Body Composition Relates Poorly to Performance in NCAA Division III Football Players

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Body Composition Relates Poorly to Performance in NCAA Division III Football Players

Abstract
We assessed body composition (height, body mass, body mass index, body fat by densitometry, fat mass, fat-free mass, and lean/fat ratio) and performance (10- and 40-yd sprints, pro shuttle run, vertical jump, sit and reach, and bench press) in 77 National Collegiate Athletic Association Division III football players. Data were analyzed by position and playing status. Significant differences ($p \leq 0.05$) were found between positions for all body composition measurements and all performance tests except the sit and reach. Starters outperformed nonstarters in all performance tests except the 10-yd sprint and sit and reach ($p \leq 0.05$). Correlations ($r$) for percent body fat and performance tests ranged from 0.52 to 0.70, and common variance with the effects of body mass removed ranged from 8 to 23%. Percent body fat is not closely correlated with results of commonly administered performance tests in Division III football players.

Keywords
anthropometry, densitometry, performance tests

Disciplines
Other Medicine and Health Sciences | Sports Sciences

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Body Composition Relates Poorly to Performance Tests in NCAA Division III Football Players

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FRANK I. KATCH,
AND DAVID E. PETRIE

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ABSTRACT

We assessed body composition (height, body mass, body mass index, body fat by densitometry, fat mass, fat-free mass, and lean/fat ratio) and performance (10- and 40-yd sprints, pre-shuttle run, vertical jump, arm, oil, grid, and hand-press) in 77 National Collegiate Athletic Association Division III football players. Data were analyzed by position and playing status. Significant differences (p < 0.05) were found between positions for all body composition measurements and all performance tests except the sit and reach. Starters outperformed nonstarters in all performance tests except the 10-yd sprint and sit and reach (p < 0.05). Correlation (r) for percent body fat and performance tests ranged from 0.52 to 0.70, and common variance with the effects of body fat ranged from 8 to 36%. Percent body fat was inversely correlated with results of commonly administered performance tests in Division III football players.

Key Words: anthropometry, densitometry, performance tests.

Introduction

Strength and conditioning programs are an integral component of most football programs. The programs are designed to improve factors believed important to success on the football field, including muscular strength and endurance, cardiovascular endurance, flexibility, agility, explosiveness, quickness, agility speed, and a good fat-muscle ratio (1). Testing often is included in the program to assess players’ strengths and weaknesses and to improve player motivation (1, 9, 13).

Numerous studies in the last 20 years have reported body composition and performance tests at the professional (15, 27, 33, 35, 37) and National Collegiate Athletic Association (NCAA) Division I (3, 4, 6, 11, 17, 23, 26, 31, 32) level. Several of these studies have focused on comparing methods of assessing body composition (17, 30) or changes in football players over time (26, 35). Other researchers have assessed body composition and performance test results among players by position (5, 6, 11, 24, 30, 33) and playing status (starters vs. nonstarters) (5, 6, 11, 24, 31).

A relationship between body composition and performance tests has been commonly assumed. In vitro, it makes sense that an increase in body fat would negatively influence athletic performance (12). Results of previous studies (7, 20, 25, 28) have suggested that an increase in body fat decreases performance on general physical fitness tests. Relatively few investigators have examined this relationship in football players (2, 8, 23). Weak (r = 0.12) to moderate (r = 0.72) positive correlations have been found between body fat and the 10-yd sprint (23), 40-yd sprint (8, 23), and bench press (2, 8, 23). The aims of the present study were to develop baseline body composition and performance test data for Division III football players by position and playing status (starters vs. nonstarters) and to investigate the influence of body fat on commonly used tests of performance that measure speed, agility, power, flexibility, and strength.

Methods

Experimental Approach to the Problem

Anthropometric characteristics and performance tests were assessed in 77 football players from Gettysburg College (Gettysburg, PA), an NCAA Division III school with a 115-year history of competition in football at this level. Testing was completed within a 2-week period after players reported to preseason camp in mid-August 2005. The team was not ranked in NCAA Division III rankings during the 2005 season. The college institutional review board approved this study, and subjects were fully informed of the purpose and nature of the study and provided informed consent.

Subjects

Players were grouped by position and status: offensive line (OL), center, guards, tackles, tight end, or (n = 13),

defensive line (DL): noseguard, tackles, n = 16, offensive backfield (OR): quarterback, running backs, receivers, kickers, n = 26, defensive backfield (DB): linebackers, corner, safety, n = 22, starters (S) = 32, nonstarters (NS) = 45. Starters were players who started in at least half of the games; nonstarters were the remaining players on the team. The authors took all of the anthropometric measurements, and members of the coaching staff administered the performance tests following guidelines established during the previous 22 years.

Height, Body Mass, and Body Mass Index

Height was measured with a meter stick to 1 decimal place, and body mass was measured on a Health O meter balance beam scale accurate to 0.025 lb. Body mass index was calculated as body mass (kg) divided by height (m)^2.

Densitometry

Prior to underwater weighing, 3 trials of seated vital capacity (ATPs) were determined according to manufacturer's directions using a Medgraphics metabolic cart. Residual lung volume was estimated from vital capacity (F(r)ETi) by the method of Wilmore (38), which revealed very close agreement between body composition measurements using measured vs. estimated residual large volumes. Body mass in water was assessed by hydrostatic weighing in the seated position at 91% ~ 95% of maximal aluminum tank. Subjects performed 10 successive trials of underwater weighing, with an approximately 1-minute rest interval between trials following procedures described previously (19). Ten repeated weighings (using an average of the last 3 trials) produce a "true" underwater weight score (18). For white players, percent body fat was determined by measuring the equation of Siri (36), where %BF = (495 - density g/ml) ÷ 450, and for black players, the Schuna equation (38) was applied, where %BF = (574.3 - density g/ml) ÷ 392.

Performance Tests

Testing was completed in 1 day. The vertical jump, sit and reach, and 1 repetition maximum (RM) bench press were administered in the morning, and the 10- and 40-yd sprints and pro shuttle were completed in the afternoon. The 10- and 40-yd sprints and the pro shuttle were run on an outdoor all-weather track. The vertical jump was performed in a gym with a wooden floor, and the 1RM bench press and sit and reach tests were carried out in a weight room. Athletes wore t-shirts, gym shorts, and running shoes, and scores were not revealed during testing. The coaches selected the performance tests, which were administered according to procedures established over the past 22 years. All the tests except the 10-yd sprint and pro shuttle run had previously established high reliability.

r = 0.970 for 40-yd sprint (10); r = 0.93 for vertical jump (16); r = 0.96 for sit and reach (22); and r = 0.97 for bench press (8).

Vertical Jump

The athlete warmed up by stretching, jogging, and doing 2 or 3 vertical jumps at approximately 6 to 8 effort. Using a flat measuring scale attached to the wall, stretching reach at the tip of the tallest dulled finger was measured to the nearest inch, with the athlete standing with the feet together and in the dominant side against the wall. Jumping reach was measured following a 24-took walkup with 1 approach step. The score was calculated as the difference between stretching reach and vertical jump reach. These trials were given with approximately 10 seconds of rest between trials, and the highest score was used to represent vertical jump ability.

Sit and Reach: Within 5 minutes of submaximal jogging and light stretching, the shoeless athlete sat with legs extended and feet placed against a box with a mounted flat measuring scale. With legs extended, the athlete bent at the hips and reached forward as far as possible, with distance recorded to the nearest 0.5 in. Zero indicates the point where the foot presses against the box. Positive values represent the distance the athlete reached beyond his toes, and negative values represent the distance the athlete fell short of reaching his toes. The highest score of 3 trials, with approximately 5 seconds of rest between trials, served as the measure of flexibility.

JEMC Bench Press. Prior to testing, the athlete performed 10 repetitions of 60% of estimated 1RM, 5 repetitions of 80% of estimated 1RM, 1 repetition at 90% of estimated 1RM. Following this warm-up, the athlete lay supine on the bench with scapulae and hips on the bench and feet flat on the floor. A spotter placed the bar in the athlete's prewarmed, chalked, ungloved hands spread slightly wider than shoulder width, with the arms extended in a position directly above the chest. The athlete lowered the bar to the chest and then pushed upward, returning the bar to the starting position. The athlete selected the starting weight for the test (estimated 1RM). If the athlete could not lift the weight using correct form after 3 attempts, the athlete selected a lower weight and repeated the test. In contrast, if the athlete could lift the weight with proper form, the athlete selected a higher weight, and the test was repeated. A 5- to 10-minute rest interval was allowed between attempts. This process was repeated until the athlete achieved 1RM. 10- and 40-yd Sprints. The sprint tests were conducted simultaneously following an approximately 10-minute warm-up of stretching and 4-20 yd sprints at 1/4, 1/3, 1/2, and 3/4 speeds. Athletes started from a 3-point stance, and timers started their stopwatches when the athlete made the first movement to sprint. One timer recorded when the athlete crossed the 10-yd line. Two other timers recorded when the
Body Composition Relates Poorly to Performance Tests in NCAA Division III Football Players

KRISTIN J. STEUMPLE,1 FRANK I. KATCH,1 AND DAVID E. PETERS1

1Department of Health and Exercise Sciences, Gettysburg College, Gettysburg, Pennsylvania 17325; 2Department of Exercise Science, University of Massachusetts, Amherst, Massachusetts 01003-9254.

ABSTRACT
We assessed body composition (height, body mass, body mass index, body fat by densitometry, fat mass, fat-free mass, and lean/fat ratio) and performance (10- and 40-yd sprints, pro shuttle run, vertical jump, vert, 30-yd, 40-yd, and broad jumps) in 77 National Collegiate Athletic Association Division III football players. Data were analyzed by position and playing status. Significant differences (p < 0.05) were found between positions for all body composition measurements and all performance tests except the sit and reach. Starters outperformed nonstarters in all performance tests except the 10-yd sprint and sit and reach (p > 0.05). Correlations (r) for percent body fat and performance tests ranged from 0.52 to 0.70, and percent fatness with the effects of body mass remained marginally significant (r = 0.26). Percent body fat was markedly correlated with results of currently administered performance tests in Division III football players.

Key Words: anthropometry, densitometry, performance tests


Introduction
Strength and conditioning programs are an integral component of most football programs. The programs are designed to improve factors believed important to success on the football field, including muscle strength endurances, cardiovascular endurance, flexibility, leg explosiveness, quickness, agility, speed, and a good fat-muscle ratio (1). Testing often is included in the program to assess player’s strengths and weaknesses and to improve player motivation (1, 2, 3).

Numerous studies in the last 20 years have reported body composition and/or performance test data at the professional (15, 27, 33, 35, 37) and National Collegiate Athletic Association (NCAA) Division I (3, 4, 6, 11, 17, 23, 24, 26, 31, 32) level. Several of these studies have focused on comparing methods of assessing body composition (17, 59) or changes in football players over time (36, 35). Other researchers have assessed body composition and performance test results among players by position (5, 6, 11, 4, 32, 33) and playing status (starter vs. nonstarter) (5, 6, 11, 24, 31).

A relationship between body composition and performance test results has commonly been assumed. Intuitively, it makes sense that an increase in body fat would negatively influence athletic performance (12). Results of previous studies (7, 20, 25, 28) have suggested that an increase in body fat decreases performance on general physical fitness tests. Relatively few investigators have examined this relationship in football players (2, 8, 23). Weak (r = 0.12) to moderate (r = 0.57) positive correlations have been found between body fat and the 10-yd sprint (23, 40-yd sprint (8, 23), and bench press (5, 25, 32).

The aims of the present study were to develop baseline body composition and performance test data for Division III football players by position and playing status (starter vs. nonstarter) and to investigate the influence of body fat on commonly used tests of performance that measure speed, agility, power, flexibility, and strength.

Methods
Experimental Approach to the Problem
Anthropometric characteristics and performance tests were assessed in 77 football players from Gettysburg College (Gettysburg, PA) on an NCAA Division III school with a 119-year history of competition in football at this level. Testing was completed within a 2-week period after players reported to preseason camp in mid-August 2005. The team was not ranked in NCAA Division III rankings during the 2005 season. The college institutional review board approved this study, and subjects were fully informed of the purpose and nature of the study and provided informed consent.

Subjects
Players were grouped by position and status: offensive line (OL), center, guard, tackle, tight end; n = 13; defensive line (DL), noseguard, tackles, n = 16, offensive backfield (DB), quarterback, running backs, running backs, kickers, n = 26, defensive backfield (DB), linebackers, corner, safety, n = 22, starters (S); n = 32, nonstarters (NS); n = 45. Starters were players who started in at least half of the games; nonstarters were the remaining players on the team.

The authors took all of the anthropometric measurements, and members of the coaching staff administered the performance tests following guidelines established during the previous 22 years.

Height, Body Mass, and Body Mass Index
Height was measured with a meter stick to 1 decimal place, and body mass was measured on a Health O Meter balance beam scale accurate to ±0.02 lb. Body mass index was calculated as body mass (kg) divided by height (m)².

Densitometry
Prior to underwater weighing, 3 trials of seated vital capacity (ATPs) were determined according to manufacturer’s directions using a MedGraphics metabolic cart. Residual lung volume was estimated from vital capacity (VT) residual lung volume = vital capacity × 0.24 according to the report of Wilmore (56), which revealed very close agreement between body composition measurements using measured vs estimated residual lung volume. Body mass was recorded by hydrostatic weighing in the seated position in kg × 0.95 × 100 cm aluminum tank. Subjects performed 10 successive trials of underwater weighing, with an approximately 1-minute rest interval between trials following procedures described previously (19). Ten repeated weighings (using an average of the last 3 trials) produced a “true” underwater weight score (18). For white players, percent body fat was estimated using the equation of Siri (56), where %fat = (495/density) – 450, and for black players, the Schaaf equation (28) was applied, where %fat = (2474/density) – 392.

Performance Tests
Testing was completed in 1 day. The vertical jump, sit and reach, and 1 repetition maximum (RM) bench press were administered in the morning, and the 10- and 40-yd sprints and pro shuttle were completed in the afternoon. The 10- and 40-yd sprints and the pro shuttle were run on an outdoor all-weather track. The vertical jump was performed in a gym with a wooden floor, and the 1RM bench press and sit-and-reach tests were carried out in a weight room. Athletes were t-shirts, gym shorts, and running shoes, and scores were not revealed during testing. The coaches selected the performance tests, which were administered according to procedures established over the past 22 years. All the tests except the 10-yd sprint and pro shuttle run had previously established reliability.

Correlation coefficient (r) values for 40-yd sprint (0.97), 10- and 40-yd sprints (0.93), vertical jump (0.96), and sit and reach (0.74) and 0.97 for each test were 0.97 for each test. The vertical jump was performed on a steel bar, using 2 doing 2 or 3 vertical jumps at approximately 0.5 in 50% effort. Using a flat measuring scale attached to the wall, stand reach on the tip of the tallest half finger was measured to the nearest inch, with the athlete standing with the feet together and in a dominant side against the wall. Jump reach was measured following a 2-4 second ramp with a 0.5 second stop. The score was calculated as the difference between standing reach and vertical jump reach. These tests were given with approximately 10 seconds of rest between trials, and the highest score was used to represent vertical jump ability.

Sit and Reach. Within 5 minutes of submaximal jogging and light stretching, the shoeless athlete sat with legs extended and feet placed against a box with a mounted flat measuring scale. With legs extended, the athlete bent at the hips and reached forward as far as possible, with distance recorded to the nearest 0.5 in. Zero points the point where the foot press against the box. Positive scores represent the distance the athlete reached beyond his toes, and negative values represent the distance the athlete fell short of reaching his toes. The highest score of 3 trials, with approximately 5 seconds of rest between trials, served as the measure of flexibility.

JEMBE Press. Prior to testing, the athlete performed 10 repetitions at 60% of estimated 1RM, 5 repetitions at 80% of estimated 1RM, and 1 repetition at 90% of estimated 1RM. Following this warm-up, the athlete lay supine on the bench with scapulas and hips on the bench and feet flat on the floor. A spotting placed the bar in the athlete’s grounded, chinked, unweighted hands spread slightly wider than shoulder width, with the arms extended in a position directly above the chest. The athlete lowered the bar to the chest and then pressed upward, returning the bar to the starting position. The athlete selected the starting weight for the test (estimated 1RM). If the athlete could not lift the weight using correct form after 3 attempts, then he selected a lower weight and repeated the test. In contrast, if he could lift the weight once with proper form, he selected a higher weight, and the test was repeated. A 5- to 10-minute rest interval was allowed between attempts. This process was repeated until the athlete achieved 1RM. 10- and 40-yd sprints. The sprint tests were conducted simultaneously following an approximately 10-minute warm-up that consisted of stretching and 20-30 yd sprints at 1/4, 3/4, and 5/4 speeds. Athletes started from a 5-point stance, and times started by the stopwatch when the athlete made the first movement to sprint. One timer recorded when the athlete crossed the 10-yard line. Two other timers recorded when the
Table 1. Anthropometric characteristics by position. *Values expressed as mean ± SD (range).

<table>
<thead>
<tr>
<th>Variable*</th>
<th>Team</th>
<th>CL</th>
<th>DL</th>
<th>LB</th>
<th>DB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>17.8 ± 1.7</td>
<td>19.1 ± 1.7</td>
<td>18.5 ± 1.2</td>
<td>17.7 ± 1.4</td>
<td>18.4 ± 1.2</td>
</tr>
<tr>
<td>HT (cm)</td>
<td>180 ± 5.1</td>
<td>179 ± 5.6</td>
<td>180 ± 5.8</td>
<td>179 ± 6.2</td>
<td>179 ± 5.3</td>
</tr>
<tr>
<td>BM (kg)</td>
<td>88.6 ± 10.9</td>
<td>101.6 ± 12.4</td>
<td>94.6 ± 7.5</td>
<td>96.6 ± 4.0</td>
<td>96.7 ± 6.5</td>
</tr>
<tr>
<td>BMI</td>
<td>27.4 ± 2.6</td>
<td>26.6 ± 2.5</td>
<td>25.5 ± 2.1</td>
<td>25.5 ± 1.7</td>
<td>27.3 ± 2.6</td>
</tr>
<tr>
<td>Waist</td>
<td>102 ± 6.7</td>
<td>105 ± 6.9</td>
<td>98 ± 5.8</td>
<td>96 ± 4.0</td>
<td>97 ± 5.3</td>
</tr>
<tr>
<td>BMIwaist</td>
<td>30 ± 2.4</td>
<td>31 ± 2.9</td>
<td>28 ± 2.2</td>
<td>27 ± 1.8</td>
<td>29 ± 2.3</td>
</tr>
<tr>
<td>BMIwaist</td>
<td>36 ± 3.0</td>
<td>35 ± 2.3</td>
<td>33 ± 2.2</td>
<td>33 ± 2.1</td>
<td>35 ± 2.5</td>
</tr>
<tr>
<td>L:F ratio</td>
<td>4.6 ± 0.5</td>
<td>4.9 ± 0.5</td>
<td>4.9 ± 0.5</td>
<td>4.9 ± 0.5</td>
<td>4.9 ± 0.5</td>
</tr>
</tbody>
</table>

* CL = offensive line; DL = defensive line; LB = linebacker; DB = defensive backfield.

Table 2. Performance tests by position. *Values expressed as mean ± SD (range).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Team</th>
<th>CL</th>
<th>DL</th>
<th>LB</th>
<th>DB</th>
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</thead>
<tbody>
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</tbody>
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* CL = offensive line; DL = defensive line; LB = linebacker; DB = defensive backfield.

Table 3. Anthropometric characteristics by position. *Values expressed as mean ± SD (range).

<table>
<thead>
<tr>
<th>Variable*</th>
<th>Team</th>
<th>Stoppers</th>
<th>Nonstopers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
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<td>17.7 ± 1.4</td>
<td>17.7 ± 1.4</td>
</tr>
<tr>
<td>HT (cm)</td>
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<tr>
<td>BMI</td>
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</tr>
<tr>
<td>Waist</td>
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<tr>
<td>BMIwaist</td>
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</tr>
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<td>35 ± 2.3</td>
<td>33 ± 2.2</td>
</tr>
<tr>
<td>L:F ratio</td>
<td>4.6 ± 0.5</td>
<td>4.9 ± 0.5</td>
<td>4.9 ± 0.5</td>
</tr>
</tbody>
</table>

* CL = bright; BM = body mass; BM = body mass index; FM = fat mass; FM = fat mass; L:F ratio = Lean:fat ratio.

Discussion
The present study provides both comparative data by position and status for football players and performance tests in Division III football players and addresses the crucial time-honored concern that body composition is related to performance deemed important at all levels in football. We assessed body composition by hydrostatic weighing, a criterion (valid) method with high reliability (31), and commonly administered "football" tests of speed, agility, power, flexibility, and muscular strength with previously established high reliability (5, 10, 16, 22).

The results of this study suggest that neither body mass nor percent fat body can be used to predict performance with any degree of confidence. The highest significant correlation with body mass was found for the 40-yd sprint (r = 0.48), which still accounted for only 41% of the common variance. This result was not entirely surprising because heavy athletes do not necessarily do poorly on running tests. Heavy athletes who are also overly fat might perform poorly in running tests, whereas heavy athletes with low lean mass might perform well.
Table 1. Anthropometric characteristics by position. *Values expressed as mean ± SD (range).

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<tr>
<th>Variable</th>
<th>Team</th>
<th>OL</th>
<th>DL</th>
<th>LB</th>
<th>DB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>18.4±1.3</td>
<td>19.6±1.3</td>
<td>18.5±1.2</td>
<td>19.0±1.4</td>
<td>18.4±1.2</td>
</tr>
<tr>
<td>HT (m)</td>
<td>176.2±9.8</td>
<td>176.0±10.0</td>
<td>175.0±10.8</td>
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<tr>
<td>BM (kg)</td>
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<td>76.3±12.0</td>
<td>76.0±10.9</td>
<td>76.0±10.7</td>
<td>76.0±10.9</td>
</tr>
<tr>
<td>BMI</td>
<td>25.4±2.9</td>
<td>25.6±3.0</td>
<td>25.5±2.9</td>
<td>25.5±2.9</td>
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<tr>
<td>%BF</td>
<td>17.2±3.4</td>
<td>17.3±3.9</td>
<td>17.4±3.9</td>
<td>17.4±3.9</td>
<td>17.4±3.9</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>23.6±3.5</td>
<td>23.6±3.5</td>
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<tr>
<td>LM (kg)</td>
<td>72.0±6.7</td>
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<td>72.0±6.7</td>
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<td>72.0±6.7</td>
</tr>
<tr>
<td>L:F ratio</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
</tr>
</tbody>
</table>

* OL = offensive line; DL = defensive line; LB = linebacker; DB = defensive back.

Table 2. Performance tests by position. *Values expressed as mean ± SD (range).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Team</th>
<th>OL</th>
<th>DL</th>
<th>LB</th>
<th>DB</th>
</tr>
</thead>
<tbody>
<tr>
<td>V̇O₂ (mL · kg⁻¹ · min⁻¹)</td>
<td>44.9±5.0</td>
<td>44.9±5.0</td>
<td>44.9±5.0</td>
<td>44.9±5.0</td>
<td>44.9±5.0</td>
</tr>
<tr>
<td>V̇O₂ max (mL · kg⁻¹ · min⁻¹)</td>
<td>51.0±5.0</td>
<td>51.0±5.0</td>
<td>51.0±5.0</td>
<td>51.0±5.0</td>
<td>51.0±5.0</td>
</tr>
<tr>
<td>VO₂ max (mL · kg⁻¹ · min⁻¹)</td>
<td>0.76±0.06</td>
<td>0.76±0.06</td>
<td>0.76±0.06</td>
<td>0.76±0.06</td>
<td>0.76±0.06</td>
</tr>
<tr>
<td>VO₂ max LM (mL · kg⁻¹ · min⁻¹)</td>
<td>1.10±0.10</td>
<td>1.10±0.10</td>
<td>1.10±0.10</td>
<td>1.10±0.10</td>
<td>1.10±0.10</td>
</tr>
<tr>
<td>L:F ratio</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
<td>0.32±0.04</td>
</tr>
</tbody>
</table>

* OL = offensive line; DL = defensive line; LB = linebacker; DB = defensive back.

Discussion

The present study provides both comparative data by position and status for football players in Division III and addresses the crucial time-honored concern that body composition and performance tests are necessary for football players and addresses the crucial time-honored concern that body composition and performance tests are necessary for football players.

The results of this study suggest that neither body mass nor percentage body fat can be used to predict performance with any degree of confidence. The highest significant correlation with body mass was found for the 40-yard sprint (r = 0.64), which still accounted for only 41% of the variance. This result was not entirely surprising because high athletes do not necessarily do poorly on running tests. Heavy athletes who are also overly fat might perform poorly in running tests, whereas heavy athletes with high lean mass might perform well.
Table 4. Performance tests by playing status. Values expressed as mean ± SD (range).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Team Starters</th>
<th>Team Nonstarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-yd (t)</td>
<td>5.6 ± 0.3</td>
<td>5.6 ± 0.6</td>
</tr>
<tr>
<td>40-yd (t)</td>
<td>6.3 ± 0.3</td>
<td>6.3 ± 0.4</td>
</tr>
<tr>
<td>PS (s)</td>
<td>4.4 ± 0.4</td>
<td>4.4 ± 0.4</td>
</tr>
<tr>
<td>VJ (cm)</td>
<td>110.0 ± 15.0</td>
<td>110.0 ± 15.0</td>
</tr>
<tr>
<td>S/R (m)</td>
<td>13.1 ± 0.9</td>
<td>13.1 ± 0.9</td>
</tr>
<tr>
<td>BF (kg)</td>
<td>116.0 ± 15.0</td>
<td>116.0 ± 15.0</td>
</tr>
</tbody>
</table>

*Intt* significantly different from nonstarters.

Intuitively, this says that existing body fat should not affect performance; however, this assumption was not supported by the data. Correlations between percent body fat and performance were not significantly different from 0.32 to 0.70, indicating no significant correlation. Fat-free mass was found to be independent of percent body fat and performance. Total body water, percent body fat, and body density were not significantly correlated. This approach permits the net relationship between percent body fat and performance to emerge without the confounding influence of body mass. All partial correlations between percent body fat and performance were diminished, ranging from 8 to 25% of the common variance compared with 25-40% of the common variance for zero-order correlations on the same variables. This analysis further reveals the specificity among the variables, providing confirming evidence that test performance in the area assessed is better suited to percent body fat.

To our knowledge, this is the only third study of NCAAA Division I football players and is the first to measure body composition with the criteria method of densitometry. The extensive survey of 19 schools, including 6 Division II schools, by Fry and Kraemer (19x1) in 1991 produced the first published performance test data for Division I football players. Subsequently, Schmidt (29x7) in 1999 reported preseason testing results for a Division II football team. Athletes in the present study were shorter (1%) and lighter (7%) than athletes in Schmidt's study (29x7). When comparing performance test results, the athletes in this study were slightly slower (2%) in the 40-yd sprint than athletes in the Fry and Kraemer study (29x4). Vertical jump scores were virtually identical to jump scores in the Schmidt study (29x7) but were 4% lower than those in the Fry and Kraemer survey (14x4). Flexibility findings were essentially identical to those of Schmidt (29x7). In this study, 3M bench press scores were lower than those reported by Fry and Kraemer (14x4) and Schmidt (14x4).

When data were analyzed by position, the results confirmed the findings of others (3, 5, 6, 11, 14, 24, 29, 32, 33) that significant differences occur among positions for body composition and performance test scores. Analysis of performance test data by playing status confirmed significant differences reported in previous reports (3, 5, 6, 11, 14, 24, 29, 33) that test results can distinguish starters from nonstarters.

Practical Applications

This study provides the first body composition data for Division II football players using the criterion method of densitometry and provides results for common performance tests that measure speed, agility, power, flexibility, and strength. However, it also provides evidence that percent body fat is not correlated with performance in these general tests. Because each test assesses characteristics believed important to football ability, does it follow that performance on the football field is unrelated to percent body fat? A certain amount of fat may be valuable for football players, particularly linemen, because the fat allows a cushion to help protect the body from the constant violent contact of the sport. However, the effect of an increased percent body fat on the wellbeing of the athlete is a different story.

Note: Frank Kent is retired and currently living in Santa Barbara, CA.
Table 1. Performance tests by playing status. Values expressed as mean ± SD (range).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Team Starters</th>
<th>Nonstarters</th>
<th>n = 77</th>
<th>n = 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Y (t)</td>
<td>1.6 ± 0.1</td>
<td>1.6 ± 0.1</td>
<td>1.6 ± 0.1</td>
<td>1.6 ± 0.1</td>
</tr>
<tr>
<td>40 Y (t)</td>
<td>4.8 ± 0.3</td>
<td>4.8 ± 0.3</td>
<td>4.8 ± 0.3</td>
<td>4.8 ± 0.3</td>
</tr>
<tr>
<td>PS (s)</td>
<td>4.0 ± 0.2</td>
<td>4.0 ± 0.2</td>
<td>4.0 ± 0.2</td>
<td>4.0 ± 0.2</td>
</tr>
<tr>
<td>SJ (m)</td>
<td>11.5 ± 1.0</td>
<td>11.5 ± 1.0</td>
<td>11.5 ± 1.0</td>
<td>11.5 ± 1.0</td>
</tr>
<tr>
<td>5x15m (m)</td>
<td>44.5 ± 1.0</td>
<td>44.5 ± 1.0</td>
<td>44.5 ± 1.0</td>
<td>44.5 ± 1.0</td>
</tr>
<tr>
<td>3RM bench press</td>
<td>20.5 ± 2.0</td>
<td>20.5 ± 2.0</td>
<td>20.5 ± 2.0</td>
<td>20.5 ± 2.0</td>
</tr>
</tbody>
</table>

Intention tells us that excessive body fat should negatively affect performance; however, this assumption was not supported by the data. Correlations between percent body fat and performance tests were only 0.23 to 0.57, accounting for only 27 to 49% of the common variance. These findings are similar to those for women. Intention reduces the correlation between variables (e.g., percent body fat and 10-year sprint) by misinterpreting the relationship between the variables. In this case, percent body fat and 10-year sprint are not related because the correlation can be influenced by body mass. To avoid this problem, partial correlations were calculated between percent body fat and performance tests, with body mass held statistically constant. This approach permits the net relationship between percent body fat and performance to emerge without the confounding influences of body mass. All partial correlations between percent body fat and performance were determined, ranging from 8 to 23% of the common variance, compared with 27 to 49% of the common variance for zero-order correlations on the same variables. This analysis further reveals the specificity among the variables, providing confirming evidence that performance tests in the area assessed is poorly related to percent body fat.

To our knowledge, this is only the third study of NCAA Division I football players and is the first to measure body composition with the criterion method of densitometry. The extensive survey of 19 schools, including 6 Division I schools, by Fry and Kraemer (14) in 1991, produced the first published performance test data for Division I football players. Subsequently, Schmidt (29) in 1999 reported preseason testing results for a Division I football team. Athletes in the present study were shorter (1%) and lighter (7%) than athletes in Schmidt's study (29). When comparing performance tests results, the athletes in this study were slightly slower (7%) in the 40-yard sprint than athletes in the Fry and Kraemer study (14). Vertical jump scores were virtually identical to jump scores in the Schmidt study (29) but were 14% lower than those in the Fry and Kraemer survey (14). Flexibility was essentially identical to that of Schmidt (39). In this study, the median bench press score was lower than that reported by Fry and Kraemer (1476 ± 168) and Schmidt (1939 ± 259).

When data were analyzed by position, the results confirmed the findings of others (3, 13, 11, 14, 24, 25, 32, 33) that significant differences occur among positions for body composition and performance test scores. Analysis of performance test data by playing status confirmed status-specific proven reports (3, 13, 14, 16, 24, 25, 33) that test results can distinguish starters from nonstarters.

Practical Applications

This study provides the first body composition data for Division I football players using the criterion method of densitometry and provides results for common performance tests that measure speed, agility, power, flexibility, and strength. However, it also provides evidence that percent body fat is not correlated with performance in these general tests. Because such tests assess characteristics believed important for football ability, does it follow that performance on the football field is unrelated to percent body fat? A certain amount of fat may be valuable for football players, particularly linemen, because the fat acts as a cushion to protect the body from the constant violent contact of the sport. However, the effect of an increased percent body fat on the health of the athlete is a different story. Note: Frank Kent is retired and currently living in Santa Barbara, CA.

References


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