CHAPTER 17

Observations of Dietary Intake and Potential Nutritional Demands of a National Football Squad.

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Vignette

In preparation for the 2010 South Africa World Cup, nutritional intake and diagnostic assessment was undertaken on the England National Squad (n=29). The purpose was to evaluate provisional nutritional intake/demands, with post assessment recommendations aiming to optimise dietary support. Urinary and plasma sampling for diagnostic assessment was undertaken on 29 players, with dietary intake recall diaries collected over a 4 day period for 16 players.

Average daily energy and carbohydrate intakes were 1998.6±412.2 kcal/d and 228.0±66.5 g/d respectively, both of which being below current recommendations for athletes. Average daily protein and fat intake was found to be 130.4 ±49.6 g/d and 66.0±28.8g/d respectively, both falling within current guidelines. Various recommendations including increased energy intake, balanced meal timings, portion size, glycemic loading and protein/carbohydrate ratios were addressed as part of the nutrition programme.

With challenges faced in assessing nutrition status or demand, the use of a relatively new model of functional analysis was carried out (NutrEval profile, Genova Diagnostics Ltd). Data indicated a number of areas where nutrient demand was elevated, despite sufficient recommended nutrient intake (RNI) levels. Whilst care should be taken to interpret functional tests, the combined use of dietary recall and diagnostic testing may be useful for providing nutritional support. Directed nutritional support should be undertaken several times throughout the season, to provide more specific guidelines for athletic needs.

Discussion

Football is a demanding sport requiring repeated high intensity interval performance, including speed endurance. With elevated carbohydrate oxidation rates, rapid glycogen depletion could negatively influence physical and mental performance. Furthermore, poor hydration status and/or high individual sweat rates might also contribute to player fatigue (1). In addition, the limitations imposed by player specific training demands, travelling, food timing strategies, and individual needs pre/post match could all contribute to getting nutritional practices correct.

It has been documented that good nutrition practices are important for energy metabolism, and performance efficiency (2). In terms of daily nutrition practices, total calories consumed as well as total carbohydrate and protein intakes are considered key to high-level performance. However, Total Energy Intake (TEI) for football athletes have been reported to be below recommended levels, with estimated TEI needs ranging from 3819 – 5185 kcal/day (3). This implies the need for nutritional assessment and player support.

Observations from Dietary Intake Assessment.

1) Energy and Carbohydrate Intake:

A 4-day dietary recall was obtained on 16 players, with consideration given to total food/fluid intake over a 24-hour period, including portion size and meal timings. Average TEI was surprisingly low at 1998.6±412.2 kcal/d. It was noted that there was wide variance between players, with average TEI probably influenced by low food consumption on recovery days, and tendency to skip meals pre and/or post training. Such practices have been linked with injury prevalence (4), overreaching (5) and compromised power to weight ratios (6). Energy intake was therefore highlighted as a key area to address through additional meal planning and pre training loading.

Average daily carbohydrate intake for the 16 players interviewed was 228.0±66.5 g/d. It has been recommended that for team sports, daily carbohydrate intake guidelines should fall between 5-7g/kg/d (7). For an average 75kg player, this would require a daily carbohydrate intake of 375-525g/d. There was again diversity between players in terms of total carbohydrate intake, however on average players were consuming 3g/kg/d. This is considerably less than demonstrated elsewhere (8). Increasing carbohydrate intake closer to 8g/kg/d has been shown to increase pre training muscle glycogen content, and extend total time whilst performing high intensity work (9).

2) Protein and Fat Intake:

The Dietary Reference Value (DRV) for protein is 55.5g/d (10). This would equate to approximately 0.74g/kg/d for a typical 75kg athlete. However, recommended daily protein intake for athletes, with reference to football has been stated as 1.4-1.7g/kg/d (11). Within this squad, protein intake was 130.4±49.6 g/d (equating to approximately 1.74g/kg/d for an average player weighing 75kg). Whilst this appeared to be sufficient, the variance between players indicated the need for individualized support. Indeed, some players consumed close to or below DRVs; which has been shown to accentuate exercise-induced immune suppression (12).

Average daily fat intake was 66.0±28.8 g/d, with 23.7±10.5 g/d coming from saturated fat (36% of total fat intake) and 10.5±4.4g/d coming from polyunsaturated fats (16% of total fat intake). The total fat intake was found to be approximately 30% of TEI, which falls within current population guidelines. It is questionable whether this amount is suitable for such athlete's warrants consideration, especially in light of both low energy and carbohydrate intakes.

3) Micronutrient Intake:

With regards to micronutrients, as metabolic rate is increased, nutrient turnover is accelerated. This could lead to marginal states of acute nutrient deficiency (8). Magnesium, as example, is intrinsically involved in energy regulation, acting as a cofactor for various enzymes. Increased sweat rates lead to increased loses of magnesium and other electrolytes, potentially leading to increased functional demand. Other micronutrients have important functions as antioxidant cofactors and hence support post exercise free radical defence (13).

A summary of average daily micronutrient intake is shown in Table 1 in comparison to Recommended Nutritional Intakes (RNIs). The results indicated that players were on average consuming sufficient amounts of micronutrients in relation to population based RNIs. Whether these are appropriate for professional athletes warrants consideration in relation to suggested ‘performance intakes’, ‘upper tolerance levels’ and results from functional assessment. The degree of variance between players in terms of dietary intake should also be noted.

Table 1: Selected micronutrient intakes (n=16) in relation to Recommended Nutritional Intake and NutrEval Indices.

NUTRIENT	**Dietary Assessment Evaluation**	**Recommended Nutrient Intakes (RNIs)**	**NutrEval Indices (% of whole squad showing elevated nutrient demand indicated)**
Vitamin A (μg/d) (Retinol equivalents)	691.9 ± 322.4	700	↑ antioxidant demand (96.3%)
Vitamin C (mg/d)	109.8 ± 81.0	40	
Vitamin E (mg/d)	5.4 ± 2.4	>4	
Vitamin D (μg/d)	3.8 ± 3.6	0-10	↓ plasma status* (78.6%)
Calcium (mg/d)	753.3 ± 241.9	700	Not assessed
Magnesium (mg/d)	311.0 ± 96.6	300	↑demand (80.8%)
Zinc (mg/d)	10.4 ± 3.0	9.5	Low demand (23.1%)
Iron (mg/d)	13.6 ± 6.0	8.7	↑demand (42.3%)
Copper (mg/d)	1.4 ± 0.7	1.2	↑demand (38.5%)
Selenium (μg/d)	90.1 ± 49.6	75	↑ antioxidant demand (96.3%)
Vitamin B_6 (mg/d)	3.02 ± 1.00	1.4	↑demand (63.0%)
Vitamin B_{12} (μg/d)	5.8 ± 3.3	1.5	Normal (<10%)
Folate (μg/d)	252.9 ± 85.9	200	Low demand (25.9%)

**Plasma 25-hydroxycholecalciferol*

Observations from the Diagnostic Tests:

The NutrEval profile provides an overview of nutritional demands at a functional level. Assessment of amino acids, organic acids, essential fatty acids, oxidative stress, toxic elements and nutrient ratios from plasma and urinary sampling provide a potential means to overview gastrointestinal health, cellular energy production and vitamin/mineral demands (14,15).

Although average daily carbohydrate intake was reported to be below recommended guidelines, the habitual intake of refined sugars was relatively high. Interestingly, assessment of gastrointestinal dysbiosis was evident in 44.4% of the squad. This could relate to the relatively high glycemic index of assessed diets, and supported the recommendation to modify the glycemic load of player diets. There was also evidence of protein maldigestion, with 81.5% of the squad demonstrating elevated functional indices. Whilst this could relate to negative eating patterns (for example, inadequate chewing time, or rushed eating), protein maldigestion is indicative of digestive enzyme inefficiency, increased mucosal permeability and/or gastrointestinal dysbiosis.

Despite the fact the dietary analysis indicated normal RNIs for all selected antioxidant nutrients, 96.3% of the whole squad (and 88% of the 16 players assessed for dietary intake) were found to have moderate to high functional indices for antioxidant status. This potentially suggested that the physical demands for these athletes exceeded population guidelines. Additionally, 85.2% of the whole squad were found to have a moderate to high oxidative stress index (82% for the players assessed separately). Such information should be treated with consideration, but does indicate the potential need for increased wholefood antioxidant nutrients (15).

Plasma 25-hydroxycholecalciferol is accepted as a valid marker of vitamin D status (16). Diagnostic data revealed that 78.6% of the whole squad had below average levels of vitamin D (40.1±13.5ng/ml); and was similar when adjusted for those players undertaking dietary assessment (74.0%; with average levels of vitamin D being 38.5±12.9ng/ml). Compromised vitamin D status may negatively influence innate immunity, inflammatory cytokine cascades, and lead to suboptimal athletic performance (17). With average daily intake of vitamin D recorded at 3.8±3.6µg/d, there is indication that dietary vitamin D intake should be higher in athletes (18).

Functional indices for magnesium demand were elevated in 86% of the players assessed (and 80.8% for the whole squad), despite normal red blood cell (RBC) magnesium levels for all athletes. RBC magnesium has been shown to be a sensitive marker of magnesium deficiency (15); however, as nutrient turnover is likely to be increased with repetitive exercise, the functional test data may provide useful information for increased nutrient demands for such athletes.

Conclusions

In preparation for the 2010 South Africa World Cup, the use of combined diagnostic and dietary assessment provided useful information on player/squad nutritional needs. Whilst there are limitations imposed with the use of such methods, and care should be taken when interpreting data, the results indicated the need to address factors such as total energy and carbohydrate intake, antioxidant nutrients, and vitamin/mineral demands.

Observations from both assessments highlighted the importance of regular monitoring of individual and team nutritional intake, as well as sourcing both robust and practical evaluation methods. Awareness of essential dietary practices such as frequent meal patterns, portion size, protein-carbohydrate ratios, food timing, and appropriate recovery strategies were addressed as part of the follow up programme as a means to support athletic performance.

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***Commentary**: Chris Barnes*, Australian Institute of Sport.
Justin Roberts presents an interesting report on the nutritional intake of elite soccer players in the run up to the 2010 World Cup, coupled with an appraisal of associated Glycaemic Index and cellular function. The reported sub-optimal calorie intake concurs with the findings of many other studies of a similar nature, both in the UK and abroad. Whilst the use of dietary recall diaries may have its limitations, the consistency of findings raises cause for concern for team sports athletes preparing for competitions such as the World Cup.

It is interesting to note that the shortfall in calorie intake would appear to be in carbohydrates, and more specifically complex carbohydrates for many players, with other macronutrient intakes being within what would be considered adequate for their population. It is a shame that there is no reference to the time of the season, or phase of training cycle that the food diaries represent, which would have provided a little more context to the case study.

When prescribing nutrient intake strategies for soccer players, consideration should be given to the potential huge variation in their weekly training / match structure. Depending on circumstances, players could participate in one, two or, in exceptional circumstances, three matches within a 7-day period. Given that a 90-minute game of soccer can result in muscle glycogen levels dropping by 40% to 90% (1), then restoration of glycogen stores through appropriate nutrient intake is of paramount importance.

Additionally, daily training volume and intensity can vary markedly in accordance with the phase of the season and aims of sessions. For example, volume, represented by total and high-intensity locomotive distances covered may range between 30% and 80% of individual match performances. Similarly, intensity, represented by total and high-intensity distances covered per unit time may range between 30% and 120% of individual match performances. Such variation in training / match demands has clear implications on both a qualitative and quantitative level for nutrient prescription. Add to this the different positional demands of the sport with, for example, wide midfield players covering double the distances at high-intensity than centre halves (2) then the job of the sports nutritionist in providing a prescription which is appropriate to individual, positional and circumstantial needs becomes even more challenging.

Individualised and periodic nutrient intake strategies for elite team sports athletes are essential to optimise both performance and recovery, and to protect hormonal, metabolic and immune function (3). Regular monitoring of intake and associated functional indices of health are an important component of any support programme for elite team sports athletes.

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