Changes in the Athletic Profile of Elite College American Football Players

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Abstract

Robbins, DW, Goodale, TL, Kuzmits, FE, and Adams, AJ. Changes in the athletic profile of elite college American football players. *J Strength Cond Res* 27(4): 861–874, 2013—The purpose of this study was to compare positional anthropometric and National Football League (NFL) Combine performance levels in elite college American football players over the 3-year period from 1999 to 2001 to the 3-year period from 2008 to 2010. The sample included 15 offensive and defensive positions, and only those players invited to the combine and subsequently drafted in the same year ($n = 1{,}712$) were included in the study. Data from 10 combine physical tests were examined, including weight; height; the 9.1-, 18.3-, and 36.6-m sprints; the vertical and horizontal jumps; the 18.3-m shuttle run; the 3-cone drill; and the 102.1-kg bench press for maximum repetitions. Independent samples *t*-tests detected differences for each of the 15 positions ($p < 0.05$). There were no discernible trends in height and weight over the period in question, whereas players in the more recent group significantly improved performance in straight sprinting, the 3-cone drill, and the horizontal jump. Findings suggest that these tests better reflect characteristics such as explosiveness and first-step quickness as compared with the 18.3-m shuttle and the vertical jump, and that such characteristics have become more highly sought after by NFL coaches and scouts. The results of the present research suggest that the position-specific profiles changed over a relatively short period of time. Coaches and practitioners will be able to use the findings of this research to better prepare athletes for entry into the NFL.

Key Words NFL Combine, National Football League, position, performance testing, sprint

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Introduction

A number of changes (e.g., rules, roster, and salary) have been implemented by the National Football League (NFL) over the past 20 years. For example, in recent years, changes have been made to overtime rules, creating the potential for longer games. It may be that changes have influenced the game of American football and that certain changes have been accompanied by revisions in tactical methodologies concerning the player selection process. It is possible that tactical revisions have led NFL team coaches and managers to aggressively draft college players with certain physical attributes, such as speed, change-of-direction ability, and jumping ability. In addition to a possible rule-driven evolution of positional athletic and anthropometric profiles necessary to succeed at high levels of American college and professional football, advances in training methodologies underlying the development of elite athletes may also contribute to dynamic physical profiles at advanced levels. Albeit over longer periods of time, as compared with that of interest in the current study (1999–2010), athletic profiles of elite athletes have been shown to change over time (4). It is generally accepted that the physical profiles of athletes are continually evolving in a progressive manner, and as a result, both collegiate and professional football performance is continually elevating. Regardless of the sport, it would be hard to argue that both the level of performance and competition does not elevate with time.

Among other things, American football requires speed, change-of-direction ability, strength, and power. It is quite possible that today's elite players, as compared with players of the past, excel with respect to these physical characteristics. Anecdotal statements suggesting that players are continually becoming bigger, faster, more powerful, and stronger are commonplace. Nonetheless, scientific evidence supporting such statements is scarce.

The NFL holds an annual player assessment process termed "the combine," at which the most promising collegiate players—generally between 300 and 350 per year—are subjected to anthropometric assessments (weight and height), physical skills tests, position-specific drills, interviews, medical and drug tests, and mental ability tests. The battery of physical tests is designed to measure, among other things, speed, power, change-of-direction ability, and

strength. The data from these tests provide excellent measures of the physical abilities of players being drafted into the NFL. Although these data have been previously examined for various reasons, research investigating the physical abilities of players entering the NFL over time is absent.

The purpose of the present study was to compare positional anthropometric and physical skill levels at the NFL Combine over the 3-year period from 1999 to 2001 to similar measures over the 3-year period from 2008 to 2010 and to provide support for the hypothesis that the profiles of physical abilities of athletes entering the NFL have changed over this time frame.

Methods

Experimental Approach to the Problem

National Football League Combine data were examined to determine if changes in weight, height, sprint speed, change-of-direction ability, jump ability, and upper-body strength have occurred over the years 2008–10, as compared with 1999–2001. Data were examined and the results are presented by player position.

Subjects

Players who attended the combine from 1999 to 2001 and 2008 to 2010 and who were drafted in the same year they attended the combine were included in the study. Those players invited to the combine but not selected in the subsequent draft were not included. It is also possible that data for certain players invited to the combine and subsequently drafted the same year have not been obtained. Data were collected from NFLdraftscout.com. Data from this Web site are deemed accurate. Place kickers and punters were not included because players in these positions are required to perform 1 physical test (36.6-m sprint) only. Although a total of 1,712 players were included in the study, all combine draftees did not necessarily complete all physical tests making up the combine; for example, the quarterback and wide receiver positions are exempt from performing the bench press test. In addition, injuries may have also prevented a combine participant from performing certain drills. As data analysis was performed by player position, results have been calculated from samples much smaller than 1,712. Sample sizes are presented for each result. Institutional review was considered a nonissue because of the retrospective nature of the current study and the fact that no names are revealed. Furthermore, all data were retrieved from public access domains.

Procedures

Data from the following combine tests were analyzed. In addition to the 8 performance tests described in the following, weight and height data were also analyzed.

Sprint: 36.6 meters. From a 3-point stance, players run 36.6 m as fast as possible. Split times are also recorded at 9.1 and

Table 1. Anthropometric and performance outcomes in elite college American football centers attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	140.88* (±7.89), *n* = 41	191.41 (±2.74), *n* = 33	1.82 (±0.07), *n* = 24	3.05 (±0.11), *n* = 24	5.34 (±0.21), *n* = 24	4.64 (±0.19), *n* = 23	7.81 (±0.29), *n* = 23	29.10* (±2.85), *n* = 24	102.58 (±7.28), *n* = 24	23.92 (±6.35), *n* = 26
2008–10	137.34 (±3.01), *n* = 20	191.72 (±4.27), *n* = 20	1.76* (±0.05), *n* = 17	2.96* (±0.06), *n* = 17	5.21* (±0.14), *n* = 17	4.67 (±0.18), *n* = 18	7.62* (±0.21), *n* = 18	26.91 (±3.09), *n* = 17	101.22 (±6.16), *n* = 17	26.31 (±4.92), *n* = 16

*Denotes significantly different anthropometry or performance.

Table 2. Anthropometric and performance outcomes in elite college American football cornerbacks attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	86.45 (±4.75), *n* = 93	183.49* (±8.23), *n* = 92	1.59 (±0.05), *n* = 74	2.63 (±0.07), *n* = 74	4.53 (±0.10), *n* = 74	4.15* (±0.16), *n* = 65	7.06 (±0.27), *n* = 64	36.21* (±2.52), *n* = 74	119.07 (±4.35), *n* = 76	13.57 (±3.56), *n* = 56
2008–10	87.72* (±3.48), *n* = 90	180.44 (±3.35), *n* = 90	1.50* (±0.05), *n* = 66	2.56* (±0.05), *n* = 66	4.47* (±0.08), *n* = 66	4.20 (±0.12), *n* = 53	6.94* (±0.20), *n* = 55	35.34 (±2.93), *n* = 65	121.79* (±5.80), *n* = 67	16.06* (±4.50), *n* = 63

*Denotes significantly different anthropometry or performance.

Table 3. Anthropometric and performance outcomes in elite college American football defensive ends attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	123.31 (±6.60), *n* = 83	192.63 (±3.35), *n* = 83	1.72 (±0.05), *n* = 66	2.84 (±0.08), *n* = 66	4.91 (±0.14), *n* = 66	4.42* (±0.16), *n* = 65	7.49 (±0.29), *n* = 64	32.85 (±3.33), *n* = 65	112.43 (±6.04), *n* = 65	22.28 (±4.18), *n* = 58
2008–10	122.68 (±5.90), *n* = 54	192.94 (±3.96), *n* = 53	1.63* (±0.06), *n* = 41	2.76* (±0.07), *n* = 41	4.81* (±0.12), *n* = 41	4.53 (±0.16), *n* = 35	7.38* (±0.021), *n* = 35	32.53 (±3.41), *n* = 38	114.51 (±6.98), *n* = 37	24.95* (±5.07), *n* = 38

*Denotes significantly different anthropometry or performance.

Table 4. Anthropometric and performance outcomes in elite college American football defensive tackles attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	122.20 (±6.65), *n* = 81	191.11 (±3.96), *n* = 81	1.78 (±0.06), *n* = 67	2.95 (±0.09), *n* = 67	5.11 (±0.17), *n* = 67	4.56* (±0.20), *n* = 57	7.76 (±0.32), *n* = 56	29.63 (±2.36), *n* = 58	103.25 (±13.84), *n* = 59	24.92 (±6.17), *n* = 64
2008–10	140.40* (±6.45), *n* = 56	190.20 (±3.35), *n* = 56	1.71* (±0.07), *n* = 44	2.90* (±0.11), *n* = 44	5.07 (±0.17), *n* = 44	4.72 (±0.17), *n* = 36	7.74 (±0.30), *n* = 35	29.23 (±3.40), *n* = 44	104.02 (±5.77), *n* = 40	29.52* (±5.65), *n* = 42

*Denotes significantly different anthropometry or performance.

Table 5. Anthropometric and performance outcomes in elite college American football free safeties attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	90.91 (±4.64), *n* = 41	184.40 (±3.66), *n* = 41	1.61 (±0.04), *n* = 32	2.66 (±0.06), *n* = 32	4.58 (±0.09), *n* = 32	4.20* (±0.12), *n* = 31	7.10 (±0.22), *n* = 31	36.24 (±1.91), *n* = 33	119.10 (±4.39), *n* = 33	15.67 (±3.42), *n* = 33
2008–10	94.51* (±3.75), *n* = 27	184.71 (±3.05), *n* = 27	1.51* (±0.05), *n* = 27	2.55* (±0.06), *n* = 20	4.52* (±0.11), *n* = 20	4.29 (±0.09), *n* = 17	7.01 (±0.23), *n* = 17	36.15 (±3.43), *n* = 20	120.85 (±8.35), *n* = 20	17.05 (±3.93), *n* = 21

*Denotes significantly different anthropometry or performance.

Table 6. Anthropometric and performance outcomes in elite college American football fullbacks attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	110.89 (±6.75), $n = 27$	183.18 (±3.96), $n = 27$	1.66 (±0.05), $n = 25$	2.75 (±0.09), $n = 25$	4.76 (±0.17), $n = 25$	4.36 (±0.22), $n = 21$	7.43 (±0.44), $n = 21$	33.00 (±2.65), $n = 25$	111.91 (±5.46), $n = 25$	21.61 (±6.29), $n = 23$
2008–10	110.40 (±4.05), $n = 12$	183.80 (±4.27), $n = 12$	1.57* (±0.04), $n = 12$	2.67* (±0.05), $n = 12$	4.68 (±0.07), $n = 12$	4.36 (±0.11), $n = 7$	7.14* (±0.16), $n = 7$	32.89 (±3.41), $n = 9$	114.56 (±4.28), $n = 9$	24.90 (±4.51), $n = 10$

*Denotes significantly different anthropometry or performance.

Table 7. Anthropometric and performance outcomes in elite college American football inside linebackers attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	110.45 (±3.42), $n = 41$	186.84 (±3.96), $n = 41$	1.67 (±0.06), $n = 35$	2.76 (±0.09), $n = 35$	4.80 (±0.13), $n = 33$	4.33 (±0.10), $n = 33$	7.45 (±0.26), $n = 33$	33.15 (±2.45), $n = 32$	112.64 (±4.54), $n = 32$	20.28 (±4.80), $n = 36$
2008–10	109.73 (±2.64), $n = 29$	186.54 (±3.05), $n = 29$	1.56* (±0.05), $n = 21$	2.69* (±0.08), $n = 21$	4.72* (±0.13), $n = 17$	4.35 (±0.12), $n = 17$	7.12* (±0.25), $n = 20$	32.75 (±3.36), $n = 21$	115.00* (±5.41), $n = 21$	24.36* (±3.49), $n = 22$

*Denotes significantly different anthropometry or performance.

Table 8. Anthropometric and performance outcomes in elite college American football offensive guards attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	141.03 (±6.30), $n = 92$	193.85 (±3.66), $n = 92$	1.85 (±0.07), $n = 80$	3.07 (±0.09), $n = 80$	5.34 (±0.18), $n = 80$	4.74 (±0.19), $n = 75$	7.97 (±0.31), $n = 72$	28.04* (±2.81), $n = 80$	99.41 (±5.74), $n = 77$	23.97 (±4.79), $n = 76$
2008–10	143.10 (±5.61), $n = 33$	193.85 (±2.74), $n = 33$	1.79* (±0.05), $n = 23$	3.02* (±0.07), $n = 23$	5.24* (±0.16), $n = 23$	4.80 (±0.19), $n = 14$	7.75* (±0.29), $n = 14$	26.68 (±3.69), $n = 19$	101.52 (±7.31), $n = 14$	27.04* (±6.36), $n = 23$

*Denotes significantly different anthropometry or performance.

Table 9. Anthropometric and performance outcomes in elite college American football offensive tackles attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	146.04* (±9.66), $n = 67$	198.12 (±3.96), $n = 67$	1.86 (±0.07), $n = 56$	3.08 (±0.11), $n = 56$	5.35 (±0.21), $n = 56$	4.81 (±0.55), $n = 49$	7.97 (±0.37), $n = 48$	27.92 (±3.47), $n = 53$	99.19 (±13.76), $n = 53$	24.03 (±4.94), $n = 61$
2008–10	143.00 (±4.64), $n = 55$	197.82 (±3.35), $n = 55$	1.77* (±0.06), $n = 44$	2.98* (±0.09), $n = 44$	5.22* (±0.18), $n = 44$	4.76 (±0.16), $n = 40$	7.74* (±5.34), $n = 39$	27.52 (±3.67), $n = 43$	102.76 (±5.82), $n = 41$	25.92* (±5.34), $n = 48$

*Denotes significantly different anthropometry or performance.

Table 10. Anthropometric and performance outcomes in elite college American football outside linebackers attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	109.50 (±4.87), *n* = 68	188.98* (±3.96), *n* = 68	1.66 (±0.06), *n* = 53	2.75 (±0.09), *n* = 53	4.76 (±0.15), *n* = 53	4.29* (±0.14), *n* = 50	7.33 (±0.27), *n* = 46	33.85 (±2.43), *n* = 51	114.84 (±4.57), *n* = 52	20.08 (±4.03), *n* = 52
2008–10	109.34 (±5.12), *n* = 67	187.76 (±3.05), *n* = 67	1.57* (±0.04), *n* = 56	2.68* (±0.07), *n* = 56	4.67* (±0.09), *n* = 56	4.34 (±0.14), *n* = 46	7.07* (±0.19), *n* = 47	34.04 (±3.24), *n* = 51	116.88* (±5.48), *n* = 51	23.78* (±4.99), *n* = 50

*Denotes significantly different anthropometry or performance.

Table 11. Anthropometric and performance outcomes in elite college American football quarterbacks attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)
1999–2001	98.73 (±5.35), *n* = 61	188.67 (±3.96), *n* = 61	1.69 (±0.07), *n* = 56	2.82 (±0.11), *n* = 56	4.87 (±0.20), *n* = 56	4.37 (±0.17), *n* = 52	7.29 (±0.49), *n* = 50	31.83* (±3.57), *n* = 53	108.32 (±6.72), *n* = 55
2008–10	101.82* (±4.92), *n* = 35	191.72* (±3.96), *n* = 35	1.63* (±0.05), *n* = 28	2.76* (±0.08), *n* = 28	4.82 (±0.14), *n* = 28	4.39 (±0.13), *n* = 26	7.11* (±0.21), *n* = 25	30.20 (±3.86), *n* = 25	109.15 (±5.27), *n* = 27

*Denotes significantly different anthropometry or performance.

Table 12. Anthropometric and performance outcomes in elite college American football running backs attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	96.66 (±7.65), $n = 86$	184.40* (±8.23), $n = 86$	1.61 (±0.05), $n = 68$	2.66 (±0.07), $n = 68$	4.59 (±0.12), $n = 68$	4.20* (±0.16), $n = 56$	7.09 (±0.22), $n = 56$	35.01 (±3.35), $n = 63$	117.54 (±5.84), $n = 63$	18.00 (±4.18), $n = 59$
2008–10	97.30 (±5.87), $n = 51$	181.05 (±3.96), $n = 51$	1.51* (±0.05), $n = 44$	2.58* (±0.07), $n = 44$	4.49* (±0.11), $n = 44$	4.28 (±0.14), $n = 29$	6.96* (±0.19), $n = 31$	34.42 (±3.20), $n = 44$	119.27 (±6.40), $n = 44$	21.45* (±3.92), $n = 38$

*Denotes significantly different anthropometry or performance.

Table 13. Anthropometric and performance outcomes in elite college American football strong safeties attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	94.97 (±4.32), $n = 41$	184.20 (±4.20), $n = 41$	1.60 (±0.05), $n = 32$	2.66 (±0.07), $n = 32$	4.60 (±0.10), $n = 32$	4.17 (±0.16), $n = 29$	7.13 (±0.19), $n = 27$	36.50 (±2.58), $n = 32$	119.10 (±6.05), $n = 33$	16.50 (±5.44), $n = 30$
2008–10	99.45* (±3.62), $n = 22$	183.31 (±3.30), $n = 22$	1.54* (±0.05), $n = 17$	2.57* (±0.05), $n = 17$	4.52* (±0.08), $n = 17$	4.25 (±0.13), $n = 11$	7.09 (±0.21), $n = 11$	35.20 (±3.05), $n = 15$	119.27 (±4.54), $n = 15$	19.89* (±5.11), $n = 18$

*Denotes significantly different anthropometry or performance.

Table 14. Anthropometric and performance outcomes in elite college American football tight ends attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
1999–2001	116.81* (±5.17), $n = 57$	183.80 (±3.35), $n = 57$	1.70 (±0.06), $n = 50$	2.80 (±0.18), $n = 50$	4.85 (±0.33), $n = 50$	4.35 (±0.17), $n = 46$	7.34 (±0.29), $n = 46$	32.43 (±3.08), $n = 51$	110.91 (±5.97), $n = 49$	24.73 (±35.82), $n = 44$
2008–10	114.10 (±4.23), $n = 47$	194.46* (±3.05), $n = 47$	1.59* (±0.06), $n = 32$	2.69* (±0.08), $n = 32$	4.71* (±0.13), $n = 32$	4.39 (±0.14), $n = 28$	7.10* (±0.23), $n = 28$	32.85 (±3.77), $n = 33$	115.63* (±5.32), $n = 30$	21.72 (±3.24), $n = 36$

*Denotes significantly different anthropometry or performance.

Table 15. Anthropometric and performance outcomes in elite college American football wide receivers attending the National Football League Combine and subsequently drafted for the years 1999–2001 and 2008–10 (mean ± *SD*).

Year	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)
1999–2001	89.54 (±7.11), $n = 143$	186.54 (±6.40), $n = 143$	1.59 (±0.05), $n = 112$	2.65 (±0.06), $n = 112$	4.56 (±0.11), $n = 112$	4.16* (±0.14), $n = 89$	7.15 (±0.22), $n = 88$	35.80* (±2.85), $n = 114$	117.88 (±5.95), $n = 115$
2008–10	91.77* (±6.74), $n = 92$	185.32 (±6.10), $n = 92$	1.51* (±0.04), $n = 73$	2.58* (±0.06), $n = 73$	4.47* (±0.10), $n = 73$	4.30 (±0.15), $n = 57$	6.92* (±0.18), $n = 51$	34.50 (±3.71), $n = 67$	119.80* (±5.82), $n = 64$

*Denotes significantly different anthropometry or performance.

Table 16. Directional summary of significant differences between the 1999–2001 and 2008–10 groups by position and measure.*

Position	Weight (kg)	Height (cm)	9.1-m sprint (s)	18.3-m sprint (s)	36.6-m sprint (s)	18.3-m shuttle (s)	Three-cone drill (s)	Vertical jump (cm)	Horizontal jump (cm)	Bench press (no.)
Center	−		+	+	+		+	−		
Cornerback	+	−	+	+	+	−	+	−	+	+
Defensive end			+	+	+	−	+			+
Defensive tackle	+		+	+		−				+
Free safety	+		+	+	+	−				
Fullback			+	+			+			
Inside linebacker			+	+	+		+		+	+
Offensive guard			+	+	+		+	−		+
Offensive tackle	−		+	+	+		+			+
Outside linebacker		−	+	+	+	−	+		+	+
Quarterback	+	+	+	+			+	−		N/A
Running back		−	+	+	+	−	+			+
Strong safety	+		+	+	+					+
Tight end	−	+	+	+	+		+		+	
Wide receiver	+		+	+	+	−	+	−	+	N/A

*"+" = significantly greater anthropometry or better performance in the 2008–10 group; "−" = significantly lesser anthropometry or worse performance in the 2008–10 group; N/A = not applicable.

18.3 m. Thus, the 36.6-m sprint test provides 3 separate outcome measures.

Shuttle: 18.3 meters. From the starting position, players run 4.6 m in one direction, quickly change direction and run 9.1 m in the opposite direction, and then change direction again and run a final 4.6 m in the opposite direction (i.e., the direction initially run). The test is run in both directions (i.e., left and right) for maximal speed, and the average of the 2 tests is recorded as the score. The 18.3-m shuttle run measures change-of-direction ability (1).

Three-Cone Drill. Players run around 3 cones placed in the shape of an "L," with 4.6 m between each cone. From a 3-point stance, players run a predetermined route as quickly as possible. The 3-cone drill also measures change-of-direction ability (3).

Vertical Jump. Jump height is measured using a device (e.g., Vertec) whereby players jump for maximal height from a standing 2-footed position in a countermovement manner using arm swing. At the peak of the jump, the player reaches as high as possible with a single hand to move horizontal vanes of the Vertec. Vertical jump height is calculated by subtracting the player's standing-reach height from the height of the highest vane moved.

Horizontal Jump. Horizontal jump distance is measured. From a standing 2-footed position, players jump forward for maximal distance using a countermovement and arm swing. Jump distance is measured as the distance from the start line to the nearest body part upon landing (this is typically the point of heel contact).

Bench Press. Players bench press 102.1 kg for maximum repetitions to measure upper-body strength. The bar must touch and briefly pause on the chest before being returned to the start position, of full-arm extension, for a repetition to be deemed countable. Because of the achievement of high repetitions (Tables 1–15), this test is considered a measure of upper-body strength endurance.

Statistical Analyses

To determine if differences exist within each of the 15 positions sampled over the two 3-year periods examined, independent samples *t*-tests were performed comparing the mean scores of the anthropometric and performance measures. The dependent variables compared across years were height in centimeters; weight in kilograms; time in seconds to complete the 18.3-m shuttle run; the 3-cone drill; the 9.1-, 18.3-, and 36.6-m sprints; vertical and horizontal jump distances in centimeters; and number of repetitions completed in the 102.1-kg bench press. Analysis of the data to determine if any significant differences existed between the sample groups was performed to investigate the comparative levels of physical profile at the 2 time periods. All statistical tests were completed using SPSS version 19 (SPSS, Inc., Chicago, IL, USA).

Results

Anthropometric and performance characteristics, means and *SDs*, are presented by player position in Tables 1–15. Differences were detected in multiple measures at each of the 15 positions ($p < 0.05$). A directional summary of these differences is presented in Table 16. Of the 15 positions, players in 3 (centers, offensive tackles, and tight ends) were lighter and in 6 were heavier (cornerbacks, defensive tackles, free safeties, quarterbacks, strong safeties, and tight ends) in the 2008–10, as compared with the 1999–2001, group. With respect to height, players in 3 positions were shorter (cornerbacks, outside linebackers, and running backs) and in 2 (quarterbacks and tight ends) were taller in the 2008–10, as compared with the 1999–2001, group. Over the 3 straight sprint distances, every position was faster in 2 or 3 of the distances in the 2008–10, as compared with the 1999–2001, group. Players in 7 (cornerbacks, defensive ends, defensive tackles, free safeties, outside linebackers, running backs, and wide receivers) of the 15 positions exhibited worse performance in the 18.3-m shuttle in the 2008–10, as compared with the 1999–2001, group. With the exception of defensive tackles and safeties, all positions exhibited better performance in the 3-cone drill in the 2008–10, as compared with the 1999–2001, group. Regarding the jump measures, players in 5 positions exhibited worse performance in the vertical jump (centers, cornerbacks, offensive guards, quarterbacks, and wide receivers) and players in 5 positions (cornerbacks, inside and outside linebackers, tight ends, and wide receivers) exhibited better performance in the horizontal jump in the 2008–10, as compared with the 1999–2001, group. Of the players in the 13 positions performing the bench press, all but 4 (centers, free safeties, fullbacks, and tight ends) displayed enhanced performance in the 2008–10, as compared with the 1999–2001, group.

Discussion

There is little doubt that in most, if not all, sport, athletic performance tends to elevate over time. A number of themes emerge from the present research–some ubiquitous in nature, whereas others appear to be more position-specific. Although some differences were observed in the anthropometry (weight and height) of certain positions, obvious trends across elite college American football players are not apparent. Over the time period analyzed, there is little evidence to suggest that players drafted into the NFL in recent years are, in general, any heavier or taller as compared with 10 years ago. As regards combine performance, almost unambiguous evidence exists suggesting that players at all positions are faster in the latter, as compared with the earlier, group. Although perhaps less universal, as compared with the straight sprint outcomes, players in more recent years seem to be excelling at the 3-cone drill, whereas

performance declined in the 18.3-m shuttle. Similarly counterintuitively (to that of the contradictory directional trends in the 2 change-of-direction ability measures), the 2008–10 group presented enhanced performance in the horizontal jump and decreased performance in the vertical jump, as compared with the earlier group.

Anthropometric changes over the analyzed time period are less prevalent and incontrovertible than many of the performance measures. Because of the equivocal nature of the data, it is difficult to speculate as to what, if any, trends have occurred in elite college players. Furthermore, of the limited differences among groups, there do not seem to be any apparent associations with respect to similar positions. For example, it is difficult to suggest trends within linemen or defensive backs (corner backs and safeties) or ball carriers (running backs and fullbacks), or any other group of positions. That is, it is difficult to go beyond statements related directly to the position-specific outcomes (e.g., quarterbacks are heavier and taller in the latter, as compared with the earlier, group).

The outcomes related to the 3 straight sprint speed measures clearly indicate that in recent years, players at all positions excel at straight sprinting, as compared with the earlier group. Forty-one of the 45 sprint outcomes indicate that players from the latter group are faster. The equivocal nature of the anthropometric data suggests that this likely has little to do with changes in weight or height. It may be that the observed enhanced performance is influenced by factors other than anthropometric, such as the deemed value of athletic characteristic or training technology.

It is possible that players being drafted from 2008 to 2010 are faster than those drafted from 1999 to 2001 because of changes in the perceived importance of speed. It may be that changes in the game have led those responsible for draft decisions to believe that sprint speed has become relatively more important as compared with other physical characteristics. Thus, rather than all college players having become faster, players exhibiting speed have become more attractive to NFL coaches and scouts. If, over the past decade, straight sprint speed and associated characteristics (e.g., acceleration) have become qualities deemed necessary for success, it would seem to follow that players exhibiting these qualities are drafted into the NFL.

In conjunction with, and perhaps driven by, an increased importance placed on speed, advanced training methods and technologies may be helping to produce faster players. In addition to pervasive enhanced training methodologies realized by college players nationwide, private sector training camps aimed solely at assisting invitees to the NFL Combine achieve enhanced results at the combine have become prevalent. Perhaps, as speed has become a relatively more desirable (as deemed by coaches and scouts) physical characteristic, training to achieve enhanced speed has developed. That is, market demand has been a significant factor in motivating players to develop greater speed. Whatever the reason, players attending the combine and subsequently drafted into the NFL during the 2008–10 period were significantly faster than those entering the NFL a decade earlier.

The 18.3-m shuttle and 3-cone drill are measures of change-of-direction ability. Although commonly accepted to be measures of agility, the authors of this article would argue that the lack of a reactive component limits these tests to measures of premeditated change-of-direction ability. Detailed discussion of agility and appropriate measures is beyond the scope of this article. It terms of duration, the 18.3-m shuttle is the shorter of the 2 tests requiring 4–5 seconds to complete, whereas the 3-cone drill required ~7–8 seconds for the attendees to complete. The findings of the present study suggest that players in the latter group (2008–10) improved performance in the 3-cone drill, whereas performance in the 18.3-m shuttle declined.

Although it is somewhat counterintuitive to reason that performance in similar measures would trend in opposite directions, it may be that the nature of the tests provides possible, or partial, clarity. Although the tests are similar in that each is designed with the intent of measuring change-of-direction ability, it is possible that the 3-cone drill better measures characteristics deemed to be of greater importance. It may be that the 3-cone drill, as compared with the 18.3-m shuttle, measures athletic characteristics (e.g., first-step quickness or explosiveness) deemed to be of greater value to decision makers. If this is the case, reasons similar to those discussed previously regarding straight sprint speed may help to explain why more recently drafted players are presenting enhanced 3-cone drill performance.

Although the vertical and horizontal jump tests are measures of vertical and horizontal jump ability, respectively, it is also commonly accepted that each is a measure of lower-body power. That one-third of player positions in the latter group increased horizontal jump performance and one-third of positions decreased vertical jump performance is interesting. Further confounding interpretation of the jump measure outcomes is that both cornerbacks and wide receivers in the 2008–10 group, as compared with the 1999–2001 group, improved horizontal performance and decreased vertical jump performance. Although research investigating horizontal and vertical jump ability in elite college American football players is scarce, prior research (5) examining a database similar to that of the present research may provide a possible explanation for these contradictory findings.

It has previously been suggested that vertical jump ability is more strongly associated with maximum speed, as compared with acceleration, whereas horizontal jump ability is similarly associated with maximum speed and acceleration (5). It has also been previously suggested that the 9.1- and 18.3-m sprint tests incorporated at the NFL Combine are measures of acceleration, and that the 36.6-m sprint test is strongly associated with acceleration (5). The 36.6-m sprint

is initiated from a stationary start and, as such, is influenced by acceleration. The first 18.3 m of the 36.6-m sprint can be viewed as an acceleration phase (2). Because of the inclusion of the "acceleration" phase (0–18.3 m) in the 36.6-m time, the measure of 36.6 m is influenced by acceleration. Given that all positions in the latter group demonstrated improved straight sprint performance (i.e., acceleration), and acceleration is more strongly associated with horizontal, as compared with vertical, jump ability, it is perhaps not so surprising that the latter group tended to improve horizontal, as compared with vertical, jump performance.

Nine of 13 positions performing the bench press exercise presented greater upper-body strength in the 2008–10 group, as compared with the 1999–2001 group. Given the strength of the trend in the data and the equivocal nature of the anthropometric measures, the trend is likely not attributable to anthropometry. It may be that similar postulations to those presented with respect to straight sprint speed are appropriate. That is, upper-body strength became a relatively more desirable quality as deemed by the draft decision makers. In response, elite-level college American football players became stronger over the time period in question and those players drafted into the NFL in the latter group were a representation of this stronger population. Whatever the underlying mechanism driving greater upper-body strength in the latter draftees, the trend is apparent. Worthy of note is that it has been previously suggested that upper-body strength plays a role in sprint performance (6).

A topic of concern garnering much media attention of late is the incidence of head injury in the NFL. Given that there are no discernible trends in height and weight over the period in question and that there appear to be improvements in acceleration and upper-body strength in the 2008–12 group, it is likely that players in the more recent group are more powerful. That is, if players of similar height and weight are faster and stronger, it would follow that they are more powerful. More powerful players are able to create greater impacts. If players have become more powerful, this may in part explain the increases in head injury.

There are limitations to the present study. Because the data were mined and not directly collected by the authors, it is impossible to comment on collection technique rigor. It has further been assumed that the data collected from the public domain is accurate. It may also be worth mentioning that this research is not meant as a critique of the purpose or value of the NFL Combine. The combine involves extensive player evaluation and assessment beyond the limited physical tests examined here (e.g., medical, mental, and drug tests). The primary purpose of the current investigation was to determine whether the positional anthropometric and performance profiles of NFL draftees changed over the years examined.

The very strong trends related to the 9.1-, 18.3-, and 36.6-m sprint times indicate that the players improved acceleration from the period 1999–2001 to 2008–10. Mechanisms associated with horizontal, as compared with vertical, jump ability may play a greater role in acceleration. As with improvements in acceleration, improved upper-body strength in the latter group may be explained by a combination of relatively greater deemed importance in the minds of NFL draft decision makers and enhanced training technologies and NFL draft preparation camps.

Practical Applications

The results of the present study provide some insight into what NFL draft decision makers have considered important in college players drafted in recent years as compared with a decade ago. Acceleration is a physical characteristic that would appear to be coveted by the NFL draft decision makers recently. Given the improved profiles of players with respect to stationary-start straight sprint speed, coaches and practitioners may be well advised to focus attention on the development of associated athletic characteristics (e.g., first-step quickness and acceleration). Although research is scarce, development of the underlying mechanisms associated with the horizontal jump may prove fruitful to NFL hopefuls. Similarly, development of upper-body strength would also appear to be beneficial. Those involved in the preparation of combine invitees may find the results of the present research useful in best preparing players for combine testing. It is suggested that because of the positional nature of player preparation, coaches and practitioners interpret results in a positional manner.

Important for players and coaches is determining the prerequisite level of physical ability necessary for entry into the NFL. The current sample contains only players drafted into the NFL and thus provides an excellent measure of the physical skills necessary to be drafted. Any sample contaminated by those not drafted risks providing a distorted benchmark for players to achieve. The average levels provided for the 2008–10 positions in Tables 1–15 allow NFL hopefuls to measure themselves against those successfully drafted. Strengths and weaknesses can be identified against these benchmarks and training programs subsequently tailored to develop the athlete appropriately.

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