Physical Characteristics and Performance of Japanese Top-Level American Football Players

Daichi Yamashita,[1] Masaki Asakura,[2] Yoshihiko Ito,[1] Shinzo Yamada,[3,4] and Yosuke Yamada[5]

[1]Department of Sports Science Japan Institute of Sports Sciences, Tokyo, Japan; [2]Deers Football Club, Tokyo, Japan; [3]Graduate School of Comprehensive Human Sciences, University of Tsukuba, Ibaraki, Japan; [4]Japan American Football Association, Tokyo, Japan; and [5]Department of Nutritional Science, National Institutes of Biomedical Innovation, Health and Nutrition, Tokyo, Japan

Abstract

Yamashita, D, Asakura, M, Ito, Y, Yamada, S, and Yamada, Y. Physical characteristics and performance of Japanese top-level American football players. J Strength Cond Res 31(9): 2455–2461, 2017—This study aimed to compare the physical characteristics and performance between top-level nonprofessional football players in Japan and National Football League (NFL) Combine invited players and between top-level and middle-level players in Japan to determine the factors that enhance performance in international and national competitions. A total of 168 American football players (>20 years) in Japan participated in an anthropometric (height and weight) and physical (vertical jump, long jump, 40-yard dash, pro-agility shuttle, 3-cone drill, and bench press repetition test) measurement program based on the NFL Combine program to compete in the selection of candidates for the Senior World Championship. All players were categorized into 1 of the 3 position groups based on playing position: skill players, big skill players, and linemen. Japanese players were additionally categorized into selected and nonselected players for the second tryout. The NFL Combine candidates had significantly better performance than selected Japanese players on all variables except on performance related to quickness among the 3 position groups. Compared with nonselected players, selected Japanese skill players had better performance in the 40-yard dash and bench press test and big skill players had better performance in the vertical jump, broad jump, and 40-yard dash. Selected and nonselected Japanese linemen were not different in any measurements. These results showed the challenges in American football in Japan, which include not only improving physical performance of top-level players, but also increasing the number of football players with good physical performance.

Introduction

American football is a team sport that requires high levels of physical attributes such as strength, power, speed, and quickness. The National Football League (NFL) is a professional league in the United States and the highest level of athletic competition for American football in the world. Before the NFL Draft, the NFL Scouting Combine is held at a neutral venue in Indianapolis each year to measure athletic abilities and football skills of college football players. About 300 college football players from National Collegiate Athletic Association (NCAA) Division I teams are invited to the Combine. A previous study suggested that Combine performance affects draft status, the draft order in turn affects salary and bonuses (16), and also influences future performance in the NFL (29). Therefore, athletes invited to the Combine prepare themselves as much as possible to boost their physical performance.

In an American football game, each position has distinct performance demands. A recent study has quantified positional differences in movement characteristics using Global Positioning System technology during a game (31) and preseason practice (4). For example, players in skill position completed greater distance, high-intensity sprint, and acceleration and deceleration efforts than those in other positions. With the different performance requirements in a game, physical profiles differ between position categories (11,20,30).

The measurement and evaluation of the physical performance of American football players has currently been a much-discussed topic in the area of strength and conditioning because many studies have shown that physical abilities also determined the potential risk factors of injury (10) and the competition level within each position category,

such as draft status (16), NCAA Divisions (6), playing status (starter vs. nonstarter) at Division I schools (3), a Division III school (22), and high school (5,7). These data on football players in the United States help football coaches and strength and conditioning specialists properly design year-round position- and player-specific training programs (26).

Next to the United States, Japan is one of the leading nations in American football. The International Federation of American Football (IFAF) Senior World Championship was held 5 times, and Japan had 2 career world championships (twice in the second place and once in the third place). Nevertheless, there is a big gap between these countries: Japan has never won against the United States, and no Japanese player has played in an NFL regular-season game. A previous study comparing Japanese and U.S. Division I college football players showed that U.S. players had much superior physical performance than the Japanese players (11). However, only football players from 2 of 20 Division I universities participated in the study, and no study compared the physical characteristics and performance of top-level players between countries. Although there is no professional league in Japan, it has the X-League, which is its top-level nonprofessional American football league. Most players who participated in past world championships belonged to the X-League. If Japanese players become better football players, world championship will become more competitive, and Japan might become a good market for the NFL. To enhance the performance of Japanese players in international competitions, we must attain knowledge about the global standing of top-level Japanese players in terms of the physical characteristics and performance.

The aims of this study were twofold: (a) to compare the physical characteristics and performance between top-level nonprofessional football players between countries (Japan and Unites States), clarify the problems, and determine the possible solution(s), thus enhancing performance in international competitions; (b) to examine the physical differences between top-level and middle-level players in Japan, clarify the problems, and determine the possible solution(s), thus enhancing performance in national competitions. To offer these findings, strength and conditioning specialists have to design and prescribe optimal training programs, and coaches and scouts have to identify talented players with a clear goal.

METHODS

Experimental Approach to the Problem

The physical and performance data were compared between top-level nonprofessional American football players in Japan and the United States and between top-level and middle-level players in Japan. The U.S. data included the results of the NFL Combine held in February 2015, which were acquired from archived data available for public access (http://www.nfl.com/ and http://www.cbssports.com/). The Combine for Japanese players was held in March 2015 for the Japan American Football Association senior

football academy program. We held 2 anthropometric and 6 physical performance measurements based on the NFL Combine. It was a 4-day program held at 2 sites (eastern and western parts of Japan) that aimed to select a trial 45-player roster for the IFAF Senior World Championship in July 2015. Any Japanese footballer older than 20 years could participate freely on the physical (day 1) and football skill tests (days 2–4). After these programs, 81 players were selected for the second tryout in May and were further trimmed down to 51 players for the third tryout in June; finally, 45 players were chosen for the roster. Coaches assessed the players' abilities based on the results of the tests, practice during trials, and historical performance, and selected the roster in a comprehensive manner. The United States won in the 2015 World Championship, with Japan in the second place.

Subjects

A total of 245 footballers with an age range of 20 to 45 years (26.2 ± 3.9) registered in the academy and 168 players participated in the anthropometric and physical measurements. They signed a written informed consent to join the experiment, which were conducted in accordance with the Declaration of Helsinki and were approved by the ethics committee of Japan Institute of Sports Sciences.

Players ware categorized into 1 of the 3 groups based on playing position: skill players, big skill players, and linemen. Skill players consisted of wide receivers, running backs, and defensive backs. Big skill players consisted of fullbacks, tight ends, and linebackers. Linemen consisted of offensive lines and defensive lines, based on Miller et al. (17). Recent studies categorized defensive ends as big skill players, not as linemen (26,30), but in this study, we categorized defensive ends as linemen because their movement characteristics were similar to defensive tackles rather than linebackers (31) and defensive ends in Japan are usually grouped with defensive tackles and offensive lines as linemen in training and football practice. Quarterbacks, punters, and place kickers were not compared because of their position-specific skill (26) and small sample size of Japanese players.

To select top-level Japanese players from free-entry trials, players were divided 2 groups: selected and nonselected players, i.e., those who were and were not selected for the second tryout, respectively. The number of selected and nonselected players who underwent measurement was 49 (of 74 registered players) and 113 (of 157 registered players) across 3 positional categories, respectively. The results of the NFL Combine included a total of 295 players positioned across these 3 position categories.

Procedures

We measured 2 anthropometric and 6 performance measures based on the same variables as the NFL Combine: height, weight, vertical jump, broad jump, 40-yard dash, pro-agility shuttle, 3-cone drill, and 100-kg bench press repetition test. Anthropometric measurements included height and

body mass. Height was measured to the nearest 0.1 cm and body mass to the nearest 0.1 kg. The performance test took place at an American football field on synthetic turf. Vertical jump height was assessed using a yardstick (Swift Performance, Wacol, Australia). Each jump test was performed in 2 attempts, and the highest scores were recorded to the nearest 0.01 m. The 40-yard dash, pro-agility shuttle, and 3-cone drill were measured in 2 attempts using a handheld stopwatch, and the fastest times were recorded to the nearest 0.01 second. The 100-kg bench press repetition test was performed in 1 attempt with proper form and full range of motion.

Statistical Analyses

We compared each variable of the Japanese selected players with that of the NFL Combine invited players and the Japanese selected players with the nonselected players across the 3 positional categories. The number of repetitions during the bench press repetition test was not compared between Japanese selected players and NFL Combine invited players

because the weight performed was only slightly different between the groups (100 vs. 102.1 kg [225 lb]). A Shapiro-Wilk test was performed to determine whether each variable was normally distributed. A comparison between the 2 groups was performed by unpaired t-tests or Mann-Whitney U-test for data with normal and non-normal distribution, respectively. The alpha level was set at 0.0167 (0.05/3) to minimize the risk of type I errors when performing multiple comparisons across the 3 categories (26). Statistical analyses were performed using MATLAB 2011a (MathWorks, Inc., Natick, MA, USA).

RESULTS

The comparison of selected Japanese players with the NFL Combine invitees showed great differences in physical characteristic and performance across 3 categories (Table 1). Japanese skill players and linemen had significantly inferior values, with the exception of their performance on the 3-cone drill, compared with those of the NFL invitees

TABLE 1. Physical characteristics and performance of selected players representing Japan in the world championship and NFL combine invited players by position group.*

Variables	NFL combine invitees			Selected Japanese players			
	Mean ± SD	Range	n	Mean ± SD	Range	n	p
Skill players (RB, WR, DB)							
Height (m)	1.82 ± 0.05	1.65–1.98	130	1.76 ± 0.05	1.65–1.83	17	<0.001†
Weight (kg)	92.5 ± 6.75	70.7–108.0	130	80.0 ± 6.62	70.2–92.4	17	<0.001†
Vertical jump (m)	0.91 ± 0.08	0.69–1.14	111	0.67 ± 0.07	0.58–0.79	19	<0.001†
Broad jump (m)	3.06 ± 0.16	2.74–3.73	114	2.66 ± 0.15	2.36–2.91	19	<0.001†
40-yard dash (s)	4.54 ± 0.11	4.28–4.83	112	4.84 ± 0.12	4.55–5.00	19	<0.001†
Pro-agility shuttle (s)	4.20 ± 0.14	3.82–4.58	99	4.44 ± 0.21	4.15–4.94	19	<0.001†
3-cone drill (s)	7.00 ± 0.19	6.61–7.63	97	7.08 ± 0.23	6.76–7.58	18	0.281
Bench press (rep)	16.30 ± 4.37	7–26	90	5.71 ± 4.67	0–13	13	
Big skill players (FB, TE, LB)							
Height (m)	1.89 ± 0.05	1.80–2.01	63	1.79 ± 0.05	1.72–1.86	11	<0.001†
Weight (kg)	111.6 ± 5.0	100.7–125.6	63	92.1 ± 9.78	83.0–119.5	11	<0.001†
Vertical jump (m)	0.87 ± 0.08	0.71–1.08	47	0.68 ± 0.07	0.61–0.85	10	<0.001†
Broad jump (m)	2.96 ± 0.16	2.54–3.35	47	2.59 ± 0.14	2.43–2.85	10	<0.001†
40-yard dash (s)	4.77 ± 0.14	4.53–5.04	48	4.96 ± 0.11	4.76–5.06	8	<0.001†
Pro-agility shuttle (s)	4.35 ± 0.17	4.00–4.70	43	4.45 ± 0.25	4.12–4.78	8	0.322
3-cone drill (s)	7.25 ± 0.24	6.68–7.66	41	7.17 ± 0.20	6.85–7.49	9	0.357
Bench press (rep)	21.70 ± 4.26	14–35	50	10.44 ± 6.62	0–20	8	
Linemen (OL, DL)							
Height (m)	1.93 ± 0.04	1.85–2.03	102	1.83 ± 0.05	1.74–1.92	17	<0.001†
Weight (kg)	137.3 ± 11.1	106.6–161.0	102	119.8 ± 14.0	93.3–142.7	17	<0.001†
Vertical jump (m)	0.77 ± 0.10	0.44–1.07	78	0.58 ± 0.08	0.41–0.70	16	<0.001†
Broad jump (m)	2.70 ± 0.24	2.13–3.51	77	2.39 ± 0.17	2.02–2.65	16	<0.001†
40-yard dash (s)	5.13 ± 0.26	4.56–5.74	82	5.37 ± 0.31	4.93–5.98	14	<0.001†
Pro-agility shuttle (s)	4.62 ± 0.22	4.05–5.15	72	4.83 ± 0.29	4.38–5.32	14	0.015†
3-cone drill (s)	7.71 ± 0.35	7.07–8.28	68	7.84 ± 0.55	7.00–8.78	14	0.540
Bench press (rep)	25.60 ± 4.80	14–37	75	16.80 ± 5.68	5–25	16	

*RB = running backs; WR = wide receivers; DB = defensive backs; FB = fullbacks; TE = tight ends; LB = linebackers; OL = offensive lines; DL = defensive lines.
†$p < 0.0167$.

TABLE 2. Physical characteristics and performance of nonselected and selected players as candidates to represent Japan in the world championship by position group.*

Variables	Nonselected Japanese players			Selected Japanese players			
	Mean ± SD	Range	n	Mean ± SD	Range	n	p
Skill players (RB, WR, DB)							
Height (m)	1.73 ± 0.05	1.62–1.91	50	1.76 ± 0.05	1.65–1.83	17	0.040
Weight (kg)	78.0 ± 5.53	68.5–92.7	50	80.0 ± 6.62	70.2–92.4	17	0.290
Vertical jump (m)	0.67 ± 0.09	0.48–0.84	49	0.67 ± 0.07	0.58–0.79	19	0.924
Broad jump (m)	2.62 ± 0.14	2.30–2.89	49	2.66 ± 0.15	2.36–2.91	19	0.218
40-yard dash (s)	4.95 ± 0.16	4.65–5.50	49	4.84 ± 0.12	4.55–5.00	19	0.010†
Pro-agility shuttle (s)	4.44 ± 0.21	4.10–5.12	49	4.44 ± 0.21	4.15–4.94	19	0.743
3-cone drill (s)	7.21 ± 0.34	6.78–8.40	49	7.08 ± 0.23	6.76–7.58	18	0.193
Bench press (rep)	2.93 ± 3.19	0–11	27	5.71 ± 4.67	0–13	13	0.011†
Big skill players (FB, TE, LB)							
Height (m)	1.78 ± 0.06	1.66–1.88	17	1.79 ± 0.05	1.72–1.86	11	0.724
Weight (kg)	92.7 ± 8.83	77.0–108.1	17	92.1 ± 9.78	83.0–119.5	11	0.466
Vertical jump (m)	0.58 ± 0.06	0.51–0.75	17	0.68 ± 0.07	0.61–0.85	10	0.001†
Broad jump (m)	2.41 ± 0.11	2.11–2.55	17	2.59 ± 0.14	2.43–2.85	10	0.002†
40-yard dash (s)	5.34 ± 0.27	5.01–5.90	17	4.96 ± 0.11	4.76–5.06	8	0.001†
Pro-agility shuttle (s)	4.68 ± 0.22	4.32–5.15	16	4.45 ± 0.25	4.12–4.78	8	0.033
3-cone drill (s)	7.48 ± 0.34	7.01–8.21	16	7.17 ± 0.20	6.85–7.49	9	0.031
Bench press (rep)	5.53 ± 4.20	0–12	14	10.44 ± 6.62	0–20	8	0.042
Linemen (OL, DL)							
Height (m)	1.80 ± 0.05	1.68–1.90	46	1.83 ± 0.05	1.74–1.92	17	0.045
Weight (kg)	111.7 ± 11.4	91.5–139.7	46	119.8 ± 14.0	93.3–142.7	17	0.034
Vertical jump (m)	0.58 ± 0.08	0.40–0.75	45	0.58 ± 0.08	0.41–0.70	16	1.000
Broad jump (m)	2.37 ± 0.19	1.81–2.22	45	2.39 ± 0.17	2.02–2.65	16	0.549
40-yard dash (s)	5.53 ± 0.33	4.83–6.35	45	5.37 ± 0.31	4.93–5.98	14	0.123
Pro-agility shuttle (s)	4.95 ± 0.28	4.35–5.57	44	4.83 ± 0.29	4.38–5.32	14	0.322
3-cone drill (s)	8.08 ± 0.47	7.15–9.15	44	7.84 ± 0.55	7.00–8.78	14	0.198
Bench press (rep)	14.36 ± 7.43	0–29	38	16.80 ± 5.68	5–25	16	0.156

*RB = running backs; WR = wide receivers; DB = defensive backs; FB = fullbacks; TE = tight ends; LB = linebackers; OL = offensive lines; DL = defensive lines.
†$p < 0.0167$.

($p < 0.001$). Japanese big skill players had significantly inferior values, with the exception of their performance in the pro-agility shuttle and 3-cone drill, compared with those of the NFL Combine invitees ($p < 0.001$).

The comparison of nonselected Japanese players with selected players across 3 categories showed that selected skill players were significantly superior in the 40-yard dash and bench press repetition, whereas selected big skill players were superior in the vertical jump, broad jump, and 40-yard dash (Table 2). Meanwhile, there was no difference between selected and nonselected linemen.

DISCUSSION

The primary purpose of this study was to compare the physical characteristics and performance of the Japanese candidates for the world championship with those of NFL Combine invitees. Across the 3 positional categories, the Japanese selected players had no greater performance in any variables than that of NFL combine invitees (Table 1). The

Japanese players were smaller, lighter, slower, and weaker than the NFL candidates. The number of bench press repetitions of Japanese selected players was lower than that of NFL candidates, even with the use of lighter weight (100 vs. 102.1 kg [225 lb]). Recently, Vitale et al. (30) reported the results of the measurement of physical characteristics and performance in accordance with the NFL Combine standards in 1 of the 12 teams in top-level nonprofessional American football leagues in Italy. A comparison of their data (30) with ours showed no difference in height and weight between countries, but Japanese selected players were better in most physical performance across 3 position categories. Japan, which ranked top 3 in all 5 world championships, is one of the leading nations in American football in the world, with the United States at the top. Meanwhile, Italy has ranked fourth in the 1999 World Championship and has not participated in the other 4 world championships. In American football, heavier, faster, and stronger players have a greater advantage because of the higher

momentum to push back an opponent in tackles and blocks. Therefore, physical and performance characteristics are suggested to be related to rank in international competitions.

In this study, selected Japanese players were not inferior in variables related to quickness, especially the 3-cone drill. Young et al. (32) proposed a deterministic model of agility, and they indicated that change of direction speed was composed of technique, straight sprinting speed, and leg muscle qualities. Applying the same logic to this result, selected Japanese players were inferior in sprinting speed, as shown by the results of the 40-yard dash, and muscle qualities, as represented by the results of the vertical jump, but they were not inferior in technical factors such as stride adjustments for change of direction compared with those of the NFL Combine invitees.

In variables related to quickness, Japanese skill players and linemen were slower in the pro-agility shuttle, but not in the 3-cone drill. The pro-agility shuttle and 3-cone drill require similar change of direction abilities (14,26), but these tests seem to require different cutting abilities because the time in the pro-agility shuttle in selected Japanese skill players and linemen was slower than that of U.S. players, but the time in 3-cone drill did not differ. The pro-agility shuttle was composed of two 180° turns. When changing to the opposite direction, eccentric strength from the planted foot is mainly required, such as the 505 test (28). Meanwhile, the 3-cone drill was composed of two 180° turns, two 90° corners, and a 180° corners. When cornering around a cone, the ability to produce lateral force while braking forward force with several steps rather than producing great lateral force in one step is required. Therefore, more of the technical factors described above seem to be required for the 3-cone drill than for the pro-agility shuttle. Sheppard and Young (25) suggested that body height might affect the change of direction performance. Generally, shorter players have lower center of gravity and higher step frequency, which may be an advantage when adjusting their stride length with smaller foot displacement and increasing step frequency to complete cornering around a cone.

Japanese top-level players were shorter than NFL Combine invitees in all 3 positional categories. Taller players have an advantage in professional level sports, such as rugby (1,24), soccer (18), and basketball (2). This is also important for playing American football because they can catch a ball with higher position and have greater opportunity to defend a pass. Even if comparing NFL invited skill players with Japanese selected big skill players, there were big differences in speed, quickness, and strength, despite having almost similar height (1.82 vs. 1.79 m) and weight (92.5 vs. 92.1 kg). These results show the solutions of the Japanese national team. Strength coaches in Japan should prescribe training programs that emphasize weight, speed, and strength to compensate for the lack in height, and scouts should recruit taller players with better speed and strength.

Also noteworthy is the large difference in the number of players who joined the measurements (Japanese selected players, $n = 49$; NFL invited players, $n = 295$). If the top 300 Japanese players were invited to the trial and performance measurement, the variables would be worse than those included in these selected data. Moreover, the Japanese selected players ranged in age from 20 to 45 years, whereas the NFL Combine invited players were limited to mostly seniors from NCAA Division I colleges. From this gap, Japan's challenges are not limited to the improvement of physical performance of top-level players but also to increase the number of football players with good physical performance.

The secondary purpose of this study was to compare physical differences between selected and nonselected players as candidates to represent Japan in the world championship. Japanese selected players in skill position were faster than nonselected players (Table 2). This result is similar to the results of the comparison of NFL drafted with nondrafted skill players (26). Moreover, selected players had greater performance in the bench press repetition test than nonselected players. The bench press test can predict 1 repetition maximum (15); thus, this test was used as a measurement of upper-body strength and power. Upper-body strength is important in collision sports to fend off and block an opponent (9). These results suggested that skill players required high sprint ability to separate from the defensive player, pursue the offensive player, and contact an opponent with greater momentum.

Significant differences in 40-yard dash, vertical jump, and horizontal jump were observed between selected and nonselected big skill players in Japan. Despite the lack of statistical significance, the results of the pro-agility shuttle, 3-cone drill, and bench press tests were better for selected players ($p \leq 0.05$). This is a legitimate requirement because big skill players, as a previous study suggested, should be bigger, faster, stronger, and more powerful (26). In addition, as mentioned above, this difference in big skill players suggests that Japan has fewer big skill players with good size and performance and those candidates are selected from a small pool of players.

Meanwhile, no difference was observed between selected and nonselected linemen. This result indicated that selected linemen were superior in abilities other than physical performance such as technical and/or tactical skills for game situations. To be selected as a candidate to represent Japan in the international competition, a player needs to spend a lot of time on improving technical and tactical skills, instead on strength training. However, Japanese players must improve their physical performance because there is a large gap in that aspect between countries and specific exercises can improve on-the-field skills; e.g., there is a positive correlation between vertical jump height and velocity of the drive block (12).

In the United States, many researchers and strength coaches have reported on the anthropometric and physical performance of American footballers across a number of

generations (6–8,22,31), including NFL players (13,19,27). College football players have become bigger, stronger, faster, and more powerful over a decade (21,23), partly because of the diffusion of such information. Previous longitudinal studies for college football players reported a trainability of college football players (8,17). Thus far, there are only a few cross-sectional and longitudinal fitness data for football players in Japan, making it impossible to predict the trainability of their physical performance. Therefore, researchers in Japan should store these data across generations, and such data should be accessed by strength coaches and serve as basis when prescribing an optimal training program for Japanese players to boost physical performance.

This study had some limitations. The first was the difference in criterion for selection. Coaches and scouts in NFL teams select players to build the team not only for short-term goals, but also for long-term success. Meanwhile, Japanese players were selected to build a team to compete in the fifth IFAF Senior World Championship. Japan scheduled 3 matches in 8 days with a 45-player roster. Therefore, up and coming players suitable for the competition were preferred rather than players with good potential for future competitions. The second limitation is that not all players who underwent the Combine program were not negligible. Some were absent for a day and participated in rest of the 3-day tryout because of conflicting schedules, and others who cancelled on the measurement because of injury participated in the second tryout. However, this survey was the best and only opportunity for measuring the anthropometric and physical performance of top-level American football players in Japan who participate in the tryouts for selection in Japan's national team.

PRACTICAL APPLICATIONS

This survey showed the physical characteristics and performance of top-level American football players in Japan, in comparison with NFL candidates and middle-level players in Japan, as well as the features of top nonprofessional football player in Japan and the difference between national and international competitions. These results offer a strategic plan to reduce the gap between the United States and Japan. Strength coaches working for X-league should prescribe an intensive training program even if there are a few different physical profiles between top-level and middle-level X-league players. This approach also makes the top-level league more exciting. As in Italy (30), American football is not very popular in Japan. Most of the talented young athletes tend to play popular team sports such as baseball and soccer in which many players are competing successfully on the world stage. If the top-level league becomes more exciting, more players may become interested and the pool of talented players would become larger. Then, coaches and scouts can identify and recruit many young talented players who are tall, heavy, and with good physical performance.

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