Jacqui Lowden
Paediatric Dietitian - Team Leader Critical Care, Therapy & Dietetics, RMCH

Presently team leader for Critical Care and Burns, Jacqueline previously specialised in gastroenterology and cystic fibrosis. Although her career to date has focused on the acute sector, Jacqueline has a great interest in paediatric public health.

For full article references please email info@networkhealthgroup.co.uk

NUTRITION IN CYSTIC FIBROSIS: REQUIREMENTS AND RECOMMENDATIONS

Cystic Fibrosis (CF) is the most common life-threatening genetic disorder in Caucasians, with one in 4,750 live births being affected.[1] CF is defined by a gradual deterioration in lung function, intestinal malabsorption and resultantly, impaired nutritional status. As lung disease and nutritional status are closely related,[2] both are strong predictors of morbidity and mortality.[1,3,4] Jacqui Lowden examines the nutritional requirements.

Nutritional requirements in CF are well documented and variations exist between different guidelines. However, all of these guidelines are based on crude estimates.[5,6] Table 1 summarises present dietary recommendations. Due to the diversity amongst patients with CF, such as genotype, nutritional status, respiratory function, and existence of co-morbidities, it is becoming more and more difficult to recommend nutritional requirements for energy and protein that are all-embracing.

WHAT AFFECTS ENERGY AND PROTEIN REQUIREMENTS IN CF?

Many factors contribute towards poor nutritional status in CF, but there are three main contributors:

- increased energy expenditure, e.g. chest infections
- increased energy losses, e.g. mal-absorption
- infection-related anorexia

A negative energy balance can occur, due to a combination of malabsorption and increased energy requirements secondary to chronic infections.[8] A number of studies have also examined resting energy expenditure (REE) in CF. These studies have concluded that REE is consistently higher in CF individuals.[5,8,9,10]

One of the more recent studies[11] compared Pancreatic Sufficient (PS) patients with Pancreatic Insufficient (PI) patients and demonstrated a strong negative correlation between REE and pulmonary function in the CF PI group, whilst the CF PS group did not reach statistical significance. They found a significant correlation between REE and lean body mass, supporting previous studies.[12,13] They also found a significant correlation between REE and Shwachman clinical score. As the disease progresses, REE% increased as Shwachman score decreased.

Other factors which impact on REE are summarised in Table 2.

Table 1: Present dietary recommendations

Reference	Recommendations
UK CF Trust	120-150% Estimated Energy Intake (EAR) 200% Required Nutrient Intake protein
European CF Society	Normal energy requirements in presence of good lung function >120% EAR for malnourished individuals
CF Foundation	110-120% energy measured against standards for healthy population No protein recommendations

Table 2: Factors that impact on resting energy expenditure (REE)

Factor	Studies	Impact
Genotype	Fried et al 1991[14] Richards et al 2001[15]	No difference REE increased in class I, II, III
Disease severity	Dorlochter et al 2003[16]	Increased REE associated with low Shwachman score
Lung function (FEV1)	Dorlochter et al 2002[17]	Increased REE associated with low lung function
Gender	Allen et al 2003[18] Stallings et al 2005[19]	Females greater REE compared to controls than males Increases in females post menarche
IV antibiotics	Beghin et al 2003[20]	Increased REE post IVs, due to systematic inflammation causing an increase in REE
Cystic Fibrosis Related Diabetes (CFRD)	Ward et al 1999[21]	Decreased REE when recovering from exercise , which is increased in CFRD
Exercise	Richards et al 2001[22]	Increased REE associated increases energy cost of exercise
Nutritional status	Fuster et al 2007[23] Marin et al 2006[24]	Increased REE associated with lean body mass

It has been suggested that patients with CF may need up to 200% of the recommended daily caloric intake. These recommendations can be difficult to achieve, however, due to a number of other reasons, such as gastro-oesophageal reflux, abdominal pain and behavioural eating difficulties.[8,25]

OTHER CONSIDERATIONS

Social deprivation

A UK study examined the effect of social deprivation on clinical outcomes and the use of treatments in the UK CF population. Using the UK CF Registry, this longitudinal study found that children from the most deprived areas weighed less, had a lower BMI and were more likely to have chronic *Pseudomonas aeruginosa* infection and a lower %FEV1. After adjusting for disease severity, these children were more likely to receive intravenous antibiotics, nutritional treatments and less likely to receive inhaled antibiotic treatment, compared with children from the least deprived areas. In conclusion, children with CF from more disadvantaged areas had worse growth and lung function compared with children from more affluent areas.[26]

Drug therapy

There has been a recent breakthrough in the drug treatment of CF with the advent of 'precision medicines', which target particular CF mutations. The first drug of this kind KALYDECO (ivacaftor) is a CF Transmembrane conductance Regulator (CFTR) potentiator. It is indicated for the treatment of CF in patients age two years and older who have certain mutations in the *CFTR* gene. A statistically significant gain in body weight has been seen in patients receiving KALYDECO (ivacaftor) compared to patients treated with placebo.[27]

KALYDECO is a systemic CFTR modulator, which may also affect CFTR function in the gastrointestinal epithelia. This may contribute to improved absorption of nutrients. However, the mechanisms whereby changes in CFTR function may result in weight gain are, as yet, not completely understood and are probably multifactorial.

ARE WE ACHIEVING ADEQUATE GROWTH IN CF?

Over the years, improvements have been achieved in clinical outcomes for patients with CF. However, recent UK data is demonstrating a levelling off of BMI (Table 3).

Charts 1 and 2 show the median BMI of children and adults with CF in the UK. This data demonstrates that optimal growth and weight gain is still not being achieved and maintained. The targets of 50% median BMI percentile for children and BMI of 23 for adult males and 22 for adult females have been chosen as they have demonstrated better lung function at these levels.[28]

Table 3: UK CF Trust Registry data

	2007	2008	2009	2010	2011	2012
Median						
BMI kg/m2						
Adults	21.7	21.7	21.7	21.4	22	22
Median						
BMI centile						
children						
</= 17 years	53.3	51.7	51.1	52.2	53.8	52.7

Chart 1: The median Body Mass Index (BMI) percentiles in children and young people (<20 years) with CF (CF Trust Registry Report 2014)

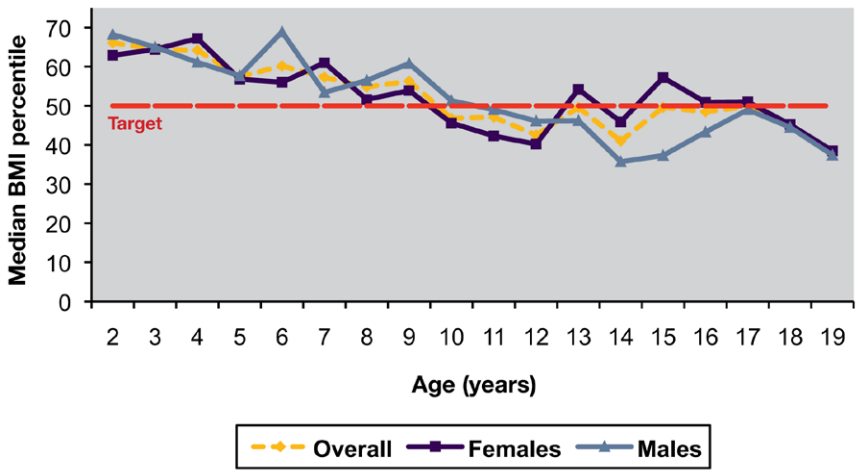
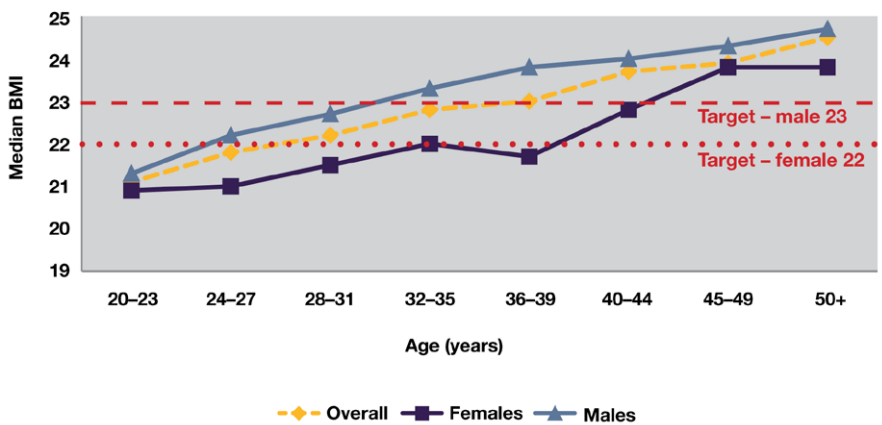
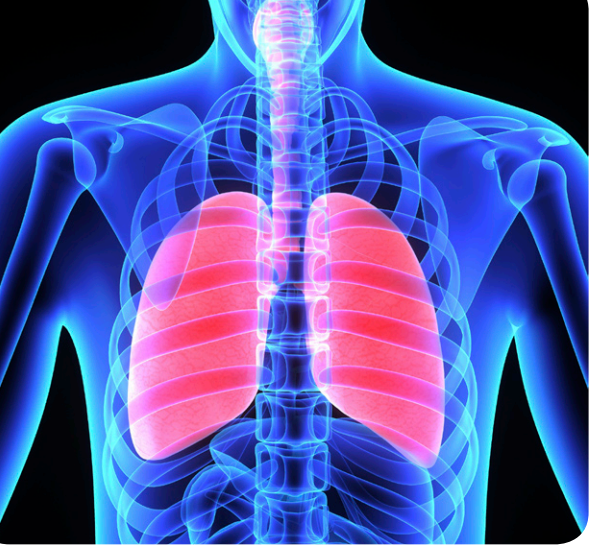


Chart 2: The median BMI of adults with CF aged 20 and over in relation to the target BMI for a healthy adult; 22 for women and 23 for men (CF Trust Registry Report 2014)





THE WAY FORWARD

Nutritional strategies

Dietary fortification, the use of nutritional supplements, maximising absorption, behavioural interventions and tube feeding are all strategies that have been employed to aid weight gain and growth in CF. Table 4 shows a breakdown of nutritional therapy data from the UK Cystic Fibrosis Registry 2014 .There is, however, a lack of good quality studies to assess the effectiveness of some of these strategies.

A recent systematic review has assessed the literature published after 1997, describing the effectiveness of nutritional interventions in patients with CF. Seventeen research articles were reviewed, focusing on behavioural interventions (n=6), oral supplementation (n=4) and enteral tube feeding (n=7). The latter intervention was universally successful at promoting weight gain. One behavioural study and two oral supplementation studies also reported significant weight gain. The review concluded that enteral tube feeding is effective to improve nutritional status, while the effects of behavioural intervention and oral supplementation are not sufficiently consistent at present. Additionally, enteral tube feeding is especially effective at improving the nutritional status in malnourished patients and slowing down further pulmonary function decline.[29]

Adherence

Non-adherence to treatments has always been a major challenge in CF, but data on the prevalence of non-adherence is limited. A recent systematic review concluded that methods on how to measure adherence are lacking and the quality of studies addressing adherence in CF is inadequate. Studies that use self-reported measures resulted in higher adherence scores than those that used objective measures. Due to these limitations, therefore, the prevalence of non-adherence remains unclear. The systematic review also concluded that, although adherence to a treatment program for CF is generally low, it also varies hugely depending on the type of treatment. The data, albeit limited, has indicated that nutritional therapy is at the lower end of adherence at 22% compared to 130% for oral antibiotics.[30]

CONCLUSION

With the increasing diversity amongst patients with CF, it is essential that each patient's nutritional status is monitored closely and individually assessed. Any changes made to their nutritional management will require to be monitored and adjusted, depending on outcome. A poor nutritional status can be reversed, unlike loss of pulmonary function. If we are to reverse this recent levelling off of nutritional status, it is crucial, that as dietitians, we care able to introduce more effective interventions individually tailored to our patients' needs.

Table 4: a breakdown of nutritional therapy data from the UK Cystic Fibrosis Registry 2014

	Overall (n=9432)	<16 years (n=3840)	≥16 years (5592)
Any supplemental feeding; n (%)	3214 (34.1)	857 (22.3)	2136 (38.2)
Nasogastric tube	114 (1.2)	12 (0.3)	102 (1.3)
Gastrostomy tube/Button	572 (6.1)	221 (5.8)	351 (6.3)
Jejunal	6 (0.1)	0	6
TPN	2	1	1

UK Cystic Fibrosis Registry 2014. Annual Data Report Published August 2015