's a lifelong skill of physical activity, um, that's the goal. Not just knocking somebody out in dodgeball, you know our goal is to promote wellness and fitness, and cardiovascular health.

Multiple focus group participants described negative experiences associated with PE programs in public schools. Lack of organization and student safety were two areas of concern for the parents. A

parent of two children described the lack of organization in public school PE:

> One of the biggest complaints from my son, who is the older one, uh, when he was in fourth grade, um, one of his biggest complaints was that they didn't do physical education. That most of the time was spent sitting, working in a workbook on health. . . . There was too much sitting and too much focus on other things.

Another instance of a lack of organization in public school PE stemmed from the size of the class. One mother spoke of a personal experience as a substitute PE teacher:

> I've actually worked as a substitute gym teacher before too, and my kids have been in public school. Sometimes it's hard to control the kids depending on what population you work with. And there's so many kids. . . . It's just sometimes [the teachers are] overwhelmed with so many kids, and that's part of why they give them health work to do because when you have 40 kids and some of them don't listen, or a lot of them won't listen, it's just, it can be like pandemonium.

When describing negative PE experiences, the parents said that large class sizes not only affect classroom organization but also present a safety issue.

The size of a class in PE classes, public or homeschool, was identified as a safety concern for the homeschool parents. One mother described a space issue for the oldest group attending the college PE program for homeschool children: "I know for the bigger kids, the space sometimes when they're playing the games is not enough. They feel like they might hit into each other." Another parent linked her son's negative experience in public school PE to large class sizes. The homeschool mother stated,

> I think [the college physical education program is] really well organized too. My older son when he was in seventh grade in public school last year broke his arm during gym. And the gym teacher didn't notice for 15 minutes that his arm was broken. So, I like the fact that the [preservice teachers] here

> really watch what people are doing, and they're really safe. . . . I think it's really important for gym teachers in general. The safety issue. Because I found that especially in public schools, sometimes they're not really watching. They only have one person, and um, kids get out of control.

Parents identified access to another college PE program for homeschool children in the local area. Both college PE programs are taught with preservice teachers from the PETE programs from the institution supporting the program. One mother compared the two programs, stating, "It is rather early, and it's actually not as well organized, I think as this program." Another stated,

> The student teachers didn't seem to have as much of a plan to keep the kids busy or I don't know, I just didn't feel—not just the safety, but the whole thing as a whole didn't seem put together as well as it is here.

Parents were supportive of the PE curriculum and felt the college PE program encouraged their children to be physically active. They perceived lifelong physical activity as a major objective for PE and identified organization and safety as important pieces crucial to quality PE. In addition to the perceptions of PE, parents perceived specific benefits for their homeschool child's participation in a college PE program.

Affective Learning

Participants shared the benefits they perceived for their homeschool children participating in a college PE program. Child participation in the college PE program directly influenced the psychomotor domain, with children being physically engaged within each lesson of the program. However, participants consistently recognized growth in their homeschool child's social and emotional development as a benefit of participation in the college PE program.

Homeschool parents discussed the importance of increasing social awareness in their children and the use of PE as a vehicle for growth in all three learning domains. A mother shared how the college PE program provided her homeschool children with a sense of normalcy:

> I also like that, that my kids, my kids have a lot of opportunity to be around other kids, but it's nice that I can justify this because they are learning at the same time. And they're exposed to larger groups of kids their age and similar ages. And other kids that are homeschool. . . . but it's nice to have some homeschool-centered activities so that they don't feel like 'I'm the only homeschool kid in this room.'

Another parent echoed how being involved in the program has furthered her son's social development:

> It's helped with being part of a group and having to pay attention to something outside of himself like he, uh, he's not the only one in the area. He has to realize that his actions affect every other kid that he's doing things with, for better or worse. So, more awareness.

Additionally, participants recognized the importance for children to be exposed to a variety of learning environments. A mother of two children stated,

> I know that they gained some socialization skills and benefited from the teachers' interaction with them. . . . Um, they naturally get used to having one teacher unless they belong to a co-op or something. Um, so it's good to have other teachers teaching them in their own styles.

For the homeschool students, participation in the college PE program was key to developing friendships and interacting with other children and adults.

Exposure

When discussing the college PE program for homeschool children, parents reported that their children's exposure to a variety of PE activities had positive benefits outside of the school setting. From a physical standpoint, being exposed to a variety of physical activity and sport skills has led the homeschool students to learn about self-awareness. One mother described how exposure has affected her two children in the youngest age group:

> Exposing kids to activities that they might not choose to do themselves. I know our kids all have their certain things they like to do, but, um, you know, my kids don't like to play catch, for example, my girls that are in this program, they wouldn't choose to do that. However, here, they work on those skills as part of it, and then they see that it's kind of fun and then they'll choose to do that at home. So I think that an introduction of skills that they wouldn't choose to work on their own is something that I've noticed.

In reference to the benefits of being physically educated, a mother simply stated, "I also think it's a good way to realize where their strengths and weaknesses are too, because sometimes they might be good at one thing and the other week they are struggling."

Parents felt encouraged that their homeschool children were being exposed to a variety of new activities in the college PE program. The exposure has led to an increase in physical activity in their homeschool children outside of the college program. Multiple participants described how a team handball unit led to various engagement at home among their children: "I know they learned the rules of handball. . . . So, they've never been exposed to that before. So, now, they know how to play it and they actually play it at other places too, parks." Another member of the focus group followed up, stating, "The handball, especially, they had never heard of handball before. And they were talking—my, both of my kids were talking—about, um, the rules at home. And, discussing what's allowed and what's not allowed [laughs]." Despite not having "a ball for it," the second participant indicated her children would like to participate in team handball outside of the program. This was echoed by a mother of six taking part in a different focus group. She stated,

> One of the benefits is the exposure to things that I couldn't have given them like lacrosse. Um, and I mean they got—they got a lot of interest in that to the point that they wanted to buy lacrosse sticks after. Playing in the backyard. But, I'd say they're more physically fit.

From exploring personal strengths and weaknesses to bringing new content home, exposure to new movement opportunities was

perceived by parents as a benefit of participation in the college PE program.

Impact on Family

Homeschool child participation in the college PE program directly influenced the families at home. When parents reported their children's physical activity completed at home, their responses were consistent with most children increasing their physical activity outside of the program. Parents described their children discussing, and when possible, performing, the activities being taught to them in the college PE program. Parents also discussed the socialization process of younger children watching their older siblings participating in the college PE program.

Parents chose to enroll their homeschool children in the college PE program and wanted their children to be physically active outside of it. Parents described an increase in discussions around physical activity among family members. A mother of six described the influence of the homeschool program at home:

> Playing in the backyard. . . . I'd say they are more physically fit. . . . But in all, [I think it's helped them become more, like, physically fit] and also it's given them like a love for these things that they want to, like, do them at home. You know, they bring it home and they do it, and since there's a big group of them, they can play it at home too, so it's good.

When reporting the benefits of the college PE program, participation in PE influenced the frequency of family physical activity. In reference to increased family physical activity, a mother described how she and her 11-year-old son are active together:

> Like, [the college PE program] has kind of set up that, that precedent. Because the hikes and stuff were just for mom, but this, like, he gets it. . . . And it helps us get up in the morning because we're not out-of-the-door-early people.

Another mother of two described an increase in communication between father and son:

> But, I've noticed they talk a little bit more about sports because he'll—my son—will now go and tell [his father] about some sport they're learning, and they can kind of engage that way a little bit more now. So, that's nice for my husband… that's just a nice little additional thing that has come out of [the college PE program].

Parents discussed how the environment of the college PE program created a socialization process for younger siblings. The program is situated inside of a collegiate fieldhouse with four full-size basketball courts inside of a track. See-through dividers enclose the teaching spaces while allowing families to observe all aspects of a lesson. Toddlers observe their siblings from the outside, frequently mimicking the skill themes and movement patterns being taught. A mother of four described the socialization process:

> I see that [watching and mimicking] in my four-year-old being close to developmentally ready. And now I see her trying, you know, you know at the edge of the class watching everybody, really being interested. And I feel like just observing . . . you can see into the nets—really helps prepare the little ones as well.

Parents perceived the college program to be beneficial not solely to the children engaged in the physical education lessons but also to the family as a whole.

Discussion

The research served to inform about homeschool parent perceptions of PE and their perceived benefits of PE. Parents of homeschool children recognized the importance of PE and believed developmentally appropriate PE to be a stepping stone to a physically active lifestyle. Participant descriptions of the college PE program for homeschool children revealed positive social interactions among their children. Further, child participation in the college PE program dispelled any negative thoughts or experiences of PE perceived by the parents (Na, 2015; Sheehy, 2011). Purposeful PE may increase social skills and positively increase physical activity in homeschool students while affecting the overall perception of PE.

Participants identified benefits to participation in a college PE program for homeschool students. At the individual level, the college PE program exposed the homeschool children to a variety of movement and motor skills that they may or may not have engaged in. Parent participants appreciated their children stretching their "physical" comfort zones and were encouraged to see their children actively bringing home activities learned at the college program. Whether practicing new skills, teaching and playing sports to friends, or discussing rules and games, the benefits of a PE program for homeschool students were highlighted by the participants.

The study served to address the gaps in the literature pertaining to parent perceptions and benefits of a college PE program for homeschool students. Findings indicate that homeschool students and their families are positively influenced by purposeful PE programming. Participant comments indicate that a college PE program can encourage homeschool children to pursue physical activity outside of the program and can challenge their physical and social comfort zones. These PE experiences positively affect families and encourage the pursuit of a physically active lifestyle. The reflections of the parents of homeschool children participating in a college PE program show the field of PE in a positive light.

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POINT OF VIEW

Will Dodgeball Ever Die? Former K–12 Students' Experiences and Perceptions of Playing Dodgeball in PE Class

David C. Barney and Keven A. Prusak

Abstract

When discussing the game of dodgeball, people usually discuss it with fond memories and excitement for the thrill that came from the game. Then there were those who strongly disliked it for reasons that it was embarrassing, hurtful, and just not fun. The game of dodgeball has been played by many students in their physical education (PE) classes, for better and for worse. The purpose of this study was to better understand the perceptions, experiences, and opinions of recently former K–12 students toward dodgeball in PE. The results of the study indicate that generally males more than females view dodgeball as appropriate and competitive.

For many, perhaps most, students who participated in K–12 physical education (PE), the following scenario likely played itself out, beginning with the teacher announcing,

> "Today, we are going to play dodgeball. There will be two teams and eight balls. If you get hit by a thrown ball, off you go to the sidelines until the last player is standing."

While rules vary, generally students are divided into two teams with the balls placed at midcourt, the whistle blows, and the game

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begins. Students rush forward, retrieve a ball, and throw it at opposing players in hopes of eliminating them. Some—often the most athletic, early-maturing students—are having the time of their lives. They dodge, jump, and duck to avoid being hit by an opponent's ball. Some, cleverly, use a retrieved ball to fend off thrown balls. The very confident, brave, or foolish stand in the open, daring the opposition to take their best shot. You see, if they catch the ball, the thrower is eliminated. Players from both sides get hit on the arms, legs, torso, groin, or a full-facial! Ouch! Some are hit so hard that they are knocked off their feet.

If a player is struck with a thrown ball, they move to the sidelines, relegated to spectator status. Some teachers allow players to be recycled if, for example, a thrown ball is caught. The game is exciting, energetic, and athletic. Often the sense of self-preservation provides students with the motivation to run, dodge, leap, zig and zag, and throw and catch, all while raising heart rates (as high as 150 bpm; Strand et al., 1997)—all desirable outcomes for PE students. What a game! Who would *not* love this game?

As it turns out, many students do not like this game, going so far as to employ avoidance strategies. Some move quickly to the middle ground, sacrificing themselves to the first ball that sends them to the sidelines. Others hide near the far wall, hoping to hide in plain sight or at least dodge the longer throws. Eventually, they are struck and sent to the sidelines where they, along with the early sacrificial players, happily stand, doing nothing as the game proceeds. "It is better than getting pelted," they reason. For them, dodgeball is not an enjoyable PE experience. Nonetheless, for good or bad, dodgeball has been and continues to be a PE standard.

The cumulative effects of negative dodgeball experiences led the National Association for Sport and Physical Education (NASPE, 2006) to release a position statement specific to the *appropriateness* of dodgeball in PE:

> NASPE believes that dodgeball is *not an appropriate* [emphasis added] activity for K–12 school physical education programs. The purpose of physical education is to provide students with: the knowledge, skills, and confidence needed to be physically active for a lifetime. A daily dose of physical activity for health benefits. *Positive experiences* so that kids

> want to be physically active outside of physical education class and throughout their lifetime. (p. 1)

NASPE has created three consensus statements outlining *appropriate* and *inappropriate* instructional practices with the intent to guide physical educators in elementary (2009a), middle school (2009b), and high school (2009c) PE and to "address key aspects of instructional strategies and practices that are essential to delivery of quality physical education to children, adolescents and young adults" (NASPE, 2009, p. 3). Appropriate practices include "Activities are selected carefully to ensure that they match students' ability levels and are *safe* [emphasis added] for all students, regardless of ability" (NASPE, 2009b, p. 3) Inappropriate practices include "Human-target games (dodgeball) and/or drills that allow aggressive behavior toward other students" (NASPE, 2009c, p. 11). In all three of these documents, dodgeball is considered an *inappropriate instructional practice at all levels*. On its face, dodgeball is an elimination game where the least capable players get eliminated quickly, while the most gifted players get all the play time—a case of the rich getting richer? Those who need the repetition and refinement to gain skill and the physical activity to produce health benefits are sitting on the sidelines. All things considered, there seems to be little to recommend dodgeball in the public schools. Indeed, dodgeball has earned an ignominious place on the PE Hall of Shame (Williams, 1992).

These NASPE consensus statements have afforded Barney and his colleagues the opportunity to investigate knowledge of instructional practices in K–12 PE across a variety of populations. For example, Barney and Pleban (2010) investigated parents' knowledge of appropriate instructional practices in elementary PE. Parents were surveyed and asked to identify the appropriateness of common instructional practices, including dodgeball. Parents misidentified as appropriate the following statement: "Teachers may use activities such as relays, dodgeball, and elimination tag since they provide opportunities for everyone in the class." Surprisingly, 84% of the parents felt dodgeball was an appropriate practice in elementary PE. The researchers surmised that if parents were to recall their PE experience—positively or negatively— dodgeball would probably be *the* activity that defined their PE experience. Similarly, 75% of school administrators (Barney & Prusak, 2016) misidentified dodgeball as

appropriate for K–12 PE. Some administrators did, however, place certain conditions on the practice. One principal stated, "Dodgeball is fine to play, if done correctly . . . if it is played with soft balls . . . [and] . . . played occasionally, not all the time." As for the students, Barney and Christenson (2014) surveyed third- to fifth-grade students and 87% of males and 68% of females felt dodgeball is an appropriate activity for PE class.

These studies illustrate that dodgeball is not only commonplace in virtually everyone's PE experience but is also deeply engrained across all segments of society—almost a given, something not even to be questioned. Curiously, it seems to be a highlight of the PE experience. Other names for dodgeball including "murderball," "warball," "killerball," and "poisonball" (Crockett, 2014) provide a perverse sense of eagerness toward the game. Further, dodgeball jargon such as "headshot," "kill ratio," "hit," and "shooting" (Fagogenis, 2010) brings into question how the game or its verbiage could possibly be considered appropriate.

On the other hand, there seems to be staunch support by the majority of former and current participants cautioning against overlooking the merits of the game. After all, the embattled PE game has spawned recreational (a popular spinoff game is played on a surface of trampolines; Sky Zone, 2019) and professional leagues and movies (Cooper et al., 2007).

Although limited, research does exist that presents dodgeball in a more favorable light. Thinking to convince a local teacher why dodgeball should not be included in PE (limited student engagement and resultant lack of cardiovascular fitness), Strand et al. (1997) used heart rate telemetry to investigate. Over 4 days, three classes of seventh-grade male students wore heart rate monitors as they played a version of dodgeball called "Road Warrior." The first day 10 balls were used; the second day, 15 balls; the third day, 20 balls; and the fourth day, 25 balls. One of the findings from this study was that one class averaged over 140 bpm for 17 min of class time. The other two class periods had similar results. Interestingly, 45% of the students had lower beats per minute when participating in a fitness run during class. Strand et al. concluded that although activity rates did not suffer (as they had supposed), the chance of injury must be weighed carefully in the decision to include dodgeball.

Another population with a vested interest in this debate is K–12 physical educators. The *Journal of Physical Education, Recreation and Dance* ("Is There a Place," 2001), posed the question, "Is there a place for dodgeball in physical education?" soliciting input from the teachers themselves. A female participant stated,

"As someone who enjoyed dodgeball as a kid, I believe that there is a place for this game in physical education. Dodgeball is a great way for students to enjoy participating in physical education while learning a variety of movement skills" (p. 18). Another K–12 PE teacher stated, "I graduated college with the notion that dodgeball was not an acceptable activity in physical education. However, I now believe that with modifications, dodgeball can be both an effective and fun activity for all students" (p. 19). Another K–12 PE teacher said,

> Safety is the first issue that needs to be addressed in the game. The equipment used should be such that the chance for injury is decreased . . . In my opinion, the advantages of the game outweigh the disadvantages. If students are instructed and supervised properly, the game can be beneficial to a physical education program, not to mention fun. (p. 20)

For the past two decades, the debate over dodgeball has raged on. At its core, the issue revolves around the rationale of playing human-target games, primarily for safety reasons. But the popularity of the activity is undeniable. Teachers seem to have made modifications (e.g., equipment, object-targets, role variation to avoid being a human target if students wish, and additional recycling strategies) to reduce unnecessary risk and to take full advantage of the high levels of physical activity. As with any debate, there seem to be arguments both for and against dodgeball. Thus, in a time when positions statements (NASPE, 2006) have largely condemned dodgeball, it seems as popular as ever.

On one side, parents, students, administrators, and PE teachers give at least tacit approval, while, on the other, researchers and NASPE condemn the practice. We do not take a philosophical stand for or against the practice. Although the majority of previous populations studied seem to endorse dodgeball, we wonder about the minority who do not. We also wonder about those who grew up in

this time of mixed messages with respect to dodgeball. Therefore, the purpose of this study was to better understand the perceptions, experiences, and opinions of recently former K–12 students toward dodgeball in PE.

Method

Participants

A convenience sample of 239 college students (113 males, 126 females) from a private university in the western United States participated in the study. Participants for this study were enrolled in five university physical activity classes (basketball, bowling, volleyball, weight training, and Zumba). Each participant received, signed, and returned a letter of informed consent and university IRB approval was granted.

Instrumentation

Based on the literature dealing with dodgeball, we developed eight statements (see Table 1), assessed on a 5-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, and 5 = *strongly agree*). Additionally, students were asked to provide reasons for their answers on each statement. Two survey questions asked about the participants' experience with dodgeball. One survey question was open-ended. The concluding section of the survey addressed demographics. To establish content validity, we asked four college students and two PETE faculty to read through the survey questions, to ensure clarity and understanding of the instrument for the intended population. Further, the survey was pilot tested on 10 nonparticipant college students and was found suitable to its proposed purposes.

Procedures

We sought and attained permission from university, IRB, the department supervisor, and the individual course instructors to recruit students for this study. We attended each physical activity class, explained the purpose of the study, collected signed letters of informed consent, and administered the 10-min survey to the 263 students who participated in this study. Ninety-eight percent of the students agreed to participate in the study. All students were assured that

Table 1
Eight Items to Assess Perceptions of Dodgeball in Physical Education

The following survey questions will ask you about experiences with dodgeball in your K–12 physical education classes. Questions will ask you to circle and respond from your experiences with dodgeball in your K–12 PE. Thank you for participating in this survey.

1. Where did you first learn to play dodgeball?
   a. PE class
   b. Afterschool
   c. Playground
   d. Recreation center
   e. Other (specify)
2. How often did you play dodgeball?
   a. Daily
   b. Weekly
   c. Twice monthly
   d. Monthly
   e. Less than once per month

Use the following scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*) for the next four questions:

3. Dodgeball is an appropriate game for physical education
   Please explain you answer:
4. Dodgeball doesn't allow for the less-skilled kids to get better.
   Please explain you answer:
5. Dodgeball is an inappropriate game for physical education
   Please explain you answer:
6. Dodgeball is a form of bullying.
   Please explain you answer:
7. Dodgeball is an appropriate game for co-ed PE classes.
   Please explain you answer:
8. Based on your experience with dodgeball, has it had a *positive* or *negative* effect on your physical activity choices and habits.
   Please explain you answer:

their voluntary decision to participate or not to participate in the study would not affect their grade or standing in the class.

Quantitative Data Analysis

Response frequencies; means and standard deviations (see Table 2); correlations (see Table 3); and tests for normality, effects sizes, and between gender differences (see Table 2) were calculated for each of the nominal variables.

Table 2
Means, Standard Deviations, and Effect Sizes

	N = 239		*M*		*SD*		
Question	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	η^2
Q3: appropriate	113	126	4.04***	3.25	.97	.93	.15
Total	239		3.62		1.03		--
Q4: affects skills	113	126	2.60***	3.22	1.0	1.1	.09
Total	239		2.93		1.06		--
Q5: inappropriate	113	126	2.12***	2.75	.91	.94	.10
Total	239		2.45		.98		--
Q6: bullying	113	126	2.18***	2.82	.97	.88	.11
Total	239		2.51		.97		--
Q7: co-ed OK	113	126	3.59***	3.18	.96	1.11	.04
Total	239		3.38		1.06		--

Note. Questions 3 and 5 (in boxes) asked the same question in opposite directions (i.e., dodgeball is *appropriate* [Q3] or *inappropriate* [Q5]) and yielded nearly identical results.

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

Open-Ended Responses

Open-ended questions asking for participants to provide reasons for answering the survey question as they had were compiled, transcribed, and content-analyzed and offered as anecdotal, supplementary evidence only.

Table 3
Pearson Correlations

Question	Q2	Q3	Q4	Q5	Q6	Q7	Gender
Q2: how often		-.199**	.150*	.202**	.079	-.135*	.106
Q3: appropriate			-.451**	-.507**	-.386**	4.98**	-.390**
Q4: affects skills				.440**	.403**	-.336**	.294**
Q5: inappropriate					.437**	-.374**	-.317**
Q6: bullying						-.318	.329
Q7: co-ed OK							-.193**
Gender							

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

Results

Quantitative Results

Frequency Analysis

Results revealed that, by in large, dodgeball is contextually a PE phenomenon with 74.5% of participants reporting that they first learned to play the game in PE. The remaining 25.5% were introduced to the game in after-school, playground, recreational, or other settings. Thus, it can be surmised that the majority of perceptions toward the game can be linked most prominently to PE classes. Next, participants reported having played dodgeball daily (1%), weekly (23%), twice monthly (28%), monthly (19%), and less than once per month (30%).

With respect to the appropriateness of dodgeball, Questions 3 and 5 (asked in opposite directions) revealed consistent results. Fifty-nine percent (39% *agree*, 20% *strongly agree*) of all participants reported that they considered dodgeball as an appropriate activity for PE.

Question 4 addressed the proposition that dodgeball would lead to students with lesser skills to be eliminated early or, perhaps, by choice would be denied skill-building opportunities. Results revealed that students were equally split (7.5% *strongly disagree*, 33% *disagree*, 22.2% *neutral*, 34% *agree*, and 3.8% *strongly agree*).

A current concern with respect to all forms of bullying prompted us to consider if the aggressive nature of dodgeball might lead to bullying smaller, lesser skilled individuals within gameplay. Forty-eight percent of the participants (17% *strongly disagree*, 14% *disagree*, 37% *neutral*, 14% *agree*, and 1% *strongly agree*) that dodgeball might be a form of bullying.

Descriptive Statistics Analysis

Data were examined and found to be normal (r_{skewness} = .08–1.30, r_{kurtosis} = .33–1.5). Means, standard deviations, effect sizes, and Pearson correlations were calculated for each of the nominal questions and compared across genders. Overall means indicated that (a) participants agreed that dodgeball was appropriate for PE (Q3&5: M = 3.62), (b) disagreed that dodgeball led to less skill acquisition

(Q4: $M = 2.60$), (c) disagreed that dodgeball was a form of bullying (Q6: $M = 2.51$), and (d) agreed that co-ed dodgeball was appropriate (Q7: $M = 3.38$). However, no mean score was decidedly *strongly agree* or *strongly disagree*. Rather, means reflected scores slightly above or below a neutral response (i.e., a score of 3) with the exception of males (Q3: $M = 4.04$).

Correlational analysis (see Table 3) revealed that (a) the more often students played, the more appropriate dodgeball became ($r = -.199$); (b) the more appropriate the students felt dodgeball to be, the less they thought it affected skills ($r = -.451$); (c) the more appropriate the students felt dodgeball to be, the less they considered it to be a form of bullying ($r = -.386$); (d) the more appropriate the students felt dodgeball to be, the more they thought it appropriate for co-ed participation ($r = .498$).

Comparison tests (see Table 2) revealed significant (Bonferroni adjusted, $p < .0125$) gender effects. Females (a) considered dodgeball to be significantly less appropriate than did males, Q3: $F(1, 237) = 42.40$, $p < .000$; Q5: $F(1, 237)$, $p < .000$; (b) were significantly more likely than males to say that dodgeball adversely affects skill acquisition, Q4: $F(1, 237) = 22.38$, $p < .000$; (c) were significantly more likely than males to consider dodgeball as a form or bullying, but still generally disagreed that it did, Q6: $F(1, 237) = 28.78$, $p < .000$; and (d) were less likley than males to consider dodgeball to be an appropriate co-ed game, Q7: $F(1, 237) = 9.21$, $p < .01$.

Open-Ended Responses Results

Questions 3 and 5

Participants provided additional insight for the reasons they answered Questions 3 to 8 as they did. In response to the appropriateness of dodgeball in PE, they gave the following comments:

> To many who like PE it was a blast, but if you were shy, not athletically inclined, or had not friends in the class, it was horrible. (Student 1)

> As much as I like it, I think most of the time at least one student comes out unhappy. (Student 2)

It's not inherently inappropriate but can become a form of bullying if unchecked. (Student 3)

I feel that it doesn't teach students anything. But it is a fun game. (Student 4)

Question 4

When asked if dodgeball does not allow for the less-skilled players to get better, participants responses included the following:

Kids who have confidence do very well; however, this game knocks out kids that don't have much activity immediately eliminating further activity . . . Mostly the dominant players take over the game. (Student 5)

I never improved because I would get hit as soon as I got back in the game. (Student 6)

Dodgeball doesn't teach physical skills and isn't enjoyable for many people, especially girls. (Student 7)

Question 6

Participants were asked if dodgeball is a form of bullying. Student responses for this statement included the following:

When I got older, kids would use it to pelt kids they didn't like or make fun of those that were weaker. (Student 8)

While I love the game, sometimes kids will pick on others. This happens in other sports as well. (Student 9)

It can be [a form of bullying]. Media has painted it as such so those stereotypes are fulfilled in reality. (Student 10)

Question 7

Participants were asked if dodgeball is appropriate for co-ed PE. Responses included the following:

> Guys throw much harder than girls, it makes most girls feel weak or helpless even if they aren't in the other sports. (Student 10)

> Boys have a big advantage usually they can throw the ball a lot harder. (Student 11)

> It isn't very fun for most girls, who get out very quickly and generally can't throw as well as males. It is frustrating as a girl. (Student 12)

> Boys hit harder (: (Student 13)

Question 8

Finally, participants were asked if their experiences playing dodgeball in PE class had a positive or negative effect on their physical activity choices and habits. Interestingly, both positive and negative responses were represented including the following:

> It's fun and gets people active but doesn't teach things like staying active on your own. (Student 14)

> I did not enjoy dodgeball in elementary school and so I pursued other sports, which led me to running in high school. (Student 15)

> It made me not look forward to PE class. I avoided physical activity for some time. (Student 16)

Discussion

The purpose of this study was to better understand the perceptions, experiences, and opinions of recently former K–12 students toward dodgeball in PE. It was generally found that dodgeball holds more appeal to males than females. From the male perspective for this study, they felt that dodgeball allowed them to show off their athleticism. Female statements such as the "guys throw harder than girls and it hurts" and the "girls were always the first to be hit and

out of the game" reinforced why males liked playing dodgeball in PE class. The results revealed positive and negative experiences from playing dodgeball in PE. The literature shows both positive and negative perceptions, experiences, and opinions regarding dodgeball.

Positive Aspects of Dodgeball

From a positive perspective Strand et al. (1997) discovered that when junior high males played dodgeball for 35 min they maintained a higher heart rate than when they participated in a fitness run. Barney and Christenson (2014) studied elementary-aged students' knowledge of appropriate instructional practices in elementary PE. Of the many instructional practices elementary students were asked about, they felt dodgeball was appropriate to play in PE. In the Barney and Christenson study, elementary-aged students were not asked why they liked playing dodgeball in PE class and there was no qualitative data. Yet, in this study, students used phrases such as "[Dodgeball] is a blast," "It is fun trying to knock out your friends," and "It was fun trying to not get hit." These studies highlight the positive attitudes and effects of dodgeball on those who participate.

Negative Aspects of Dodgeball

Looking at the negative side of dodgeball, Williams (1992) highlighted a number of inappropriate instructional practices that are considered a part of the Physical Education Hall of Shame. The top inappropriate instructional practice was dodgeball. Williams stated that dodgeball's main focus is to inflict pain, harm students, and embarrass the opponent. Williams continued by stating that dodgeball "may have done our profession more harm than any single factor" (p. 57). In this study, students stated that dodgeball was "a form of bullying," "Kids can pick on others," and "Dodgeball makes girls appear weak and helpless." Barney and Deutsch (2009) studied elementary classroom teachers' attitudes and perceptions of elementary PE. Classroom teachers were asked what some of their experiences were in elementary PE. For example, it was stated, "All I remember was running and dodgeball." Another statement was, "Dodgeball, fat kid, no encouragement, nor variety of activities." These types of experiences do not bode well for PE.

One might think that the dodgeball dilemma had long been put to rest. That does not seem to be the case—52% of the participants

in this study reported playing dodgeball at least twice monthly. Dodgeball seemingly remains a staple in the majority of current PE practices. Sure, some modifications have been made, but it is clear that many PE teachers and students are not willing to let go of this popular game. Even parents (Barney & Pleban, 2010) and administrators (Barney & Prusak, 2016) are seemingly okay with the game, so why are we still rooting around on this topic? As researchers, we try to understand and, if possible, reconcile the polar opinions for and against a game.

Although the participants in this study, as well as the majority of each of the populations we have studied in the past, are in favor of dodgeball in PE, not all are. In particular, the participants in this study agreed only slightly more than neutral that the game was appropriate. Not surprisingly, males found the game more appropriate, less likely to affect motors skills acquisition, and less likely to consider it bullying, or more appropriate for co-ed play than did the females. Therefore, we caution against overstating perceptions of dodgeball as appropriate for PE for all.

We are also concerned with those who are least attracted to the game: those who are perhaps most at risk of physical or emotional damage. Participants of in this study disagreed slightly less than neutral that dodgeball might be considered as a form of bullying. However, the 15% who agreed to some degree that it is should not be overlooked.

The data from this study present attitudes, experiences, opinions, and perceptions of former K–12 PE students. We are not taking a philosophical stand for or against dodgeball in PE class. The data were presented, and we are letting the reader make their own conclusions.

Dodgeball With a Twist: Practical Applications and Future Research

Modifying the game can remove or mitigate the use of human targets and increase the safety. For example, using bowling pins along the end line as targets or using an earth ball to be driven across opposing lines to score a point provide plenty of throwing and target practice. When the pins are all knocked down, the game ends. Or combine both into a game. A student may wish to guard a pin or

perhaps catch a ball in hopes of returning an eliminated player. But that is their choice.

One can also include alternative recycling strategies to limit the amount of time eliminated players spend along the sidelines. Most versions of the game provide for a caught ball to reenter one eliminated player. Here are some other possibilities: Establish a safe zone in enemy territory (e.g., the circle at the free-throw line, outside the three-point line, or from the center circle) where a student can attempt to score a basket. If they make the shot, some or the entire sideline is allowed back into the game. Creativity can provide all of the enjoyable elements of dodgeball but also include additional motor skills practice (e.g., shooting baskets). We recommend further that the game be played with soft, lightweight foam balls. Never use rubber playground balls or volleyballs. Ban all headshots.

We strongly argue against gameplay that forces all players to be human targets. Create a game where some are allowed wear red jerseys that place them in a nontarget role and have them perhaps retrieve balls for the throwers. We also caution about playing co-ed dodgeball in its traditional form. Some females are certainly capable, competitive by nature and might wish to play against the males, but probably not all. Using some of the suggestions or other appropriate ideas might help you create a game that is both enjoyable and socially reinforcing.

It is unlikely that dodgeball or the controversy surrounding it will be going away any time soon. It is far more likely that with some creativity, teachers can develop a version of the game that retains all of the desirable physicality, activity, and skills practice while maintaining an appropriate safety levels.

In regard to future research, researchers can interview current PE teachers to better understand why they might have their students participate in the game of dodgeball. Also, they can investigate current PE teachers' experiences with dodgeball and what they have observed as their students have played the game of dodgeball.

Limitations

Because the participants came from one university, it may not allow a representative sampling of participants from other colleges or universities or geographic regions, thus limiting the generalizability of the findings. Additionally, the research study was conducted at

a private university, which may further limit the generalizability of the findings. Thus, the conclusions and implications are mostly applicable to those participants' demographics.

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YOU AND THE LAW

The Underlying Truth: Performance Supplements and Membership Provisions in the Fitness Industry

Makenzie A. Schoeff and Lawrence W. Judge

Herren v. Sucher, 325 Ga. App. 219 (2013)

Prior to Court

The plaintiff in this case (Herren) is seeking a review of an order from a Georgia trial court that awarded summary judgment to defendants (Gregory Paul Sucher, Nonstop Fitness Incorporated, and Club Management Services Incorporated) and the original seller of a dietary supplement known as R.A.G.E RV-5. The plaintiff filed an amended complaint, seeking to recover damages under theories of ordinary and gross negligence. The underlying facts of the case are undisputed. Herren began training with a personal trainer a few weeks after joining the gym. The plaintiff brought suit after suffering a stroke following an exercise session with a personal trainer at the gym. The plaintiff alleged that the stroke was at least partly attributable to the non-FDA approved dietary supplement and overexercising. The defendants filed a motion for summary judgment, contending that the exculpatory clauses in the Membership Agreement, Fitness Assessment Agreement, and Personal Training

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Program Service Agreement release them from liability. Further, Herren assumed the risk of injuries.

The plaintiff responded, asserting that the exculpatory clauses within the three separate agreements did not bar his claims against the gym defendants for gross negligence. Further, Herren stated that a material issue of fact exists concerning whether Nonstop Fitness or Club Management Services was operating the health club at the time the agreements were executed. Herren also stated that the agreements were unenforceable because the agreements had not been approved by state legislation OCGA § 10-1-393.2 of the Fair Business Practices Act. The trial court found that the exculpatory clauses did not bar claims against the defendants based on allegations of gross negligence. However, the exculpatory clauses were binding and enforceable for claims based on allegations of ordinary negligence. Herren filed a notice of appeal.

The original seller of the dietary supplement, Barrin Innovations, also filed a motion for summary judgment. Barrin Innovations contended that it was not a proper party to the proceedings because its assets and liabilities had been transferred to William Mellor in a purchase agreement executed prior to the time Herren was injured. The trial court found that Mellor had assumed Barrin's liabilities. As a result, the trial court granted summary judgment in favor of Barrin Innovations. Herren filed a notice of appeal.

The key issue is to determine whether the Georgia trial court erred in granting summary judgment on the evidence in favor of defendants (Gregory Paul Sucher, Nonstop Fitness Incorporated, and Club Management Services Incorporated) and the original seller of a dietary supplement in a negligence action.

Court Action

The Court of Appeals of Georgia held that the trial court properly granted summary judgment to the gym defendants, but erred in granting summary judgment to the original seller of the dietary supplement. The court concluded that the exculpatory clauses were binding and enforceable. Herren signed a Membership Agreement at the time he joined Nonstop Fitness. The agreement included a section titled "WAIVER AND RELEASE LIABILITY" (*Herren v. Sucher*, 2013):

> The Club urges you and all members to obtain a physical examination from a doctor before using any exercise equipment or participating in any exercise class. All exercises . . . shall be at the member's sole risk. Member understands that the agreement to use, or selection of exercise programs, methods and types of equipment shall be member's entire responsibility, and the Club shall not be liable to member for any claims, demands, injuries, damages, or actions arising due to injury to member's person or property arising out of or in connection with the use by member of the services, facilities, and premises of the Club. Member hereby holds the Club, its officers, owners, agents and employees harmless from all claims which may be brought against them by member or on member's behalf for any such injuries or claims. (para. 7)

Herren also signed a Fitness Assessment agreement that contained the following waiver (*Herren v. Sucher*, 2013):

> MEMBERS ACKNOWLEDGMENT, ASSUMPTION OF RISK AND FULL RELEASE FROM LIABILITY OF NONSTOP FITNESS:
>
> Member acknowledges that the fitness assessment hereunder includes participation in the strenuous physical activities, including but not limited to, aerobics dance, weight training, stationary bicycling, various aerobic conditioning machines and various nutritional programs offered by Nonstop Fitness. Member agrees to assume all risks and responsibility involved with participation in the physical activities. Member affirms that member is in good physical condition and does not suffer from any disability that would prevent or limit participation in physical activities. Member acknowledges that participation will be physically and mentally challenging, and member agrees that it is the responsibility of the member to seek competent medical or other professional advice regarding any concerns involved with the ability of member to take part in the Nonstop Fitness physical activities. Member

> agrees to assume any and all risks and take responsibility for not exceeding his/her own physical limits. (para. 9)

The final document that Herren signed was a Personal Training Program Service Agreement and Release of Liability that contained the following provisions (*Herren v. Sucher*, 2013):

> IMPORTANT NOTE: Buyer . . . agrees [to] release . . . Nonstop Fitness, Inc. from liability due to participation. Buyer is urged to have this release agreement reviewed by an attorney before signing. By signing this Agreement, Buyer acknowledges that Buyer has read, understood and agreed with all terms and conditions of this agreement, after having the opportunity to have it reviewed by an attorney at the discretion of Buyer.
>
> BUYER AGREES TO ASSUME ALL RISK AND RESPONSIBILITY INVOLVED WITH PARTICIPATION IN THE PHYSICAL ACTIVITIES. . . . BUYER . . . AGREES TO FULLY RELEASE TO NONSTOP FITNESS, INC. (AS WELL AS ANY OF ITS OWNERS, EMPLOYEES, OR OTHER AUTHORIZED AGENTS, INCLUDING INDEPENDENT CONTRACTORS) FROM ANY AND ALL LIABILITY, CLAIMS AND OR LITIGATION ACTIONS THAT BUYER MAY HAVE FOR INJURIES, DISABILITY OR DEATH OR OTHER DAMAGES OF ANY KIND, INCLUDING, BUT NOT LIMITED TO THE PERSONAL TRAINING/NUTRITIONAL PROGRAMS AND THE PHYSICAL ACTIVITIES. (paras. 10–11)

Herren argued that the exculpatory clauses were ambiguous and therefore not legally binding or enforceable. The Court of Appeals of Georgia disagreed. The court provided that the contractual provisions constituted clear and express waivers and releases from liability. The use of exculpatory clauses by health and fitness facilities does not render the contract unenforceable.

The plaintiff also argued a material issue of fact existed concerning whether Nonstop Fitness or Club Management Services was operating the health club at the time the agreements were executed. Herren argued that if the wrong corporate entity was listed, the

exculpatory clauses are unenforceable. The plaintiff pointed to the gym owner's deposition testimony in support of his argument. In his deposition, Sucher testified that the gym was initially operated under Club Management Services Incorporated but was transitioning to Nonstop Fitness. Although Sucher testified that he was unsure which corporate entity was operating the gym at the time the plaintiff executed the agreements, he later clarified that the transition must have been complete because the agreements Herren signed had the corporate name Nonstop Fitness and had been approved by state legislation OCGA § 10-1-393.2. It was undisputed that Club Management Services and Nonstop Fitness were both registered with the Georgia Secretary of State as closely held corporations. It was also undisputed that the services provided remained substantially the same throughout the transition period. The court found the plaintiff's argument that the uncertainty concerning which corporate entity was operating the health club at the time the agreements were executed brought into question the enforceability of the agreements unavailing.

Herren also argued that the agreements were unenforceable because they had not been approved by the state. After determining that the record showed otherwise, the plaintiff recast his argument. In his reply brief, the plaintiff contended that the agreements on file did not list the correct corporate entity operating the gym. As such, the contract was void because it had never been approved by the state. The court dismissed this argument for the reasons listed above.

The plaintiff also argued that the trial court erred in granting summary judgment to Barrin Innovations on their negligence and strict liability claims. The trial court found that Mellor assumed Barrin's liabilities as a result of the following provision in the Purchase Agreement: "Buyer shall indemnify and hold harmless Seller from any liability arising from the actions of the business including but not limited to liabilities incurred, outstanding debts, harm caused by products and/or machinery owned or produced by the businesses" (*Herren v. Sucher*, 2013, para. 19).

The Court of Appeals reversed the trial court's decision that Mellor was the proper party in this case. The appellate court stated that an agreement to indemnify is not the same as an agreement to assume liabilities. The court held that indemnification of liabilities

means reimbursement or compensation for loss or damage. There was no express agreement between Mellor and Barrin that Mellor assumed all liabilities and obligations of Barrin. Therefore, the trial court's order granting summary judgment to Barrin was reversed.

Discussion

The results of this decision were decided on November 6, 2013. The outcome of this case is significant in relation to consumer use of fitness facilities. New members are often required to sign membership agreements and contractual provisions before gaining access to the facility. The specific coverage of contractual agreements in the health and fitness industry is set in precedent by the court system. The outcome in *My Fair Lady v. Harris* (1987) and *Lovelace v. Figure Salon* (1986) established that the inclusion of exculpatory clauses in health and fitness club agreements is valid and binding in the state of Georgia. All individuals listed in the contract are presumed to have read the provisions and understood the contents. It is important that fitness professionals and consumers are aware of the contract conditions and provisions before engaging in exercise training.

An additional discussion of contract law is also relevant to the current case. The fitness marketplace has an increasing number of sport nutrition, weight loss, and vitamin supplements distributed for retail sale. When the assets of an organization are purchased, it is important to have clear and unambiguous provisions in the purchase agreement. In the state of Georgia, there must be an express agreement between the buyer and the seller that the buyer assumed all liabilities and obligations of the seller. There is a distinct difference between agreements that create an assumption of liabilities and agreements that indemnify for loss, damage, or liability. State and local laws can differ between each state. Therefore, it is important for health and fitness professionals to be aware of the differences in state law and the provisions applicable to the state in which they reside or work.

This case could have broad implications for professionals in physical education, fitness, and recreation. For professionals in the fitness industry, it is important to review state laws and ensure that membership agreements have clear and unambiguous terms, to avoid liabilities resulting from claims of ordinary negligence. Personal trainers may also use personal training agreements to wave

and release liability. In an effort to improve fitness safely and appropriately, fitness professionals executing such agreements should provide full disclosure of all of the information within the contract and encourage members to read it carefully.

Further implications involve the use of non-FDA regulated dietary supplements. Sport nutrition and fitness supplements are used by consumers for a variety of reasons, including to enhance performance, to build muscle mass, to aid in recovery, to stimulate weight loss, and to increase energy and focus. According to the U.S. Food and Drug Administration (FDA, n.d.), dietary supplements can improve overall health—but the use of supplements can also involve health risks. The FDA is not authorized to review the safety or effectiveness of dietary supplements. Manufacturers are required to produce quality supplements that do not contain impurities or contaminants. Manufacturers must also label supplements according to the current Good Manufacturing Practice and labeling regulations before they go to market. Many supplements contain ingredients that have strong biological effects that could result in health complications (FDA, n.d.). Therefore, it is important for students and professionals to be knowledgeable of the potential benefits and drawbacks of supplement use when working with clients to enhance overall health and improve fitness. This case further illustrates the significance of preexercise screening and the administration of a proper and thorough health history questionnaires to protect not only the personal trainer but also the client.

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