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Relationship Between Middle School Students Functional Squat and Fitness Levels

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Abstract

Background: Functional movement patterns, such as the squat, are used on a daily basis and are the foundation for movement in activities of daily living and fitness. If teens do not have good functional movement, this can induce injury, pain, and/or lack of confidence in movement, which can lead to less physical activity. **Aims and Objectives:** The objective of this research is to investigate the relationship of the functional movement pattern of the deep squat in middle school students with the fitness variables: broad jump, push-up, PACER test, and BMI. **Materials and Methods:** Students from a Midwest school district in the United States (N = 161, 42.2% male) in grades 7-9 (32.9%, 27.3%, 39.8%) completed a functional movement squat screener. The screener has three levels of performance: (1) limited, (2) proficient, and (3) advanced. Students also performed the broad jump, 1-minute push-up test, PACER test, and a BMI assessment. **Results:** The squat screen indicated that 37.3% of students were limited, 39.8% proficient, and 23.0% advanced. Correlational data indicated the squat screen correlated with all measures; broad jump ($r = .288$, $p < .001$), push-up ($r = .436$, $p < .001$), PACER ($r = .279$, $p < .001$), and negatively correlated with BMI ($r = -.264$, $p < .001$). Conclusions: Roughly 60% of students could perform the deep squat correctly; however, almost 40% of students were unable. Data showed the squat screener correlated positively with all fitness measures which is concerning for the 40% of students that did not achieve proficiency in the squat, as this indicates that other fitness variables are also lower with students who performed poorly on the squat screen. Physical educators and health professionals should work to improve functional movement and fitness levels in students to better prepare them to be active and fit into adulthood.

Keywords: Functional movement screen, squat screen, movement proficiency, physical education.

INTRODUCTION

Whether an individual is five or 85 years old, it is important to move well. The possession of good foundational movement patterns will allow a performer to better complete activities of daily living (ADLs) and maintain a high health-related quality of life (HRQoL) into older adulthood. As health and fitness practitioners, if we want to facilitate improvement in the motor skills of students, athletes, or clients for lifetime fitness, we can either work around a physical limitation or we can work with to improve the limitation. These goals require diagnosing the strengths and weakness of a performer and implementing effective teaching strategies to enhance functionality, but to accomplish these tasks, we first need to know the movement capabilities of our learners. Due to the logistics of limited time and resources, practitioners need efficient, effective methods of assessment that provide critical information regarding technique (i.e., knowledge of performance, or KP). One tool that has risen in popularity in recent years is the functional movement screen through organizations such as Functional Movement Systems [1], the Titleist Performance Institute [2], and On Base University [3].

Researchers in the field of kinesiology recommend using the deep squat to screen for movement capabilities and deficiencies prior to movements that are loaded or athletic in nature [4-8]. It is also suggested as one of the useful indicators of movement quality by the National Academy of Sports Medicine (NASM) [9, 10]. According to Butler et al. [11], differences in squatting technique between individuals with poor technique and good technique were not attributable to differences in ankle dorsiflexion – instead they were due to differences in the amount of knee and hip flexion achieved at the bottom of the squat. This suggests more of a "hip hinge" strategy rather than an "ankle strategy" to get lower in the squat, which is in line with recommendations for preferential squatting technique according to strength and conditioning research [7].

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Along with concern by the general public about adult back issues and the societal impact [12], injury rates in secondary (i.e., middle and high school) and collegiate sports are a significant concern to the organizers, parents, coaches, and other adults affiliated with youth sport and collegiate athletics. Musculoskeletal injury rates in these domains have been reported as 6.6 injuries per 1,000 athlete exposures, and over half of these injuries occur in the lower extremities [13, 14]. These types of injuries can have long-term consequences such as chronic joint problems, osteoarthritis, and a decreased quality of life due to recurrent injury risk and decreased levels of physical activity because of concern about the possibility of reinjury [15]. Therefore, to promote lifelong physical activity, it is paramount that movement scientists and practitioners utilize methods of screening and assessment that will identify movement deficiencies and specifically target areas of improvement for the individual.

Kinesiology researchers who are interested in functional movement over the lifespan and industry-leading organizations who focus on improving movement have begun to examine and utilize the deep squat screen as a tool and valuable source of information about the performer. Research suggests that a person's performance on the deep squat can predict performance on the battery of tests as a whole. Research by Clifton, Grooms, and Onate [16] suggests that this is the case with the FMS screen. Participants who scored below two on the deep squat subsequently performed significantly worse on the overall screen that than those who score a two or above. This outcome is likely due to the holistic and multifaceted nature of the screen, which assesses both upper and lower body elements. The deep squat is a dynamic movement that requires both mobility and stability in multiple joints for correct performance [11, 17]. The purpose of the current study was to investigate the relationship between the squat screener and other fitness variables.

MATERIAL AND METHODS

Participants

All research was approved by the institutional review board and the school district's superintendent. Parent consent and student assent was obtained prior to data collection. A total of 161 students (42.2% male) from a junior high school/middle school, 7-9, (32.9%, 27.3%, 39.8%) in a Midwestern U.S. city completed the study (N = 223 recruited, 72.2% full data sets). Students came from eight different physical education classes ranging in classroom size from 24 to 31 students.

Measures

Students completed a squat screener and four fitness tests: broad jump, 1-minute push-up test, PACER test (i.e., Beep test), and height and weight to calculate BMI.

Squat Screen

Procedure: The student faces the wall with feet shoulder width apart, hands overlapped in front, arms straight, and toes two inches from the wall (feet cannot move after screener begins). Student will squat down, eyes facing forward with no head movement, and strive to touch the ground with the fingertips. When the ground is touched, hold for a five count, stand back up, and hold for a two count without falling back or moving.

1. Limited: Cannot touch the ground or touches the ground but the feet or head move or body moves to the side and/or unable to stand up without holding for a two count.

2. Proficient: Able to hold for a five count while touching the ground with body aligned straight up and down; can stand up and hold for a two count.

3. Advanced: Toes against the wall, able to hold for a five count at the bottom and two count at the top with body aligned straight up and down.

Fitness Tests

The four fitness tests were derived from the five health-related fitness components:

Cardiovascular endurance was evaluated using the PACER test (i.e., Beep test). This test consists of students running 20 meters under a prescribed time, the time will consistently speed up during the test. Two missed times ends the test.

Muscular endurance was measured in the upper body test (1-minute push-up). Students perform as many push-ups as possible within 1-minute. Students can rest at the top, but knees or stomach cannot touch, or the test is ended.

Muscular strength which in this case also involved muscular power (Force x Velocity) was measured in the lower body test (broad jump). Students stood behind a line and jumped off two-feet and landed on two-feet. The investigator would mark the heel of the farthest foot back with a clip board that would align with a tape measure to calculate distance. The greater of two trials was counted.

Body composition was measured by collecting height (inches) and weight (pounds) of each student and then calculating BMI using the formula (weight (lbs) / [height (in)]^2 x 703).

Flexibility was evaluated through the functional movement squat screener as range of motion of the hips, lower back, knees, and ankles are encompassed within the screen.

Data Collection

The primary investigator collected all data from the eight classes. Testing was conducted over a three-day period at the beginning of the Fall semester (September). Day 1: squat screener and height and weight; Day 2: push-ups and broad jump; Day 3: PACER test. Students were broken up into groups of 4-6 and rotated through stations for the first two days and then two groups ran the PACER test on the third day.

Data Analysis

Data analysis was conducted using IBM SPSS 28.0. Descriptive statistics were calculated to numerically describe the data (e.g., examine distributions, examine outliers, etc.) and to describe the sample (e.g., age, grade, gender). Pearson's bivariate correlations were examined to evaluate relationships between the squat screener and the fitness measures.

RESULTS

A total of 161 student (93 females, 68 males) data sets were analyzed for research. The mean age was 13.17 as grade distribution was 32.9% 7th, 27.3% 8th, and 39.8% 9th (see Table 1). Males outperformed females in the squat screener (M = 2.0, 1.75), broad jump (M = 71.29 in, 64.99 in), push-ups (M = 23.00, 13.46), PACER (M = 51.10, 36.45), and had a lower BMI (M = 20.85, 21.41). In comparison to national data sets, male scores for all five measures were at a healthy status while females were at a healthy status for broad jump, PACER and BMI, above the healthy average for push-ups, but were below proficient in the squat screener (see Table 2). The squat screener indicated that 37.3% of students were limited, 39.8% proficient, and 23.0% advanced (see Table 3). Correlational data indicated the squat screen correlated with all fitness measures; broad jump ($r = .288$, $p < .001$), push-up ($r = .436$, $p < .001$), PACER ($r = .279$, $p < .001$), and negatively correlated with BMI ($r = -.264$, $p < .001$) (See Table 4).

DISCUSSION

This research indicates there is a relationship between fitness and functional movement (i.e., deep squat) in middle school students. The data also indicates that nearly 40% of students in this study were not proficient in the deep squat. To be noted, the participants within in this study were overall relatively fit as all fitness measure means were at a healthy status or above, other than the squat screener for females. The overall fit student population is not in line with research that indicates the fitness levels of adolescents is low and continues to decline [18-24]. Having such a fit population could have an impact on proficiency of the squat screener, as 60% of the students were proficient. Further research with a more unfit population, as is more common in schools across America, is needed to have a better understanding of overall proficiency of the squat screener.

As research indicates, the importance of the deep squat/functional movement to injury prevention within the lower extremities along with a correlation to other functional movements, physical activity, fitness [12, 16, 25], the 37% of students not proficient are a concern. Research indicates that motor skills, fitness levels, and physical activity in youth lead to adult patterns of physical activity, fitness, and health [26-30]. Stated differently, youth that move well and are physically active and fit are more likely to be physically active and fit as adults. Functional movement plays a key role in the ability for individuals to be and stay physically active which in turn will impact fitness levels. This should be a high priority in K-12 physical education and other health professionals working with children and teens.

Table 1: Demographic Statistics of the Study Population

Variable	**N**	**Percentage**
Age[a]		
11	1.0	0.6
12	47.0	29.2
13	46.0	28.6
14	57.0	35.4
15	10.0	6.2
Grade		
7th	53.0	32.9
8th	44.0	27.3
9th	64.0	39.8
Proficient (2)	64.0	39.8
Advanced (3)	37.0	23.0

[a] Mean = 13.17, N = 93 females and 68 males.

Table 2: Descriptive Statistics of Squat Screener and Fitness Measures by Gender

	Females		**Males**	
Variable[a]	Mean	SD	Mean	SD
Squat Screener	1.75 [b]	0.75	2.0 [c]	0.77
Broad Jump (inches)	64.99 [c]	13.40	71.29 [c]	12.57
Push-ups	13.46 [d]	9.62	23.00 [c]	12.99
PACER	36.45 [c]	18.68	51.10 [c]	25.48
BMI	21.41 [c]	4.79	20.85 [c]	3.99

[a] N = 93 females and 68 males. [b] Scores indicate below healthy standard. [c] Scores indicate healthy standard. [d] Scores indicate above healthy standard. *Note*. Healthy standards are derived based off 13 years olds.

Table 3: Squat Screener Proficiency Levels

Level	N	Percentage
Limited (1)	60.0	37.3

Table 4: Correlations Table for Squat Screener and Fitness Measures

Variables	Squat	Broad Jump	Push-ups	PACER	BMI
Squat	1.00				
Broad Jump	.288**	1.00			
Push-ups	.436**	.590**	1.00		
PACER	.279**	.590**	.594**	1.00	
BMI	-.264**	-.347**	-.215**	-.413**	1.00

Note. BMI = Body mass index. **Correlation is significant at the 0.01 level (2-tailed)

Figure 1: Investigator Conducting the Squat Screener with Students

CONCLUSION

The functional movement of the deep squat correlates with multiple fitness measures but nearly 40% of middle school students in this study were not proficient in this basic foundational movement. Physical educators and health professionals must be intentional about equipping children and teens with the skills to functionally move to promote and provide opportunities to stay active and fit for a lifetime. If individuals are unable to functionally move well, the likelihood of them moving to promote health and fitness will be hindered. Longitudinal research needs to further investigate if functional movement within the deep squat is an indicator of physical activity and fitness levels over extended periods of time.

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Disclosure

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