CHAPTER 5 NUTRITION ASSESSMENT

T. Crowder & S. King

Significant improvements in the nutritional status of CF populations have been achieved in recent decades. This chapter focuses on the time points, processes and tools for nutrition assessment and guidance on the use of these tools and standards of practice for measurement of nutritional parameters in people with CF.

Disease Aetiology

Suggested nutritional status classification categories are outlined in table 5a. This table will aid identification and prioritisation of higher risk patients for further assessment, and/or nutrition intervention (Chapter 6). Optimal nutritional status may not be achievable for everyone with CF. It is also important ensure that genetic height potential is considered when evaluating nutritional status. Explanations of cut-off values used:

- The Cystic Fibrosis Foundation (CFF) based in the United States of America (USA) have set targets for optimal weight status of a BMI ≥50th percentile for children and adolescents and ≥22 kg/m² (women) and ≥23 kg/m² (men) due to the association between these targets and an FEV_1 >60% predicted. However, it is important to note that this information is derived from population-based cross-sectional data and to date there is no evidence to demonstrate that FEV_1 in an individual can be increased as a result of increasing their BMI or BMI percentile.
- To date there is insufficient evidence to attribute any CF-specific increase in morbidity or health risk to being overweight. There is also no agreed cut-off that defines overweight or obesity in CF. The cross-sectional association between FEV_1 % predicted and BMI in adults shows no further increase in FEV_1 percent predicted for people with a BMI >25 kg/m² and no decline for those with a BMI up to 29 kg/m² [132].

Completing Nutrition Assessments

In order to detect declining nutrition status early on and to optimise outcomes, the following are essential components of a systematic approach to nutrition management:

- Routine and comprehensive nutritional assessments; and
- Comparison to reference standards, previous assessments and nutritional targets for the individual.

Nutrition screening for malnutrition is mandatory for the general population on admission to public hospitals in most Australian states and territories and NZ. As per the Australia and NZ Standards of CF Care, nutrition surveillance by a dietitian is recommended at least four times a year [2,3]. The scope of each review will be dictated by the individual's nutritional needs and priorities.

Recently a number of nutrition risk screening tools for CF have been proposed [246-248]. As yet these tools have not been evaluated for validity in or applicability in the Australian or NZ setting and are not recommended currently. Nutrition assessment tools, including the subjective global assessment (SGA) tool in adults and subjective global nutrition assessment (SGNA) in paediatrics are not typically used as stand-alone nutrition assessment tools for the Australasian CF population. These tools lack the breadth required for comprehensive nutritional assessment in CF and the classification categories are not validated in CF.

A comprehensive nutrition assessment should be undertaken at least annually [2,3]. This should encompass the collection and integration of anthropometric, biochemical, dietary and relevant clinical data, which are compared with previous assessments and clinical status changes; and then used to formulate nutritional goals and a management plan for the individual. While in most cases this occurs on an outpatient basis, there may be circumstances, for example when a patient is unable to travel to an additional clinic appointment, where an annual assessment as an inpatient is justified.

Table 5a. Criteria for weight status in cystic fibrosis*

Nutritional status	Infants <2 years**	Children and Adolescents 2-18 years**	Adults
Optimal	Weight-for-length >50th percentile*** AND weight & length tracking AND within 2 percentile bands of each other	BMI 50-85th percentile using CDC growth chart (Australia)** OR BMI 50-91st percentile using NZ-WHO growth chart**	Female BMI 22-27 kg/m² Male BMI 23-27 kg/m²
Acceptable	Weight-for-length 25-50th percentile AND weight & length tracking AND within 2 percentile bands of each other	BMI 25-50th percentile AND weight & height tracking along previous percentiles AND no recent weight loss	Female BMI 20-22 kg/m² Male BMI 20-23 kg/m² AND no unintentional recent weight loss
Suboptimal – at risk of undernutrition	Weight-for-length 10-25th percentile AND/OR weight or length decreasing >1 percentile band AND/OR no weight gain	BMI 10-25th percentile AND/OR weight loss or plateau over 2-4 months	BMI <20 kg/m² AND/OR ≥5% unintentional weight loss over 2 months
Persistent undernutrition	Persistent weight for length <10th percentile AND/OR weight falling >2 percentile bands with stunting of growth AND/OR failure of previous nutritional interventions to improve nutritional status	BMI <10th percentile AND/OR weight falling >2 percentile bands with stunting of growth AND/OR failure of previous nutritional interventions to improve nutritional status	BMI persistently <18.5 kg/m² AND/OR ≥ 5% unintentional weight loss over 2 months despite previous nutritional interventions, regardless of starting BMI
High BMI	Not applicable **** Use growth chart to identify rapid weight gain.	**Overweight:** BMI 85- 95th percentile using CDC growth chart (Australia)** **OR** BMI >91-98th percentile using NZ-WHO growth chart** **Obese:** BMI>95th percentile using CDC growth chart (Australia)** **OR** BMI>98th percentile using NZ-WHO growth chart** **High risk of developing overweight or obesity** Unintentional weight gain resulting in an increasing of ≥2 BMI centile bands	BMI >27 kg/m² AND/OR unintentional weight gain from previously acceptable BMI of >5 kg within a year.

*Adapted from Australian population guidelines and previous Australasian and international recommendations for CF [1,78,132]

** WHO growth charts are used for all infants < 2 years of age. For 2-18 years, at the time of writing, CDC growth charts are used in Australia, NZ-WHO growth charts are used in New Zealand (http://www.health.govt.nz/our-work/life-stages/child-health/well-child-tamariki-ora-services/growth-charts). Refer to Appendix B for conversion between the two charts.
*** See 'Interpreting anthropometric measurements in children and adolescents' on page 17-18.

**** While there are no evidence-based guidelines for treating overweight in infancy, recognition of rapid weight gain might identify if interventions to ameliorate the rate of weight gain are indicated (Centers for Disease Control, https://www.cdc.gov/mmwr/pdf/rr/rr5909.pdf). Important to distinguish between catch-up growth after early deficit, and rapid weight gain risking overweight or obesity in childhood.

DIET

ANNUAL REVIEW

The annual dietary review should encompass an assessment of diet quality/nutrient density as well as energy and macronutrients. The following should be considered:

- intake (current and recent);
    - Conduct a detailed assessment of energy, macronutrient and micronutrient intake using qualitative and/or quantitative methodology [244,249,250].
    - Quantitative assessment may be more beneficial if nutrition status is of concern. It may also be beneficial when focusing on nutrients most relevant to the patient's nutritional issues and goals e.g. carbohydrate intake and distribution with CF-related diabetes or fat intake for those requiring more tailoring of PERT, iron or calcium to evaluate need for supplementation.
- contribution of alcohol to energy intake (where relevant);
- use of oral/enteral/parenteral nutrition support;
- previous involvement with and/or advice provided by a dietitian;
- the impact of previous dietary advice/education;
- knowledge/beliefs including cultural around food;
- changes in dietary pattern;
- meal time behaviours;
- feeding difficulties;

ROUTINE CLINIC APPOINTMENTS

Routine reviews should identify changes in dietary intake patterns from previous dietetics consultations and include evaluation of changes made in relation to education/advice/goal setting. It should also integrate dietary intake with weight changes/expected weight gain, symptoms (e.g. malabsorption) or biochemical monitoring (e.g. blood glucose levels) as applicable. Any of the considerations listed under annual assessment i.e. use of oral/enteral nutrition support or PERT should also be reviewed, if applicable.

Considerations for infants

- Aim for dietary review with each clinic appointment (usually monthly) until steady growth established and then a minimum of every three months after that.
- An additional dietary review is required around the time of introduction to solids.

Considerations for children (>2 years), adolescents and adults

- Anthropometric parameters are important at each clinic visit which is usually every three months. People with milder genotypes and who are clinically stable from a nutrition and respiratory perspective, a dietary review may only be required six-monthly or annually.

REVIEW DURING ADMISSIONS

In addition to what would be covered during a routine review, the following should be considered in the inpatient setting:

- acute changes in appetite and intake arising from the current reason for admission;
- possible impact of hospital menu/options e.g. refusal to eat hospital food;
- calculation of energy, protein and other relevant nutrient requirements to meet identified nutritional goals of the admission. This is particularly relevant for people receiving enteral nutrition support; and
- quantification of dietary intake in relation to usual intake, calculated requirements and evaluation/integration with weight changes observed in hospital. Methods for assessing dietary intake in hospital include food record charts, mealtime observations and recall methods.
- Frequency of review will vary according to hospital policy and individual patient circumstances.

As a general guide, all people with CF should be seen by a dietitian within 48 hours of admission and a minimum of once per week throughout their admission.

METHODS FOR ASSESSING DIETARY INTAKE

There are a range of methods for assessing dietary intake in CF, including:

- 24 hour recall (qualitative tool that is easily implemented)
- dietary history
- food diaries (3-5 day records)

When choosing a dietary assessment method consider:

- tools and resources available
- timeframe of the assessment (e.g. inpatient short term monitoring of intake vs. annual review)
- specific issues to be assessed
- patient participation and acceptance of the assessment method
- nutritional goals being evaluated or which may emerge from the assessment

Completion of a food diary is necessary for quantitative evaluation of energy and nutrient intake [78]. Moreover, they can be beneficial for completing meal-to-meal analysis (e.g. for carbohydrate counting in CF-related diabetes and evaluation of PERT adequacy). There is a high burden associated with completing food diaries, as well as, a risk of exaggeration of intake. Analysis usually requires a computerised food composition software e.g. *Foodworks®*.

Care should be taken when interpreting results of dietary assessments. In particular, the limitations of the methodology implemented should be considered. For example, multiple day food diaries can result in over- or under-reporting of intake [251].

CLINICAL

- pancreatic status and the efficacy of PERT (Chapter 10);
- relevant medications such as insulin type and timing, fat soluble vitamin regimens and sodium supplementation. Medications directly affecting the gastrointestinal tract may also influence dietary intake e.g. proton pump inhibitors, anti-emetics, laxatives and some antibiotics;
- psychosocial and lifestyle influences that may contribute to dietary intake, and
- other clinical factors that may impact on dietary intake including infection frequency and severity, symptoms affecting dietary intake (e.g. dyspnoea, nausea, vomiting, anorexia, early satiety, reflux, constipation, diarrhoea) and presence of any comorbidities.

ANTHROPOMETRY

Routine measurement of anthropometric parameters is a cornerstone of nutritional status monitoring in CF and plays an important role in the facilitation of early detection of nutritional deficits [249,250,252]. The recommended frequency for routine monitoring of anthropometric measurements is outlined in table 5b.

Routine anthropometric parameters include:

- height (length in those <2 years),
- weight
- BMI (≥ 2 years)

Percent weight loss over time may also be a useful calculation when assessing anthropometric parameters, particularly for adults. During inpatient admissions, weight loss should be compared to 'well' weight and malnutrition status should be documented (Chapter 6).

INTERPRETING ANTHROPOMETRIC MEASUREMENTS IN CHILDREN AND ADOLESCENTS

Plotting a child's growth on a chart contributes to forming an overall clinical impression of that child's nutritional status. However, recommendations regarding choice of growth chart differ between Australia and NZ.

- New Zealand [253]
  - World Health Organisation (WHO) growth chart for the paediatric population (0-18 years)
- Australia [254]
  - WHO growth charts for infants (0-2 years)
  - Centers for Disease Control and Prevention (CDC) growth charts for children and adolescents (2-18 years)

When using the WHO growth standards to measure children 0-24 months, a higher weight-for-length percentile is routinely observed compared to the CDC curves in both the general and CF populations [255,256], meaning that a child who plots above the 50th% percentile weight-for-length on the WHO growth standard between 12-24 months

of age will be below the 50th%ile on transition to the CDC BMI growth curve at 2 years of age. The US CF Foundation recently released a statement recommending a goal of WHO weight-for-length ≥75th percentile for infants aged 12-24 months[257,258] related to the expectation that this will convert to a BMI ≥50th percentile on the CDC growth charts after the age of two years. It is important to note that this is a US recommendation and cannot be automatically generalised to Australia or New Zealand, where newborn screening has been standard practice in CF for over two decades, and infant feeding practices including breastfeeding may differ in both the general and CF populations. It will be prudent to examine and compare such trends using Australian and New Zealand CF registry data before determining whether there is sufficient evidence of better nutritional and pulmonary outcomes for Australia and New Zealand to adopt the US CFF recommendation to aim for a weight-for-length of ≥50th percentile in infants with CF aged 12-24 months.

More information on the use and development of the CDC and WHO growth charts is available via the Royal Children's Hospital Growth Learning Package (http://www.rch.org.au/childgrowth/Child_growth_e-learning/).

Refer to Appendix B for further information on conversion between the two growth charts.

More information on the use and development of the CDC and WHO growth charts is available via the Royal Children's Hospital Growth Learning Package (http://www.rch.org.au/childgrowth/Child_growth_e-learning/)

Additional paediatric specific anthropometric parameters (centile and z-score measures) to consider include:

- head circumference – not routinely measured in infants with CF unless of specific concern
- weight-for-length
- genetic growth potential via mid-parental height
  - Girl's = [(Mother's height + Father's height) ÷ 2] – 7cm
  - Boy's = [(Mother's height + Father's height) ÷ 2] + 7cm

There are many considerations in the practical application of assessing a child's growth. Taking serial measurements is of utmost importance and growth charts are not to be used alone as a nutrition diagnostic tool. Care should be taken when interpreting BMI percentiles for children with poor height growth as falling height percentiles may indicate nutritional stunting. Additionally, parents and caregivers may have difficulty understanding growth charts thus, ongoing explanation and education should be provided.

Table 5b. Recommended frequency for routine monitoring of anthropometric measurements in CF

Measurement	FREQUENCY			Considerations
	Infants	Children and Adolescents	Adults	
Height – supine (length)	Every month until thriving	n/a	n/a	All infant growth charts are based on supine lengths
Height standing	n/a	Every clinic	Annually	When transitioning from length (supine) to height (standing) measurements, there may be a small discrepancy of 1-2cm between methods. Note that if an adult has lost height over time, then caution should be taken to interpret changes in BMI appropriately, and it may be useful to examine changes in total body weight as well as BMI.
Weight	Outpatient: weekly until thriving Inpatient: within 24 hours of admission Minimum of once per week On discharge	Outpatient: every clinic Inpatient: within 24 hours of admission	Outpatient: Every clinic Inpatient: within 24 hours of admission	Determine the change in weight status from previous measurement, and compare with goals/targets to identify (as applicable) (a) lack of expected weight gain; (b) weight gain towards a goal; (c) weight gain towards normal growth and development; (d) unplanned weight loss (e) planned weight loss in overweight/obese (f)unplanned weight gain towards overweight/obese range

METHODS FOR ANTHROPOMETRIC MEASUREMENT

Practitioners need to be trained in correct anthropometry procedures and follow standard measurement procedures. This is to ensure appropriate precision and accuracy of measurement so that changes in nutritional status parameters can be detected early and accurately. All centres should have access to a manual of anthropometric procedures and training. Accepted practice standards [1] include:

Infants (<2 years)

- Bare weight on a paediatric scale in a supine position or weighing the carer and bare infant together as above and then subtracting the carer's weight
- Recumbent length in a supine position on a paediatric measuring board of infants
- Flexible non-stretch tape for measuring head circumference
- Length and weight measurements should be corrected for gestational age in premature infants (i.e. born before 37 weeks gestation) until 2 years of age

Children (≥2 years), adolescents and adults

- Weight measurements taken dressed in light clothing, without shoes and jumper on a platform, electronic chair or beam balance (not bathroom) scale.
- Stadiometer to measure the standing height

Anthropometric equipment should be re-calibrated regularly. All equipment that comes into contact with patients with CF must also be handled and cleaned as per the local "Infection Control" policy for CF.

While BMI and BMI percentiles are most commonly used as indicators of nutritional status, they cannot distinguish if deficits, excess stores or changes in weight are in the fat or fat-free mass (FFM) compartments, or both [213,259,260]. This information, if required, is ascertained via the assessment of body composition which usually encompasses analysis of percent body fat, muscle, water and bone.

There are many body composition assessment methods available, see table 5c for the most commonly used methods. Some of these, however, are not widely available in the clinical setting and are confined to research use only. Newer methods being researched in other disease states include ultrasonography for limb muscle thickness estimation; computerised tomography analysis of skeletal muscle. At the present time, these have not been applied to in CF clinical practice in Australia and NZ.

Where a body composition method yields information on fat-free mass, this can be converted to fat-free mass index (FFMI) by dividing by height-squared (in metres). There are not yet any CF-specific validated cut-offs for FFM or FFMI that correlate with functional status, clinical risk or survival. The recent European Society for Clinical Nutrition and Metabolism (ESPEN) definition of malnutrition in adults proposed a cut-off of FFMI <15kg/m^2 for females and <17kg/m^2 for males [261].

Whilst current evidence does not support the routine assessment of body composition in all individuals with CF, these assessments may be indicated in the following situations:

- Undernutrition, overweight, obesity or unexplained weight gain.
- Assist with nutrition status evaluation, goal setting and evaluation of nutrition interventions after determining if weight changes are reflective of changes in FFM stores, fat stores or both.
- Severe CF lung disease including those being considered for lung transplantation [19].

There is no evidence on which to base recommendations for the frequency of body composition assessment. This should be guided by available resources and individual nutritional goals. If monitoring body composition changes following institution of nutrition support, it is unlikely that clinically important changes in FFM or fat mass would be detectable in less than 1-3 months.

Table 5c. Strengths and consideration of available body composition assessment methods [212,262-266]

	Strengths	Considerations
Skinfold thickness measurements	Quick and non-invasive	Prediction equations for conversion for measurements to FFM and percent fat are based on healthy populations and show variable accuracy in CF
Multi-frequency bioelectrical impedance analysis (BIA) and Bioelectrical impedance spectroscopy (BIS)	Quick and non-invasive Tetrapolar multi-frequency BIA and BIS (newer technology) have fewer limitations than older BIA devices.	Single frequency BIA (older technology) - poor accuracy compared with reference methods • Simple BIA devices such as stand-on scales with only two contact points (feet) are not validated in CF and not recommended as the results may not reflect the distribution of FFM and fat mass across the whole body. • Equipment is expensive to acquire • Limited validation studies in CF with tetrapolar multi-frequency BIA or BIS
Whole body dual-energy X-ray Absorptiometry (DXA) scanning	Accurate reference method for body composition assessment. • Provides information on regional body composition as well as total FFM, fat mass, and bone mineral content. • Newer DXA scanners are much quicker than older devices. • Low exposure to ionising radiation	Whole body DXA scanning is not routinely performed when bone density scanning is undertaken, and may require additional cost. • Requires individual to lie still and flat for duration of scan, which may be difficult for young children and those with severe lung disease.
Mid-arm circumference measurements	Used to assess muscle stores in conjunction with TSF • Simple, quick and non-invasive. • Useful for sequential monitoring	Cannot reliably be converted to whole body FFM stores as arm muscle and fat stores may not reflect whole body distribution
Abdominal circumference	Useful for monitoring abdominal/ central adiposity and comparison with reference norms for metabolic risk in adults with high BMI • Simple, quick and non-invasive. • Measuring abdominal circumference may be useful for identifying excess central adipose tissue in adults with high BMI and for monitoring the effect of interventions in individuals identified as suitable for weight loss.	No CF-specific evidence to determine if the general population cut-offs for abdominal obesity apply to the stratification of risk in this group of adults with CF.
Whole body plethysmography	Has been studied in CF	Not widely available

NUTRITION FOCUSED PHYSICAL FINDINGS

Muscle and subcutaneous fat stores can be visually examined for signs of depletion. Commonly used sites in clinical nutrition are outlined in figure 5a [267].

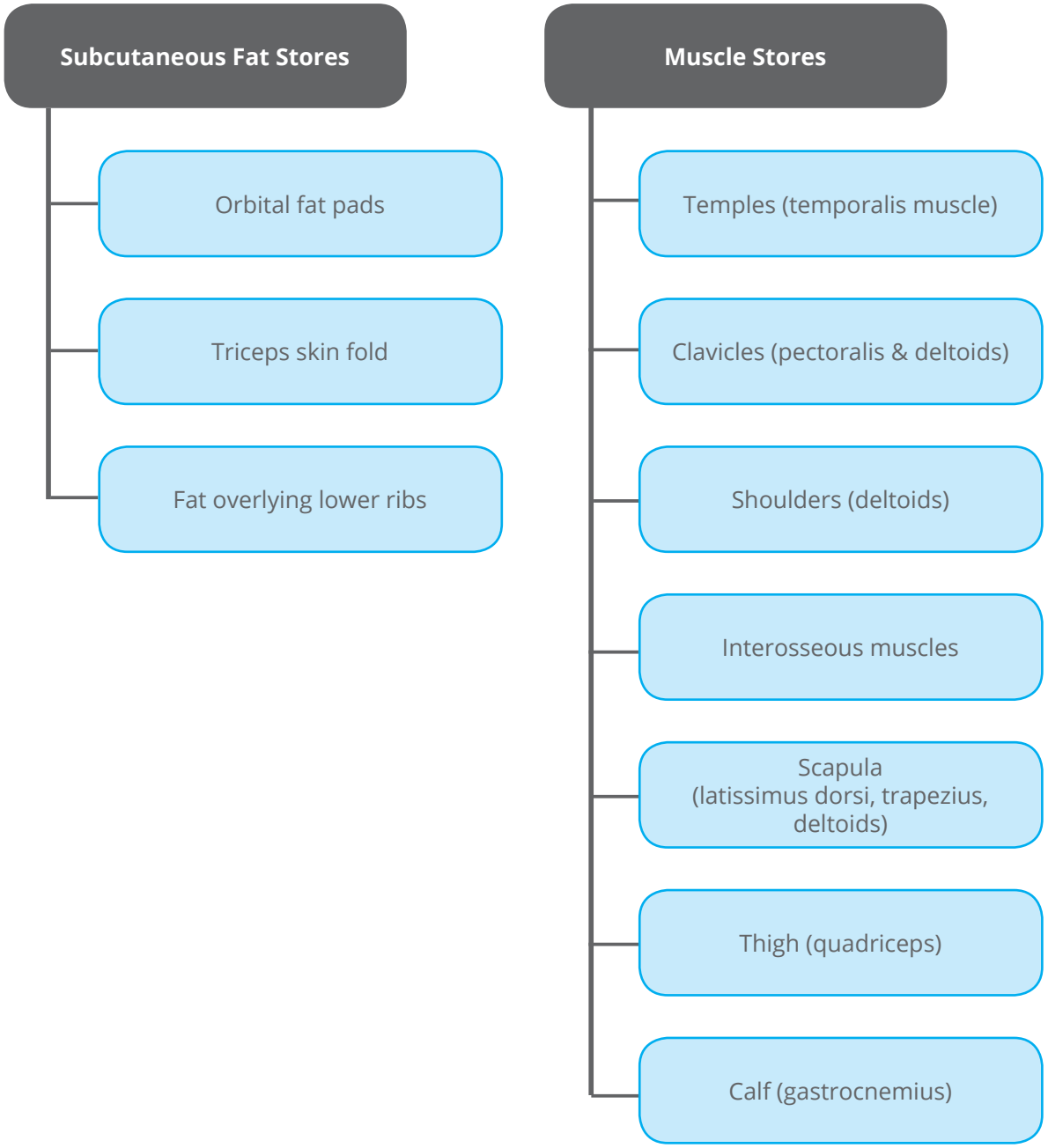

Figure 5a. Sites to assess muscles and subcutaneous fat stores [267]

ESTIMATED ENERGY REQUIREMENTS

Estimation of energy expenditure and thus energy requirements is a key component of the nutrition assessment in CF. The doubly-labelled water method is the gold standard but is extremely expensive and only available in limited research settings. Indirect calorimetry can also be used to estimate energy requirements and is recommended in the general population for those who are malnourished, or critically ill [268,269]. The strengths and considerations of the use of indirect calorimetry are outlined in table 5d.

Table 5d. Strengths and considerations for indirect calorimetry [269-271]

Strengths	Considerations
Measurement of resting energy expenditure (REE) can help identify if energy expenditure is: • Higher than estimated using prediction equations or published targets • Contributing to negative energy balance or failure to meet positive energy balance and nutrition goals	Measurement of REE will not incorporate the following: • Energy cost of physical activity • Energy expended in normal activities of daily living • Additional energy required to offset gut-related energy losses Must be undertaken by trained personnel in accordance with accepted standards and test conditions and local institutional protocols. Not routinely available in all clinical settings, although it may be available in some tertiary hospitals

Overall there are no clinically accessible methods for measuring total energy expenditure. In practice, prediction equations and/or energy targets are most commonly used to evaluate dietary energy intakes and plan targets. Historically, recommendations for energy intake in CF were based on a % of the healthy population RDI values, which were fixed values published for age and gender [272]. Fixed age- and gender-specific RDI values for energy are no longer used as energy targets in Australian or New Zealand nutrition practice for energy targets for the general population [43]. The current approach recommended by the NHMRC should be the basis for calculating energy requirements in CF [43], with adjustment for CF-specific factors.

STEPS TO ESTIMATE ENERGY REQUIREMENTS IN CF

1. Calculate REE (in mJ/day) in using the age- and gender-specific Schofield prediction equation [273]

Age (years)	Male Equation	Female Equation
0-3	(0.249 x weight kg) – 0.127	(0.244 x weight kg) – 0.130
3-10	(0.095 x weight kg) + 2.110	(0.085 x weight kg) + 2.033
10-18	(0.074 x weight kg) + 2.754	(0.056 x weight kg) + 2.898
18-30	(0.063 x weight kg) + 2.896	(0.062 x weight kg) + 2.036
30-60	(0.068 x weight kg) + 3.653	(0.034 x weight kg) + 3.538
> 60	(0.049 x weight kg) + 2.459	(0.038 x weight kg) + 2.755

2. Apply an activity factor based on current physical activity level [273]

Physical activity level	Male	Female
Bed rest	1.2	1.2
Very sedentary	1.3	1.3
Sedentary/maintenance	1.4	1.4
Light	1.5	1.5
Light/moderate	1.7	1.6
Moderate	1.8	1.7
Heavy	2.1	1.8
Very heavy	2.3	2.0

3. Apply a CF-specific stress factor to account for the estimated elevation in energy requirements for that individual, which may encompass energy losses due to malabsorption and/or increased energy expenditure due to CF lung disease. Further information is available in Chapter 7.

Stress factor	
CF	1.1 – 2.0

4. If applicable to the individual's nutrition goals, add or subtract an energy allowance for weight gain or weight loss, to achieve positive or negative energy balance respectively [274].

Prediction equations typically use total body weight as a variable, however, the major variables influencing resting energy expenditure are FFM and disease state [268]. In situations where FFM is outside the general population reference range, as is often the case in CF, prediction equations may yield greater inaccuracies. In CF, both low percentage body fat (high FFM) and depleted FFM can occur [213,225]. This may result in under- and over-estimation of resting energy expenditure (REE) [43,274,275]. It is important to note that if REE is elevated, total energy expenditure (TEE) is not necessarily higher for people with CF. This is thought to be due to lower physical activity that offsets the effects of higher REE [276].

There are no evidence-based recommendations to guide practice around the frequency of revising estimated energy requirements for a person with CF. Practitioners should consider the clinical application and benefits of calculating energy requirements as frequent calculation of requirements without quantifying intake, may not be relevant to practice. Situations in which calculating a revised energy requirement may be important include:

- review of an infants or young child during a period of rapid growth (particularly important for children with faltering growth);
- during hospital admissions where energy requirements are likely to fluctuate (especially at the beginning of admission if acutely unwell and when activity levels may be lower than usual);
    - This is particular important for those requiring enteral nutrition support
- when instituting and evaluating a nutritional intervention aimed at improving weight status;
- when instituting and evaluating a nutritional intervention aimed at reducing weight in overweight/obese;
- when exercise/activity has changed; and
- during pregnancy/lactation.

BIOCHEMCAL & LABORATORY DATA

There are no specific biochemical parameters that indicate nutritional status in isolation from other nutritional assessments [277]. Serum albumin is not a useful marker of nutritional status or protein intake in acute or chronic illnesses associated with infection and/or inflammation. Even during periods of apparent clinical stability, a high proportion of adults with CF have serum albumin below the reference range despite adequate protein intakes [262] which is likely to reflect chronic infection and inflammation rather than protein intake or nutritional status.

Care should be taken with interpretation of nutritional biochemistry during acute illness. While it may appear convenient to undertake periodic measurement of markers of micronutrient status during a hospital admission, many markers are affected by the acute phase response which occurs during acute illness. Chapter 8 and Chapter 9 discuss these topics in further detail.

Monitoring and Evaluation

The components of nutrition assessment for CF, as outlined above, are also those which are used for the monitoring and evaluation of nutrition status and care. The results obtained from routine assessments and reviews may trigger escalation to more detailed and focused assessments.

A systematic approach to nutritional monitoring/review, together with comparison with reference standards, previous assessments and nutritional targets for the individual, are essential to optimise nutrition outcomes and detect any decline in nutrition status over time.

The following sub-groups of people with CF are more likely to require more intensive monitoring and review:

- infants and young children during periods of rapid growth
- those at risk of or who have persistent undernutrition or overweight/obesity
- those requiring oral, enteral and parenteral nutrition support
- women who are pregnant or lactating
- those with known CF co-morbidities