FITNESS

Skill-Related Fitness of Undergraduate Kinesiology Students

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Abstract

The purposes of this study were to investigate the skill-related fitness levels of undergraduate kinesiology majors in relation to the general population of college students of the same age, to investigate whether a difference exists between females and males in overall performance, and to examine the relationship between fitness and kinesiology specializations. Undergraduate kinesiology students were assessed using skill-related fitness tests that included scores from power, agility, speed, and balance tests. It was anticipated that undergraduate kinesiology students would possess higher skilled fitness than (or, at a minimum, equal to) the general public; however, the results were ambiguous and also no significant differences were found between female and male performance. Data from this study can serve to update normative population information, to add to the body of knowledge of current fitness levels for this population, and to contribute to the issue of inclusion of fitness standards for kinesiology preprofessionals.

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Declining American health, coupled with the prevailing trend of childhood obesity, has led to a focus on the health-related fitness levels of both children and adults (National Center for Health Statistics, 2006; Sawyer, 2006). Accordingly, current fitness testing and exercise prescription of the general public emphasizes and places importance on health-related fitness parameters, including body composition, VO_2 max, muscular endurance, and flexibility (Barrow, 1954; Cleary et al., 2011; Hoffman, 2006; Hunsicker & Reiff, 1976; Nieman, 2001; Welk & Meredith, 2008). Currently, skill-related fitness tests are not emphasized in general health and fitness inventories; however, evaluation of skill-related fitness can lead to a more complete assessment of an individual's overall physical fitness and their ability to perform in various activities (Nieman, 2001). Skill-related fitness is defined as the components of physical fitness that "have a relationship with enhanced performance in sports and motor skills" including agility, power, speed, balance, coordination, and reaction time (Corbin, Pangrazi, & Franks, 2000). Specific tests for evaluating skill-related fitness levels include the vertical jump or standing long jump often used for power, the T-test or shuttle run for agility, sprints or dashes for speed, the stork stand or stick method to measure static balance, basketball dribbling for coordination, and timing devices to measure reaction time (Corbin & Ruth, 2005; Morrow, Jackson, Disch, & Mood, 2005). The President's Council on Physical Fitness and Sports states that "people who possess skill-related fitness will be more likely to engage in regular activity and for this reason will have enhanced health-related fitness and a lower risk of hypokinetic diseases and conditions" (Corbin et al., 2000, p. 6). Information gathered from skill-related fitness tests is also useful for coaches as a diagnostic tool for developing training programs for athletes, and furthermore, this data can also be used to help nonathletic individuals train in specific areas (Morrow et al., 2005).

Physical activity and fitness levels assessment has changed over the past 50 years from a focus on skilled movements toward a health-related fitness construct (Mood, Jackson, & Morrow, 2007). Accordingly, accreditation standards and university curricula have changed and now emphasize health-related constructs for kinesiology preprofessionals (Sawyer, 2006). This has led to a noted shift in research and focus in kinesiology from skill-related fitness to prescription of exercise as preventative medicine for cardiovascular disease and weight loss (Zelaznik & Harper, 2007). Though it is important that kinesiology students understand how and when to implement both health-related and skill-related fitness testing during their coursework, much of the literature recommends that these preprofessionals also possess a basic level of fitness. Although some studies have investigated the health behaviors and fitness of kinesiology undergraduates and professionals, much of this research, which focuses only on health-related fitness parameters, is self-reported and therefore may be unreliable (Boer, Wilson, & Heath, 2008; Brandon & Evans, 1988; Cardinal & Cardinal, 2001; Ebben & Brudzynski, 2008; Jenkins & Olsen, 1994; Loucks, 1976; Mack, Wilson, Lightheart, Oster, & Gunnell, 2009).

In addition to the changing accreditation standards and expectations for kinesiology preprofessionals, updated findings aer continuously needed for the normative data for health-related and skill-related fitness tests. Norm-referenced measurement, or normative data, allows the comparison of a performance or score to "a large number of scores on tests and measurements from a specifically defined population" (Morrow et al., 2005). In much of the kinesiology literature, normative data is used to rate subjects as above, below, or meeting the skill-related fitness level for the average, normal population at the 50th percentile (Hoeger & Hoeger, 2009). Some of the skill-related tests have more current normative data available; however, normative data available for many fitness and skills tests is still dated and may not present an accurate representation of current norms among different age groups for each gender.

Although the focus appears to be changing, kinesiology professionals are expected to be skilled leaders and to serve as role models (Cardinal, 2001; Zelaznik & Harper, 2007). In a survey of HPERD professionals and pre-professionals, role modeling was ranked number one as a "powerful teaching tool" and indicated that HPERD professionals should practice what they teach (Cardinal & Cardinal, 2001). Not only is it necessary to possess basic skill-related fitness levels for enjoying recreational sports activities, but it is also argued critical for professionals to possess some expertise and aptitude in the areas they are coaching and teaching and when they are prescribing exercise programs (Cardinal, 2001; Mellville, 1999; Sawyer, 2006; Zelaznik & Harper, 2007). Although kinesiology professionals do not have to possess skill-related fitness aptitude to be successful, research has indicated that physically fit kinesiology professionals are more likely to make a positive impression during the hiring process and to succeed in interacting with students in the classroom setting (Melville & Cardinal, 1997).

If leaders and researchers in the field were to argue that kinesiology professionals should model a healthy lifestyle and be skillful, this begs the question, are they? Therefore, research in this area is needed to investigate the current state of skill-related fitness among kinesiology majors. The objectives of this study were threefold: to investigate whether a difference exists between undergraduate kinesiology students' and the normal population's skill-related fitness, to compare skill-related fitness between genders, and to examine the relationship between skill-related fitness and undergraduate kinesiology specialization (all-level teaching certification, exercise science, sport management, and pre-physical/occupational therapy). Subsequently, the following hypotheses were made:

1. There would be a significant difference between undergraduate kinesiology students and the normal population for skill-related fitness levels.
2. There would be no significant difference between female and male performance on each of the four skill-related fitness tests.
3. There would be no significant difference between skill-related fitness and area of specialization.

Methods

Experimental Approach to the Problem

To investigate the objectives of this study, the skill-related fitness of kinesiology undergraduates was measured with established standardized skill-related test protocols for the vertical jump (power), T-test (agility), 50-yd dash (speed), and stork stand (balance) tests. Coordination and reaction time components of skill-related fitness were not included, as test success can be subjective and may require several types of tests to achieve a reliable score. The four skill-related fitness tests used in this study were consistently administered each semester to each student as a required component of the measurement and evaluation course, and the course professor and kinesiology department agreed to share existing data for the purposes of this investigation. This research was approved by the Institutional Review Board for the protection of human subjects. All identifiers were removed to uphold confidentiality, and subject numbers were added in their place to maintain organization of the data.

Subjects

The sample consisted of 210 undergraduate kinesiology students enrolled in an undergraduate kinesiology measurement and evaluation course for the years 2004 to 2009. The sample only included subjects who had a declared area of specialization and completed all four skill-related tests. The sample included 44.8% (n = 94) female and 55.2% (n = 116) male students whose ages ranged from 18- to 29 (females, 22.15 ± 2.10; males, 22.9 ± 2.15). Average height was 64.41 ± 2.94 in. for females and 70.17 ± 3.18 in. for males. Average weight was 141.51 ± 25.67 lb for females and 193.06 ± 35.08 lb for males. The students' areas of specialization were identified prior to testing and are summarized in Table 1. Overall, 42.86% of subjects were EC-12 (n = 90), 25.71% were exercise science (n = 54), 20.48% were sport management (n = 43), and 10.95% were pre-PT/OT (n = 23) majors.

Table 1

Subject Sample Size in Each Specialization Category

	EC-12	Exercise Science	Sports Management	Pre-PT/OT
Female	29	30	21	14
Male	61	24	22	9
Total	90	54	43	23

Note. EC-12 = early childhood through 12th grade teacher certification; Pre-PT/OT = pre-physical therapy/pre-occupational therapy.

Procedures

Basic test protocol equipment was used to delineate test parameters (cones, stopwatch, tape, etc.). Additionally, the Vertec™ apparatus (Vertec Scientific Ltd., Aldermaston, UK) was used for the power test due to its simplicity and reliability (0.93 to 0.99) of measurement (Patterson & Peterson, 2004) and was administered using standard testing protocol as outlined in established sources (Hoffman, 2006; Kirby 1991). The T-test for agility followed standard protocol and is considered a valid test for measuring agility, and the reliability of this test is 0.98 (Pauole, Madole, Garhammer, LaCourse, & Rozenek, 2000; Sassi et al., 2009; Seminick, 1990). Speed was assessed with standardized 50-yd dash protocol (Hoffman, 2006; Kirby, 1991). This is a highly reliable test ($r = 0.95$) and is considered a valid measure of speed (Kirby, 1991). Balance was measured using the stork stand test, which is a simple measure of static balance with a 0.87 reliability coefficient (Hoffman, 2006; Kirby, 1991).

Data were collected during normal class times in consecutive class meetings. During testing sessions, students were given written and oral instruction and were assigned to a group. Participants were encouraged to warm up and stretch properly before testing. Test administrators demonstrated proper test procedure, and participants were encouraged to familiarize themselves with tests by way of completing submaximal practice trials. The tests were set up in the main gymnasium on campus where each group was assigned a specific test administration site. Once groups completed one test, they rotated to the next station. They rotated until participants completed all tests at all testing sites. Test data were discarded if any subject failed to execute proper test protocol. The test administrators gathered and recorded the data for each participant and provided the original raw data for this study. The best of three trials was recorded to the nearest 0.01 in. for the vertical jump. The best time out of two trials was recorded to the nearest 0.01 s for the T-test. The 50-yd dash consisted of one trial recorded to the nearest 0.01 s. Three trials for the stork stand were performed with the best effort recorded to the nearest 0.01 s.

Statistical Analyses

Descriptive information and test score data for each participant was compiled and entered into Microsoft Excel and then placed into SPSS for statistical analyses. An alpha level of .05 was used for all statistical tests except where the Bonferroni adjustment was needed to reduce the probability of error. The one-sample *t* test was used to assess the difference in skill-related fitness levels between kinesiology undergraduates and the normal population for each skill-related test. Four independent *t* tests were used to determine whether differences exist between female and male overall performance. The research team used the multiple *t* test statistical method, as it was important to show the readership where the differences occurred and to avoid the application of additional post hoc statistical tests. As indicated in Siegel (1990), multiple *t* tests, when coupled with the Bonferroni adjustment to the *p* value, reduce the probability of error. In addition, a one-way ANOVA was used to determine whether significant differences existed between the kinesiology specializations.

Normative data were used to rate subjects as above, below, or meeting the skill-related fitness level for the average, normal population at the 50th percentile (Hoeger & Hoeger, 2009). The vertical jump was assessed at the 50th percentile, which is 19.5 in. for males and 13.2 in. for females (Fitness Institute of Texas, 2009). The T-test was assessed at the 50th percentile, which is 10.49 s for males and 12.52 s for females (Hoffman, 2006; Pauole et al., 2000). The 50-yd dash was assessed at the 50th percentile, which is 6.6 s for males and 7.9 s for females (Hoffman, 2006). The stork stand was assessed at the 50th percentile, which is 9.2 s for males and 7.6 s for females (Hoffman, 2006).

Results

One-Sample *t* test: Females

The first objective of this investigation was to identify whether kinesiology undergraduates differed significantly from the normal population. A one-sample *t* test was computed for the skill-related fitness levels of females and the normal population at the 50th percentile (Table 2). Undergraduate kinesiology females (M = 17.77, SD = 3.29) had higher vertical jump scores than the normal population (M = 13.2), $t(93)$ = 13.47, p = .000. In addition, females (M = 10.51, SD = 12.12) balanced significantly longer than the normal population (M = 7.6) for the stork stand test, $t(93)$ = 2.32, p = .022. However, female *t*-test scores (M = 12.51, SD = 1.50) did not differ significantly from the normal population (M = 12.52), $t(93)$ = -.047, p = .963. Also, female 50-yd dash scores (M = 8.07, SD = .92) did not differ significantly from the normal population (M = 7.9), $t(93)$ = 1.77, p = .080

One-Sample *t* test: Males

A one-sample *t* test was computed for the skill-related fitness levels of males and the normal population at the 50th percentile (Table 3). Undergraduate kinesiology males (M = 24.01, SD = 3.62) jumped significantly higher than the normal population (M = 19.5

in.), $t(115) = 13.42$, $p = .000$. However, males ($M = 10.73$, $SD = 1.07$) ran significantly slower than the normal population for the T-test ($M = 10.49$ s), $t(115) = 2.43$, $p = .016$. Males ($M = 6.78$, $SD = .62$) ran significantly slower than the normal population for the 50-yd dash ($M = 6.6$ s), $t(115) = 3.16$, $p = .002$. Male stork stand scores ($M = 9.85$, $SD = 10.26$) did not differ significantly from the normal population ($M = 9.2$ s), $t(115) = .68$, $p = .498$.

Table 2

Descriptive Information for Females on Skill-Related Fitness Protocol

	Female $M \pm SD$	**Normative Data (50th Percentile)** M
Vertical Jump (in.)	17.77 ± 3.29*	13.2
T-Test (s)	12.51 ± 1.50	12.52
Stork Stand (s)	10.51 ± 12.12*	7.6
50-yd Dash (s)	8.07 ± .92	7.9

Note. $M \pm SD$ = mean ± standard deviation; M = mean; p = alpha level; in. = inches; s = seconds.
*p < .05.

Table 3

Descriptive Information for Males on Skill-Related Fitness Protocol

	Male $M \pm SD$	**Normative Data (50th Percentile)** M
Vertical Jump (in.)	24.01 + 3.62*	19.5
T-Test (s)	10.73 + 1.07*	10.49
Stork Stand (s)	9.85 + 10.26	9.2
50-yd Dash (s)	6.78 + .62*	6.6

Note. $M \pm SD$ = mean ± standard deviation; M = mean; p = alpha level; in. = inches; s = seconds.
*p < .05.

Independent *t* test

Female and male scores for each test were converted to *z* scores and subsequently *t* scores to normalize the data based on 50th percentile scores for each gender category. An independent *t* test was computed for each skill-related fitness test. No significant difference was found between female and male performance on any of the skill-related tests. Results of this analysis are shown in Table 4.

Table 4

Descriptive Information for Specializations on Skill-Related Fitness Protocol

	EC-12 ***M* ± *SD***	**Ex Sci** ***M* ± *SD***	**Sports Mgt** ***M* ± *SD***	**Pre-PT/OT** ***M* ± *SD***	**Total** ***M* ± *SD***
Vertical Jump (in.)	21.57 ± 4.12	21.61 ± 5.43	20.40 ± 4.45	20.47 ± 5.15	21.22 ± 4.66
T-Test (s)	11.36 ± 1.27	11.55 ± 1.64	11.79 ± 1.99	11.65 ± 1.47	11.53 ± 1.55
Stork Stand (s)	9.87 ± 9.99	9.80 ± 12.27	10.32 ± 11.33	11.70 ± 12.56	10.14 ± 11.11
50-yd Dash (s)	7.28 ± .88	7.31 ± 1.06	7.54 ± 1.13	7.41 ± 1.06	7.36 ± 1.00

Note. EC-12 = Early Childhood (EC) Through 12th Grade Teacher Certification; Ex Sci = Exercise Science; Sports Mgt = Sports Management; Pre-PT/OT = Pre-Physical Therapy/Pre-Occupational Therapy; *M* ± *SD* = mean + standard deviation; in. = inches; s = seconds.

One-Way ANOVA

The third objective of the study was to investigate whether differences in skill-related fitness existed between undergraduate kinesiology specializations. A one-way analysis of variance indicated that the differences between all undergraduate kinesiology specializations were not significant (Table 5).

Table 5

Analysis of Variance for Skill-Related Fitness Between Specializations

	df	*SS*	*MS*	*F*	*p*
Vertical Jump (in.)	3	60.981	20.33	.935	.425
Error	206	44.77.48	21.74		
Total	209	4538.46			
T-Test (s)	3	5.85	1.95	.806	.492
Error	206	499.04	2.42		
Total	209	504.90			
Stork Stand (s)	3	69.70	23.24	.186	.906
Error	206	25726.71	124.89		
Total	209	25796.42			
50-yd Dash (s)	3	2.03	.68	.674	.569
Error	206	206.69	1.00		
Total	209	208.71			

Note. df = degrees of freedom; *SS* = sum of squares; *MS* = mean square; *F* = F ratio; *p* = significance or alpha level; in. = inches; s = seconds.

Discussion

Many studies have explored the debate of whether kinesiology and health science professionals should exhibit a healthy level of fitness or even be required to pass fitness tests (Brandon & Evans, 1988; Loucks, 1976; Melville, 1999; Melville & Cardinal, 1997; Melville & Jones, 1990; Sawyer, 2006; Stern, Johnson, Spaziani, & James, 2001). From these studies, it was found that a number of programs integrate a fitness component into their exit requirements for graduation or admission into the program. The University of Central Arkansas "Kinesiology and Physical Education" program requires students to take a fitness test consisting of "pull-ups for men and modified pull-ups for women, 1.5 mile run, sit and reach, sit-ups, and measurement of body composition" (University of Central

Arkansas, 2009). Another example is the Department of Kinesiology and Health Science at Stephen F. Austin State University, which requires "successful completion of [a] physical fitness test" as they "require that all students be able to participate in vigorous physical activity" (Stephen F. Austin State University, 2009, p. 207).

Existing research regarding the fitness levels of undergraduate kinesiology students relies heavily upon health-related fitness test performance and self-reporting surveys of physical activity (Boer et al., 2008; Brandon & Evans, 1988; Cardinal & Cardinal, 2001; Loucks, 1976). Although empirical research has not proven that kinesiology professionals have to possess skill-related abilities to be successful, one would assume their levels of fitness and skills would be at a higher level than the general public, or at a minimum, equal to them. However, with the population in this study, the results were ambiguous. Females and males tested better than the normal population at the 50th percentile for power for the vertical jump. Additionally, females tested better than the 50th percentile for balance for the stork stand test and males performed similarly to the normal population. Females scored similarly to the normal population for agility (T-test) and speed (50-yd dash); however, males were slower than the normal population for both tests. As a result of other analyses, no significant difference was found in performance between females and males on any of the four skill-related tests, as well as between the skill-related fitness of kinesiology specializations.

The skill-related fitness tests used in this study were chosen based on their validity and reliability, availability of established norms, and ease of administration. However, several relevant limitations should be considered. Although best effort was expected, intrinsic student motivation to do his or her best was a factor that contributed to test results. For grading purposes, varying point values were placed on different tests. Participation points were assigned for skill-related tests; however, higher point values were assigned to several health-related tests (1.5 mile, push-ups, and sit-ups). The emphasis on health-related parameters for this course is consistent with the importance placed on this type of fitness in the research, but may have affected test results. Another consideration is that data in this study were collected in a "fitness battery" fashion, allowing recovery between tests. However, sequencing of tests was not standardized year to year due to time and feasibility constraints. Sequencing could affect test performance, as factors such as fatigue may become relevant. It is recommended to administer nonfatiguing tests first (balance and vertical jump) followed by tests for agility and then speed (Baechle & Earle, 2000). In addition, although standard test protocol was used in every testing session, test administrators varied from semester to semester. Further research is needed to determine whether performance differences would occur if testing for each skill-related fitness test were done on different days or whether sequencing affects outcomes for this study.

Practical Applications

The authors have compiled a rich database of information regarding the skill-related fitness of undergraduate kinesiology students. One practical application for the results of this study is the possibility for the use of these data in future normative population information. Much of the normative data available is dated and may not present an accurate representation of current norms among different age groups for each gender. Norms from tests such as the 50-yd dash are often referenced from AAHPERD test manuals dating from 1976, and other normative data such as the vertical jump can be accessed from a more current source such as Fitness Institute of Texas (FIT) from the University of Texas at Austin (FIT, 2009; Hunsicker & Reiff, 1976; Patterson & Peterson, 2004). Therefore, potentialities for future research may include establishing more comprehensive and current normative data. Another practical application may be the implementation of a requirement of skill-related fitness standards to which preprofessional kinesiology majors should adhere across the board. However, caution should be used here as no current studies prove that skill level is necessary for successful performance for kinesiology majors. Though kinesiology preprofessionals may be required to be familiar with concepts associated with skill-related fitness, they may not ever be required to attain any level of proficiency in performing these skills. Nonetheless, future related studies are needed to collect further data on similar populations, to update normative data, and to promote further important discussion for the issue of inclusion of required fitness standards for kinesiology preprofessionals.

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