GATORADE SPORTS SCIENCE INSTITUTE™

SPORTS NUTRITION TOOLKIT

PRACTICAL TOOLS FOR QUALIFIED PROFESSIONALS WORKING WITH ATHLETES

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THE GATORADE SPORTS SCIENCE INSTITUTE

LIAM BROWN, MSc

CAROLINE TARNOWSKI, MSc

REBECCA RANDELL, PhD

KHALIL LEE, PhD

KEVIN LUHRS, MS

ERIC FREESE, PhD

JAMES CARTER, PhD

IAN ROLLO, PhD

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SPORTS NUTRITION TOOLKIT

The Gatorade Sports Science Institute (GSSI) is committed to helping athletes optimize their health and performance through research and education in hydration and nutrition science. The GSSI has experience working with some of the best practitioners, teams and athletes in the United States and across the globe. The provision of this service would not be possible without the translation of sports nutrition research into sports nutrition practice.

Over the last 40 years GSSI have provided free Sports Science Exchange articles to review the latest scientific evidence on core and hot topics in sports nutrition. Thus, the GSSI leads with science to inform sports nutrition recommendations.

To complement the information gained via research, the GSSI provide translational online "tools" for athletes, dietitians and sports nutritionists to utilise in practice. Examples include the fluid loss calculator, diet analysis tool for athletes and fuel habit surveys. Furthermore, GSSI partner closely with the Gatorade Performance Partner team to provide a suite of educational and practical materials for individuals working with athletes.

The aim of this Sports Nutrition Toolkit is to provide a guide and resource for qualified sports professionals such as nutritionists and dietitians (referred to as 'nutritionist' throughout) working with athletes. The toolkit is not designed to cover all topics in sports nutrition. Nor should the toolkit be considered as a consensus for practice in sports nutrition. Instead, the toolkit aims to provide introductory materials on the fundamental topics in sports nutrition to support best practice.

It is our ambition that these resources are taken, modified and adapted to the needs of the individual athlete, team or sport. We hope this book will provide a good starting point for people new to the profession, as well as be of interest to more established sports nutrition practitioners.

DR IAN ROLLO
GSSI Principal Scientist: Head of GSSI International Service, UK

DR ERIC FREESE
GSSI Principal Scientist: Lead of U.S. Satellite Laboratory in Frisco, Texas

GSSI Sports Science Exchange articles:
gssiweb.org/en

Gatorade Performance Partner Sport Nutrition resources:
performancepartner.gatorade.com/resources

BUILDING A TEAM

"Building a team" typically refers to the recruitment of athletes and support staff and the experimentation with training and/or tactics in pursuit of winning performances. However, in literal terms, it is the sports nutritionist who may in fact have the biggest impact on "building" a successful team. This is because the foods in the athlete's diet fundamentally provide the building blocks for all movement, for example muscle, bone and energy production. Thus, without food the athlete would not be able to complete sport-specific skills, nor would they be able to cope with the repeated demands of training and competition over the duration of a season.

The nutritionist is an integral part of the sports performance team (a network of individuals who support the athlete's health, performance and development). However, we recognise that nutrition in sport can be low on the list of priorities as coaches and team physicians prepare athletes for competition. To this end, it is important for the nutritionist to integrate within the sports performance team to maximise the impact of sports nutrition advice on the athlete. Thus integrating nutrition into an interdisciplinary team may result in improved outcomes that would not be achieved by a single discipline alone.

Figure 1 provides examples of where the nutritionist can integrate with the Sports Performance team. It is important to recognise that members of the performance team are often best placed to reinforce nutrition messages to the athlete.

HEAD COACH AND COACHING STAFF

Educate Head Coach and Coaching Staff on sports nutrition principles and messaging.

Share body coamposition results and educate on body composition goals.

TEAM DOCTOR

Understand medical priorities.

Understand return to play strategies.

Develop food / hygiene education.

Communicate on pre-existing and/or developing medical conditions with nutritional interventions where appropriate.

Collaborate on assessment of blood profiles and appropriate nutrition interventions.

Provide resources on recent sports nutrition science.

PHYSIOTHERAPIST

Integrate sports nutrition protocols to support specific rehabilitation programs.

STRENGTH AND CONDITIONING COACH

Understand individual training goals and build sports nutrition to support.

Collaborate on sports nutrition and strength and conditioning periodization.

SPORT SCIENTIST

Collaborate in quantifying individual athlete and/or team training and competition demands and plan sports nutrition protocols accordingly.

Build sports nutrition into recovery strategies.

SPORT PSYCHOLOGIST

Partner in understanding and setting short and long term nutrition / performance related objectives.

Collaborate in fostering healthy athlete-food relationships.

Partner in framing body composition goals appropriately.

Partner in return to play process.

PERFORMANCE CHEF

Educate Performance Chef and Food Service Staff on sports nutrition principles and messaging.

Partner in menu development. Offer recipe and menu analysis.

Figure 1

Examples of how the nutritionist can integrate with the Sports Performance Team.

PREPARATION

The nutritionist should prioritise the foundations of nutrition i.e. a healthy, balanced diet, before moving to the more advanced details of personalization.

Before the nutritionist begins to communicate with an athlete, they are encouraged to complete the pre-requisites of practical nutritional support (highlighted in this chapter). Focusing on these foundations sets the nutritionist up for future success and ensures that both the nutritionist and athlete have safeguards in place to protect the individual as well as the integrity of the team/sport.

This chapter provides key resources and tools to help build these foundations, including suggested resources for the nutritionist to utilise periodically to ensure they are adhering to current best practice (Table 1). For the translation of sports nutrition into practice, a list of some helpful nutrition tools to utilise around training and competition is provided (Table 2).

RESOURCE	FUNCTION
World Anti-Doping Agency (WADA) Resources	To help the nutritionist understand the World Anti-Doping Code, prohibited substance list and other relevant documentation, to protect athlete, nutritionist and the integrity of the sport.
Local and Sport Specific Anti-Doping Resources	To help the nutritionist understand local/sport specific anti-doping requirements to protect athlete, nutritionist and the integrity of the sport.
Sport Nutrition Accreditation	Becoming accredited in region specific sport nutrition associations (e.g. the Sport and Exercise Nutrition Register, UK) can help protect and promote both the role as a nutritionist, and the wider sport nutrition profession.
Food Hygiene Certificate	Recommended if working with food. The knowledge gained by completing the certificate will help to protect the health and safety of the athlete.
Gatorade Sport Science Institute Website	Education and professional development resource; supports nutritionists by providing information on a multitude of sport science and nutrition topics via Sport Science Exchange articles, webinars, research articles and more. Provides scientific rationale for sports nutrition recommendations.
Gatorade Performance Partner Website	Education and professional development resource; supports nutritionists development, athlete performance and collaboration through professional development opportunities, athlete education tools, and events with sports performance industry leaders.
Collegiate and Professional Sports Dietitians Association Website	Education and professional development resource; The Association's mission is to create leaders who elevate the profession of Sports Nutrition through ethical, science-based, cutting-edge care. The website offers career development opportunities, education resources and more.
Academy of Nutrition and Dietetics Sports and Human Performance Nutrition Website	Education and professional development resource; The group leverages the integration of nutrition, exercise science, and technology to set industry standards. The website provides continuing education, and helps prepare the next generation of cutting-edge professionals.
Australian Institute of Sport Position Statement on Supplements and Sports Foods in High Performance Sport	Provides a classification system ranking sports foods and supplements into groups according to scientific evidence and safety. Can be used to educate and inform practice.

Table 1

A selection of recommended resources for nutritionists.

Table 2

Nutrition tools to support the nutritionist around the exercise occasion.

**Availability may vary depending on the region.*

EQUIPMENT	NAME OF EQUIPMENT	USE / IMPORTANCE
	**Squeeze Bottle**	To support fuelling and hydration
	**Gx Bottle**	To support personalized fuelling and hydration
	**Bottle Carrier**	To transport bottles during training and competition
	**Drinks Cooler**	To keep drinks cool in heat and ensure availability of fluids
	**Shaker Bottle**	To support refuelling and muscle repair
	**Towel**	To wipe away sweat and dry off post-exercise
	**Gx Patch and App***	To understand athlete's fluid and sodium losses during exercise to help personalize hydration recommendations

Table 3

Checklist of tasks for the nutritionist prior to starting a new role.

PREPARATION CHECKLISTS

Checklists provide a useful guide to evaluate which key tasks have been completed, as well as identifying opportunities to improve practice. Lists of suggested tasks that the qualified professional could complete before starting their role in sports nutrition, and tasks that could be completed once their role has began have been provided (Tables 3 and 4). These lists are not in any particular order, nor are they extensive. However, the lists can be used as a starting point to evaluate the importance of each task, and to help identify any additional tasks relevant to specific roles.

TASK	COMPLETED?
Read and understand WADA and local and sport specific anti-doping resources.	
Read and understand relevant data security policies.	
Read and understand relevant safeguarding policies.	
Apply for, or renew, sports nutrition, and other relevant accreditations i.e. ISAK for taking anthropometric measurements.	
Complete a food hygiene certificate.	
Refresh knowledge with educational resources.	
Research the team / individual to support relationship building.	

TASK	COMPLETED?
Meet the athlete(s), members of the sports performance team and remaining staff to understand roles and responsibilities.	
Begin to build relationships with athlete(s), members of the sports performance team and remaining staff through non-nutrition related conversations.	
Begin to understand the knowledge and attitudes towards sports nutrition of the athlete(s), members of the sports performance team and remaining staff.	
Ensure the athlete(s) / team has the required physical tools (bottles, body mass scales, etc) listed throughout this document. Understand where these tools are stored, or purchase and store tools in a safe location.	
Where appropriate, observe the process in restaurants / canteens at meal times.	
Where appropriate, ask for menus from chefs for breakfast, lunch and dinner; including training, competition, travel and overnight stay menus. This could include meals at hotels and during charter flights/travel on buses, for example, as well as any foods provided in the locker room, and post-exercise.	
Observe and monitor current training and competition routines and nutrition strategies; including those pre-, during and post-exercise, during breaks in play (i.e. half time), and during travel and overnight stays.	
Discuss current supplementation strategies with members of the sports performance team ensuring all supplements meet WADA regulations and their use is based on science (see pages 53 - 55).	
Observe different kinds of training sessions pre-, during and post-exercise. E.g. technical sessions, recovery sessions, and gym sessions.	
Review current educational resources available to the athlete(s) / team.	

Table 4

Checklist of tasks for the nutritionist once they have started a new role.

CONSULTATIONS AND DIETARY ANALYSIS

Consultations and dietary analyses are significant tools that can be used independently, or in tandem, by the nutritionist to learn more about an athlete with the aim to inform personalized nutrition advice. This chapter provides practical tools to support the nutritionist in running both consultations and dietary analyses with athletes (Figure 2).

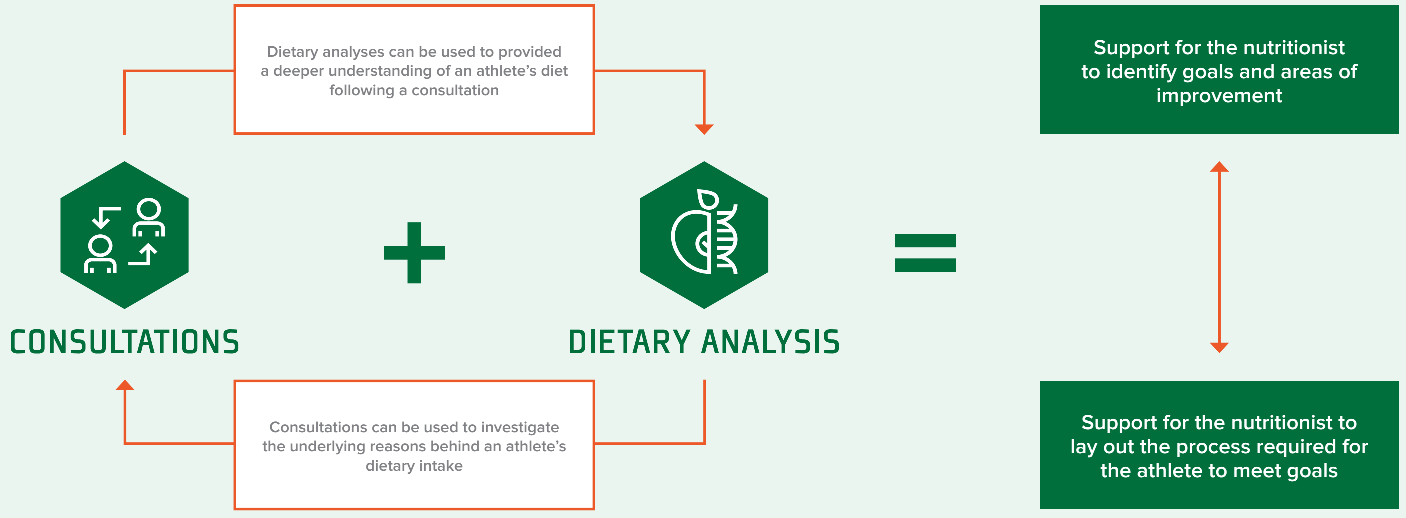


Figure 2

The relationship between consultations and dietary analysis.

CONSULTATIONS

A consultation is a one to one conversation between the nutritionist and athlete. The aim of the consultation is to establish the athlete's history and current situation, to review barriers to good practice, and to identify targets, goals, and areas of improvement.

Consultations are a significant tool for the nutritionist to build an understanding of the athlete and should be utilised throughout any partnership to inform personalized nutrition recommendations. This section provides practical tools to support nutrition consultations.

CONSULTATION FORMS

Pages 11 - 16 contain consultation templates and feedback forms to support the nutritionist in facilitating consultations with athletes (Table 5). These consultation templates are based on the COM-B behaviour change wheel (Michie, et al., 2011) and can be used by the nutritionist to guide conversations with an athlete to understand their capabilities, opportunities and motivation around food and nutrition. Decision trees can be utilised as a guide for the consultation process (Figures 3 and 4).

Each template can be used to guide conversations and may be adapted by the nutritionist to suit their needs. These templates act as data collection sheets for conversations with athletes to be monitored over time. These records are confidential and should be stored accordingly.

Table 5

An overview of consultation forms displayed on pages 11 - 16.

NAME OF SHEET	FUNCTION	SHARE WITH ATHLETE?
Initial Nutrition Assessment	To be used for the initial consultation with an athlete. The sheet can be used to direct the conversation during the consultation, with the aim of understanding the athlete and identifying some areas to work on.	**YES**
Nutrition Consultation	To be used each time you have a consultation with an athlete following the initial assessment. It can either be filled out at the time of the consultation, or afterwards to document the conversation.	**YES**
Goal Setting	To be used to set a goal with an athlete. Designed to direct the conversation during the goal setting process and to be filled out at the time of the consultation.	**YES**
Goal Setting Follow-up	To be used to follow-up on the progress of the goal. Can be used multiple times throughout the goal setting process.	**YES**

CONSULTATION DECISION TREE

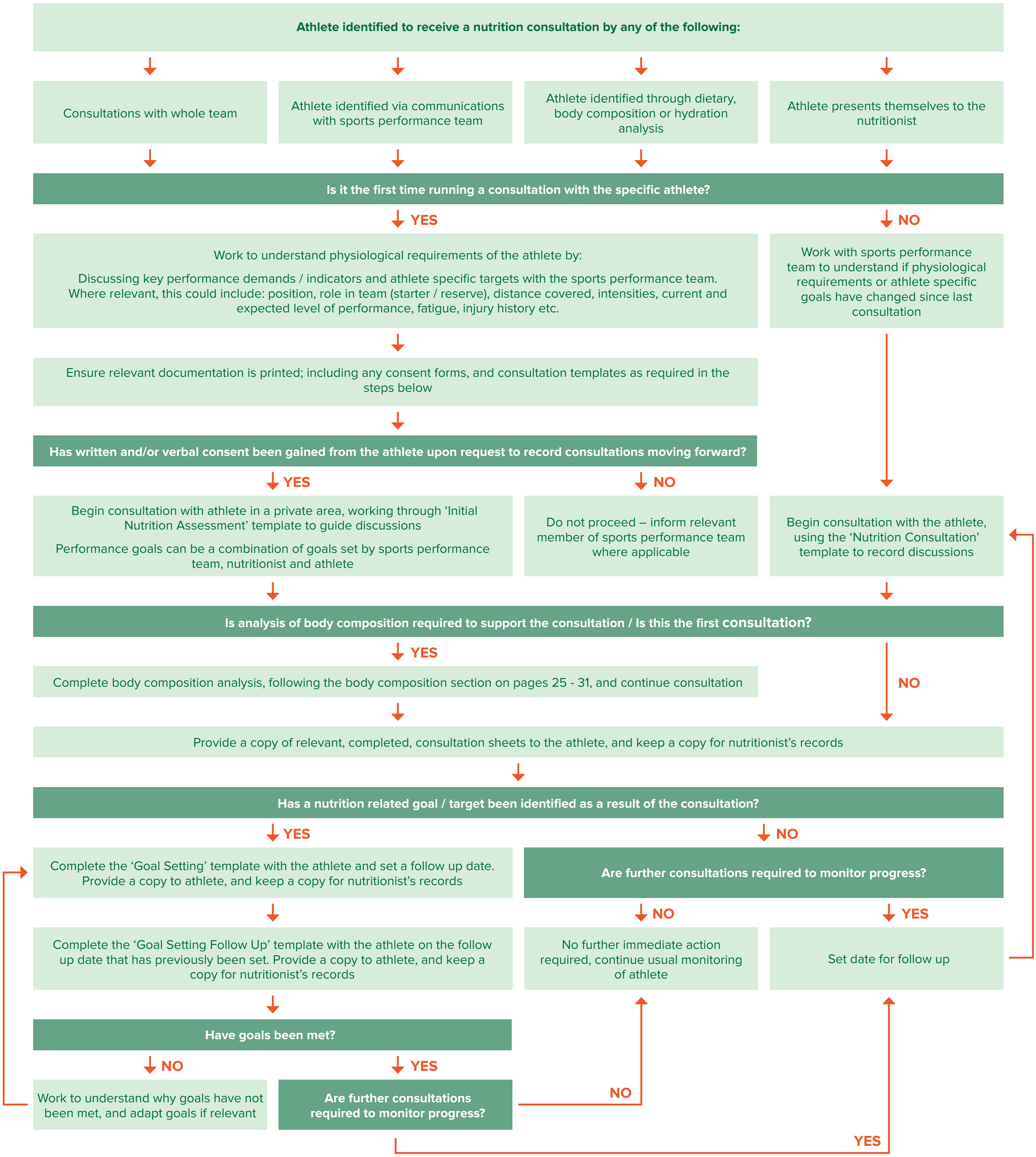
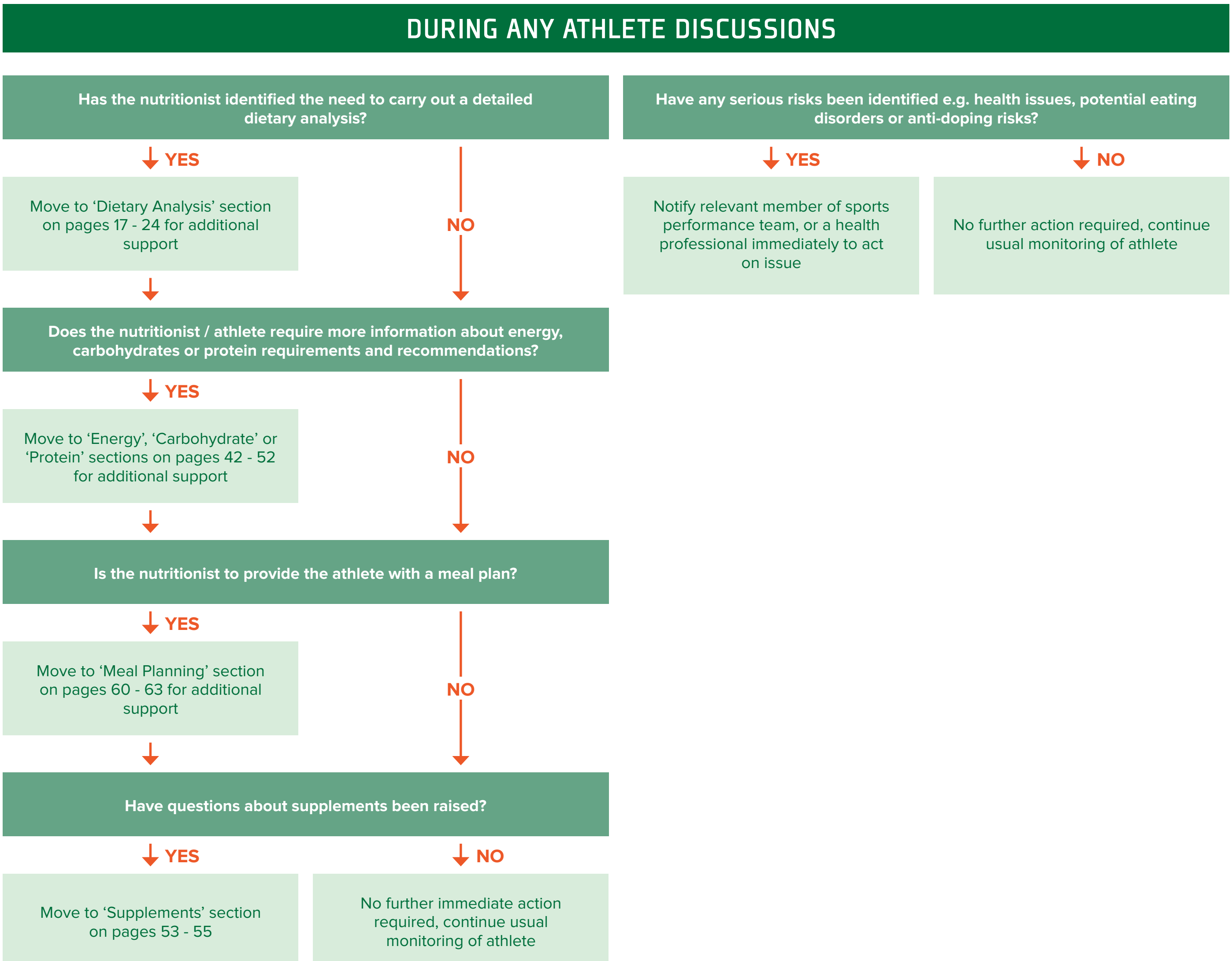


Figure 3

Decision tree to be used as a guide for nutritionist when completing consultations.

Figure 4

Decision tree to be used during any conversations with an athlete.



INITIAL NUTRITION ASSESSMENT

NAME: ______________________ DATE: ______________
AGE: ________ SPORT: ______________
PREFERRED CONTACT METHOD: ______________ POSITION: ______________

PERFORMANCE GOALS

1. ______________________________
2. ______________________________
3. ______________________________

GENERAL INFORMATION

Type of diet?	Food preferences (e.g. dislikes)?	Food allergies / intolerances?	Supplements?

Frequency of illness / URTIs?	Injury history	Menstrual cycle information	Medication?

BODY COMPOSITION RESULTS AND TARGETS

	Current	Target
Height (ft, in or cm)		N/A
Body mass (lb or kg)		
Sum of 8 skinfolds (mm)		
Predicted body fat %		

BODY COMPOSITION METHOD USED: ______________________________
DATE FOR TARGET TO BE REACHED BY: ______________________________

INITIAL NUTRITION ASSESSMENT

NAME: ______________________ DATE: ______________________

WHAT ARE THE ATHLETE'S CAPABILITIES?

Knowledge of nutrients in foods?	Food type / timing knowledge?	Cooking ability?	Meal planning skills?

ARE THERE ANY OBSTACLES / OPPORTUNITIES?

Home environment, who cooks / shops?	Travel / commuting habits?	Training habits?	Competition habits?

WHAT IS GOING TO KEEP THE ATHLETE MOTIVATED?

Motivations in terms of both sport and nutrition?	Physical development goals?	Prefer information to be scientific or basic?	Frequent nutrition reminders needed?

NOTES

INITIAL NUTRITION ASSESSMENT

NAME: ____________________ DATE: ____________________

KEY STRENGTHS

KEY AREAS TO DEVELOP

INITIAL NUTRITION SPECIFIC WORK-ONS

FOLLOW UPS

NEXT REVIEW / CHECK IN DATES

NUTRITION CONSULTATION

NAME: ____________________ DATE: ____________________

AGE: __________ HEIGHT: ____________________

BODY MASS: ____________________ SKINFOLDS: __________ mm

PERFORMANCE GOALS

1. ____________________
2. ____________________
3. ____________________

AREAS DISCUSSED

OUTCOMES / FOLLOW UPS

NEXT REVIEW / CHECK IN DATES

GOAL SETTING

NAME: ____________________ DATE: ____________________

AGE: __________ HEIGHT: ____________________

BODY MASS: ____________________ SKINFOLDS: __________ mm

PERFORMANCE GOALS

1. ____________________
2. ____________________
3. ____________________

NUTRITION RELATED GOAL

CAPABILITY

Do you have the knowledge / skills to be able to achieve it?

OPPORTUNITY

Will your environment allow the behaviour to occur?

MOTIVATION

Is this a habit or do we need to make a more structured plan?

WHAT IS GOING TO HOLD YOU ACCOUNTABLE?

HOW CAN WE MEASURE IF YOU HAVE ACHIEVED IT?

KEY REVIEW / CHECK IN DATES

GOAL SETTING FOLLOW-UP

NAME: ____________________ DATE: ____________________

AGE: __________ HEIGHT: ____________________

BODY MASS: ____________________ SKINFOLDS: __________ mm

PERFORMANCE GOALS

1. ____________________
2. ____________________
3. ____________________

NUTRITION RELATED GOAL

HAVE YOU ACHIEVED THE GOAL?

WHAT WENT WELL?	WHAT DID YOU FIND DIFFICULT?	WHAT NEEDS TO HAPPEN NEXT?

NEXT REVIEW / CHECK IN DATES

DIETARY ANALYSIS

Dietary analysis is a tool that can be used to understand an athlete's food choices and how they align with daily goals. Results from dietary analyses can be used to provide personalized nutrition feedback to an athlete to support their health, development and performance.

There are several different dietary analysis techniques. This section will provide tools to identify which technique to utilise and how to provide feedback to the athlete. The nutritionist should understand that no single form of dietary analysis is 100% valid or reliable. In addition, many other factors should be considered alongside diet when evaluating health and performance, thus results of dietary analyses should be interpreted in regard to these limitations.

OVERVIEW OF DIETARY ANALYSIS METHODS

There are several commonly used dietary analysis methods (Table 6), each of which come with potential errors, be that of validity, or reliability. The nutritionist is encouraged to weigh up the pros and cons to select the most appropriate dietary analysis method for their needs; the use of a checklist can help guide their choice of dietary analysis method (Table 7).

It may be the case that the nutritionist decides to use a combination of dietary analysis methods, rather than one single method. In fact, many nutrition applications (apps) for mobile devices are taking this approach, and are becoming increasingly popular with sport clubs and athletic departments. These apps may increase convenience for both athlete and nutritionist, with some including conventional search and select methods for food and beverage items, and others allowing the athlete to send images of their choices directly to the nutritionist. In some cases, these apps act as a real time feedback method, allowing real time analysis of diets and combining athlete-nutritionist communications, or by connecting to ordering systems in canteens, for example. However, it should be noted that whilst there are an abundance of nutrition apps coming to the market, their accuracy, reliability and validity cannot be guaranteed, thus if the nutritionist decides to use a nutrition app, they should critically evaluate the app before choosing the one appropriate for their needs, taking into consideration the factors highlighted in Table 6.

Should the athlete not require a full dietary analysis, but instead a less detailed analysis of fuel habits around an exercise session, the nutritionist can utilise the online GSSI Fuel Habits Survey* This survey can be used to capture basic information about the athlete's habits which are scored based on the importance of the nutritional behaviour based on level of athlete, time of day, goal, duration, and intensity. The results provide a snapshot of behaviours, with a loss of points indicating areas of improvement, acting as a starting point for nutritionists conversations with the athlete.

*www.gssiweb.org/toolbox/survey/fuelhabits

METHOD	OVERVIEW OF METHODS	PERIOD OF INTEREST	PROS	CONS
RETROSPECTIVE				
24 h Recall	Athlete describes foods consumed over the last 24 h or a "typical day"	24 h	• Speedy to implement • Low burden for the athlete • Interview can be structured around daily activities • Does not alter intake • Suited to epidemiological research	• Relies on athlete's honesty, memory and food knowledge • Requires trained interviewer • Day for recall may be "atypical" • Suitable for group surveys but not representative of individual's normal intake
Food Frequency Questionnaire (FFQ)	Athletes asked how often they eat foods from a standardised list and to estimate portion sizes often using photos or food models as a prompt	From 24 h period to open-ended	• Can be self-administered to lower burden on the nutritionist • Can be used to cross-check data obtained from other methods • Validated for ranking individuals • Can be modified to target certain nutrients • Can be automated to allow quick processing by nutritionist	• Relies on athlete's honesty, memory, literacy and food knowledge • Validity dependent on the food list and the quantification method
Diet History	Open-ended interview concerning food use, food preparation, portion sizes, food like/dislikes and a food checklist	Open-ended or over a specified period	• Accounts for daily variation in food intake by investigating a "typical" day • Can target contrasts between periods of interest as a sub-theme • Collects information on timing of intake and factors that influence food patterns	• Relies on athlete's honesty, memory, food knowledge • Labour intensive & time consuming • Requires trained interviewer • Mostly appropriate for qualitative assessment rather than quantitative
PROSPECTIVE				
Written Food Diary (diet record)	Athlete's dietary intake is quantified by weighing foods and beverages consumed	May be undertaken for 1-7 d, with increasing ability to track usual intake as duration increases, but reduced compliance	• Provides a more accurate quantification of foods than household measures • Considered the "gold standard" for dietary assessment	• Relies on athlete's honesty and food knowledge • Time consuming for athletes to keep and nutritionists to process • Distorts food choice and quantity. Athlete may alter their diet to improve their intake or to reduce the workload of recording
	Athlete's dietary intake is quantified using household measures (descriptions of cups, teaspoons, dimensions of food portions, etc.)	May be undertaken for 1-7 d, with increasing ability to track usual intake as duration increases, but reduced compliance	• Improved compliance with athletes compared with weighted record • Less alteration of normal eating pattern compared to weighed or semi-weighed records	• See comments for weighed record • Requires checking by a trained person • Needs standardised set of household measures • Subjective/inaccurate assessment of portion sizes
Remote Food Photography Method (RFPM) **"Snap-N-Send"**	Athlete takes and sends photographs of their plate pre- and post- consumption via mobile phones in real time	Real time and open-ended	• Self-administered • Speedy to implement • Low burden for the athlete • Can be used to cross-check data obtained from other methods	• Relies on athlete's honesty • May distort food choice and quantity. Athletes may alter their diet to improve their intake • Subjective/inaccurate assessment of portion sizes • Subjective/inaccurate assessment of ingredients in multi-ingredient dishes e.g. casseroles, if additional details are not provided • When used alone, validity and inter-practitioner reliability reported as poor (Stables, et al., 2021)

Table 6

Overview of dietary analysis methods, adapted from Burke, 2015.

DIETARY ANALYSIS METHODS

This section provides an overview of the standard operating procedures for the different dietary analysis methods. Pages 23 - 24 provide an athlete feedback form that can be used to document results of dietary analyses. This form can be used to provide feedback and practical recommendations to the athlete (information on calculating predicted nutrition requirements can be found in the Nutrition Interventions chapter on pages 42 - 59). This form can also be used for record keeping and should be stored accordingly. A decision tree is used to pull these resources together, acting as a guide to walk the nutritionist through the process of selecting, and running a dietary analysis (Figure 5).

24 HOUR RECALL

The GSSI website contains an online 24 hour recall tool which the nutritionist can use with an athlete*. This online tool uses the 'multiple pass' method, and produces a report that includes an estimate of total daily nutrient intake, pre-, during and post-exercise intakes, and an estimate of energy expenditure based on activities. Findings of a validation study reported that these outputs are in good agreement with traditional 24-hour recall, and observations made by nutritionists. Instructions can be found at the link above, and it is advised that the nutritionist runs through the recall with the athlete, adding athlete information, exercise data and data on food and beverage intake over the last 24 hour period. The nutritionist should then encourage the athlete to review the data and add anything that was missed first time round (multiple pass) before the report is created; it is important to advise the athlete to be honest when completing the recall so that results reflect actual food and beverage intake. The process will take approximately 15-20 minutes.

*www.gssiweb.org/toolbox/dietaryanalysis/profile

FOOD DIARY

A template food diary to be completed by the athlete can be found on page 22, with one page completed per day during the analysis period (usually 3 to 7 days). An athlete, where possible, is recommended to complete analysis on at least one rest, training and competition day to evaluate dietary intake over days with different physiological demands. Food diaries can provide insight into types and quantities of food consumed, alongside specific timings of consumption; it is important to regularly remind the athlete that they should not deviate from their current nutrition habits/behaviours whilst filling out the diary so that results reflect actual dietary intake, and do not hide any potential deficiencies in intake.

When filling out the food diary, the athlete should be advised to record all food and drink consumed on these days, and to be as specific as possible; e.g. including cooking methods (e.g. boiled, fried etc), product brands (e.g. Gatorade), important details (e.g. zero sugar) and quantities of foods and drinks before, and after eating (to account for waste). Quantities can be in ounces / grams or fluid ounces / millilitres, to be weighed by the athlete using weighing scales, or using the 'household measures' method as described in Table 6. The method chosen for documenting quantities of foods is at the discretion of the nutritionist after weighing up the pros and cons of each method. Athletes should also be remined to breakdown all meals into their component parts, e.g. scrambled eggs on toast would be bread, butter, eggs and oil and to include all condiments, such as ketchup. The more detailed the diary, the more accurate the results of the analysis will be. Finally, there is a section at the bottom of the diary where the athlete can input factors that they feel may have impacted dietary intake, such as mood or quality of sleep. Detailed nutritional intake data such as energy intake and macro- and micronutrient intake can be evaluated if the nutritionist inputs the data into dietary analysis software.

REMOTE FOOD PHOTOGRAPHY METHOD (RFPM)

The RFPM is a relatively new method of dietary analysis compared to the aforementioned methods. The RFPM uses real time images of an athlete's diet to capture dietary intake in free-living situations (Martin, et al., 2009). A later study, using an adaptation to the RFPM, 'Snap-N-Send', describes the methods used to collect dietary analysis data (Costello, et al., 2017). To help reduce inaccuracies in subjective portion size assessments, the athlete can place their plate, or food item on a A3 1 x 1cm grid placemat in each photo, as per Costello, et al., 2017. However if this is not practical, the athlete is encouraged to place their hand, or a utensil next to the plate or food item. The same placemat, hand, or utensil should be used in each photo.

The RFPM can provide insight into types and quantities of food consumed, alongside specific timings of consumption. Detailed nutritional intake data such as energy intake and macro- and micronutrient intake can be evaluated if the nutritionist inputs the data into dietary analysis software. It is important to regularly remind the athlete that they should not deviate from their current nutrition habits/behaviours when using the RFPM so that results reflect actual dietary intake, and do not hide any potential dietary deficiencies. The RFPM can be used in addition to other methods of dietary analysis.

QUESTION	NUTRITIONIST ANSWER	DO THE FOLLOWING METHODS FIT WITH THE NUTRITIONISTS REQUIREMENTS? (YES/NO)					
		24 h recall	FFQ	Diet history	Food diary (Weighed)	Food diary (Household measures)	RFPM
What kind of data is the nutritionist looking for? E.g. general overview, timings of consumption, or specific amounts of micro and macronutrients consumed?							
Is the nutritionist looking for long or short term dietary intake data?							
How knowledgeable is the athlete about food? How simple should the method be to avoid confusion?							
How much time and motivation does the athlete have? Will the method be a burden on the athlete?							
How much time does the nutritionist have? Does the nutritionist have the time to evaluate the data?							
Are additional tools required to support dietary analysis, e.g. dietary analysis software? Is the appropriate software available where applicable?							
Does the nutritionist require training to run the analysis? Is the nutritionist adequately trained where applicable?							

Table 7

Checklist to support nutritionists choice of dietary analysis method. Adapted from Burke, 2015.

Figure 5

Decision tree to be used as a guide for nutritionist when completing dietary analysis.

DIETARY ANALYSIS DECISION TREE

Athlete identified to receive dietary analysis by any of the following:

- Analysis with whole team
- Athlete identified via communications with sports performance team
- Athlete identified through consultation process or body composition analysis
- Athlete presents themselves to the nutritionist

Has initial consultation already been complete with athlete?

- YES → Choose relevant dietary analysis method
- NO → Follow consultation decision tree on page 9 → Choose relevant dietary analysis method

Choose relevant dietary analysis method; Nutritionist can evaluate pros and cons of each method (Table 6), and complete the checklist in Table 7 to help guide their choice

Nutritionist should run the chosen dietary analysis method with the athlete, following standard operating procedures as highlighted on page 19

Is analysis of body composition required to support the dietary analysis?

- YES → Complete body composition analysis, following the body composition section on pages 25 - 31, and continue analysis
- NO

Has the 'Food Diary' method been chosen?

- YES → Print the 'Food Diary Template' and explain the process of recording data to the athlete. Follow methods as highlighted on page 19
- NO

Record results of the analysis; Fill in applicable sections, and add additional comments and practical recommendations on the 'Dietary Analysis Feedback' template for the nutritionist's records. Provide a copy to the athlete, alongside verbal feedback to ensure athlete understanding

Would the nutritionist like to provide estimated energy, carbohydrate and protein requirements alongside dietary analysis results?

- YES → See 'Energy', 'Carbohydrate' and 'Protein' sections on pages 42 - 52 to calculate estimated requirements before completing the templates and sharing the feedback with the athlete
- NO → Leave these sections of the template empty, and share the feedback form with the athlete

Is a further intervention required as a result of the dietary analysis results?

- YES → **Has a specific goal been set? Is a meal plan appropriate for the athlete? Does the nutritionist want to understand what is affecting or influencing the athlete's dietary intake?**
  - Goal → Follow the 'Consultation Decision Tree' (page 9) from the 'Goal Setting' step
  - Meal Plan → Move to 'Meal Planning' section on pages 60 - 63 for additional support
  - Consumption Influences → Follow the 'Consultation Decision Tree' on page 9
- NO → **Are further consultations required to monitor progress?**
  - YES → Set date for follow up → Follow Consultation Decision Tree on page 9
  - NO → No further immediate action required, continue usual monitoring of athlete

FOOD DIARY TEMPLATE

NAME: ______________________ DATE: ______________
DAY OF WEEK: ______________ TYPE OF DAY (E.G. REST): ____________
TYPE AND DURATION OF EXERCISE: ______________________________________

Time	Name of meal	Detailed list of ingredients	Quantity at start	Quantity at end
Example 8am	**Example** Breakfast; Porridge with toppings	**Example** 1.5 oz Quaker Oats; 8.5 fl oz 2% reduced fat milk; 3.5 oz banana OR 1 pot Quaker Oats; 1/2 glass 2% reduced fat milk; 1 medium banana	**Example** 13.5 oz OR 1 large bowl	**Example** 1 oz OR 1 spoon porridge

GENERAL COMMENTS FOR THE DAY

Factors that may contribute to food consumption (e.g. quality of sleep, mood etc.)

DIETARY ANALYSIS FEEDBACK

NAME: ______________________ DATE: ______________________

BODY COMPOSITION RESULTS AND TARGETS

	Current	Target
Height (ft, in or cm)		N/A
Body mass (lb or kg)		
Sum of 8 skinfolds (mm)		
Predicted body fat %		

BODY COMPOSITION METHOD USED: ______________________ DATE FOR TARGET TO BE REACHED BY: ______________________

TOTAL ENERGY INTAKE

	Rest day	Training day	Competition day
Estimated requriements (kcal / day)			
Estimated intake (kcal / day)			

FEEDBACK

PRACTICAL RECOMMENDATIONS

CARBOHYDRATE INTAKE

	Rest day	Training day	Competition day
Estimated requriements	Total: ________ g / day	________ g / day (Light) ________ g / day (Moderate) ________ g / day (High)	________ g / day ________ g / hour pre-exercise ________ g during exercise ________ g / hour post-exercise
Estimated intake	Total: ________ g / day	________ g / day (Light) ________ g / day (Moderate) ________ g / day (High)	________ g / day ________ g / hour pre-exercise ________ g during exercise ________ g / hour post-exercise

FEEDBACK

PRACTICAL RECOMMENDATIONS

DIETARY ANALYSIS FEEDBACK

NAME: ______________________ DATE: ______________________

PROTEIN INTAKE

	Rest day	Training day	Competition day
Estimated requriements (g / day)			
Estimated intake (g / day)			

FEEDBACK

PRACTICAL RECOMMENDATIONS

FAT INTAKE

	Rest day	Training day	Competition day
Estimated requriements (g / day)			
Estimated intake (g / day)			

COMMENTS ON TYPE OF FATS CONSUMED

FEEDBACK

PRACTICAL RECOMMENDATIONS

QUALITY OF DIET

OVERALL COMMENTS

(e.g. regarding micronutrient and phytonutrient consumption)

FEEDBACK

PRACTICAL RECOMMENDATIONS

NUTRITION MONITORING

Monitoring an athlete's body composition, sweat rates and hydration status, allows nutrition and hydration recommendations to be tailored to meet an athlete's individual requirements. This chapter provides practical tools to support the collection and analysis of this data.

BODY COMPOSITION

Body composition plays a role in both health and performance and is impacted by diet and physical activity. As such, body composition varies from athlete to athlete. Monitoring body composition over time can provide insights into an athlete's energy availability, physical development, and can be used to assess the impact of training and nutrition practices. In combination with performance metrics, this analysis can be used to provide personalized nutrition targets.

BODY COMPOSITION METHODS

This section provides an overview of the standard operating procedures for measuring body composition. For a review of common body composition methods in applied sports practice, see the review by Kasper, et al., 2021.

It is recommended that the same qualified professional takes measurements each time an athlete is assessed and the exact same piece of equipment should be used for each measurement, and should meet all technical requirements (Table 9). In addition, before body composition analysis, it is recommended that the athlete has not carried out any strenuous physical activity, is euhydrated, and is fasted, thus the morning before training is an ideal occasion for analysis.

Data collection and feedback forms have been provided on pages 29 - 31 (Table 10). A decision tree is used to pull all of these resources together, acting as a guide to walk the nutritionist through the process of selecting, and running body composition analysis (Figure 6).

EQUIPMENT	USE	REQUIREMENTS
Stadiometer	Measuring stature	Minimum range of measurement from 60 to 220cm (2 to 7ft). Accurate to 0.1cm / 0.1in. Sliding head board with minimum width of 6cm (2.4in).
Body Mass Weighing Scales	Measuring body mass	Electronic scale accurate to 50g (0.1lb). Scales should be calibrated regularly using calibration weights.
Skinfold Caliper	Measuring skinfolds	See International Standards for Anthropometric Assessment booklet (Stewart, et al., 2011) for information on calliper requirements.
Anthropometric Tape	Supporting skinfold measurements	Non-extensible and flexible. No wider than 7 mm (0.3in). Stub (blank area) must be at least 4cm (1.5in) in length before the zero line. Recommended to be a flexible steel tape, at least 1.5m (5ft) in length.
Anthropometer x 2	Measuring bone diameters	One small and one large. (Specific requirements are not provided by ISAK).
Anthropometric Box	Supporting skinfold measurements	A sturdy box for the nutritionist to sit or stand on to facilitate skinfold measurements. A box of 40cm (tall) x 50cm (wide) x 30cm (deep) is recommended (16 x 20 x 12in).

Table 9

Overview of equipment required to run body composition analysis. Skinfold requirements adapted from Stewart, et al., 2011.

Table 10

Overview of body composition data collection and feedback sheet templates.

NAME OF SHEET	FUNCTION	SHARE WITH ATHLETE?
Body Composition Analysis	To be used to record stature, body mass and skinfold (ISAK) measurements. Feedback can be provided with the 'Initial Nutrition Assessment' sheet, or the 'Body Composition Feedback' sheet.	**NO**
Body Composition Feedback	A feedback sheet for the athlete. To be filled in by the nutritionist to document current measurements, targets, comments and feedback and review/check in dates.	**YES**

STATURE

The stadiometer should be placed on a flat surface, against a wall where possible. The athlete should remove their shoes and stand under the stadiometer with their back touching the wall plate, and heels together against the heel plate. They should stand straight, with their head level, facing forward. To ensure the head is level, the lower edge of the eye socket should be level with the top of the tragus on the ear. The athlete should be instructed to take a deep breath in, before the nutritionist pulls down the head board to gently rest on the athlete's head. Any hair should be compressed as completely as possible. The nutritionist should record the value on the stadiometer whilst the athlete is still taking a deep breath in and the athlete can then leave the stadiometer. Results should be documented on the 'Body Composition Data Collection' form. A conversion table between centimetres and feet and inches can be found in the Appendix (Table 26).

BODY MASS

Before body mass is recorded, athletes should empty their bladder, and ensure they are wearing minimal clothing (i.e. undergarments with no shoes). Any pockets should be emptied. Once a value of zero is shown on the scales, the athlete should step onto the centre of the scales, and remain there whilst breathing normally. The athlete should not be using support, and weight should be distributed onto both feet which should be fully on the scales. The nutritionist can inform the athlete of their body mass and record the value on the 'Body Composition Data Collection' form. The athlete can then step off the scales. For repeat analysis, the same process should be followed at the same time of day as previous measurements; ideally in the morning before any training sessions and before consuming food. A conversion table between kilograms and stones and pounds can be found in the Appendix (Table 27).

ARM SPAN

To measure arm span, the athlete should be instructed to stand with the back and heels flat against a wall, the athlete's feet should be together. The wall should be at the corner of the room and the athlete's arms should be outstretched and horizontal, with the arms and back of their hands touching the back wall. The tip of one middle finger should be touching the adjacent wall at all times. The athlete should be asked to take a deep breath in, and ensure their arms are stretched maximally. Using the anthropometric tape, the nutritionist should then measure the distance from the tip of one middle finger, to the other, and record the value.

SKINFOLDS

Skinfold measurements are a technique used to obtain a comprehensive anthropometric profile of an individual and are reported as a reliable 'in field' measurement (Ackland, et al., 2012). Before analysing skinfolds, the nutritionist should gain the appropriate qualifications through the International Society for the Advancement of Kinanthropometry (ISAK). Once qualified, the nutritionist should follow ISAK guidelines (Stewart, et al., 2011). As a guide, eight skinfolds should be taken in the following order; tricep, subscapular, bicep, iliac crest, supraspinale, abdominal, front thigh and medial calf. As skinfolds are taken, results can be recorded on the 'Body Composition Analysis' form found on page 29, which follows the ISAK full proforma. Any additional measurements, such as bone diameters and girths should follow ISAK guidelines.

BIOELECTRICAL IMPEDANCE ANALYSIS (BIA)

BIA is a non-invasive method that can assess fluid distribution and body composition by passing an electrical current through an athlete's body via the feet and hands. Given that many clubs will not use the same technological devices for BIA assessment, the nutritionist should follow equipment and organisation specific standard operating procedures.

AIR DISPLACEMENT PLETHYSMOGRAPHY (ADP)

ADP is based on a two-compartment model of body composition (fat mass and fat-free mass), and uses the inverse relationships between pressure and volume (Boyle's law), to derive body volume (L). The principles of densitometry are then used to determine body composition from body density. ADP is most commonly assessed with a BOD POD™, and measurement devices are typically required to be validated at the start of each day using a known volume (50L), and again prior to each athlete assessment. When entering the chamber, athletes should wear minimal tight-fitting clothing and a swim cap. They should then minimise their movement and breathe normally as measurements are being taken. Whilst following the principles above, the nutritionist should also follow equipment and organisation specific standard operating procedures.

DUAL X-RAY ABSORPTIOMETRY (DXA)

DXA is a minimally invasive method that can measure fat-free mass, fat mass and bone mineral content for the whole body, the trunk and appendicular (arms and legs) with high accuracy and precision. Before using DXA, the nutritionist should gain the appropriate credentials to operate the device. Only those qualified to do so should analyse body composition using DXA. If the nutritionist is able to run an analysis with DXA, equipment and organisation specific standard operating procedures should be followed. It should also be considered that time of day, supplementation use, fluid and food intake, level of physical activity, and muscle glycogen content can affect the outputs of DXA (Kasper, et al., 2021), thus these factors should be controlled when testing, ensuring measurements are standardised.

BODY COMPOSITION ANALYSIS DECISION TREE

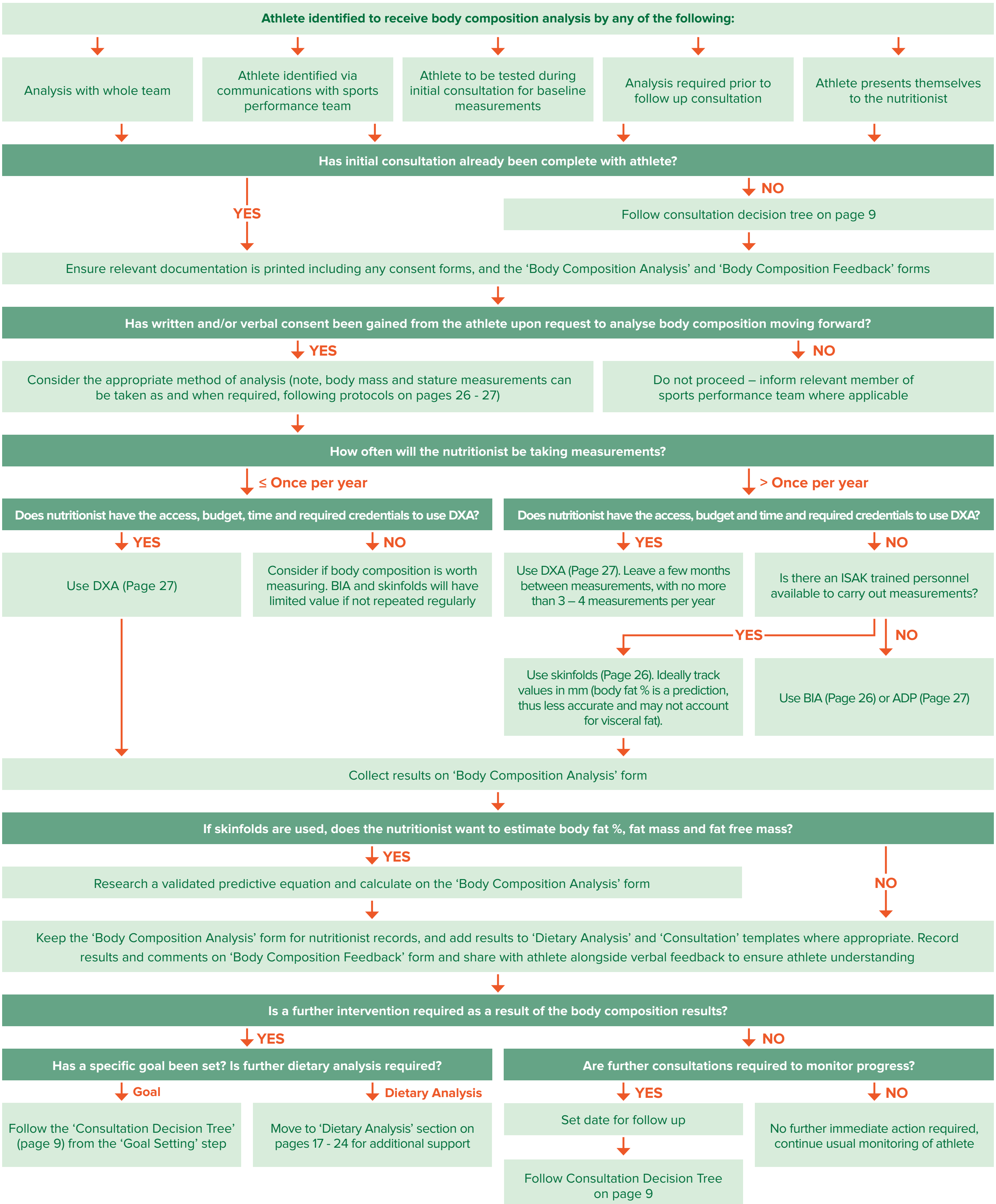


Figure 6

Decision tree to be used as a guide for nutritionist when completing body composition analysis.

BODY COMPOSITION ANALYSIS – ISAK RESTRICTED PROFILE ANTHROPOMETRIC PROFORMA

NAME: ______________________ SPORT & POSITION: ______________________
COUNTRY: ______________________ DATE OF BIRTH: ______________________
ETHNICITY: ______________________ DATE OF MEASUREMENT: ______________________
SEX: ______________________

Measure	1	2	3	Mean or Median
Body mass (lb or kg)				
Stretch stature (ft, in or cm)				
Sitting height (ft, in or cm)				
Arm span (ft, in or cm)				
Triceps sf (mm)				
Subscapular sf (mm)				
Biceps sf (mm)				
Iliac crest sf (mm)				
Supraspinale sf (mm)				
Abdominal sf (mm)				
Front thigh sf (mm)				
Medial calf sf (mm)				
Arm girth relaxed (cm)				
Arm girth flexed and tensed (cm)				
Waist girth (min.) (cm)				
Gluteal girth (max.) (cm)				
Thigh middle girth (cm)				
Calf girth (max.) (cm)				
Humerus breadth (biepicondylar) (cm)				
Femur breadth (biepicondylar) (cm)				
Bi-styloid breadth (cm)				

'sf' = Skinfold

MEASURED BY: ______________________

BODY COMPOSITION ANALYSIS – ISAK RESTRICTED PROFILE ANTHROPOMETRIC PROFORMA CONT'D

NAME: ____________________

SOMATOTYPE

ENDOMORPHY: ____________________

MESOMORPHY: ____________________

EXTOMORPHY: ____________________

BODY MASS INDEX (BMI): ____________________

WAIST / HIP RATIO (WHR): ____________________

SUM OF 6 SKINFOLDS: (excl. biceps & Iliac crest) ____________________

SUM OF 8 SKINFOLDS: ____________________

	Result	Method Used (e.g. ISAK, DXA etc.)
Body fat percentage (%)		
Fat mass (lb or kg)		
Fat free mass (lb or kg)		
Muscle mass (lb or kg)		

NOTES

(e.g. additional measurements, targets, timeframes etc.)

BODY COMPOSITION FEEDBACK

NAME: ______________ DATE: ______________ AGE: ______

RESULTS AND TARGETS

	Current	Target
Height (ft, in or cm)		N/A
Body mass (lb or kg)		
Sum of 8 skinfolds (mm)		
Predicted body fat %		
Predicted body mass (lb or kg)		
Predicted fat free mass (lb or kg)		

COMMENTS AND FEEDBACK

NEXT REVIEW / CHECK IN DATES

HYDRATION

The athlete's body is approximately 60-70% water. Large volumes of body water can be lost as the athlete sweats during exercise. Body water losses equivalent to, or more than 2% of the athlete's pre-exercise body mass can have detrimental effects on both health and performance. This is known as hypohydration, more commonly spoken about as dehydration. Dehydration has been shown to affect both mental, and physical performance, whilst contributing to fatigue. This chapter provides practical tools to support the monitoring of hydration status which can help the nutritionist provide personalized hydration recommendations to prevent or limit the risk of significant dehydration.

HYDRATION ANALYSIS METHODS

This section provides an overview of the standard operating procedures for different methods to monitor hydration status and sweat rates. To run analyses, specific equipment is required (Table 11). In addition, 'Sweat Rate Data Collection' and 'Hydration Feedback' forms can be found on 38 - 39 and 40 - 41 respectively (Table 12). A decision tree is used to pull these resources together, acting as a guide to walk the nutritionist through the process of selecting and running a hydration analysis (Figure 11).

Table 11

Overview of equipment required to run hydration analysis, adapted from Baker, 2016.

EQUIPMENT	REQUIREMENTS
Body Mass Weighing Scales	Electronic scale accurate to 50g (0.1lb). Scales should be calibrated regularly using calibration weights.
Worktop Scales x 2	One to measure weight of drink bottles and food (g/lb). One to measure weight of urine sample (g/lb).
Drinking Bottles	One bottle for each type of fluid (e.g., water, sports drinks, etc).
Plastic Container	1L / 32 fl oz, pre-weighed for urine collection.
Towels	For athletes to dry off prior to body mass assessment.
Stopwatch	To measure exercise duration.

NAME OF SHEET	FUNCTION	SHARE WITH ATHLETE?
Sweat Rate Data Collection and Calculation Forms	A form for the nutritionist to fill out an athlete's sweat test results. Two forms have been provided, one for imperial measurements, and one for metric measurements.	**NO**
Hydration Feedback Form	A feedback form for which the nutritionist can add available sweat test results, alongside the translation of these results to practical hydration recommendations. Forms are provided in both imperial and metric measurements.	**YES**

Table 12

Overview of hydration data collection and feedback forms

SIMPLE MARKERS OF HYDRATION

In many athletic settings, the use of body mass measurements in combination with some measure of urine concentration at the first urination of the morning are simple, inexpensive methods to distinguish between the likelihood of euhydration and dehydration. However, neither of these markers alone provide sufficient evidence of dehydration. Instead, alongside reporting thirst, these methods can be combined to allow the athlete to self-monitor day-to-day changes in hydration status. The presence of any two of these markers can indicate that dehydration is likely, and the presence of all three indicate that dehydration is very likely (Figure 7). Details on how to monitor each marker are listed below.

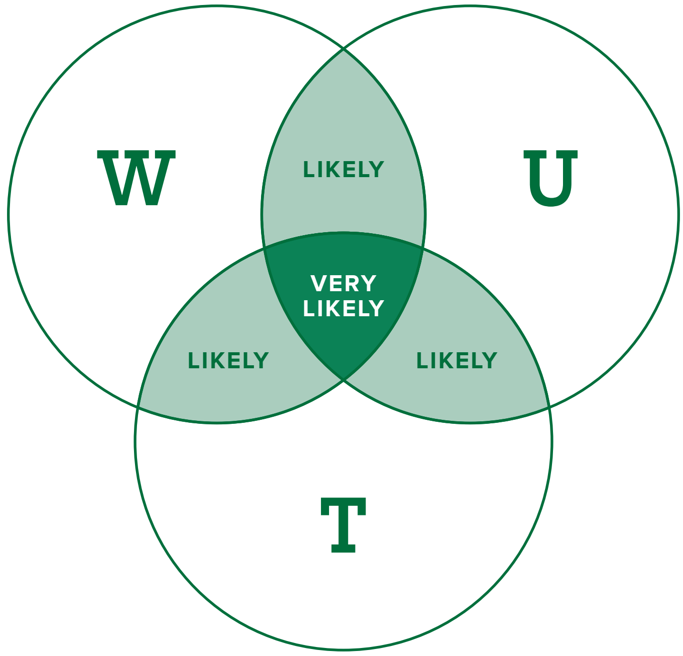


Figure 7

The 'WUT' method for self-monitoring daily hydration status (Cheuvront & Sawka, 2005).

W = Weight | U = Urine | T = Thirst

W: CHANGES IN BODY MASS (WEIGHT)

Body mass is often used to assess rapid changes of athlete hydration in both laboratory and field environments. Acute changes in hydration are calculated as the difference in body mass pre- and post-exercise, or between consecutive days (following the methods outlined on Page 26), with the level of dehydration expressed as a percentage of starting body mass. Day-to-day body mass losses in excess of 1%, alongside urine and thirst markers can be used to indicate the likelihood of dehydration. If monitoring between days, body mass should be measured in the morning, prior to training and consuming food or beverages, and at the same time each day.

U: URINE ANALYSIS – VOLUME AND COLOUR

Analysis of urine volume and color are inexpensive, easy to use indicators of hydration status that can support daily hydration monitoring. Both low urine production and/or a darker urine colour (more concentrated urine) can be used alongside thirst and body mass to indicate the likelihood of an athlete being dehydrated, with colors labelled 1-3 indicating euhydration (Cheuvront & Sawka, 2005) (Figures 8 and 9).

Figure 8

Urine Colour Chart

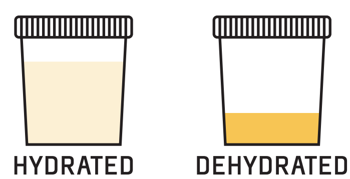


Figure 9

Example of quantities and colours of urine indicating hydration and dehydration

T: THIRST

The presence of thirst is a possible indication of dehydration and the need to drink. Although often the first symptom of dehydration, the absence of thirst does not indicate the absence of dehydration. As such, reporting thirst, in combination with urine and/or body mass can be used to indicate the likelihood that an athlete is dehydrated.

URINE ANALYSIS – URINE SPECIFIC GRAVITY AND OSMOLALITY

More precise analysis of urine can also be used as a marker of hydration status, such as a urine specific gravity (USG) and/or urine osmolality (U_{Osm}). Specific methods to measure USG and U_{Osm} should follow those as described for the specific equipment used. Specific values and thresholds are used to classify the likelihood of athlete being euhydrated, minimally dehydrated, or dehydrated (Table 13).

Table 13

USG and urine osmolality values and corresponding hydration status (Thomas, et al., 2016).

CLASSIFICATION ATHLETE LIKELY:	URINE USG VALUE	URINE OSMOLALITY VALUE (MOSMOL/KG)
Euhydrated	< 1.020	<700
Minimally Dehydrated	1.020 – 1.024	700 - 900
Dehydrated	>1.024	>900

SWEAT RATE – FLUID LOSS

The rate of fluid loss during exercise can differ depending on heat, humidity, exercise duration and exercise intensity. Whilst the trend of fluid loss will be similar between individuals in these conditions, losses will vary from athlete to athlete. As such, monitoring fluid loss, and calculating sweat rate can help to provide personalized hydration recommendations.

Given the effect of different environmental conditions, it is advised that sweat testing should be carried out under four different conditions: at both high and low exercise intensities, and in cold and hot temperatures, especially for outdoor sport athletes (Rollo, et al., 2021). The sweat test process is documented below, and results for each analysis can be added to the relevant 'Hydration Feedback' template.

PRE-EXERCISE:

Foods and beverages planned to be consumed should be weighed in bottles or packaging prior to consuming and recorded on the 'Sweat Rate Data Collection Form'. Each athlete should have their own labelled bottles and food provisions, and should not share with others during the analysis period. In addition, the weight of the empty urine container should be recorded. Pre-exercise, the athlete's body mass should be recorded, following the methods outlined on page 26. Once the athlete has been weighed, food and drinks can be consumed as required. Bottles should be re-weighed, or content in millilitres / fluid ounces documented if re-filled during exercise. Any finished bottles or food packaging should be retained.

DURING EXERCISE:

As exercise begins, the nutritionist should start the stopwatch, which should be paused during extended breaks in exercise such as half time, and re-started as exercise restarts. If an athlete needs to urinate during exercise, or breaks, they should do so in the pre-weighed container in a private cubicle. If the athlete uses water as an aid to cool down during exercise (i.e. pouring over the head), an additional bottle should be provided specifically for this use; this bottle does not need to be weighed.

POST-EXERCISE:

Once exercise is complete, the stopwatch should be stopped and time recorded in the duration box on the data collection form. As the athlete re-enters the changing room, they should dry down with a towel, before repeating the body mass protocol. After the athlete has been weighed, all pre-weighed bottles, food, and packaging should be re-weighed and recorded on the data collection form. Next, using a separate scale, the urine container should be re-weighed, and the initial weight of container subtracted from the final weight. This weight should also be added to the data collection form.

CALCULATIONS:

Once all data has been recorded, the nutritionist can complete calculations on the provided sweat rate data collection and calculation forms, or use the online GSSI Fluid Loss Calculator.* This will provide the athlete's sweat rate in fluid ounces and/or litres per hour.

*https://www.gssiweb.org/toolbox/fluidLoss/calculator.

SWEAT TESTING – FLUID AND ELECTROLYTE LOSS

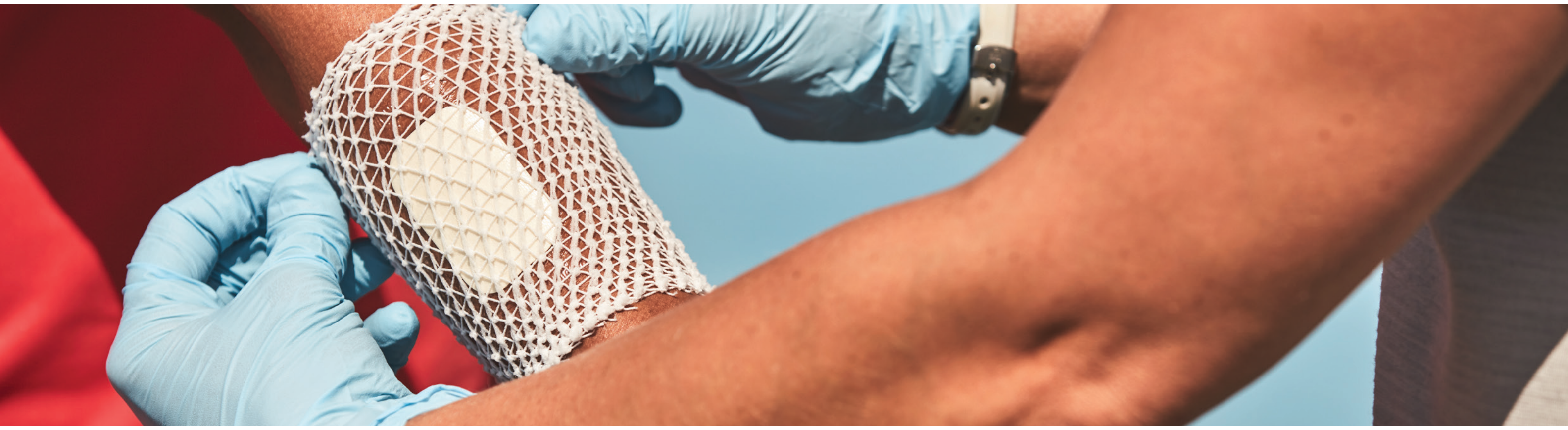
Sweat testing is a set of measurements to determine both the amount of sweat lost and the composition of sweat lost during exercise. It provides more detailed analysis compared to evaluating sweat rate alone because it also provides data on the loss of electrolytes, which athletes lose alongside water as they sweat. Each athlete will have a different sweat rate and sweat composition. As such, this information can help the nutritionist to personalize each athlete's hydration plan.

A detailed analysis of the sweat testing procedure can be found on the GSSI Sport Science Exchange article 'Sweat Testing Methodology in the Field: Challenges and Best Practices' (Baker, 2016). Please note that additional equipment is required to that in Table 11.

More recently, the sweat testing process has been advanced with the introduction of the Gx Patch (Figure 10). The Gx Patch is a single use wearable technology that measures an athlete's sweat rate and composition. At the end of the exercise session, the patch is scanned to reveal the results and subsequent hydration recommendations. Nutritionists can use the Gx Teams app to keep track of each individual athlete's sweat profile and hydration strategies. This development allows for rapid results and feedback to the athlete. The Gx Patch removes the need for any specialised equipment for sweat analysis and is easily transported. The Gx process results in little interruption to the athlete's routine before or after exercise.

Figure 10

Gx Patch, developed and validated by GSSI in partnership with Epicore Biosystems, Inc. (Baker, et al., 2020)



FLUID CONVERSION TABLES

In the 2 to 4 hours pre-exercise, it is recommended that an athlete consumes 5 to 7 millilitres of fluid per kilogram body mass (2 to 3 ml per pound) (Sawka, et al., 2007; Thomas, et al., 2016). Table 14 provides a guide as to the total volume of fluid recommended in millilitres and fluid ounces based on an athlete's body mass in kilograms and pounds. A conversion table between millilitres and fluid ounces can be found in the Appendix (Table 29).

During exercise, it is recommended that an athlete should limit their fluid losses to no more than 2% of their pre-exercise body mass (Thomas, et al., 2016). After weighing an athlete post-exercise, Table 15 can be used to evaluate if the loss of body mass exceeds 2%. This process also helps identify if athletes are accumulating body mass through fluid intake during exercise, which is strongly discouraged. The nutritionist can work with the athlete to adjust their fluid intake accordingly.

Post-exercise, around 150% of the amount of fluid lost during exercise should be consumed (Shirreffs & Sawka, 2011). A change in body mass of 1kg is the equivalent of 1 litre of fluid loss (a change of 1lb is equivalent to 16 fl oz of fluid loss).

Once pre-, during and post-exercise hydration requirements have been calculated, the nutritionist can fill in the relevant information on the 'Hydration Feedback Form' on pages 40 - 41.

Table 14

Recommended fluid intake in the 2-4 hours pre-exercise based on pre-exercise body mass (Sawka, et al., 2007; Thomas, et al., 2016). BM = Body Mass.

PRE-EXERCISE BODY MASS		RECOMMENDED FLUID CONSUMPTION PRE-EXERCISE BASED ON BODY MASS			
		Millilitres		Equivalence in fluid ounces	
kg	lb	5ml/kg BM	7ml/kg BM	5ml/kg BM	7ml/kg BM
60	132	300	420	10	14
65	143	325	455	11	15
70	154	350	490	12	17
75	165	375	525	13	18
80	176	400	560	14	19
85	187	425	595	14	20
90	198	450	630	15	21
95	209	475	665	16	22
100	221	500	700	17	24
105	232	525	735	18	25
110	243	550	770	19	26

PRE-EXERCISE BODY MASS		BODY MASS AT 2% DEHYDRATION THRESHOLD	
kg	lb	kg	lb
60	132	58.80	129.4
65	143	63.70	140.1
70	154	68.60	150.9
75	165	73.50	161.7
80	176	78.40	172.5
85	187	83.30	183.3
90	198	88.20	194.0
95	209	93.10	204.8
100	221	98.00	216.6
105	232	102.90	227.4
110	243	107.80	238.1

Table 15

Body mass at the 2% dehydration threshold (Thomas, et al., 2016) based on pre-exercise body mass.

HYDRATION ANALYSIS DECISION TREE

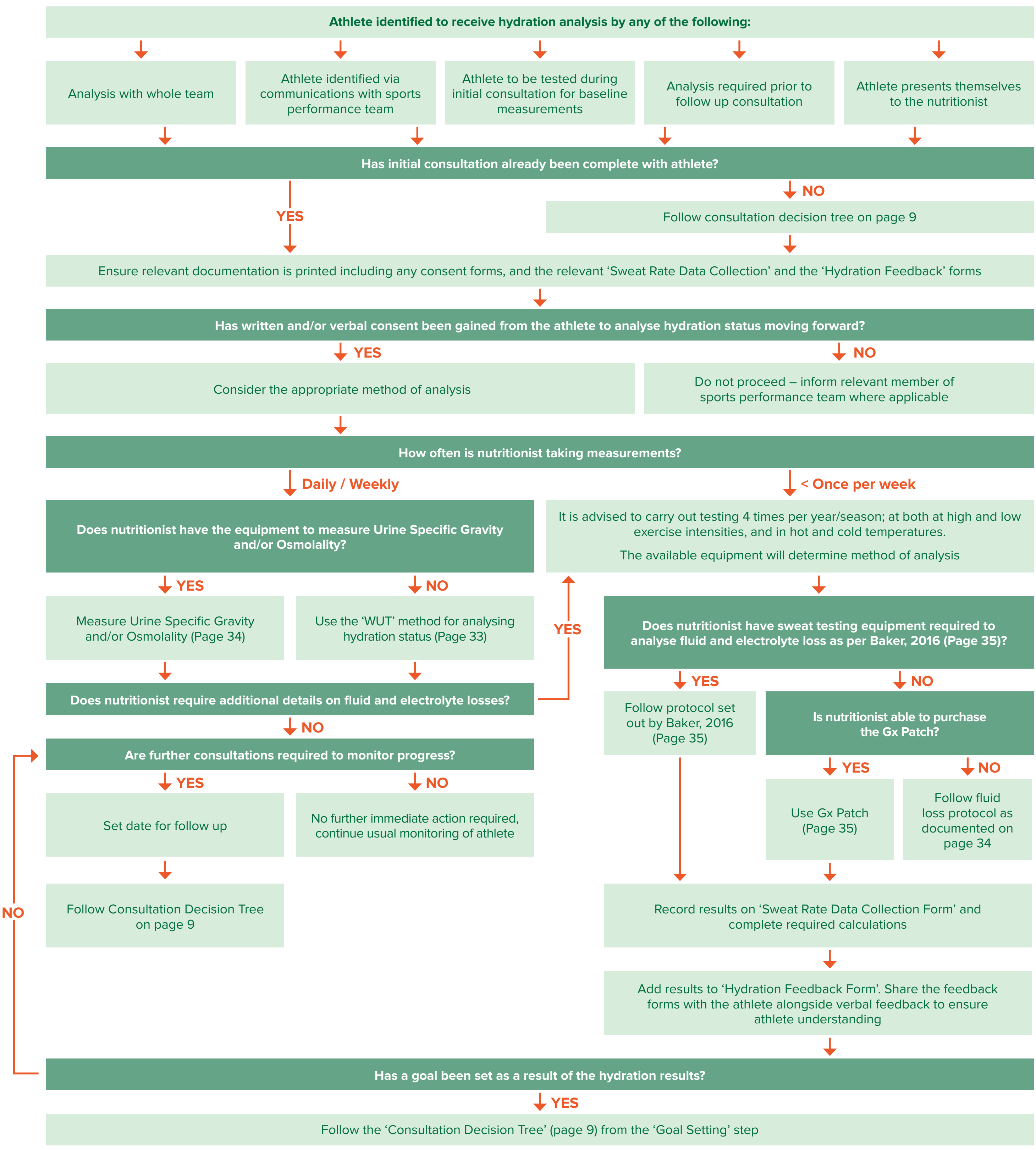


Figure 11

Decision tree to be used as a guide for nutritionist when completing hydration analysis.

GATORADE SPORTS SCIENCE INSTITUTE TM

SWEAT RATE DATA COLLECTION FORM
(For Imperial Measurements)

NAME: ____________________ **DATE:** ____________________

Pre-Exercise Body Mass __________ lb	–	**Post-Exercise Body Mass** __________ lb	=	**Body Mass Loss** __________ lb
Fluid / Bottle Weight Before __________ (fl oz or oz)	–	**Fluid / Bottle Weight After** __________ (fl oz or oz)	=	**Fluids Consumed** __________ (fl oz or oz)
Food Weight Before __________ oz	–	**Food Weight After** __________ oz	=	**Food Consumed** __________ oz
Urine Loss During Exercise __________ (fl oz or oz)		**Exercise Duration** __________ mins		

To calculate sweat rate, input the values above into the GSSI Fluid Loss Calculator

https://www.gssiweb.org/toolbox/fluidLoss/calculator

Sweat Rate

__________ fl oz/h

SWEAT RATE DATA COLLECTION AND CALCULATION FORM

(For Metric Measurements)

NAME: ______________________ DATE: ______________________

Pre-Exercise Body Mass ________ kg	−	**Post-Exercise Body Mass** ________ kg	=	**Body Mass Loss** ________ kg
Fluid / Bottle Weight Before ________ (ml or g)	−	**Fluid / Bottle Weight After** ________ (ml or g)	=	**Fluids Consumed** ________ (ml or g)
Food Weight Before ________ g	−	**Food Weight After** ________ g	=	**Food Consumed** ________ g
Urine Loss During Exercise ________ (ml or g)		**Exercise Duration** ________ mins		

SWEAT RATE*

[**Body Mass Loss** ________ kg + **Fluids Consumed** ________ (L or kg) + **Food Consumed** ________ kg − **Urine Loss During Exercise** ________ (L or kg)]

÷

Exercise Duration ________ hours

=

Sweat Rate ________ L/h

*Please convert grams to kilograms, millilitres to litres and minutes to hours before calculating sweat rate.
To automate this calculation, you can input the values into the GSSI Fluid Loss Calculator: https://www.gssiweb.org/toolbox/fluidLoss/calculator

HYDRATION FEEDBACK FORM
(For Imperial Measurements)

NAME: ____________________ DATE: ____________________

LOW INTENSITY – COLD

DATE: ____________________
EXERCISE TYPE: ____________________
TEMPERATURE: ________ °F

RESULTS

Sweat Rate	Sweat Sodium
________ fl oz/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ fl oz	________ fl oz	________ fl oz

LOW INTENSITY – HOT

DATE: ____________________
EXERCISE TYPE: ____________________
TEMPERATURE: ________ °F

RESULTS

Sweat Rate	Sweat Sodium
________ fl oz/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ fl oz	________ fl oz	________ fl oz

HIGH INTENSITY – COLD

DATE: ____________________
EXERCISE TYPE: ____________________
TEMPERATURE: ________ °F

RESULTS

Sweat Rate	Sweat Sodium
________ fl oz/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ fl oz	________ fl oz	________ fl oz

HIGH INTENSITY – HOT

DATE: ____________________
EXERCISE TYPE: ____________________
TEMPERATURE: ________ °F

RESULTS

Sweat Rate	Sweat Sodium
________ fl oz/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ fl oz	________ fl oz	________ fl oz

ADDITIONAL COMMENTS AND FEEDBACK

HYDRATION FEEDBACK FORM

(For Metric Measurements)

NAME: ______________________ DATE: ______________________

LOW INTENSITY – COLD

DATE: ______________________
EXERCISE TYPE: ______________________
TEMPERATURE: ________ °C

RESULTS

Sweat Rate	Sweat Sodium
________ L/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ ml	________ ml	________ ml

LOW INTENSITY – HOT

DATE: ______________________
EXERCISE TYPE: ______________________
TEMPERATURE: ________ °C

RESULTS

Sweat Rate	Sweat Sodium
________ L/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ ml	________ ml	________ ml

HIGH INTENSITY – COLD

DATE: ______________________
EXERCISE TYPE: ______________________
TEMPERATURE: ________ °C

RESULTS

Sweat Rate	Sweat Sodium
________ L/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ ml	________ ml	________ ml

HIGH INTENSITY – HOT

DATE: ______________________
EXERCISE TYPE: ______________________
TEMPERATURE: ________ °C

RESULTS

Sweat Rate	Sweat Sodium
________ L/h	________ mg/h

RECOMMENDED CONSUMPTION FOR EXERCISE

Before	During	After
________ ml	________ ml	________ ml

ADDITIONAL COMMENTS AND FEEDBACK

NUTRITION INTERVENTIONS

When providing sports nutrition advice, the nutritionist will often go through a 'decision making' process. The 'decisions' include determining which nutrients an athlete should consume, in which quantities, and at what time in relation to physical activity, to support the athlete's performance and recovery. The solutions come in the form of personalized nutrition recommendations, and the process of sharing these with the athlete. This is achieved through education, and the translation of recommendations to practical food-based advice.

This chapter will provide practical tools to support the nutritionist in making nutrition based decisions; specifically in regards to energy, carbohydrates, protein, dietary supplements and gastrointestinal complaints.

ENERGY

Athlete's energy expenditure can differ day to day, and between athletes within the same team depending on body composition, metabolism, and the varying life demands outside of sport. Correspondingly, an athlete's energy intake should aim to match those demands. Thus, recommended energy intake varies depending on the demands of training or competition, and the specific goals of the athlete. If an athlete consumes too little, or too much energy over time, this can be detrimental to health and performance. This section provides tools to support the evaluation of energy expenditure and to help monitor energy availability.

ENERGY EXPENDITURE ANALYSIS METHODS

There are several methods to analyse the energy expenditure of an athlete, including direct and indirect calorimetry. Direct calorimetry methods are expensive and rarely used within sport, thus alternative methods are more commonly used, with examples shared in this section. If energy expenditure is estimated, results can be included within the dietary analysis feedback sheets on pages 23 - 24.

INDIRECT CALORIMETRY

Indirect calorimetry measures oxygen consumption and carbon dioxide production; this can be used to measure Activity Energy Expenditure (AEE) and Resting Metabolic Rate (RMR), which are components of Total Energy Expenditure (TEE). Use of indirect calorimetry is limited in sport due to cost of equipment and required technical expertise, thus methods are not described in detail here. However, indirect calorimetry is the preferred method (compared to the use of predictive equations), and if this method is available to the nutritionist, equipment and organisation specific standard operating procedures should be followed.

DOUBLY LABELLED WATER (DLW)

The DLW assessment of TEE is considered a gold standard method, providing a non-invasive evaluation under "free living" conditions (Westerterp, et al., 1986). However, the method is costly and time consuming, thus is not a commonly used method to assess TEE in sport. As such, this method is not discussed in detail here, however methods for the use of DLW in elite sport have been described elsewhere (Anderson, et al., 2017).

PREDICTION EQUATIONS

TEE can be predicted using equations (Figure 12), taking into account RMR, AEE, and TEF (Table 16). Although not as accurate as the gold standard DLW assessment, they are a cheaper, more convenient method that can be used where technical equipment is not available.

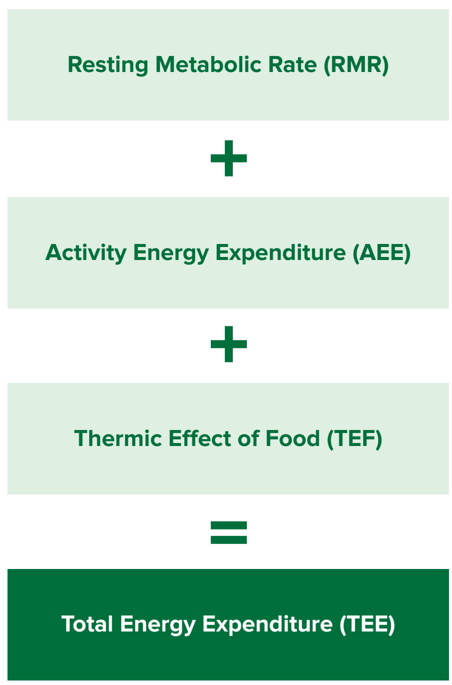


Figure 12

Prediction equation for Total Energy Expenditure (Thomas, et al., 2016).

Table 16

Details of the components of Total Energy Expenditure predictive equations.

NAME OF COMPONENT	EXPLANATION
RMR	Can be measured via indirect calorimetry, or predicted using prediction equations which take into account body mass and stature. Several different predictive equations exist to calculate RMR, thus the nutritionist is encouraged to research and use an equation that has been validated in the specific population of interest, for example, RMR in adolescent athletes been researched and validated at GSSI's IMG Lab (Reale, et al., 2020).
AEE	AEE takes into account planned and spontaneous physical activity, as well as energy expenditure of daily tasks. AEE can be estimated from exercise duration and intensities using metabolic equivalents (METs) (Thomas, et al., 2016), which have been linked to specific sports (Ainsworth, et al., 2011).
TEF	Equivalent to ~10% of TEE (Westerterp, 2004).

ENERGY AVAILABILITY

Energy availability refers to the amount of dietary energy available to maintain normal physiological functions, after subtracting the cost of exercise. These physiological functions, for example immune, hormonal and reproductive functions, are important for an athlete's health and wellbeing, therefore it is essential that the body has enough energy to carry out these processes.

ENERGY AVAILABILITY ANALYSIS

This section provides an overview of methods that can be used to monitor energy availability. Figure 13 shows the calculation for measuring energy availability, highlighting supporting tools throughout the toolkit which can be used to make measurements. It is important to note that it is challenging to accurately assess the components of energy availability, in particular energy intake and exercise energy expenditure, which in turn makes it difficult to measure energy availability, particularly in the field. As such, if this calculation is used, it should only be used as a guide.

Energy availability 'guideline values' have been proposed for males and females (Table 17). Whilst these thresholds are often used in research and practice, they are currently widely debated for a variety of reasons, and therefore they should be interpreted with caution.

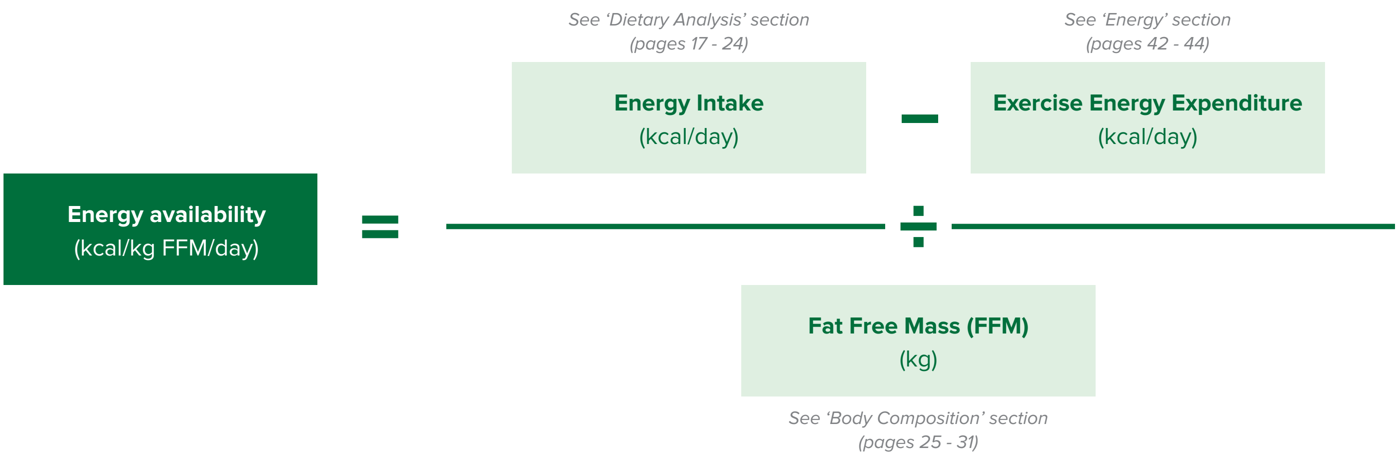


Figure 13

Energy availability calculation.

Table 17

Energy availability guideline values, adapted from Melin, et al,. 2019

GUIDELINE VALUES	EXPLANATION
Optimal Energy Availability Males: ≥ 40 kcal/kg FFM/day Females: ≥ 45 kcal/kg FFM/day	For weight maintenance, providing adequate energy for all physiological functions.
Subclinical Low Energy Availability Males: 30 – 40 kcal/kg FFM/day Females: 30 – 45 kcal/kg FFM/day	May be tolerated for short periods during a well-constructed weight loss program.
Clinical Low Energy Availability Males: < 30 kcal/kg FFM/day Females: < 30 kcal/kg FFM/day	Could lead to health implications, with impairment of physiological functioning, training adaptation and performance.

LOW ENERGY AVAILABILITY (LEA)

Many athletes expend large amounts of energy on a daily basis through the undertaking of heavy training loads. Resultingly, energy requirements are increased to ensure sufficient energy is available for the body to carry out physiological processes that are important for the athletes health. However, athletes may fail to match their energy intake to their energy demands. If this occurs on a daily basis, for a prolonged period of time, the body can enter into a state of LEA, where the body may begin to save energy by shutting off those important physiological processes that are important for health (Logue, et al., 2020).

LEA is the underlying cause of the conditions known as Relative Energy Deficiency in Sport (RED-S) and the Female Athlete Triad. It is important to note that LEA can affect both females and males.

Table 18 displays some potential signs and risk factors which may indicate that an athlete is experiencing LEA; an athlete does not need to show all of these symptoms to be in LEA.

In female athletes, the Low Energy Availability in Females Questionnaire (LEAF-Q) has been used as a screening tool, whereby a score of ≥8 indicates that an individual is at risk for LEA (Melin, et al., 2014). In addition, the Relative Energy Deficiency in Sport Clinical Assessment Tool (RED-S CAT) can be used by medical professionals to clinically evaluate and manage athletes that are experiencing RED-S (Mountjoy, et al., 2015; Mountjoy, et al., 2018). A Low Energy Availability in Males Questionnaire (LEAM-Q) is currently being developed (Lundy, et al. 2022).

POTENTIAL SIGNS AND RISK FACTORS		
Chronic dietary restriction and/or extreme dieting	Menstrual irregularities or complete loss of menstrual cycle	Perfectionist tendencies
Continual and constant drive for thinness	For weight maintenance, providing adequate	Frequent injuries
For weight maintenance, providing adequate	Low bone mineral density	Over training
Training inconsistencies and/or constant fatigue	Regular illnesses/signs of compromised immunity	Poor recovery between training sessions
Issues with concentrating	Reduced libido	Low iron levels
Reduced resting metabolic rate	Decreased cardiovascular function	Osteoporosis

Table 18

Potential signs and risk factors of low energy availability in athletes.

Table 19

A guide to daily carbohydrate consumption based on body mass (BM), and activity levels, adapted from Burke, et al., 2011.

CARBOHYDRATES

Consuming adequate quantities of carbohydrate, tailored to daily activities, ensures that an athlete can fuel for, and recover from exercise. The aim of this approach is to help the athlete to perform at their best both mentally and physically. This section provides tools to support the athlete in meeting the energy demands of training, competition, and recovery.

CARBOHYDRATE CONVERSION TABLES

Daily carbohydrate intake (Table 19) and target quantities to ingest pre- and post-exercise (Table 20) can be modified based on an athlete's body mass (BM) and physical activity levels. A conversion table between kilograms and stones and pounds can be found in the Appendix (Table 27).

		Light Intensity Exercise							
				Moderate Intensity Exercise					
					High Intensity Exercise				
Body Mass		Recommended Carbohydrate Intake (g) Per Day Based on Body Mass							
kg	lb	3 g/kg BM/d	4 g/kg BM/d	5 g/kg BM/d	6 g/kg BM/d	7 g/kg BM/d	8 g/kg BM/d	9 g/kg BM/d	10 g/kg BM/d
60	132	180	240	300	360	420	480	540	600
65	143	195	260	325	390	455	520	585	650
70	154	210	280	350	420	490	560	630	700
75	165	225	300	375	450	525	600	675	750
80	176	240	320	400	480	560	640	720	800
85	187	255	340	425	510	595	680	765	850
90	198	270	360	450	540	630	720	810	900
95	209	285	380	475	570	665	760	855	950
100	221	300	400	500	600	700	800	900	1000
105	232	315	420	525	630	735	840	945	1050
110	243	330	440	550	660	770	880	990	1100

		Pre-exercise Fuelling				
		Re-Fuelling				
Body Mass		Recommended Carbohydrate Intake (g) in the Pre- and Post-Exercise Periods Based On Body Mass				
kg	lb	1 g/kg BM	1.2 g/kg BM	2 g/kg BM	3 g/kg BM	4 g/kg BM
60	132	60	72	120	180	240
65	143	65	78	130	195	260
70	154	70	84	140	210	280
75	165	75	90	150	225	300
80	176	80	96	160	240	320
85	187	85	102	170	255	340
90	198	90	108	180	270	360
95	209	95	114	190	285	380
100	221	100	120	200	300	400
105	232	105	126	210	315	420
110	243	110	132	220	330	440

Table 20

A guide to the pre- and post-exercise carbohydrate consumption based on body mass (BM), adapted from Burke, et al., 2011. Athletes should consume 1 – 4 g/kg BM 3 – 4 hours before kick-off. Re-fuelling recommendations are 1 – 1.2 g/kg BM per hour for 4 hours. No values are provided for carbohydrate during exercise as a set 30 – 60 g/h is recommended (increasing to 90 g/h for ultra-endurance exercise).

CARBOHYDRATE QUANTITIES

Table 21 presents a selection of commonly consumed foods and beverages that will provide approximately 30 or 100g of carbohydrate. These examples, whilst not practically feasible in all cases, can be used as a guide for adapting quantities to meet an athlete's requirements. There is space within this column for the nutritionist to add foods that are more relevant to the athlete / club / country. A conversion table between grams and ounces can be found in the Appendix (Table 28).

Table 21

Common sources of carbohydrate providing ~30g and 100g respectively. Please note these values are estimates and food/beverage packaging can be reviewed to evaluate actual nutritional content.

~30g

1.5 SERVINGS OF GATORADE
Serving size: 12 fl oz / 540 ml
Carbohydrate: 33 g
Calories: 120 kcal

1 GLASS OF FRUIT JUICE
Serving size: 10 fl oz / 300 ml
Carbohydrate: 30 g
Calories: 140 kcal

1 PACK OF GATORADE CHEWS
Serving size: 1 oz / 28 g
Carbohydrate: 24 g
Calories: 100 kcal

1.5 BAG OF BAKED CHIPS
Serving size: 1.5 oz / 42g
Carbohydrate: 30 g
Calories: 180 kcal

~100g

LARGE PLATE PASTA
Serving size: 10.6 oz / 300 g
Carbohydrate: 100 g
Calories: 515 kcal

LARGE PLATE RICE
Serving size: 10.6 oz / 300 g
Carbohydrate: 95 g
Calories: 430 kcal

LARGE PLATE COUSCOUS
Serving size: 10.6 oz / 300 g
Carbohydrate: 100 g
Calories: 545 kcal

2 LARGE PLATES QUINOA
Serving size: 21.2 oz / 600 g
Carbohydrate: 105 g
Calories: 700 kcal

5 RICE CAKES
Serving size: 1.6 oz / 45 g
Carbohydrate: 32 g
Calories: 160 kcal

HANDFUL OF DRIED MANGO
Serving size: 1.4 oz / 40 g
Carbohydrate: 28 g
Calories: 155 kcal

2 SLICES WHOLEGRAIN BREAD
Serving size: 2.7 oz / 75 g
Carbohydrate: 28 g
Calories: 170 kcal

1.5 MEDIUM BANANAS
Serving size: 7.9 oz / 225 g
Carbohydrate: 30 g
Calories: 90 kcal

1 TORTILLA
Serving size: 1.8 oz / 50 g
Carbohydrate: 25 g
Calories: 150 kcal

1 HANDFUL RAISINS
Serving size: 1.6 oz / 45 g
Carbohydrate: 30 g
Calories: 135 kcal

1 MEDIUM BOWL OF OATMEAL & MILK
Serving size: 7.8 oz / 220 g
Carbohydrate: 27 g
Calories: 250 kcal

HALF A BAGEL
Serving size: 1.6 oz / 45 g
Carbohydrate: 25 g
Calories: 120 kcal

1.5 LARGE ORANGES
Serving size: 10.6 oz / 300 g
Carbohydrate: 30 g
Calories: 150 kcal

2 PANCAKES
Serving size: 2.1 oz / 60 g
Carbohydrate: 30 g
Calories: 150 kcal

2 PLATES OF NOODLES
Serving size: 17.7 oz / 500 g
Carbohydrate: 105 g
Calories: 550 kcal

2 BAKED POTATOES
Serving size: 17.7 oz / 500 g
Carbohydrate: 105 g
Calories: 500 kcal

7 SLICES WHOLEGRAIN BREAD
Serving size: 9.2 oz / 260 g
Carbohydrate: 100 g
Calories: 600 kcal

5 MEDIUM BANANAS
Serving size: 33.5 oz / 750 g
Carbohydrate: 100 g
Calories: 450 kcal

4 TORTILLAS
Serving size: 7.1 oz / 200 g
Carbohydrate: 100 g
Calories: 600 kcal

1 LARGE SWEET POTATO
Serving size: 12.4 oz / 350 g
Carbohydrate: 95 g
Calories: 430 kcal

4 MEDIUM BOWLS OF OATMEAL & MILK
Serving size: 31.1 oz / 880 g
Carbohydrate: 108 g
Calories: 990 kcal

2 BAGELS
Serving size: 6.4 oz / 180 g
Carbohydrate: 95 g
Calories: 500 kcal

5 LARGE ORANGES
Serving size: 35.3 oz / 1000 g
Carbohydrate: 97 g
Calories: 520 kcal

7 PANCAKES
Serving size: 7.4 oz / 210 g
Carbohydrate: 100 g
Calories: 525 kcal

Key

- source of antioxidants
- low in carbohydrate
- source of protein
- source of carbohydrate

CARBOHYDRATE PERIODIZATION

Daily carbohydrate consumption should be modified on a day-by-day, and meal-by-meal basis, as different days and exercise sessions over the course of a season will have different physiological demands; for example, performance will not be the goal in every exercise session. Modification of carbohydrate consumption is known as carbohydrate periodization. The next two pages provide examples of how to personalize and periodize 3 different meals.

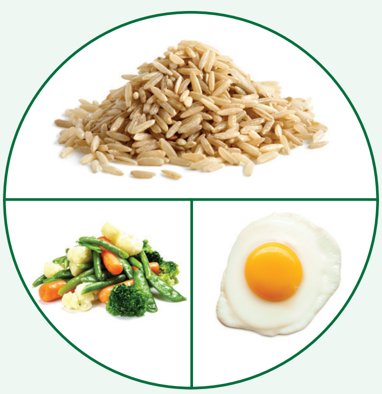
PERSONALIZATION

CARBOHYDRATE PERIODIZATION

–

VEGETABLES | SALMON

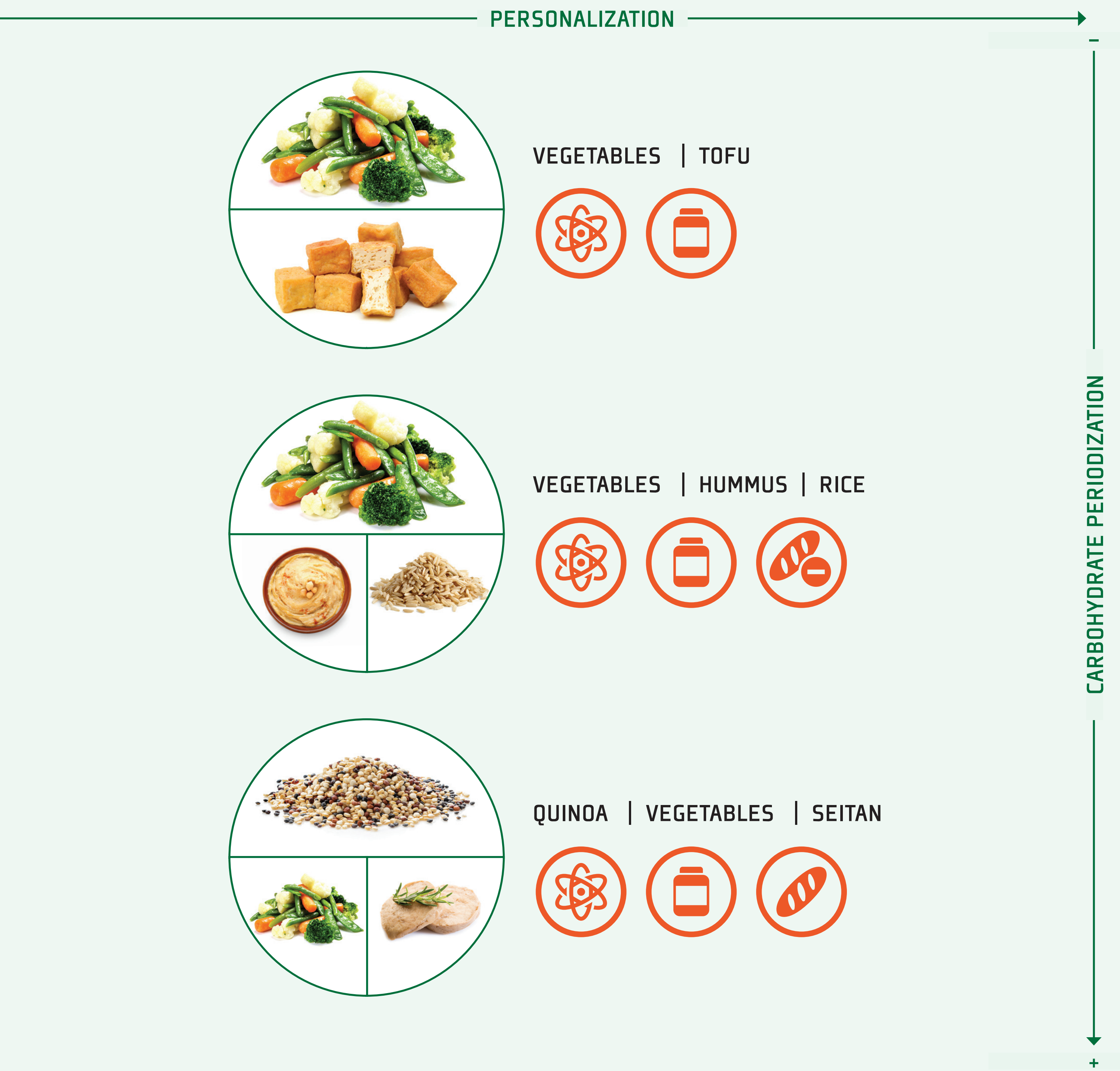
VEGETABLES | CHICKEN | SWEET POTATO



RICE | VEGETABLES | EGGS

+

Example of how a Poke bowl can be personalized (non-vegan and vegan) as well as periodized by three activity intensities: low (-), medium, and high (+).



PROTEIN

Protein supports an athlete's growth, the repair of damaged muscle, prevention of and recovery from injury, and ultimately, performance. This section provides tools to support the athlete in meeting daily protein requirements.

PROTEIN CONVERSION TABLES

Daily protein requirements (Table 22) and the recommended quantities of protein per serving (Table 23) can be modified based on an athlete's body mass and physical activity levels. Injured athletes and those aiming to build lean mass should aim for the higher end of recommendations. A conversion table between kilograms and stones and pounds can be found in the Appendix (Table 27).

Table 22

A guide to daily protein consumption based on body mass (BM), and activity levels. Recommendations adapted from (Thomas, et al., 2016).

		Increasing Exercise Intensities →								
Body Mass		Recommended Protein Intake (g) Per Day Based on Body Mass								
kg	lb	1.2 g/kg BM	1.3 g/kg BM	1.4 g/kg BM	1.5 g/kg BM	1.6 g/kg BM	1.7 g/kg BM	1.8 g/kg BM	1.9 g/kg BM	2.0 g/kg BM
60	132	72	78	84	90	96	102	108	114	120
65	143	78	85	91	98	104	111	117	124	130
70	154	84	91	98	105	112	119	126	133	140
75	165	90	98	105	113	120	128	135	143	150
80	176	96	104	112	120	128	136	144	152	160
85	187	102	111	119	128	136	145	153	162	170
90	198	108	117	126	135	144	153	162	171	180
95	209	114	124	133	143	152	162	171	181	190
100	221	120	130	140	150	160	170	180	190	200
105	232	126	137	147	158	168	179	189	200	210
110	243	132	143	154	165	176	187	198	209	220

Body Mass		Recommended Protein Intake (g) Per Serve, Depending on Body Mass	
kg	lb	0.25 g/kg BM	0.3 g/kg BM
60	132	15	18
65	143	16	20
70	154	18	21
75	165	19	23
80	176	20	24
85	187	21	26
90	198	23	27
95	209	24	29
100	221	25	30
105	232	26	32
110	243	28	33

Table 23

A guide to protein consumption per serve (meal occasion) based on body mass (BM). Recommendations adapted from (Thomas, et al., 2016).

PROTEIN QUANTITIES

Table 24 presents a selection of commonly consumed foods that will provide around, or greater than 20g of protein per serving. These examples can be used as a guide for the nutritionist, with the nutritionist adapting quantities to meet an athlete's requirements. There is space above the images for the nutritionist to add foods that are more relevant to the athlete / club / country. A conversion table between grams and ounces can be found in the Appendix (Table 28).

~20g

1 MEDIUM CHICKEN BREAST
Serving size: 4.2 oz / 120 g
Protein: 38 g
Calories: 175 kcal

1 SMALL SIRLOIN STEAK
Serving size: 3.9 oz / 110 g
Protein: 37 g
Calories: 250 kcal

SMALL PORTION LEAN GROUND BEEF
Serving size: 3.5 oz / 100 g
Protein: 22 g
Calories: 125 kcal

HALF A CAN OF TUNA
Serving size: 3.2 oz / 90 g
Protein: 21 g
Calories: 90 kcal

1 FILLET OF SALMON
Serving size: 3.5 oz / 100 g
Protein: 23 g
Calories: 205 kcal

1 MEDIUM FILLET OF COD
Serving size: 3.6 oz / 100 g
Protein: 24 g
Calories: 100 kcal

1 PLATE PRAWNS
Serving size: 4.2 oz / 120 g
Protein: 21 g
Calories: 90 kcal

3 MEDIUM EGGS
Serving size: 6.4 oz / 180 g
Protein: 21 g
Calories: 215 kcal

1 CONTAINER COTTAGE CHEESE
Serving size: 8.8 oz / 250 g
Protein: 23 g
Calories: 260 kcal

FAT-FREE YOGURT
Serving size: 7.1 oz / 200 g
Protein: 20 g
Calories: 110 kcal

1 LARGE GLASS MILK
Serving size: 20.1 fl oz / 568 ml
Protein: 19 g
Calories: 360 kcal

GLASS CHOCOLATE MILK
Serving size: 17.7 fl oz / 500 ml
Protein: 18 g
Calories: 360 kcal

SKIMMED MILK POWDER
Serving size: 2.1 oz / 60 g
Protein: 21 g
Calories: 210 kcal

1 SCOOP MILK PROTEIN CONCENTRATE
Serving size: 1.1 oz / 30 g
Protein: 23 g
Calories: 120 kcal

1 SCOOP WHEY PROTEIN ISOLATE
Serving size: 1.1 oz / 30 g
Protein: 25 g
Calories: 130 kcal

TEMPEH
Serving size: 3.5 oz / 100 g
Protein: 21 g
Calories: 200 kcal

SEITAN
Serving size: 3.5 oz / 100 g
Protein: 24 g
Calories: 120 kcal

SOY FLAKES
Serving size: 1.8 oz / 50 g
Protein: 27 g
Calories: 200 kcal

TEXTURED SOY
Serving size: 1.8 oz / 50 g
Protein: 24 g
Calories: 160 kcal

LARGE PLATE QUINOA
Serving size: 10.6 oz / 300 g
Protein: 21 g
Calories: 350 kcal

PEANUT POWDER
Serving size: 1.8 oz / 50 g
Protein: 25 g
Calories: 160 kcal

ALMOND PROTEIN POWDER
Serving size: 1.8 oz / 50 g
Protein: 22 g
Calories: 100 kcal

3 SERVINGS OF MIXED NUTS
Serving size: 3.2 oz / 90 g
Protein: 25 g
Calories: 550 kcal

TOFU
Serving size: 3.5 oz / 100 g
Protein: 24 g
Calories: 260 kcal

4 TABLESPOONS PEANUT BUTTER
Serving size: 2.1 oz / 60 g
Protein: 19 g
Calories: 450 kcal

MYCOPROTEIN
Serving size: 7.1 oz / 200 g
Protein: 22 g
Calories: 200 kcal

1 PLATE LENTILS
Serving size: 8.8 oz / 250 g
Protein: 19 g
Calories: 270 kcal

1 CAN CHICKPEAS
Serving size: 8.1 oz / 230 g
Protein: 17 g
Calories: 280 kcal

2.5 SERVINGS EDAMAME BEANS
Serving size: 7.1 oz / 200 g
Protein: 22 g
Calories: 280 kcal

1 CAN BAKED BEANS
Serving size: 14.7 oz / 415 g
Protein: 21 g
Calories: 450 kcal

Table 24

Common sources of protein providing approximately 20g. Please note these values are estimates and food/beverage packaging can be reviewed to evaluate actual nutritional content.

PROTEIN TIMELINE

NAME: ______________________ DATE: ______________

TYPE OF DAY (E.G. TRAINING DAY): ______________________

Three T's should be taken into account when evaluating protein intake: 'Total' amount, 'Timing' of intake, and 'Type' of protein consumed. To evaluate intake, the athlete can record a daily training or competition schedule on the 'Exercise Schedule' timeline and their daily protein consumption on the 'Current Protein Consumption' timeline. The nutritionist can then evaluate intake against the athlete's requirements, and present an optimized protein consumption plan on the 'Recommended Protein Intake' timeline. For information, to optimize protein synthesis for repair and adaptation, protein consumption is recommended at 15 – 20g every 3 – 5 hours (Thomas, et al., 2016).

CURRENT EXERCISE SCHEDULE

WAKE UP SLEEP

CURRENT PROTEIN INTAKE

WAKE UP SLEEP

RECOMMENDED PROTEIN INTAKE

WAKE UP SLEEP

DIETARY SUPPLEMENTS

Dietary supplements can be split into two main categories; nutritional and ergogenic. In some cases, supplements may have both nutritional and ergogenic benefits for the athlete.

Nutritional supplements may be used to support an athlete where their dietary intake is not providing the adequate amount of nutrients to support health, performance and/or recovery. This may be due to reasons, such as dietary practices (for example veganism or certain religious practices), or practical limitations (for example training and travel schedules and or/locations). On the other hand, an inadequate dietary intake may be due to poor nutritional choices made by the athlete as a result of insufficient capability, opportunity or motivation.

Ergogenic supplements may be used to support an athlete's physical or mental performance. These could be useful in cases where it is challenging to consume adequate amounts of the functional ingredient of interest through the diet.

Despite the potential benefits of supplement use, supplements are not always required, and their use can come with potential risks. For example, consuming a supplement which contains a banned substance, as classified by WADA, could result in the athlete and nutritionist facing a maximum of a lifetime ban from competing or working in sport.

As such, it is important that the nutritionist/sports performance team support the athlete in carrying out a 'needs analysis', to identify if a supplement is required, and if the supplement can be consumed safely, and within the rules of the sport. To support this needs analysis, this section provides two decision trees (Figures 14 and 15), adapted from the International Olympic Committee's statement on dietary supplements and the high-performing athlete (Maughan, et al., 2018). These decision trees can be used by the nutritionist to:

1. Guide informed decision making and reduced risk of antidoping rule violation during nutritional supplement use.

2. Guide informed decision making and reduced risk of antidoping rule violation during ergogenic supplement use.

Throughout the decision trees, where appropriate, the nutritionist is guided to different sections of this toolkit, highlighting tools that can be used to support the decision making process; these tools are provided as guides, and the nutritionist may want to consider additional aspects, in addition to those listed.

Once the needs analysis is complete, results can be documented on the 'Nutrition Consultation' template on page 14. A copy should be kept for the nutritionist's records and feedback should be provided to the athlete on any decisions that have been made in order to educate the athlete around supplement use. It is also important that the nutritionist keeps a record of any additional conversations around supplement use, decisions that have been made, and supplements that are being used by the athlete as a result.

NUTRITIONAL SUPPLEMENT USE DECISION TREE

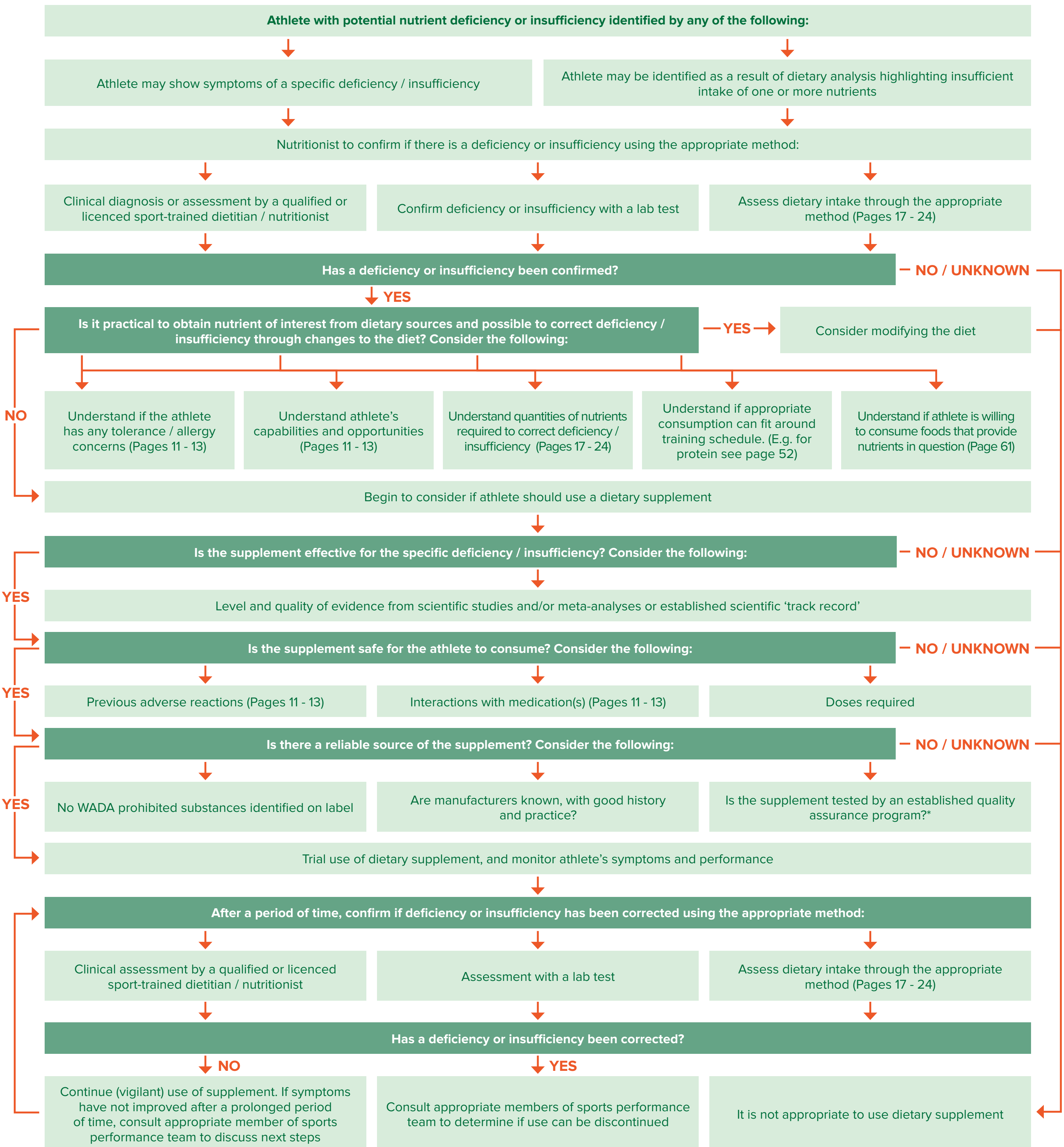


Figure 14

Decision tree to guide decision making and reduce risk of antidoping rule violation during nutritional supplement use. Adapted from Maughan, et al. 2018. *Quality assurance programs cannot 100% guarantee that a supplement will be free of banned substances. The nutritionist and athlete should make informed decisions when deciding if a supplement should be used considering strict athlete liability.

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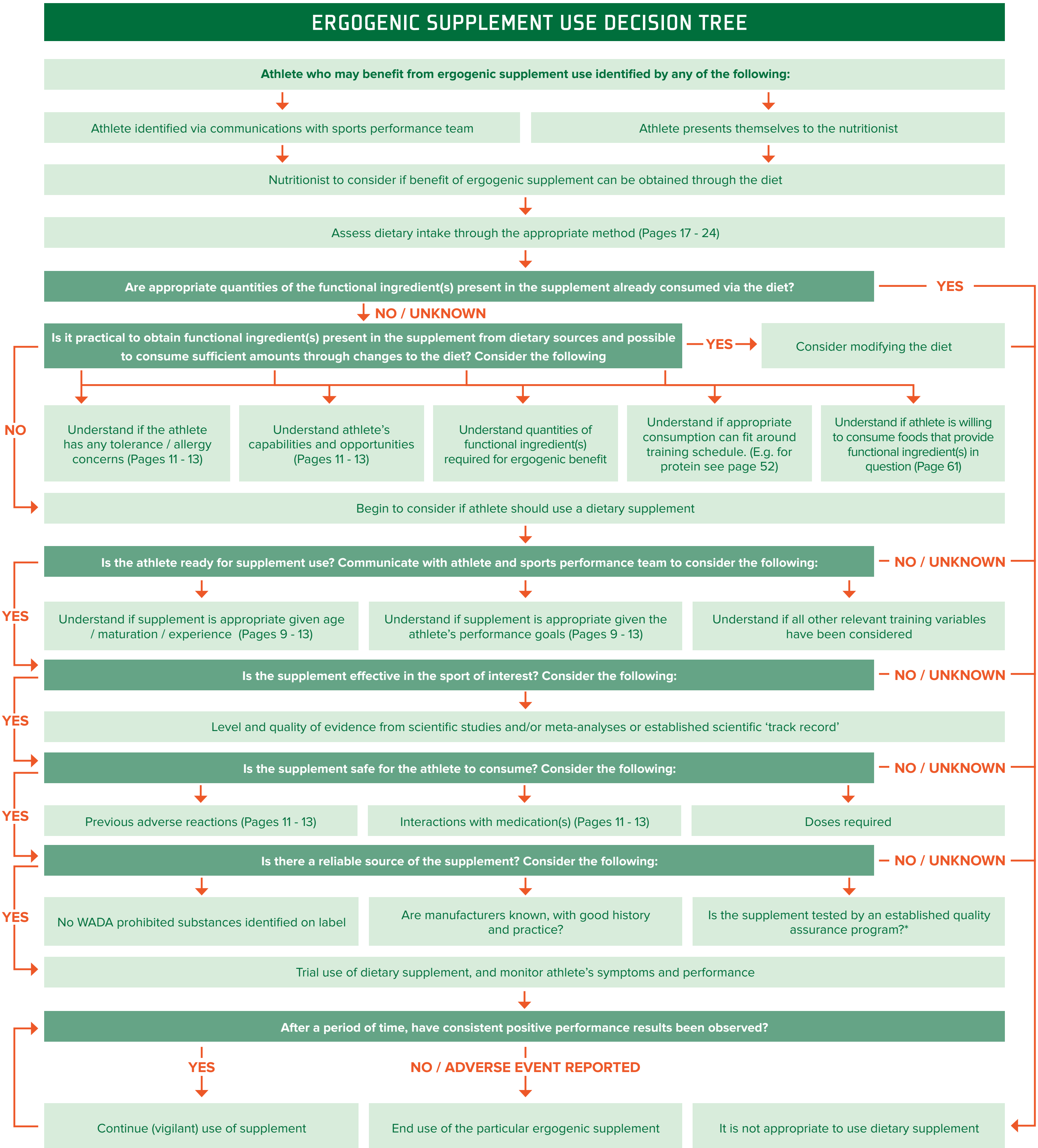
Figure 15

Decision tree to guide decision making and reduce risk of antidoping rule violation during ergogenic supplement use. Adapted from Maughan, et al. 2018. *Quality assurance programs cannot 100% guarantee that a supplement will be free of banned substances. The nutritionist and athlete should make informed decisions when deciding if a supplement should be used considering strict athlete liability.



GASTROINTESTINAL COMPLAINTS

A common concern for athletes is gastrointestinal (GI) complaints; symptoms may include bloating, stomach pain, vomiting and the urge to defecate, amongst others. If severe, these issues are likely to affect performance, thus solutions are required. GI issues during exercise may sometimes be a result of nutritional intake, be that the types of food or beverages that have been consumed, or the timing of intake around an exercise session.

GASTROINTESTINAL COMPLAINTS QUESTIONNAIRE

This section provides a questionnaire on pages 57 - 59, which aims to determine the potential cause of any GI complaints (Pfeiffer, et al., 2012; Gaskell, et al., 2019). This questionnaire can be used as a standalone tool, or as a follow on during a consultation session. The nutritionist can move through the questionnaire stage by stage with the athlete, circling/documenting the athlete's responses.

Section one aims to capture any symptoms and their severity during training and competition. If symptoms are only reported in one of either training or competition, the questionnaire can be run once for the particular event where issues occur. If both training and competition cause different symptoms and/or severity, the questionnaire can be run twice, once in regards to training, and once in regards to competition. The nutritionist can cross out the term 'training' or 'competition' where it is not relevant.

Section two of the questionnaire aims to evaluate the athlete's dietary habits around training and/or competition, and the nutritionist can use the results to try to establish the potential causes of the GI distress, be that the type, or timing of food or beverage consumption.

Section three reviews GI complaints outside of training and competition, and also considers the potential role of the menstrual cycle in women. This section aims to identify if GI complaints may be an issue independent of physical activity. If this is the case, and no solution can be found through modifying the diet, the team doctor, and/or other relevant members of the sports performance team should be consulted to support the athlete.

Feedback can be provided to the athlete verbally, however the 'Nutrition Consultation' form on page 14 should be used to document any conversations, with a copy provided to the athlete, and a copy kept by the nutritionist for their records.

GASTROINTESTINAL COMPLAINTS QUESTIONNAIRE

NAME: ____________________ **DATE:** ____________________

Section One - Gastrointestinal Complaints During Exercise

During training and competition

Which GI symptom(s) do you suffer from during training? If you suffer from a symptom, please rank their severity next to the symptom(s). 1 = very mild, 10 = extremely severe

Belching		Heartburn		Bloating		Stomach Pain		Nausea		Vomiting	
Flatulence		Urge to defecate		Defecation (normal stool)		Defecation (loose stool)		Defecation (diarrhoea)		None	

Which GI symptom(s) do you suffer from during training? If you suffer from a symptom, please rank their severity next to the symptom(s). 1 = very mild, 10 = extremely severe

Belching		Heartburn		Bloating		Stomach Pain		Nausea		Vomiting	
Flatulence		Urge to defecate		Defecation (normal stool)		Defecation (loose stool)		Defecation (diarrhoea)		None	

Section Two - Dietary Habits

Before [training] or [competition] (select as appropriate)

How often do you normally eat before [training] or [competition]?

Never	Sometimes	Regularly	Always

If you do not eat before, why?

If you eat before, how long before do you eat your last meal/snack?

< 30 mins	≥ 30 mins and < 1 hour	≥ 1 and < 2 hours	≥ 2 and < 3 hours	≥ 3 and < 4 hours	≥ 4 hours

How often do you drink in the 2-3 hours before?

Never	Sometimes	Regularly	Always

How often do you consume caffeine before?

Never	Sometimes	Regularly	Always

If you consume caffeine, what form? E.g. coffee, tablet, energy drink, gel etc

How often do you avoid eating or drinking certain foods or drinks before to prevent GI symptoms?

Never	Sometimes	Regularly	Always

If you avoid foods or drinks before, what do you avoid?

Fruit	Vegetables	Foods containing wheat/gluten	Soya	High fat foods	High fibre foods
Carbohydrates	Coffee	Sport nutrition products (e.g. drinks / gels)	Dairy / Lactose	Other	None

If you chose 'Other', what foods do you avoid?

How does avoiding the foods affect the severity your symptoms?

No effect	Some improvement	Large improvement	Prevents symptoms

During [training] or [competition] (select as appropriate)

How often do you drink during training or competition?

Never	Sometimes	Regularly	Always

What do you drink during?

Water	Sports drinks	Fruit juice	Other

If you chose 'Other', what do you drink?

When drinking during, do you:

Drink ad-libitum (to thirst)	Drink to a plan (known amount)	Do not drink during

How often do you eat during?

Never	Sometimes	Regularly	Always

What do you eat during?

Gels	Gummy Sweets	Fruit	Sports Bars	Other

If you chose 'Other', what do you eat?

How often do you avoid eating or drinking certain foods or drinks during to prevent GI symptoms?

Never	Sometimes	Regularly	Always

If you avoid foods and drinks during, what do you avoid?

Gels	Gummy Sweets	Fruit	Sports Bars	Water
Sports Drinks	Fruit Juice	Other	None	

If you chose 'Other', what do you avoid?

How does avoiding the foods or drinks affect the severity of your symptoms?

No effect	Some improvement	Large improvement	Prevents symptoms

Extended breaks in competition e.g. half time (if relevant)

How often do you drink during extended breaks in competition?

Never	Sometimes	Regularly	Always

How often do you eat during extended breaks in competition?			
Never	Sometimes	Regularly	Always

If you consume foods and drinks during extended breaks in competition, what do you consume?				
Gels	Gummy Sweets	Fruit	Sports Bars	Water
Sports Drinks	Fruit Juice	Other	None	

If you chose 'Other', what do you consume?

Section Three - Gastrointestinal Complaints Outside of Exercise

Outside of training and competition

How often do you feel gassy or bloated on occasions when you are not exercising?				
Once a day	Several times a day	Twice a week	Several time a week	Never

Do you get cramps or stomach aches (unrelated to your menstrual cycle)?			
Yes, several times a day	Yes, several times a week	Rarely	No

How often, on average, do you have a bowel movement?				
Several time a day	Once a day	Every other day	Twice a week	Once a week

How would you describe your normal stool?		
Normal	Diarrhoea like (watery)	Hard and dry

Outside of training and competition – Women specific

Do you experience any of the following symptoms during menstruation?						
Belching	Heartburn	Bloating	Stomach Pain	Nausea	Vomiting	Lower abdominal bloating
Increased flatulence	Increased defecation – normal stool	Increased defecation – loose stool	Increased defecation – diarrhoea	I do not menstruation	None	Other

If you selected 'Other', please specify symptoms

Do any of the symptoms you experience during menstruation prevent you from training?			
Yes	No	Sometimes	I do not experience symptoms

Do any of the symptoms you experience during menstruation prevent you from playing matches?			
Yes	No	Sometimes	I do not experience symptoms

MEAL PLANNING

To facilitate the translation of sports nutrition science and recommendations into practical advice, this chapter provides several tools: a dietary preference checklist (Page 61), a dietary intake timeline (Page 62), and a meal plan template (Page 63). The aim of the chapter is to allow the personalization of dietary recommendations based on individual requirements and dietary preferences, taking into account the three T's; 'Total' amounts, 'Timing' of intake, and 'Type' of nutrient. The aim is to increase the athlete's understanding by translating the 'numbers' into real-life food-based recommendations. Table 25 provides an overview of how the nutritionist can utilise these tools to support the athlete.

NAME OF TOOL	FUNCTION	SHARE WITH ATHLETE?
Dietary Preference Checklist	Can be used to support the personalization of dietary advice based on an athlete's dietary preferences. The athlete can add a cross next to any food they do not like, thus ensuring the nutritionist can avoid recommending foods / developing recipes that the athlete would not consume. The athlete can list any other foods or beverages they dislike at the bottom of the checklist.	**YES**
Dietary Intake Timeline	This page can be used to document an athlete's exercise schedule for a particular day on the 'Exercise Schedule' timeline, alongside the timings of habitual food and beverage intake on the 'Current Meal Timings' timeline. In turn, the nutritionist can use the use this information to fill in the 'Recommended Meal Timings' timeline, outlining ideal timings for food and beverage intake in relation to the exercise schedule. Multiple timelines can be used for different exercise schedules, e.g. training and competition days.	**YES**
Meal Plan Template	The meal plan template can be completed by the nutritionist, translating athlete's nutrition and hydration recommendations (see Pages 42 - 52 and 32 - 41 respectively) into practical food-based advice, related to their specific goals. Meal plans should take into account the different aspects highlighted throughout the toolkit, for example, meal plans should only be provided if the athlete has the capability, opportunity, and motivation to follow the plan (see Page 12). In addition, recommendations should take into account the athlete's dietary preferences (see Page 61), and should be personalized around the athlete's daily exercise schedules (see Page 62). As such, each sheet provides room for the nutritionist to provide a meal plan for three different days. This plan can be used by the athlete to guide their food and beverage consumption.	**YES**

Table 25

Overview of meal planning tools.

DIETARY PREFERENCE CHECKLIST

NAME: ____________________ DATE: ____________________

Fruit and Vegetables		Protein		Carbohydrate	
Apple		Beef		Bagels	
Avocado		Butter		Baked Chips	
Banana		Chicken		Brown Rice	
Beetroot		Cod (or other white fish)		Cereal	
Bell Peppers		Cottage Cheese		Chocolate Milk	
Berries		Eggs		Couscous	
Broccoli		Ham		Noodles	
Cabbage		Hard Cheese		Oats	
Carrots		Lamb		Pancakes	
Cauliflower		Milk		Pasta	
Celery		Ground Beef		Potatoes	
Coconut		Peanut Butter		Quinoa	
Corn		Pork		Rice Cakes	
Dates		Prawns (or other seafood)		Seeded Bread	
Dried Mango		Protein Shakes		Sports Drinks	
Eggplant		Salmon (or other oily fish)		Sports Gels	
Fruit Juice		Soft Cheese		Sweet Potatoes	
Grapes		Soy Milk		Tortilla (flour/corn)	
Kale		Tofu		White Bread	
Lettuce		Tuna		White Rice	
Melon		Turkey		Wholegrain Bread	
Mushrooms		Yogurt			
Onions		**Beans and Pulses**		**Other**	
Orange		Baked Beans		Garlic	
Peaches		Butter Beans		Herbs	
Pears		Chickpeas		Hummus	
Raisins		Edamame Beans		Nuts	
Spinach		Garden Peas		Seeds	
Squash		Kidney Beans		Soups	
Tomatoes		Lentils		Spices	
Watermelon					
Enter Own Foods					

DIETARY INTAKE TIMELINE

NAME: ____________________ DATE: ____________

TYPE OF DAY (E.G. TRAINING DAY): ____________________

CURRENT EXERCISE SCHEDULE

WAKE UP — SLEEP

CURRENT MEAL TIMINGS

WAKE UP — SLEEP

RECOMMENDED MEAL TIMINGS

WAKE UP — SLEEP

MEAL PLAN

NAME: ______________________ **DATE:** ______________

Nutritionist to enter title of each day in the row below (e.g. Rest Day / Light Training / Moderate Training / Competition etc). There is room for three different days.

Breakfast			
Snack			
Lunch			
Snack			
Dinner			
Snack			
Pre-Bed			
Other			

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MEET THE TEAM

LIAM BROWN, MSc
GSSI SCIENTIST

Liam Brown is a Scientist for the GSSI international team, based in the UK. Liam earned his Bachelor's Degree in Nutrition and Food Science from the University of Reading, UK, before completing a Master's Degree in Sport Nutrition at Liverpool John Moores University, UK, in 2018. Liam has experience working as a Sport Nutritionist for a Professional English Soccer Club, as well as working as a Nutritionist in the Food Industry. His current role with GSSI involves sport nutrition support for Gatorade partners, including professional soccer clubs such as FC Barcelona and Manchester City Football Club, as well as managing and supporting GSSI service and education engagements internationally.

CAROLINE TARNOWSKI, MSc
GSSI SCIENTIST

Caroline Tarnowski is a Scientist for the GSSI international team, based in the UK. Caroline completed her Bachelor's degree in Sport and Exercise Science and Master's Degree in Sports Nutrition at Loughborough University, UK. Upon completion of her MSc, Caroline was employed as the Lead Nutritionist at the University of Birmingham where she worked with elite scholarship athletes. Caroline's current role with GSSI involves sport nutrition support for Gatorade partners, as well as managing and supporting GSSI service and education engagements internationally.

REBECCA RANDELL, PhD
GSSI ASSOCIATE PRINCIPLE SCIENTIST

Dr Rebecca Randell is an Associate Principal Scientist at GSSI and a visiting fellow at Loughborough University, UK. Rebecca earned her Bachelor's Degree and her PhD from the University of Birmingham, UK under the supervision of Professor Asker Jeukendrup. In her current role Rebecca works for the Sports Science Application team and is working on a project on the topic of physical performance for women. Rebecca has extensive experience working with elite athletes and football clubs in the UK and abroad.

KHALIL LEE, PhD
GSSI SENIOR SCIENTIST

Dr Khalil Lee is a Senior Scientist at the GSSI Satellite Lab at IMG Academy in Bradenton, FL. Khalil earned his BS and MS degrees in Sport and Fitness Management from Troy University. In 2014, he received his PhD from Auburn University in Kinesiology with a concentration in Exercise Physiology, where he later served as an adjunct professor in the School of Kinesiology. In his current role, Khalil's responsibilities include research and oversight of sports science education programs for IMG athletes and sports staff.

KEVIN LUHRS, MS
GSSI ASSOCIATE PRINCIPLE SCIENTIST

Kevin Luhrs is an Associate Principle Scientist at the GSSI satellite lab at IMG Academy in Bradenton, FL. Kevin earned his BS at the University of Nebraska in Nutrition Science and Dietetics, before becoming a Registered Dietitian in 2009. Kevin later became the Team Sports Dietitian and Assistant Strength Coach for the Tampa Bay Buccaneers in 2010, working closely with the players, coaches and support staff whilst pioneering the Buccaneer's first Sport Nutrition Program over 9 seasons. Kevin also has a MS in Applied Exercise Science from Concordia University, Chicago. In his current role, Kevin's primary responsibly includes leading the GSSI Athlete Service Team.

ERIC FREESE, PhD
GSSI PRINCIPLE SCIENTIST

Dr Eric Freese is a Principle Scientist and lead of the GSSI satellite lab at the Baylor, Scott, and White Sports Performance Centre in Frisco, Texas. Eric earned his Bachelor degree in Kinesiology from the University of Illinois, and his Master's and Doctorate degrees in Exercise Physiology at the University of Georgia. In his current role leading the satellite facility, his team supports the Sports Performance and Nutrition team with the Dallas Cowboys, aiding in player recovery monitoring and personalised hydration strategies.

JAMES CARTER, PhD
GSSI SENIOR DIRECTOR

Dr James Carter is the Senior Director of GSSI. James earned his Bachelor's degree in Sport and Exercise Nutrition, and his PhD, focused on endurance exercise and the relationship between carbohydrate supplementation, environmental heat stress and performance, at the University of Birmingham, UK. In his current role, James oversees the strategic direction of the Institute. James is a Fellow of the American College of Sports Medicine, and throughout his career has published numerous peer-reviewed journal articles and presented internationally at a range of sport science and occupational physiology conference.

IAN ROLLO, PhD
GSSI PRINCIPLE SCIENTIST

Dr Ian Rollo is a principal scientist at GSSI and head of GSSI International service. He is a visiting research fellow at Loughborough University, UK. Ian earned his Bachelor's degree from Birmingham University in sport and exercise science and Master's degree from Loughborough University in Exercise Physiology. In 2009 he received a PhD from Loughborough University under the supervision of Professor Clyde Williams, OBE. Ian currently leads the partnerships between GSSI and partner clubs, including Manchester City Football Club and FC Barcelona, completing pre-season testing as well as staff and player education initiatives.

Table 26

A conversion table from inches to centimetres.

MEASUREMENT CONVERSION TABLES

Inches	Feet		Centimetres
in (“)	ft (‘)	in (“)	cm
1	0	1	2.5
5	0	5	12.7
10	0	10	25.4
39.4 (1 meter)	3	3	100.0
50	4	2	127.0
55	4	7	139.7
60	5	0	152.4
65	5	5	165.1
70	5	10	177.8
75	6	3	190.5
78.7 (2 meters)	6	7	200.0
80	6	8	203.2
85	7	1	215.9

Length Conversion Rates

Inches to Centimetres	1 inch is equivalent to 2.54 centimetres
Centimetres to Inches	1 centimetre is equivalent to 0.3937 inches
Feet to Inches	1 foot is equivalent to 12 inches
Feet to Centimetres	1 foot is equivalent to 30.48 centimetres

Pounds	Stones		Kilograms
lb	st	lb	kg
130	9	4	59.97
140	10	0	63.50
150	10	10	68.04
160	11	6	72.58
170	12	2	77.11
180	12	12	81.65
190	13	8	86.18
200	14	4	90.72
220	15	10	99.79
230	16	6	104.33
240	17	2	108.86

Mass Conversion Rates

Pounds to Kilograms	1 pound is equivalent to 0.4536 kilograms
Kilogram to Pounds	1 kilogram is equivalent to 2.205 pounds
Stones to Pounds	1 stone is equivalent to 14 pounds
Stones to Kilograms	1 stone is equivalent to 6.35 kilograms

Table 27

A conversion table from pounds to kilograms.

Table 28

A conversion table from grams to ounces

MEASUREMENT CONVERSION TABLES	
Grams	**Ounces**
g	**oz**
5	0.18
10	0.35
15	0.53
20	0.71
25	0.88
28 (1 ounce)	1.00
30	1.06
35	1.23
40	1.41
45	1.59
50	1.76
55	1.94
60	2.12
65	2.29
70	2.47
75	2.65
80	2.82
85	3.00
90	3.17
95	3.35
100	3.53
227 (½ pound)	8.00
454 (1 pound)	16.00
1000 (1 kilogram)	35.30
Mass Conversion Rates	
Grams to Ounces	1 gram is equivalent to 0.03527 ounces
Ounces to Grams	1 ounce is equivalent to 28.35 grams
Pounds to ounces	1 pound is equivalent to 16 ounces
Pounds to grams	1 pound is equivalent to 453.6 grams

Table 29

A conversion table from fluid ounces to millilitres.

MEASUREMENT CONVERSION TABLES		
US Fluid Ounces	**Millilitres**	**UK Fluid Ounces**
fl oz	**ml**	**fl oz**
3	100	4
5	150	5
7	200	7
9	250	9
10	300	11
12	350	12
14	400	14
15	450	16
17	500	18
19	550	19
20	600	21
22	650	23
24	700	25
25	750	26
27	800	28
29	850	30
30	900	32
32	950	33
34	1000	35

Fluid Conversion Rates	
US Fluid Ounce to Millilitres	1 US fluid ounce is equivalent to 29.6 millilitres
Millilitres to US Fluid Ounce	1 millilitre is equivalent to 0.03381 US fluid ounces
UK Fluid Ounce to Millilitres	1 UK fluid ounce is equivalent to 28.4 millilitres
Millilitres to US Fluid Ounce	1 millilitre is equivalent to 0.0352 UK fluid ounces

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