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FOOTBALL PLAYER BODY COMPOSITION: IMPORTANCE OF MONITORING FOR PERFORMANCE AND HEALTH

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KEY POINTS

- The body mass of football players has increased significantly over the past 40 years with linemen increasing body mass by 30 kg.
- The assessment and interpretation of body composition is central to the development of a football player.
- Increases in fat-free mass have a direct correlation to strength, speed and explosiveness.
- Multiple body composition measurement techniques exist and each has inherent strengths and weaknesses.
- Serial measurements of body composition can evaluate the athlete's status as well as provide insight on program development for the team.
- Athletes with excess body fat are at risk of chronic diseases associated with obesity.
- Quality nutrition and strength and conditioning programs can optimize body composition while limiting the health consequences associated with excess weight gain.

INTRODUCTION

A football athlete's body composition is of particular importance for performance. It has been suggested that an increase in body mass or height is associated with increased playing time as well as greater rates of pay (Norton & Olds, 2001). Since performance is so strongly dependent on body morphology and composition, the ability to measure these changes in an athlete over time is essential to both coaches and players. In addition to performance, there is growing interest in body composition of football athletes because of its impact on health. Studies using body mass index (BMI) as a measure of obesity suggest that up to 56% of football players, including high school players, are obese (Harp & Hecht, 2005; Laurson & Eisenmann, 2007; Malina et al., 2007). Although the inaccuracy of associating a high BMI with increased risk of mortality has been reported (Lambert et al., 2012), the link between football players and cardiovascular risk has been shown in numerous studies (Borchers et al., 2009; Buell et al., 2008). Therefore, there is a need for monitoring body composition in football athletes from both a performance and health perspective.

EVOLUTION OF PLAYER SIZE

Interest in the body composition of football athletes spans more than eight decades. In 1942, Welham and Behnke examined the body composition of 25 professional football players. At that time, the nature of the sport was very different than it is today, as the players were divided into only two groups, backs and linemen. Backs had an average height and mass of 181.0 cm (71.3 in) and 85.7 kg (188.9 lb); while linemen were 185.7 cm tall (73.1 in) and weighed 97.1 kg (214.0 lb) on average. To put those numbers in context, Ghigiarelli (2011) reported on the body composition of top high school recruits from 2001 to 2009. The backs in the study by Welham and Behnke (1942) were about the same height and weight as high school linebackers today. More telling is the fact that even the high school linemen of today are substantially taller and heavier than the professional players of 1942.

In general, football players have continued to gain size while height has remained relatively consistent. The evolution of a professional offensive lineman is presented in Table 1. Since 1972, the average body mass of an offensive lineman has increased by more than 30 kg (66 lb). While this is likely the most drastic change observed among all positions, similar, albeit smaller, changes have been observed across all positions. These changes are not limited to professional players, as comparable changes have been observed in college and high school players alike (Melvin et al., 2014; Noel et al., 2003; Olson & Hunter, 1985). Earlier studies suggested the increase in size observed in football players simply followed the similar trends of growth observed in adult males. However, Norton and Olds (2001) provided a unique commentary on the evolution of athletes over the 20th century. The authors reported that an increase in body mass of 51 kg (112.2 lb) in the National Football League (NFL) was associated with an additional playing year. Further, increments of ~0.1 cm (0.04 in) in height or 3 kg (6.6 lb) of mass were equated with ~$45,000 in additional player payments. Those were adjusted to 1993 values. Given the increase in salaries that have been observed in the last decade, it is likely that the number may be even higher today. When analyzing the height and body mass of the 300 all-time greatest players (Neft et al., 1998), the authors concluded that larger players have a clear advantage over smaller players and this has driven the increase in size over the last several decades.

It is important to note that while changes in body composition have been observed over the last several decades, football players are not a homogenous group of athletes and differences may exist across teams depending on the style of play. In support of this contention, Kraemer et al. (2005) noted significantly higher body fatness at a given position of one team when compared to another team. The authors suggested differences in strength and conditioning practices as well as nutritional intervention may play a role in the observed disparity between teams.

It is true that significant advancements in the field of strength and conditioning and nutritional sciences have occurred concurrent with changes in body composition over recent decades, as evidenced by the increase in body mass not only being associated with an increase in fat mass, which has health implications, but also with gains in lean mass. The changes in lean mass are considered relatively positive given the improvements observed in performance, even over a short period of time. Secora et al. (2004) examined differences in performance characteristics from 1987 to 2000. Significant differences were observed in 50/88 comparisons, with most positions improving significantly compared to the previous year examined. Similar improvements were noted in an earlier study comparing college players over a 10-yr span (Olson & Hunter, 1985).

	1972[1] (OL/TE)	1976[2] (OL/TE)	1984[3] (OL/DL)	1998[4] (OL/TE)	2005[5] (OL)	2013[6] (OL)
Height (cm/in)	193.5/ 76.2	193.0/ 76.0	191.2/ 75.3	194.1/ 76.4	193.3/ 76.1	192.8/ 75.9
BM (kg/lb)	113.2/ 249.6	112.6/ 248.2	117.6/ 259.3	135.7/ 299.2	140.0/ 308.6	140.9/ 310.6
% Body Fat	15.5	15.6	17.0	24.7	25.1	28.8

Table 1: Mean Body Composition Values for an Offensive Lineman Over Recent Decades

[1] (Wilmore & Haskell, 1972), [2] (Wilmore et al., 1976), [3] (Gleim, 1984), [4] (Snow et al., 1998), [5] (Kraemer et al., 2005), [6] (Dengel et al., 2013). BM, body mass. OL, offensive linemen. TE, tight end. DL, defensive linemen.

Regardless of what is driving the change in player size, it is clear that football players of today are substantially larger in terms of body mass than those of previous years and this is not limited to professional players alone. In fact, the changes at the college level have been even more drastic (Melvin et al., 2014; Noel et al., 2003; Olson & Hunter, 1985). However, the size of the college athlete still remains smaller than those on the professional field as only elite athletes make it to the professional stage.

TODAY'S FOOTBALL ATHLETE

Despite significant increases in size, a comparison of the results from the two most recent studies shows that "mirroring" or similar body types still exists in opposing positions (Dengel et al., 2013; Kraemer et al., 2005). This is likely due to the offensive and defensive play interactions which occur in the sport as suggested by Kraemer et al. (2005). In the most recent study, Dengel and colleagues (2013) assessed the body composition of 411 NFL players just before draft or before the start of summer camp using dual X-ray absorptiometry (DXA). The use of DXA technology will be described later, but briefly DXA is a three-compartment model for body composition (fat mass, lean mass, bone mass), which allows segmental analyses to assess where lean and fat mass is accumulated. It must be noted that since all of the players were recruited for a particular team, their body composition may be biased toward that team's type of play (Kraemer et al., 2005). Still, given the large sample size and the extended period in which body composition was assessed (6 yr), the results from that study provide the most comprehensive look at today's NFL player body composition.

Offensive and Defensive Linemen

Offensive and defensive linemen have previously been reported to be fairly similar in body mass with slightly higher body fat (Kraemer et al., 2005). The study by Dengel et al. (2013) is in agreement with previous reports (Kraemer et al., 2005) suggesting that offensive and defensive linemen are somewhat similar (Table 2). Offensive linemen were significantly taller and heavier than the defensive linemen in the most recent study. The greater body mass was accounted for by a greater fat mass in offensive linemen compared with defensive linemen, as both had similar lean mass. The distribution of lean mass was also similar between the two positions with greater lean mass in the upper body than the lower body resulting in a 1.64 ± 0.17 and a 1.60 ± 0.19 upper to lower lean mass ratio in offensive and defensive linemen, respectively.

	Offensive Lineman	Defensive Lineman
Height (cm/in)	192.8 ± 4.1/75.9 ± 1.6	190.9 ± 2.9/75.2 ± 1.1
Body Mass (kg/lb)	140.9 ± 6.1/310.6 ± 13.4	132.9 ± 14.7/293.0 ± 32.4
% Body Fat	28.8 ± 3.7	25.2 ± 7.6
Lean Mass (kg/lb)	96.5 ± 4.5/212.7 ± 9.9	95.2 ± 5.5/209.9 ± 12.1
Fat Mass (kg/lb)	39.3 ± 6.0/86.6 ± 13.2	33.3 ± 12.3/73.4 ± 27.1

Table 2: Body Composition Characteristics of Offensive and Defensive Lineman According to a Recent Study (Dengel et al., 2013). Data are mean ± SD.

Tight End, Linebacker and Running Back

The Dengel at al. (2013) study also measured the body composition characteristics of tight ends, linebackers and running backs (Table 3). Tight ends were more closely related to offensive linemen in height, resulting in players in that position being taller than the linebackers and running backs. Running backs were the shortest of all three positions and the reported heights are similar and in the same hierarchical pattern as those reported earlier (Kraemer et al., 2005). The same pattern was observed in body mass with tight ends having a greater body mass than linebackers, who had a greater body mass than running backs. All three positions had similar percent body fat and fat mass. Tight ends had a greater amount of lean mass and this was primarily located in the upper body. However, despite some differences in upper body lean mass, the upper to lower lean mass ratio was not significantly different among tight ends, linebackers and running backs.

	Tight Ends	Linebackers	Running Backs
Height (cm/in)	192.9 ± 2.1/ 75.9 ± 0.8	186.7 ± 3.9/ 73.5 ± 1.5	181.5 ± 4.1/ 71.5 ± 1.6
Body Mass (kg/lb)	113.9 ± 4.2/ 251.1 ± 9.3	109.9 ± 4.6/ 242.3 ± 10.1	105.4 ± 8.5/ 232.4 ± 18.7
% Body Fat	16.8 ± 3.0	17.0 ± 3.2	16.0 ± 4.0
Lean Mass (kg/lb)	90.7 ± 4.0/ 200.0 ± 8.8	87.3 ± 3.5/ 192.5 ± 7.7	84.5 ± 4.9/ 186.3 ± 10.8
Fat Mass (kg/lb)	18.4 ± 4.5/ 40.6 ± 9.9	17.9 ± 3.8/ 39.5 ± 8.4	16.3 ± 5.3/ 35.9 ± 11.7

Table 3: Body Composition Characteristics of Tight Ends, Linebackers and Running Backs According to a Recent Study (Dengel et al., 2013) Data are mean ± SD.

Quarterback and Punters/Kickers

The body composition of quarterbacks and punters/kickers was also measured by Dengel et al. (2013) (Table 4). For the most part, the heights and body masses for these positions are similar to those reported in an earlier study (Kraemer et al., 2005). Of interest is the greater body fat percentage reported in both positions compared to the previous study in which fat percentages of 14.6 ± 9.3% and 11.4 ± 8.3% were reported for quarterbacks and punters/kickers, respectively. This may be attributed to the difference in technology (discussed later) for assessing body composition. Thus, it is unlikely that significant changes over the last several years have occurred in these positions.

	Quarterbacks	Punteres/Kickers
Height (cm/in)	188.5 ± 3.6/74.2 ± 1.4	187.4 ± 4.6/73.8 ± 1.8
Body Mass (kg/lb)	103.6 ± 13.9/228.4 ± 30.6	98.4 ± 5.6/216.9 ± 12.4
% Body Fat	19.6 ± 4.6	19.2 ± 4.5
Lean Mass (kg/lb)	78.9 ± 5.1/173.9 ± 11.2	76.1 ± 4.8/167.8 ± 10.6
Fat Mass (kg/lb)	19.5 ± 6.1/43.0 ± 13.4	18.2 ± 4.8/40.1 ± 10.6

Table 4. Body Composition Characteristics of Quarterbacks and Punters/Kickers According to a Recent Study (Dengel et al., 2013). Data are mean ± SD.

Defensive Backs and Wide Receivers

In the Kraemer et al. (2005) examination, similar height, body mass and percent body fat were observed between defensive backs and wide receivers, leading the authors to conclude that mirroring held true in these positions. The authors also highlighted a strategy observed in the preceding years in which teams were trying to break the mirroring of these two positions by utilizing larger wide receivers. However, despite the strategy, that study reported similar body composition in those positions. In the Dengel et al. (2013) report, wide receivers were taller and heavier than the defensive backs reported earlier. However, both had similar percentage body fatness, fat mass and lean mass (Table 5). Thus, despite being taller and heavier, differences were not observed when examining body composition.

	Defensive Backs	Wide Receivers
Height (cm/in)	182.2 ± 3.1/71.7 ± 1.2	185.7 ± 3.9/73.1 ± 1.5
Body Mass (kg/lb)	90.8 ± 6.1/200.2 ± 13.4	94.0 ± 6.0/207.2 ± 13.2
% Body Fat	12.1 ± 3.3	12.5 ± 3.1
Lean Mass (kg/lb)	76.1 ± 4.2/167.8 ± 9.3	78.3 ± 4.3/172.6 ± 9.5
Fat Mass (kg/lb)	10.6 ± 3.5/23.4 ± 7.7	11.3 ± 3.4/24.9 ± 7.7

Table 5. Body Composition Characteristics by Defensive Backs and Wide Receivers According to a Recent Study (Dengel et al., 2013). Data are mean ± SD.

In summary, few changes have been observed over the last ~8 yr in body composition of professional football athletes. Professional football players are substantially taller and heavier, but the mirroring effect is consistent with previous reports. Interestingly, based on BMI alone, all positions would have been categorized as overweight or worse (moderately obese or obese), demonstrating the problem with using BMI for classification of body composition in this unique population of athletes. Although the data presented here are representative of one team, the similarities between the two most recent studies, in which different teams were utilized and there was a large sample size, suggest that the present data gives insight into current body composition norms for the NFL. As previously mentioned, similar and more drastic observations have been made at the college and high school level (Melvin et al., 2014; Noel et al., 2003; Olson & Hunter, 1985). However, the size of these athletes still remains smaller than the professionals as only those elite athletes make it to the professional stage.

THE VALUE OF MEASURING BODY COMPOSITION

The efficacy of evaluating body composition has been established. Depending on the method used, data can be obtained on the amount of fat mass, fat-free mass and in the case of DXA, bone density and regional fat stores. Fat-free mass has a direct correlation with performance measures including strength, speed and explosiveness (Shields et al., 1984). As opposed to genetic factors and other neurological and biological controls, body composition can be modified by quality strength and conditioning programs and effective sports nutrition including medical nutrition therapy where indicated. In addition to increasing on-field fatigue, increases in fat mass can contribute to the development of metabolic syndrome, which includes impaired glucose tolerance, dyslipidemia and hypertension. Excess body fat also contributes to obstructive sleep apnea, vitamin D deficiency and cardiovascular disease (Skolnik & Ryan, 2014).

The assessment of physiological measures can be determined via a variety of techniques and each has its strength and weakness. Although there are multiple methods for assessing body composition, the most common techniques used by NFL teams include BMI as a part of a health history, skinfold measures (calipers), DXA, bioelectrical impedance analysis (BIA) and air displacement plethysmography (ADP). In the literature, the accuracy of these methods is compared to the "gold standard" or criterion methods. Currently, the determination of body composition in the NFL is dominated by the use of the ADP technology (BODPOD), with 16 of 32 NFL reporting its use. Although other body composition methods exist, including criterion methods, few teams are using them with regularity (COSMED survey of NFL teams).

As the elusive ideal body composition is sought, there are inherent challenges and gaps in our understanding. The evolution of body composition in the NFL is influenced by external forces in addition to strength and conditioning and nutritional interventions. The role of rule changes, coaching strategies and schemes on the changing definition of ideal positional body composition (often by each individual team) is underappreciated. For example, the recent emphasis on the "hurry up" offense has the potential to alter the ideal body composition by the teams employing this scheme. College athletes invited to the NFL Combine are assessed using ADP technology and the positional ranges are large. This makes the establishment of a specific positional goal a challenge. Although the combine assessment includes body composition information for all 335 invited athletes, there is no guarantee that the athlete actually plays for a team. There is also no known published data on the body composition of Pro Bowl players which may represent a measure of the best athletes at their position.

In the NFL, body composition studies are often conducted during training camp before the season starts. As such, there is little data on the change in body composition during the season. Seasonal patterns may provide a greater insight into risk factors for injury. Injuries can also profoundly impact body composition changes and may impact the team's understanding of positional ideal body weight. Regardless of the method used, the best plan is to use serial measurements rather than a single measure. While most of the focus of body composition is on the athlete, repeated measures throughout the season using the same technology can be used to assess nutrition and strength and conditioning programs, as well as progress of rehabilitation from injury. Unfavorable changes in body composition during the season have been reported in elite rugby players with a 1.5% decrease in lean mass and an increase in body fat of almost 5% (Harley et al., 2011). This alteration in body composition can have a negative impact on the power/weight ratio ultimately impacting performance.

Assessment Techniques

Body Mass Index (BMI): BMI is a well-accepted standard for the assessment of overweight and obesity status in the adult population. Adults with a BMI between 25 and 29.9 are considered overweight and those with a BMI of greater than 30 are considered obese. Using a standard design for a population, BMI for athletic outliers limits the practicality of this method. In a study of the Green Bay Packers which assessed BMI, body fat and segmental fat according to standard BMI classifications, the linemen group would be classified as Grade 1 obese (BMI, >35), the linebacker, tight end and running back group would be classified as moderately obese (BMI, 30–34.9) and the wide receiver/defensive back group would be classified as overweight (BMI, 25–29.9) (Bosch et al., 2014). No position group had a BMI within the normal range. However, when percent body fat was determined, only the linemen were considered obese and the other two position groups were within an acceptable or healthy range.

Therefore, BMI and body mass alone can be used as a screening tool but not to determine ideal performance mass. The Green Bay Packer study also demonstrated that lean mass accrual decreases after ~114 kg (250 lbs) regardless of the somatotype, suggesting that 250 lbs may be the upper limit of an ideal body mass in the NFL. In 1970, only one player weighed over 300 lbs (~136 kg) and in 2009 there were 394 players greater than this weight. At the start of training camp in 2010, over 500 players reported at this body mass. As the theme of bigger, stronger and faster pervades the NFL, there appears to be a level at which the accrual of body fat outpaces lean mass despite quality nutrition and strength and conditioning programs. As previously highlighted, there are professional and financial rewards for increasing size and it is unlikely that this trend will be reversed (Norton & Olds, 2001).

Skinfold Measurements: Anthropometric measures (e.g., skinfolds and circumferences) aimed at estimating body fat percentages are, in principle, technically simple to perform by a skilled professional, require little time to complete, and are inexpensive. However, skinfold measures are population specific and might not be generalizable to a population of professional football players (Durnin & Womersley, 1974). Prediction equations have been developed to estimate DXA percent body fat from skinfold measurements on collegiate athletes (Oliver et al., 2012), but have yet to be validated in professional football players. Calipers are portable and inexpensive yet several factors can limit their effectiveness, including but not limited to, the skill of the technician and the type of caliper. Lohman et al. (1983)

found that ~17% of the variability in skinfold measurement can be attributed to the practitioner, even if they are trained. The type of caliper used can also influence the findings as the Lange caliper has been shown to give body fat estimates 3.5 points higher than the Harpenden (Lohman et al., 1983).

Air Displacement Plethysmography: Air displacement plethysmography (ADP), is a method for determining percent body fat using the two-compartment model, in which the body is partitioned into fat mass and fat-free mass (FFM). This model assumes a constant density of FFM as 1.10 g/mL. However, density may depend upon the bone mineral content and total body water which vary with age, gender and race/ethnicity (Fields et al., 2002). The calculation of density and mass/volume can be impacted by any variable that can alter this equation. As with all body composition methods, strictly following protocol will influence the accuracy and the reproducibility of the results. ADP also assumes the control or limitation of isothermal air, which simply stated is the air contained in the lungs, near skin or hair, and in clothing. Isothermal air from clothing and hair on the head are minimized by having the subject wear a tight-fitting swimsuit and swim cap, as loose clothing can underestimate body fat by up to 5%. In addition, other variables can influence the density equation. Subjects cannot eat or exercise within 2 h prior to the test. The athlete must be dry as moisture on the skin and in the hair can artificially elevate body mass. Beards, long hair and hair in braids that is not easily contained in a lycra swim cap can also influence the accuracy by increasing the amount of isothermal air (Higgins et al., 2001).

The measurement of lung volume is also part of the protocol but there is no universal agreement on the impact of residual lung volume on variation in body composition outcomes. Research by McCrory et al. (1995) indicated little difference in body composition using predicted vs. measured lung volume. In addition, internal tests with the Houston Texans indicated little variance between using the predicted or measured lung volume in professional football players. Given the time constraints and the need to assess multiple athletes in a short period of time, predicted lung volume was used. In practical terms, some athletes who are claustrophobic may feel uncomfortable in the ADP chamber, but using a predicted lung volume allows an experienced technician to perform the measurement in ~10 min. ADP data has been collected on all NFL Combine participants since 2006.

Dual X-Ray Absorptiometry: Dual X-Ray absorptiometry (DXA) provides a minimally invasive measure of a three compartment model to include soft tissue fat-free mass, fat mass and bone mineral content. Compared with a four component criterion method, the accuracy of body fat percentages from DXA is as good, and in some studies, better than hydrodensitometry or underwater weighing in college-aged athletes (Prior et al., 1997). Numerous validation studies have demonstrated that DXA is more accurate than skinfold measures and bioelectrical impedance (Lohman et al., 2000), while a more recent study demonstrated the accuracy and precision of DXA for assessing body composition in lean athletes (Bilsborough et al., 2015). The authors demonstrated that both pencil beam DXA and fan beam DXA provided precise measures of fat-free and soft tissue mass and bone mineral content. Fan beam technology allows for faster scanning with the consequence of a greater radiation dose (Ackland et al., 2012). Although only one team in the NFL reports using DXA for body composition, many collegiate programs currently use this technology. A disadvantage of this technology is the exposure to low dose radiation which would be serial in nature, as well as the cost of the technology which exceeds $100,000 and the requirement for specialized and qualified operating staff.

HEALTH CONSEQUENCES OF GREATER SIZE

The increase in size over the last several decades has not occurred without consequences to player health. While football athletes undergo rigorous training, often exceeding the recommended threshold for weekly kilocaloric expenditure for cardiovascular risk reduction in a single bout of exercise (Tanasescu et al., 2002), an increased risk of cardiovascular disease was reported in athletes at all levels of play, including college and high school (Buell et al., 2008; Steffes et al., 2013). This is particularly problematic in the physically immature high school football player who has not completed growth and development. In adolescence, chronological age is a poor indicator of physical maturity. Tanner stages, or sexual maturity ratings, are generally considered the physical maturation stages of puberty. Increases in testosterone generally occur in stages 3-4 which normally occurs during high school. Overfeeding of the young physically immature male athlete to mimic the changes seen in college and professional athletes increases the risk of obesity. The irony is that obese pubertal boys have reduced levels of testosterone when compared to their leaner peers. This further increases the likelihood of undesirable body composition changes despite having the BMI of a college or professional player (Taneli et al., 2010). The effectiveness of strength training on muscular development is also impacted by pubertal development. The position paper of the American Academy of Pediatrics indicated that during early adolescence, males can increase strength without muscular hypertrophy or increases in lean mass. The strength gains in younger players are often attributed to a neurological mechanism with an active recruitment of motor neurons (McCambridge & Stricker, 2008). Further, the rapid increase in weight in the high school and collegiate athlete represents a cause for alarm as only 6.5% of high school athletes play college football (NCAA) and of those only 1.6% ultimately play in the NFL.

In a pivotal study conducted in 1994 at the behest of the NFL Players Association, the National Institute of Occupational Safety and Health found that although NFL players had a 46% reduction in mortality rate, offensive and defensive linemen had a 52% greater risk of death due to cardiovascular disease. Further, when compared to other positions, linemen were three times more likely to die from cardiovascular disease. That study also reported one of the strongest associations to date between body size and death due to cardiovascular disease (Baron & Rinsky, 1994). Unfortunately, that study was unable to collect data related to other cardiovascular risk factors. However, since that initial study, a number of investigators have examined the relationship between player size and cardiovascular risk (Borchers et al., 2009; Buell et al., 2008; Garry & McShane, 2001). The consensus is that offensive and defensive linemen are at an increased risk of cardiovascular disease due to the presence of specific risk factors, collectively known as the metabolic syndrome. The metabolic syndrome is a clustering of risk factors associated with increased risk of cardiovascular and metabolic disease (Table 6). This phenomenon is not limited to professional players, as similar findings have been observed in both college and high school athletes.

Hypertension	Systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg
Triglycerides	Plasma triglycerides ≥ 130 mg•dL^{-1}
High-density Lipoprotein Cholesterol (HDL-C)	HDL-C < 40 mg•dL^{-1}
Obesity	Waist circumference ≥ 40 inches (101.6 cm)
Glucose	Fasting blood glucose ≥ 100 mg•dL^{-1}

Table 6. Metabolic Syndrome Criteria NCEP-ATP III

The NCEP-ATP III, or National Cholesterol Education Project Adult Treatment Panel states that the presence of metabolic syndrome is diagnosed when any three of the above criteria are present. One of the limiting factors to coaches and players alike is the need to increase size while concomitantly maintaining or improving player health. While assessing those risk factors identified in Table 6 may not be feasible, in the studies reporting on player health, body composition and specifically body fat percentage, is routinely associated with risk factors for both metabolic and cardiovascular disease (Borchers et al., 2009; Buell et al., 2008). Percentage body fat has been shown to be associated with triglycerides, high-density lipoprotein cholesterol (HDL-C), waist circumference, hypertension and fasting blood glucose (Borchers et al., 2009; Buell et al., 2008). Further, in a more recent examination of cardiovascular risk factors in retired NFL players, dyslipidemia and age, not body size, were the most significant predictors of cardiovascular disease risk (Chang et al., 2009).

In summary, despite the high level of physical activity associated with football training and competition, these athletes are not immune to the health consequences associated with excess body fat. Thus, there exists a need for continued monitoring not only from a performance aspect, but also for health. Given the link between body fat and the factors known to increase the risk of both metabolic and cardiovascular disease, regular body composition testing provides a simple and effective method for monitoring one of the major correlates of performance and health.

DIETARY CONSIDERATIONS AND RECOMMENDATIONS

The modification of diet is central to the reduction of disease risk associated with excess body fatness and its sequelae. Nutritional recommendations along with strength and conditioning programs are critical in modification of body composition. In linemen with a higher percent of body fat, particularly visceral fat, a high carbohydrate (CHO) diet can often contribute to insulin resistance and the risk of obesity. When other measures of insulin resistance are not available, central adiposity can serve as a surrogate, albeit somewhat imprecise, measure (Borruel et al., 2014). Although it is unclear if there are teams routinely assessing waist circumference, a measure greater than 101.6 cm (40 in) is considered high risk (Klein et al., 2007). It is clear that the moderation of kilocalories is central to excess accumulation of body fat and it is generally recommended that the decrease should be moderate (i.e., 500 kcal/d) during the season. It is also critical to control the type and amount of CHO consumed. During exercise, the need for CHO can be estimated based on the intensity and duration of sport. The over consumption of high glycemic index (GI)/glycemic load CHO may contribute to central obesity and inflammation. Conversely, the use of low GI/glycemic load diets may be beneficial to reducing the health consequences associated with excess body fat. However, high GI foods have their place during exercise and the post recovery phase and, as such, sports dietitians should consider low GI meals for pre-competition meals and high GI foods during and in the immediate post-recovery phase. Athletes with excessive body fat may benefit from consuming a reduced CHO sport drink during activity.

Although changing body composition via body fat loss may be a poor career move, teams and ultimately the league would be advised to provide a weight loss transition from football program for those players who are retiring. During the first 8 years of the Houston Texans NFL franchise, the post-playing program consisted of a low GI diet with high-intensity strength training with very favorable body composition outcomes assessed via ADP technology (unpublished data).

PRACTICAL APPLICATIONS

- Athlete body composition should be assessed over the course of a season coincident with performance measures to evaluate efficacy of training and nutrition program implementation.
- The use of skinfolds, air displacement plethysmography and dual X-ray absorptiometry are preferred methods of body composition assessment compared to body mass index in this population.
- Consistency of technique choice is important; for example, if skinfolds are preferred these should then be used throughout the monitoring period and not used interchangeably with other techniques.
- Body fat percentage and waist circumference can be used to identify those players at risk of health issues related to dislypidemia and cardiovascular disease.
- Providing nutritional guidance to athletes at risk of cardiovascular disease and those transitioning from competitive play to retirement (not limited to professional players) may help reduce the risk of cardiovascular disease.

CONCLUSIONS

In summary, while football players have increased substantially in size over the last several decades, it is important that players at all levels are increasing body mass as a result of proper nutrition and training. By doing so, players are more likely to reap the benefits of greater performance gains with fewer health consequences associated with rapid weight gain in the absence of proper dietary guidance. Body composition assessment remains one of the best tools available to coaches to monitor body composition for performance and health. Therefore, assessing body composition should be routine practice over the course of a season and multiple playing years.

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