



Commanders' Guide

Nutrition for Health and Performance

A Reference Guide for Commanders



Authors:
Paula Messer, Gail Owen and Anna Casey*
Contact details:
*Email: acasey@QinetiQ.com

Foreword

At a meeting to discuss military nutrition a couple of years ago, the Chairman quoted from a military report on nutrition dating from 1943. The report highlighted the strategic importance of adequate nutrition, and its important role, not just in safeguarding the health of the troops, but in maintaining morale. Moreover, it expressed a number of concerns that we continue to address sixty years on – the need to provide and to encourage troops to eat a balanced diet, the availability of nutritious food, menu fatigue, ethnic considerations, and the need to educate personnel at all levels about the role of nutrition. There was an urgent requirement, the disgruntled authors said, for a guide to nutrition.

Nowadays, it is not just the health of military personnel that is considered to benefit from adequate nutrition – as general health improves, attention has turned to the role of nutrition in performance. Arguably the most important aid to physical and mental performance is a balanced diet providing sufficient calories to meet daily energy expenditure. Diet should not be considered as a short-term quick fix solution to weight loss or gain, preparation for an event, or period of training. A well balanced diet should form part of the lifestyle of an individual, with small variations in the balance of certain nutrients in preparation for, and during recovery from, sustained and arduous exercises.

This guide is designed to teach you and your staff the basics of good nutrition, and to help you to identify how nutrition can help to improve both the physical and mental performance of you and your troops. We hope you find it useful.

EPAFF UK

The Expert Panel on Armed Forces Feeding UK (EPAFF UK) is a Tri Service MOD Panel led by the Defence Catering Group, that was created to support the MOD in setting the requirement for feeding the Armed Forces. It aims to provide expert guidance on meeting operational, nutritional and safety requirements, and on satisfying the practical, physiological, and quality demands of the consumer. It is also a forum in which the MOD can consult and communicate with the wider national and international food industry, and provide a ‘technology watch’ service.

Military Nutrition Advisory Service

The UK Defence Catering Group is providing a nutrition advisory service for UK military personnel.

For more information, and to access the service, go to:

www.feedingtheforces.com

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Section 1: What is Good Nutrition?

KEY POINTS

- Encourage troops to attend meals and enjoy their food
- Encourage a varied diet to ensure all nutrient requirements are met
- Educate troops on the importance of good nutrition
- Lead by example!



...Good nutrition is essential for achieving the very best physical and mental performance. It is also essential to good health.

BODY COMPOSITION

'YOU ARE WHAT YOU EAT'

A diet providing adequate carbohydrate, fat, protein, vitamins and minerals, fibre and fluid is essential for maintaining body composition and providing energy. Under or over consumption of any nutrient can be detrimental to health and performance, e.g. excess energy intake can lead to obesity, poor calcium intake can prevent sufficient bone formation, and too high a protein intake can lead to kidney failure.

The human body is composed as follows:

Substance	Male 20-24 years old; height 174cm; weight 70kg		Female 20-24 years old; height 163.8cm; weight 56.7kg	
	Weight (kg)	% Weight	Weight (kg)	% Weight
Fat	10.5	15	15.3	27
Muscle	31.3	45	20.4	36
Bone	10.4	15	6.8	12
Remainder	17.6	25	14.1	25

Body Composition of Males and Females (1)

NUTRIENTS ESSENTIAL FOR GOOD NUTRITION

Carbohydrate

The main function of carbohydrate in the diet is to supply energy. A relatively small amount of carbohydrate circulates in the blood in the form of glucose, for direct use by the body's cells (3%). Most carbohydrate is stored in the form of glycogen in the muscles (75%) or in the liver (22%). However, glycogen stores are relatively small and easily used up during exercise, and so a regular intake of carbohydrate is essential.

There are two types of carbohydrate: complex carbohydrates and simple carbohydrates. Complex carbohydrates release energy into the body slowly, whereas simple carbohydrates are an instant, but short-term energy source.

Fat

Fat is vital for health - but only in small amounts. It provides the essential fatty acids that are needed for tissue growth, cell membranes, hormone production and a healthy skin. It provides the fat-soluble vitamins A, D and E. Although fat is an important source of energy for light physical work, it is the most energy dense component of the diet, and a high intake of fat can lead to obesity and other health risks.

Protein

Protein is essential for the growth and repair of body tissues as well as supplying essential amino acids. Protein can also be broken down to provide energy in the absence of sufficient carbohydrate and fat. However, muscle tissue contains a large amount of protein, and a reliance on protein as an energy source leads to a loss of muscle mass.

Vitamins

Vitamins are essential to health, even though they are only needed in small amounts in the diet. They are required to help to break down food to provide energy for the body. Most vitamins need to be obtained from dietary sources, as the body is unable to synthesize them. Poor diet or failure to absorb vitamins from the gut (malabsorption syndromes) can lead to deficiencies.

Minerals

Minerals are required in varying amounts in the diet. They are essential for health and help to provide a continuous supply of energy to enable the brain and other organs to function properly, as well as maintaining body fluids. Adequate mineral intake can be achieved by eating a varied diet as different foods supply different and varying amounts of minerals.

N.B. Certain foods in the UK have extra vitamins and minerals added to them, such as calcium and iron. These foods are described as 'fortified'.

Fibre

Fibre is the indigestible part of a plant. Now known as 'non-starch polysaccharides', fibre is necessary to maintain a healthy gut and to prevent constipation. It can also help to lower blood cholesterol levels. The average intake should be 18grams per day (g/day). See Appendix 2 for the fibre content of foods.

Fluid

Seventy-five percent of the body is made up of fluids. To maintain this it is necessary to drink at least 8-10 glasses of water per day, although more than this will be needed during exercise. Inadequate fluid, leads to dehydration. Dehydration causes a large drop in physical performance, slows recovery and severe dehydration can be fatal.

A further Commanders' Guide within this series entitled 'Fluid Intake for Optimal Performance During Military Operations in the Heat' provides comprehensive advice on hydration (2).

DAILY NUTRITIONAL REQUIREMENTS

In 1991 the Committee on Medical Aspects of Food and Nutrition Policy (COMA) published estimated requirements for the general population of the UK - 'Dietary Reference Values for Food Energy and Nutrients for the United Kingdom' (3). Requirements vary with sex, age and health so the recommendations are based on various population groups within the UK.

This guide concentrates on the following population groups:

Male:	15 - 18 years	Female:	15 - 18 years
	19 - 50 years		19 - 50 years

To allow for individual variation within each of the above groups, a range of values is given for the intake of each nutrient; these are known as Dietary Reference Values (DRV). They include the following:

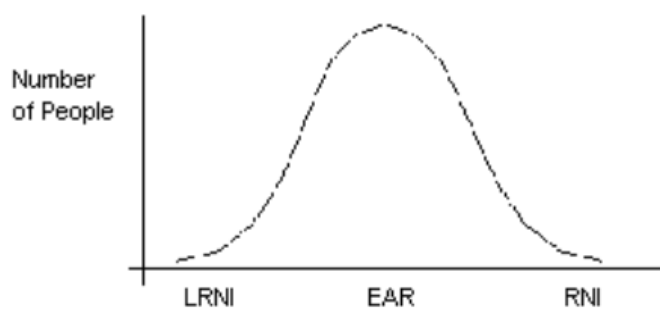
Estimated Average Requirement (EAR): This is the average requirement for energy or a nutrient; 50% of individuals will require more, 50% of individuals will require less.

Lower Reference Nutrient Intake (LRNI): this is the lowest recommended intake.

Reference Nutrient Intake (RNI): this is the amount of a nutrient that will meet the needs of most of the individuals within the group (97.5%).

Safe Intake: this is the recommended level where there is insufficient data to set an EAR, RNI or LRNI.

Dietary Reference Values



Individual Requirements

Daily Recommendations

Energy is essential to the maintenance of all functions of the body. For example, it is required for movement, breathing, digestion and temperature regulation. The main sources of energy in the diet are carbohydrate, fat and protein.

The table below shows the daily energy requirements, or the energy EAR, recommended for the general UK population.

Age Group	Males		Females	
	MJ	kcal	MJ	kcal
15-18 years	11.51	2755	8.83	2110
19-50 years	10.60	2550	8.10	1940

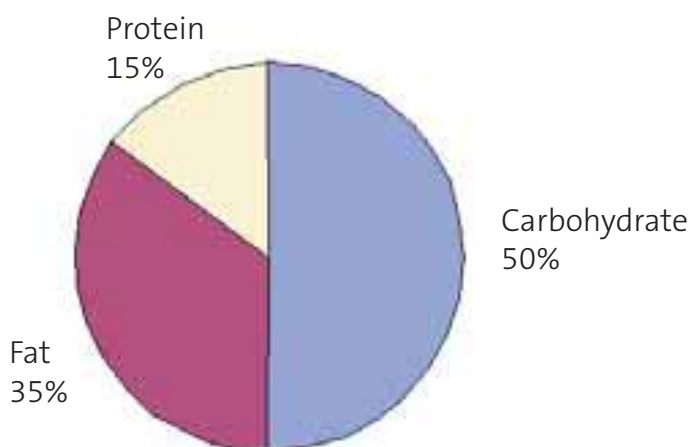
MJ (megajoules) ; kcal (kilocalories)

Extracted from (3), Table 1.1

Recommended Daily Nutrient Intake

Carbohydrate, protein, fat are energy providers within the diet. It is the percentage contribution of each of these nutrients to meeting the overall energy requirements of the body that is important to promote physical and mental performance, and good health.

For the general population, the COMA panel recommends:



Percentage energy contribution to diet, by nutrient

Energy intake:

A word of warning. It has become the norm to refer to percentages of energy intake (e.g. 50% carbohydrate). This is a good reference point, but it can be misleading for the following reasons:

50% energy intake does *not* mean 50% of food eaten:

This is because, weight for weight, carbohydrate (and protein) provides less energy than fat. One gram of carbohydrate supplies 17 kJ energy (4.1 kcal), whereas 1 gram of fat provides 39 kJ energy (9.3 kcal). For this reason, if daily energy intake is 12.5 MJ (1 MJ = 1000 kJ), which is about 3000 kcal, then 50% energy intake (6.25 MJ or 1500 kcal) equates to about 365g carbohydrate, but only about 160g fat. These figures are calculated by dividing the energy requirement by the energy yield of different foodstuffs (e.g. 1500 kcal / 4.1 kcal = 366g carbohydrate, or (6.25 MJ x 1000 = 6250 kJ) / 17 kJ = 368g carbohydrate).

The absolute amount of each type of food eaten is more important than the percentage:

From the example above you can see that the *amount* of each foodstuff (measured in grams) is dependent upon overall energy intake. For example, if carbohydrate intake is 45% of energy intake, and energy intake is 18.8 MJ (4500 kcal), this would equate to approximately 7g / kg body mass, or 495g, in a 70kg individual, which is sufficient to replace the carbohydrate used up during regular training. On the other hand, if energy intake is 8.4 MJ (2000 kcal), 45% of energy intake would equate to 3.1 g / kg body mass, or 220g, which is not sufficient to replace the carbohydrate used up, and is less than half the recommended intake for individuals undertaking regular physical training.

Calculating Individual Energy Requirements

The COMA panel recommendations for energy intake are the average requirements for the UK general population. If you wish to calculate your individual energy requirements you can do so by following the simple instructions below.

- i. Your energy requirement is found by multiplying your Basal Metabolic Rate (BMR), which is the energy required by the body to maintain its basic functions, by your Physical Activity Level (PAL). Your PAL is a score which estimates how active you are, based on the type of work and leisure activities you are involved in.



- ii. First calculate your basal metabolic rate using the table below. You will need to know your weight in kilograms. For instance, if you are a 23 year old male weighing 72kg, your BMR is equal to your weight (W) multiplied by 15.1 ($15.1 \times 72 = 1087$), added to 692 ($1087 + 692 = 1779$). Your BMR is 1779 kcal per day.

BMR Kcal/day		
Males	10-17 years	$BMR = 17.7W + 657$
	18-29 years	$BMR = 15.1W + 692$
	30-59 years	$BMR = 11.5W + 873$
Females	10-17 years	$BMR = 13.4W + 692$
	18-29 years	$BMR = 14.8W + 487$
	30-59 years	$BMR = 8.3W + 846$
W = body wt (kg)		
For conversion into MJ/day $MJ = \frac{kcal}{1000} \times 4.2$		

Table taken from (4)

- iii. Calculate your physical activity level (PAL) using Table 5 below. Decide on how active you are during your leisure time, either non-active, moderately active, or very active. Then look across the top row until you find the activity level which corresponds to your job, either low, medium or high. The number where your leisure activity level and job activity level intersect, is your PAL and is different for males and females. The general UK population is considered to have non-active leisure time and a light level of activity at work, giving a PAL of 1.4. However, you might find that your PAL is higher than this. For instance, you may be non-active outside of work, but have a moderate level activity at work, giving you a PAL of 1.6.
- iv. Using the example above, if you have a BMR of 1779 and a PAL of 1.6, your daily energy requirement is equal to 1779 multiplied by 1.6 ($1779 \times 1.6 = 2846$). You require a total of 2846 kcal per day to meet your energy requirements.

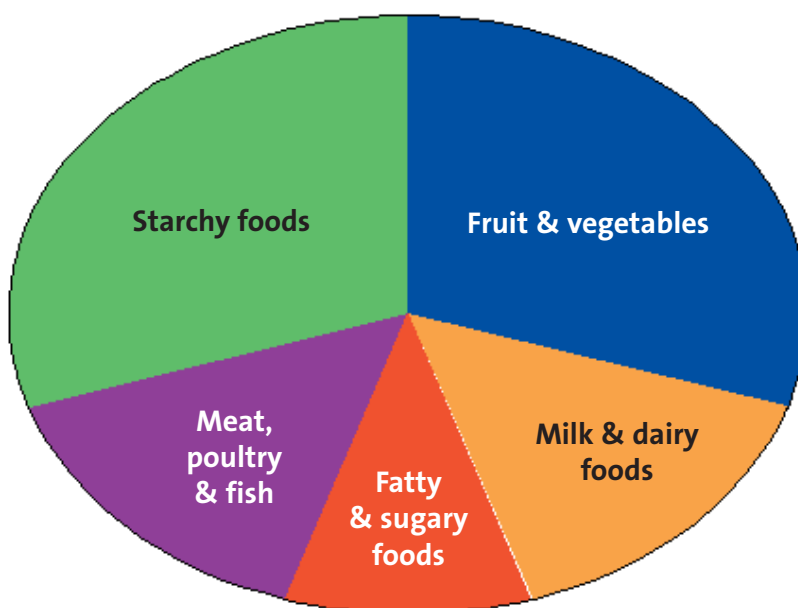
Leisure Activity	Activity at Work					
	Light		Moderate		Heavy	
Gender	Male	Female	Male	Female	Male	Female
Non-active	1.4	1.4	1.6	1.5	1.7	1.5
Moderately Active	1.5	1.5	1.7	1.6	1.8	1.6
Very Active	1.6	1.6	1.8	1.7	1.9	1.7

PAL during Occupational and Non-Occupational Activities Adapted from (3), Table 2.3

HOW TO ACHIEVE A BALANCED DIET

Balance of Good Health

The ‘Balance of Good Health’ plate model is a visual example of a balanced diet based on the COMA report (3). It shows how a balanced diet can be achieved, incorporating foods from each of the five principal food groups.



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One third of intake should be based on starchy foods which are a good source of complex carbohydrates. The foods below are all good sources of complex carbohydrates:

Bread, rolls, chapattis, breakfast cereals, oats, rice, pasta, noodles, potatoes, sweet potatoes, dishes made from maize, millet and cornmeal, plantains, green bananas, beans and lentils.

One third of intake should come from fruit and vegetables:

All fresh, frozen and canned fruit and vegetables, salad vegetables.

Almost one third of intake should come from protein foods (meat, fish and alternatives) and milk and dairy produce

Meat (beef, pork, bacon, lamb), poultry (chicken, turkey), fish (fresh, frozen and canned), fish products (fish fingers, fish cakes), offal (liver, kidney), eggs, beans and lentils, nuts and nut products, textured vegetable protein and other meat alternatives. This also includes meat products (sausages, beefburgers, meat pies), but you should be aware that these are often high in fat.

Dairy produce includes the following: milk, cheese, yoghurt and fromage frais.

Intake of fatty and sugary foods should be minimal and regarded as treats!

Butter, margarine, low fat spreads, cooking oils, mayonnaise and oily salad dressings.
Biscuits, cakes, puddings, ice cream, chocolate, sweets, crisps, sugar, sweetened drinks.

Tips for a Balanced Diet

These are some simple tips to help you eat a balanced diet. Each point is then described in detail.

- i. Consume a diet that is low in fat, especially saturated fat
- ii. Eat plenty of complex carbohydrates
- iii. Increase fibre intake
- iv. Avoid high sugar foods and drinks
- v. Eat a wide variety of fruit and vegetables – fresh or frozen
- vi. Limit alcohol consumption
- vii. Minimise salt consumption
- viii. Ensure adequate fluid intake
- ix. Read food labels



i. Consume a diet that is low in fat, especially saturated fat

- Fat is the most energy dense food there is, supplying 9 kcal per gram. A high intake of fat will therefore contribute to weight gain and obesity, and obesity-related diseases, e.g. heart disease and diabetes.
- There are two types of fat: saturated and unsaturated. There are then two types of unsaturated fat - monounsaturated and polyunsaturated.
- Personnel should be encouraged to have a low fat intake and when they do eat fat, to choose fats that are unsaturated (poly- and mono-unsaturated). A high intake of saturated fat can contribute to an increased risk of heart disease and raised fat levels in the blood.
- Saturated fats are usually solid at room temperature and they come from animal sources (except palm and coconut oil), e.g. lard, dripping, butter, cheese, cream, meat, palm oil, coconut oil.
- Polyunsaturated fats are usually liquid at room temperature and come from vegetable sources (except oily fish), e.g. vegetable oils (e.g. sunflower, corn), oily fish (e.g. mackerel, herring), seed oils (e.g. sesame), and nut oils.
- Monounsaturated fats are usually liquid at room temperature and are from vegetable sources e.g. olive oil, rapeseed oil, avocados.
- Hidden fats in foods are a major contributor to an overall high fat intake – the main sources of hidden fats are convenience foods and processed foods and snacks.
- Vending machines should contain lower fat alternatives.

- Be aware of hydrogenated fats. Fish and vegetable oils sometimes go through a manufacturing process called hydrogenation that makes them similar to saturated fats. These fats are often used in the manufacture of margarines and cooking fats and oils (you should always read the food label, see 9 below).
- Just because a product, such as margarine, is labelled 'low-fat' does not mean it can be used freely. Use the same amount of low-fat spread as you would use of the higher fat version.

WAYS TO DECREASE FAT INTAKE	
<p>REDUCE</p> <p>Full fat milk</p> <p>Hard cheese e.g. Cheddar, Red Leicester, Stilton, cream cheese spreads</p> <p>Butter, margarine, lard and all vegetable oils</p> <p>Cream, cream substitute</p> <p>Fatty meats (e.g. lamb) processed meats (e.g. sausages, pies, corned beef)</p> <p>Fried fish, battered fish and tinned fish in oil</p> <p>Salad cream, mayonnaise, vinaigrette</p> <p>Chips and roast potatoes</p> <p>Frying foods Nuts, crisps, savouries, pies, pastries, Yorkshire puddings, dumplings</p>	<p>TRY INSTEAD</p> <p>Semi- skimmed or skimmed milk</p> <p>Reduced fat Cheddar, Camembert, Brie, cottage cheese and low fat cheese</p> <p>Reduced fat spreads (e.g. Gold, Delight, Flora, Extra Light), and use vegetable oils sparingly</p> <p>Natural or diet yoghurt, diet fromage frais</p> <p>Lean meat (e.g beef with fat removed), skinless poultry (e.g. chicken) and pulses (e.g. lentils)</p> <p>Baked fish in breadcrumbs, poached or steamed fish, and fish tinned in brine, water, or tomato sauce</p> <p>Low fat or fat free versions</p> <p>Boiled, jacket, mashed or dry roasted potatoes</p> <p>Grill, dry roast, bake, poach or boil foods No lower fat alternative! Avoid or reduce intake of these foods</p>

ii. Eat plenty of complex carbohydrates

Complex carbohydrates are an excellent source of energy - they are broken down slowly and so energy is released slowly, but continuously. This enables blood glucose levels to be maintained. These foods should be eaten frequently throughout the day, especially if physical exercise and training are being undertaken. Complex carbohydrates include bread, rolls, chapattis, breakfast cereals, oats, rice, pasta, noodles, potatoes, sweet potatoes, dishes made from maize, millet and cornmeal, plantains, green bananas, beans and lentils.

iii. Increase fibre intake

Fibre is important as it keeps the gut healthy; low intake of fibre can cause constipation and increases the risk of cancers of the gastrointestinal tract. Sources of fibre include: wholemeal products e.g. bread and cereals, whole-wheat pasta, fruit, dried fruit, nuts, beans, pulses. See Appendix 2 for fibre content of foods.

WAYS TO INCREASE FIBRE

Increase intake of wholemeal and granary breads

High fibre breakfast cereals e.g. Shredded Wheat, Weetabix, Bran Flakes, Fruit and Fibre

Brown rice and whole-wheat pasta

All vegetables contain fibre - the best sources are peas and sweetcorn

Pulses are a good source - use more peas, beans and lentils in cooking

Eat the skins of fruits where possible (after washing the fruit thoroughly)

High fibre biscuits include digestives, Hob Nobs, oatcakes and bran biscuits

iv. Avoid high sugar food and drinks


Sugar is a simple carbohydrate and supplies 'empty' calories, i.e. it provides calories but has no other nutritional value. Frequent intake of these foods can lead to weight gain and obesity, and can lead to tooth decay if care is not taken. There are many low sugar/sugar free alternatives available and intake of these should be encouraged in favour of the higher sugar foods.



WAYS TO DECREASE SUGAR (SIMPLE CARBOHYDRATE) INTAKE	
<p>REDUCE</p> <p>Sugar</p> <p>Preserves</p> <p>Sugar coated breakfast cereals e.g. Frosties, Cocoa Pops, Sugar Puffs, Crunchy Nut Cornflakes</p> <p>Chocolate or cream filled biscuits and cakes, Crispbreads, melba toast, scones, crumpets and teacakes</p> <p>Ordinary squash, fizzy drinks & mixers</p> <p>Fruit canned in syrup</p> <p>Ordinary yoghurts and fromage frais</p> <p>Sweetened milk puddings and custard, puddings and pastries</p> <p>Jelly</p>	<p>TRY INSTEAD</p> <p>Artificial sweetener in tea, coffee, and cooking</p> <p>Pure fruit spreads, Marmite, Bovril</p> <p>Wholegrain cereals e.g. Weetabix, bran or oatflakes, Shredded Wheat , or All Bran</p> <p>Plain biscuits e.g. Digestive or Rich Tea</p> <p>Low-sugar or sugar free squash, drinks & mixers</p> <p>Fruit: fresh, stewed, frozen or canned in natural juice</p> <p>Diet fruit or plain yoghurt and fromage frais</p> <p>Reduced sugar milk puddings and custard - home-made or tinned</p> <p>Sugar free jelly</p>

v. Eat a wide variety of fruit and vegetables

It is recommended that you should aim for an intake of 5 portions of fruit and vegetables per day (400g per day)– fresh, frozen, dried or tinned. Fruit and vegetables contain anti-oxidant vitamins (A, C & E) which help protect against some cancers and heart disease.

<p>One portion is:</p> <ul style="list-style-type: none"> • single piece of a medium sized fruit e.g. apple, banana, orange • a cup of very small fruits such as grapes or raspberries • a couple of small fruit e.g. plums, apricots • half a grapefruit, a wedge of melon, a couple of rings of pineapple • 2-3 tablespoons of cooked or canned fruit • 1/2 - 1 tablespoon of dried fruits e.g. dates, sultanas, prunes, apricots • at least two heaped serving spoonfuls of raw, cooked, frozen or canned vegetables • bowl full of salad 	
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The Give Me 5 logo is reproduced with kind permission of the British Dietetic Association

vi. Limit alcohol consumption

Alcohol intake, for health reasons, should not exceed 21 units per week for females and no more than 28 units per week for males in the general population. One unit of alcohol is approximately equal to half a pint of beer or lager, one pub measure of spirits, or one standard glass (125ml) of wine. Sustained consumption above these levels can cause irreversible damage to the liver. Binge drinking, e.g. at weekends, should be strongly discouraged. Please note that this recommendation is for the general public. This level of alcohol intake is not recommended for military personnel undergoing arduous training and exercises.

Alcohol is very high in energy and can contribute to weight gain, obesity, and heart disease.

vii. Minimise salt intake

Due to our high intake of processed foods, our salt consumption is unnecessarily high. Salt is added to many convenience foods because it acts as a preservative and enhances the taste. Foods should not be cooked in salted water and the addition of salt to meals at the table should be reduced. A continual high consumption of salt can lead to hypertension.

viii. Ensure adequate fluid intake

Aim to drink at least 8-10 glasses of water per day, although more than this will be needed during exercise. This amount does not include tea, coffee, alcohol and other caffeinated drinks.

See 'Fluid and Physical Performance', page 20.

ix. Read food labels

It is a good idea to read food labels when you are buying foods. The food label usually gives information on ingredients, nutritional content and nutritional claims. The nutritional label can help you eat a well-balanced diet:

Nutritional values are usually given per 100g and per serving. You should read the amount 'per serving' as this shows the amount of fat, carbohydrate and protein etc. provided by the amount you actually eat.

Ingredients are listed in order of weight. The largest ingredient is listed first and the smallest ingredient is listed last. You should be aware that a single ingredient may be called many different things e.g. sugar may be listed as glucose, maltose, dextrose, or sucrose.

Nutritional claims such as 'low fat' and 'reduced sugar' can sometimes be misleading - it does not actually mean that they are low in fat and/or sugar.



A product labelled 'reduced fat' must contain 25% less fat than the full- fat brand, but a product labelled 'light' must contain 50% less fat than the full- fat brand.

As a rough guide:

- low fat food should have less than 5 grams (g) of fat per serving
- low sugar food should have less than 5 g of sugar per serving

An example of a typical food label is shown below:

Average Values	per 30g serving with 125ml of semi-skimmed milk	per 100g
Energy	728kJ 173 Calories	1571kJ 372 Calories
Protein	7g	9g
Carbohydrate of which sugars	26g 13g	66g 24g
Fat of which saturates	4.5g 2.9g	8g 4.5g
Fibre	2.3g	9g
Sodium	0.2g	0.5g
Vitamins & Minerals	%RNI	%RNI
Thiamin (B ₁)	0.4mg 29%	1.2mg 85%
Riboflavin (B ₂)	0.6mg 40%	1.4mg 85%
Niacin	4.7mg 26%	15.3mg 85%
Vitamin (B ₆)	0.6mg 29%	1.7mg 85%
Folic Acid	59µg 29%	170µg 85%
Vitamin (B ₁₂)	0.8µg 76%	0.9µg 85%
Pantothenic Acid	1.9mg 32%	5.1mg 85%
Iron	3.6mg 26%	11.9mg 85%
4.5g FAT 173 CALORIES		PER 30g SERVING WITH
APPROX 0.5g SALT		125ml SEMI-SKIMMED MILK

Information is provided 'by serving' or 'per 100g'. In the case of breakfast cereals, the amount per serving includes 125ml of semi-skimmed milk. If you use the 'per serving' information make sure you are not eating a bigger or smaller portion. Alternatively, use the 'per 100g' figure and calculate the relative proportions of nutrients.

For vitamins and minerals, the actual amount is shown in milligrams, as well as the percentage RNI that is provided by the product.

Because too much sugar or saturated fats can be harmful, these nutrients are listed separately.

Section 2: How does nutrition affect physical performance?



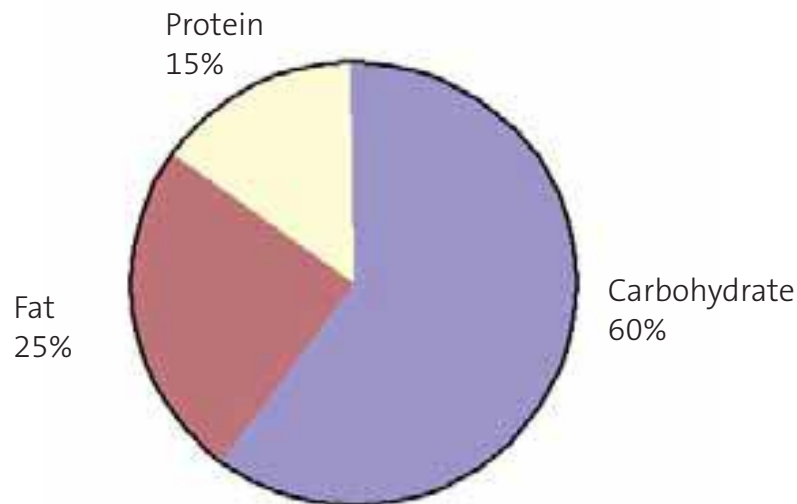
.....Good nutrition alone will not make an excellent athlete, but it will make a good athlete better.

- At any exercise intensity, carbohydrate is one of the main fuels for muscular work. **Low carbohydrate diets are not suitable for highly active military personnel**
- Encourage personnel to think about how much training they have done and how much they are going to be doing the next day
- The percentage contribution of carbohydrate to total energy intake should ideally be close to 60% in individuals engaged in regular physical training
- Encourage adequate carbohydrate and fluid consumption at all times
- Military operations often require sustained, physically arduous work. Requirements of personnel under these conditions are the same as those of an athlete
- Military operations undertaken in different climates present different nutritional problems
- Dietary supplements should be consumed with caution; they are not always necessary if a balanced diet is being consumed



ENERGY REQUIREMENTS

Energy requirements increase as the level of physical activity increases. It is important that these requirements are met through the correct mix of carbohydrate, protein and fat. Recommendations for athletes and anyone undertaking regular physical training are slightly different to the recommendations for a healthy diet in the general population.



Recommendations for the percentage energy contribution by nutrient in individuals undertaking regular physical exercise (5)

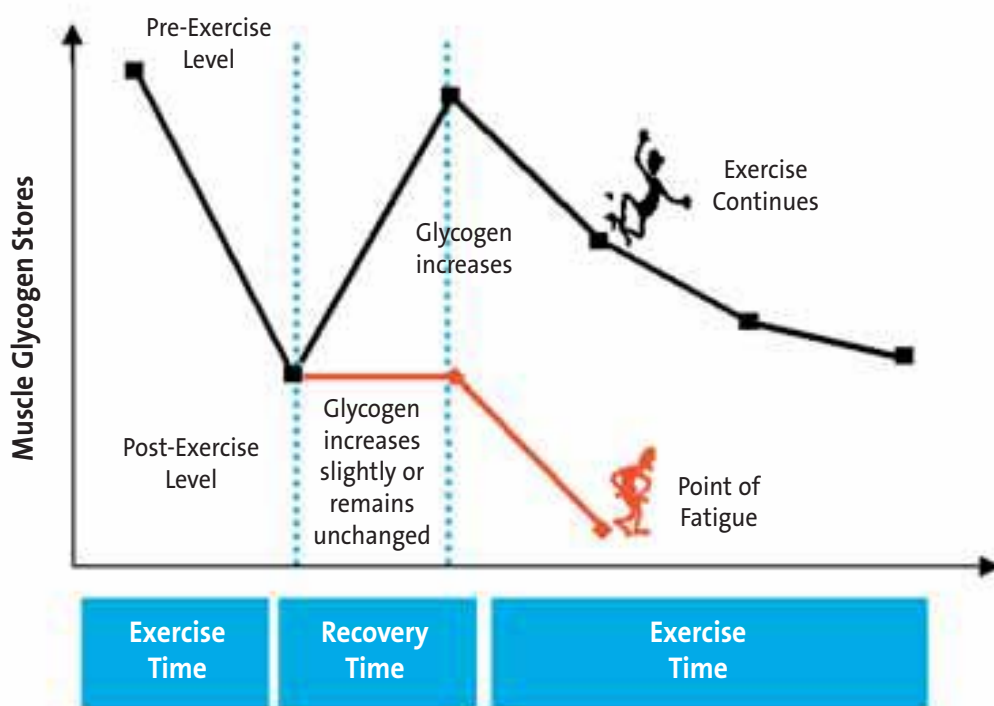
CARBOHYDRATE AND PHYSICAL PERFORMANCE

Carbohydrates are transported to muscles in the form of sugars, mainly glucose, which are delivered by the blood. These sugars are then used for energy production, or stored for future use in the form of glycogen (chains of glucose units). Glycogen stores are of critical importance to sustained exercise of any intensity; how much is stored determines endurance capacity - or sustainability. As the glycogen concentration declines there is a fall in the rate of energy production, and it becomes impossible to maintain the same level of exercise intensity, until glycogen stores are exhausted. Indeed, the resulting low blood sugar levels will not only prevent any useful physical work from being undertaken, but will also impair mental performance (see next section).

However, the ability to perform sustained exercise can be improved by increasing the size of the glycogen store by eating or drinking extra carbohydrate. Many studies have found a direct relationship between the pre-exercise muscle glycogen concentration and both endurance capacity (time to exhaustion) and endurance performance (time to complete a given distance). As muscle glycogen stores are depleted during exercise, the muscles depend to a greater extent upon glucose delivered by the blood.

Therefore, fatigue can be delayed during exercise by consuming simple carbohydrates (sugars). Ingestion of a carbohydrate-electrolyte drink, or carbohydrate alone, will help to sustain exercise, as well as to promote fluid uptake. There are many brands of these 'sports' drinks on the market (see 'Practical Recommendations') for further details.

Consumption of adequate carbohydrate in the first few hours after exercise is critical to recovery and will enhance performance during any subsequent work bouts (see Graph). Following heavy prolonged exercise, it is advisable to consume approximately 1g / kg body mass of carbohydrate (equivalent to approximately 80g, or 400 ml of a 20% carbohydrate solution) immediately after exercise and every 2 hours thereafter until mealtimes. In this situation a carbohydrate containing drink is preferable to solid food since it speeds up glucose delivery to the muscles and also begins the rehydration process. Meals should contain complex carbohydrates such as bread, rice, potatoes, cereals, pasta, etc.



Carbohydrate loading

Carbohydrate loading, in the form of short term supplementation of the normal diet with additional carbohydrate, is a common strategy used by athletes to increase glycogen stores prior to prolonged exercise, and one which has obvious military applications. In well-trained individuals, carbohydrate loading is only likely to confer a beneficial effect during exercises lasting more than 60 minutes. For exercises lasting less than 60 minutes, it is probably sufficient to simply taper training and continue eating a normal mixed diet (which should still be rich in carbohydrate). This strategy is likely to result in a substantial increase in muscle glycogen stores (6).

FLUID AND PHYSICAL PERFORMANCE



.....Drink before you feel thirsty

When should I drink more?

Drinking fluids is important when exercising in all weather conditions. However, in the **heat**, water is lost as sweat and must be replaced as often as possible. In the **cold**, you will still sweat during exercise, and breathing in cold, dry air will draw water out from your airways. If your clothing is inadequate and your body cools, you may lose water by urinating more often. Despite this, the cold will make you feel less thirsty.

The Urine Test

- Urine colour is a good indicator of hydration
- If you are well hydrated your urine will be light in colour and there will be lots of it!
- If you are dehydrated your urine will be darker in colour and there will be less of it!

HOW WILL I KNOW IF I AM DEHYDRATED?

- **Check the colour and amount of your urine**
- If you feel thirsty, you are already dehydrated
- Exercise will feel unusually hard
- Your skin may go redder
- You may feel lethargic, impatient or irritable
- You may develop a headache, and you may find it hard to concentrate

HOW WILL I KNOW IF OTHERS ARE DEHYDRATED?

- They may start to lag behind in training
- They may be irritable for no apparent reason
- If they are severely dehydrated, they will become confused and dizzy and their muscles may go into spasm

HOW DO I PREVENT DEHYDRATION?

- Drink plenty of cool fluids (water, hypotonic and isotonic sports drinks) before, during and after exercise
- Carry drinks when you can
- Use water coolers when you can
- Avoid fizzy drinks
- Avoid alcohol



NUTRITION AND MENTAL FUNCTION

The relationship between a healthy diet and physical performance is well established, but there is also evidence to suggest that eating the right foods can enhance mental performance. Glucose is the main fuel used by the brain, and mental performance is dependent upon maintaining an adequate glucose concentration in the blood. If the glucose concentration is allowed to fall below normal limits, attention, vigilance, memory, and both hearing and vision become impaired. Conversely, if a glucose supplement is given to individuals with a normal blood glucose concentration, memory and attention improve.

Carbohydrate is the main source of glucose in the diet, but it is difficult to compare the effects of high and low carbohydrate meals without also altering the proportion of fat and protein. The effects of carbohydrate vary with time of day. A breakfast high in carbohydrate and low in fat increases alertness and reduces fatigue during the morning, when compared to no breakfast, or to a breakfast high in fat. However, a meal at lunchtime which is particularly high in either carbohydrate or fat, will make an individual drowsy, and reduce performance on tests of mental function, when compared to a medium carbohydrate, medium fat meal.

The best way to maintain mental performance is to avoid large fluctuations in blood glucose. This is achieved by eating complex carbohydrates (see page 9) rather than simple carbohydrates. Since most carbohydrate is stored in the muscles, it is important to remember that prolonged exercise can cause the blood glucose concentration to fall below the limits required for normal mental function.

PRACTICAL RECOMMENDATIONS

BEFORE PHYSICAL TRAINING

- Consuming 25-50 grams (g) of carbohydrate (depending on individual tolerance) less than 30 minutes before training improves exercise performance
- 25g carbohydrate =
 - 1 large banana
 - 400ml isotonic sports drink (about 6% carbohydrate)
 - 1 slice bread with 1 tablespoon jam
 - 1 low fat cereal or fruit bar

DURING PHYSICAL TRAINING

- If exercising for more than 90 minutes, consumption of 50-60g carbohydrate per hour in either solid or liquid form during exercise helps to maintain blood sugar levels and delay glycogen depletion
- 60g carbohydrate =
 - 1000ml isotonic sports drink (6% carbohydrate)
 - 1000ml diluted fruit juice (1:1)
 - 2 x energy bar (e.g. Power bar)
 - 100g chocolate bar
 - 3 handfuls dried fruit

IMMEDIATELY AFTER PHYSICAL TRAINING

- In the first two hours after exercise, glycogen is restored at a faster rate than normal
- Eat or drink carbohydrate as soon as possible after exercise to ensure maximum refuelling
- Aim to consume 1g carbohydrate per kg body weight e.g. 70 kg male will require 70g carbohydrate

POST ACTIVITY MEALS

- It takes at about 24 hours to fully replenish carbohydrate stores after exercise
- Meals should be based on complex carbohydrates to ensure complete muscle glycogen re-synthesis



PROTEIN REQUIREMENTS AND PHYSICAL PERFORMANCE

The average person in the UK consumes more protein than his/her body requires. Protein is required for the growth and repair of tissues, and excess protein is metabolised and excreted. By increasing the overall energy content of the diet to meet the energy demands of physical exercise, you will automatically increase the amount of protein you eat therefore meeting the increased protein requirement. There is no need for protein supplements in the diet; an intake of greater than 2g protein per kg bodyweight is of no benefit - it is more important that carbohydrate requirements are met.

	Protein Requirements /kg body weight per day
Sedentary Person	0.75g
Endurance Athlete	1.2g - 1.4g
Strength Athlete	1.4g - 1.7g

Glycogen and fat are the energy providers during exercise. Muscle protein will be used as an energy source if glycogen stores are very low, thereby preventing protein from maintaining or increasing muscle mass. To prevent this occurring, it is essential that adequate carbohydrate is consumed to keep glycogen stores topped up.

OPERATIONAL APPLICATIONS

The potential for enhancing endurance exercise performance with carbohydrate is greatest in those operations that involve moderate to high intensity physical work which is sustained over two hours or more. The heavier the workload, or the longer the operation, the greater is the need for supplementary carbohydrate in the diet.

The following procedures are recommended by the Technical Cooperation Program Group HUM: Human Resources and Performance, Technical Panel 8: Physical and Cognitive Performance Enhancement for Conventional and Special Operations [7].

If carbohydrate/electrolyte solutions are not available, then solids such as energy bars should be consumed with water. If frequent consumption of carbohydrate during operational exercise is not possible, then it is important to eat high-carbohydrate meals as soon as the situation allows (see Practical Recommendations).

Immediately After Operational Exercise:

Consumption of carbohydrate immediately after arduous activity is recommended - preferably within 30 minutes, to promote replenishment of muscle and liver glycogen stores. One gram of carbohydrate per kg of body weight is recommended. A carbohydrate-containing drink is preferable to solids as it speeds up delivery of glucose to the liver and muscles and begins the rehydration process. Drinks containing approximately 20% carbohydrate (20g per 100ml) are preferred for replenishment of body glycogen stores, but any amount of carbohydrate is better than none.

Post-Activity Meals:

Meals should be based on complex carbohydrates to ensure that muscle glycogen is completely restored.

NUTRITIONAL REQUIREMENTS FOR MILITARY OPERATIONS IN EXTREME ENVIRONMENTS

Exposure to extreme environments may impair military performance, threaten the health of personnel and, in some circumstances, pose a threat to life. Severe cold stress, for example, is encountered not only in regions with sub-zero air temperatures, but is frequently experienced within North-West Europe when above-freezing temperatures are combined with wind and rain. Personnel working under these conditions are at risk from local cold injury, physical exhaustion, and a fall in deep-body temperature which, untreated, may lead to hypothermia. Likewise, hot conditions are routinely encountered by UK land forces undertaking field exercises and during deployments (e.g Iraq, Sierra Leone). Recent operations have involved the Marines working at altitudes of 10,000 feet and above where both cold and a lack of oxygen are encountered.

Nutrition in Hot Environments

There is no evidence that individuals living and working in temperatures of 30°C – 40°C (86°F- 104°F) require more energy than they would in temperate climates. Non-essential activities are generally kept to a minimum because of the heat, thereby keeping the energy requirement down. Even in temperate climates, it is known that soldiers in the field can reduce their food intake by up to 40%, and this can lead to weight loss and significant impairment of both physical and mental performance.

Adequate food intake should be encouraged to ensure enough sodium is being consumed. Sodium is lost in sweat and needs to be replaced, as deficiency can lead to dehydration, nausea or vomiting and muscle cramps.

In situations where a degree of dehydration is inevitable, foods which are high in protein, and those which stimulate urine production, such as alcohol and caffeine containing products (notably tea, coffee and some commercially available drinks (e.g. Red Bull), should be avoided.

Nutrition in Cold Environments

It has been found that energy expenditure increases in the cold. This is for two reasons. Increased shivering, due to inadequate clothing, can increase energy expenditure by 100% if at rest. If the individual is active, the increase in energy expenditure lessens i.e. 50% increase in energy expenditure when walking.

Energy requirements can also increase if the individual is adequately clothed! It is a combination of the weight of the clothing and equipment, the difficulties of travelling across snow and ice, and working in frozen conditions, that results in an increased energy expenditure.

It is important that the percentage contribution of energy from carbohydrate to total energy remains high to ensure muscle and liver carbohydrate stores are maintained. If these stores are allowed to become depleted over a couple of days, because of inadequate carbohydrate and energy consumption, physical performance will deteriorate.

Difficulties are often encountered in the preparation and serving of foods in cold climates, which can in itself lead to a reduced intake.



Nutrition at High Altitudes

An increased energy intake is required at high altitudes. This is due to the cold and the physical demands of the terrain encountered at altitude. Reliance on carbohydrate as an energy source is even greater at altitude. Under the conditions of reduced oxygen levels, carbohydrate is the more efficient fuel compared to fat and protein. Sufficient carbohydrate consumption is therefore vital.

Also, the capacity for work is reduced at altitude. Consequently, more effort is required at altitude to achieve the same level of work that would be required at sea level, increasing the demand for energy. Total energy contribution from carbohydrate increases as altitude increases (7).

The reduced oxygen also has the effect of suppressing appetite, and altering the taste of food, which influences food preferences. Preparation and cooking of palatable foods at altitude are also difficult. Weight loss is inevitable for those involved in high altitude operations (8).

NUTRITIONAL SUPPLEMENTS

ENERGY DRINKS

Sports drinks are a good way to replace fluid and provide energy before, during or after exercise. You should choose an isotonic sports drink that has about 6- 8 grams (g) carbohydrate per 100ml (find out by reading the label).

These drinks are especially suitable because they generally taste nice when you are exercising, they can be consumed quickly, and the fluid and the carbohydrate they contain are readily absorbed into the body. You may find that these drinks contain different types of carbohydrate such as glucose, fructose, sucrose, and/or glucose polymers. The type of carbohydrate is not very important, although fructose-only drinks should be avoided as they can cause stomach upsets. A drink containing 6% carbohydrate (6g carbohydrate per 100ml) will optimise hydration whilst providing some energy. Concentrations greater than 7 – 8 % will begin to slow fluid uptake by the body but will provide a greater amount of energy. These are not recommended if fluid replacement is a priority, e.g. if personnel are required to begin exercising again in a hot environment.

ENERGY BARS

Sports bars and muesli bars are convenient sources of energy, but it is important to read the labels to find out which nutrient is supplying most of the energy. Many of the bars available are very high in fat and will therefore not help to maintain carbohydrate stores whilst exercising.

PROTEIN DRINKS AND BARS

Protein supplements are not necessary if a balanced diet is being consumed. A high intake of protein over a long period of time can cause liver and kidney problems.

VITAMIN AND MINERAL SUPPLEMENTS

Requirements for vitamin and minerals are increased with exercise. These requirements will be met if food intake is increased to meet energy demands, as more vitamins and minerals will also be consumed. A vitamin and mineral intake above the requirement does not further improve physical performance and, in some cases, can actually be detrimental. Those who are at risk of vitamin or mineral deficiencies, e.g. vegetarians, strict dieters, erratic eaters, smokers, pregnant women, and those with food allergies, should have their diet assessed to determine whether vitamin and mineral supplementation is necessary.



PHYSICAL PERFORMANCE AND WEIGHT CONTROL

'Dieting', in terms of relatively short term, and often drastic, changes to the normal diet, is discouraged as a means of weight loss. There is a great deal of evidence to suggest that, although there may be appreciable short term weight loss, this loss is rarely maintained. When personnel return to eating normally, their weight returns to the same level, or even higher, as the body compensates for the period of food restriction. This approach can also severely affect physical performance, and is not recommended in military personnel.

Weight loss and / or a reduction in body fat is best achieved and maintained by a combination of i) longer-term changes to the normal diet, e.g. a reduction in snacking between meals, consumption of convenience / fast foods, and an overall reduction in fat intake, and ii) an increase in low-intensity, sustained exercise. During this type of exercise, fat is burned right from the beginning, along with carbohydrate. Moreover, the contribution of fat to total energy expenditure increases with exercise duration. This is why it is better to exercise for longer at a lower intensity in order to lose weight, i.e. soldiers should exercise longer rather than harder. The harder the exercise, e.g. the faster one runs, the greater the contribution of carbohydrate to overall energy expenditure.

Section 3: How does good nutrition promote good health?

KEY POINTS

- Aim for ideal body weight
- Females are at particular risk of iron and calcium deficiency; encourage intake of appropriate foods to reduce the risk
- Weight gain and obesity predisposes individuals to increased risk of heart disease, high blood pressure, diabetes, respiratory disorders, gall bladder disease, and infertility
- Malnourishment is not always recognisable – especially in those individuals who are overweight
- Education of personnel regarding the importance of good nutrition is essential

DISEASE PREVENTION

Good nutrition is important to maintain the normal functions of the body: breathing, temperature regulation, immune function, skeletal muscle function, mood and motivation. Diets that are deficient in, or in excess of, one or more required nutrients can be either directly or indirectly detrimental to health. Service personnel should be educated on the importance of good nutrition in relation to disease, and although the younger personnel may not feel it is pertinent to them at their stage of life, they should at least be made aware of the health consequences of poor nutrition. Any personnel with nutritional health concerns should be encouraged to pursue their query, via their Medical Centre.

The table below compares the COMA panel and the American College of Sports Medicine (ACSM) recommendations for percentage contribution of carbohydrate, fat and protein to total energy intake for the general population, with actual intake in the UK in the year 2000 (9), and current intake of Army Recruits in Phase One Training (10).



	COMA Recommendations for the general UK population	ACSM recommendations for individuals undertaking regular physical exercise	UK Actual Intake (9)	Army Phase 1 recruits (10)
Carbohydrate	50	60	47	45
Fat	35	25	38	42
Protein	15	15	12	13

The recruits’ diet does not meet either COMA or ACSM recommendations for a healthy diet (3; 5), therefore putting them at an increased risk of ill health.

Body Mass Index (BMI)

Calculating BMI is a useful way of monitoring whether you are at a healthy weight. This can be done by following the example below. You will need to know your weight in kilograms and your height in metres.

$$BMI = \frac{\text{Weight (kg)}}{\text{Height}^2 \text{ (m)}}$$

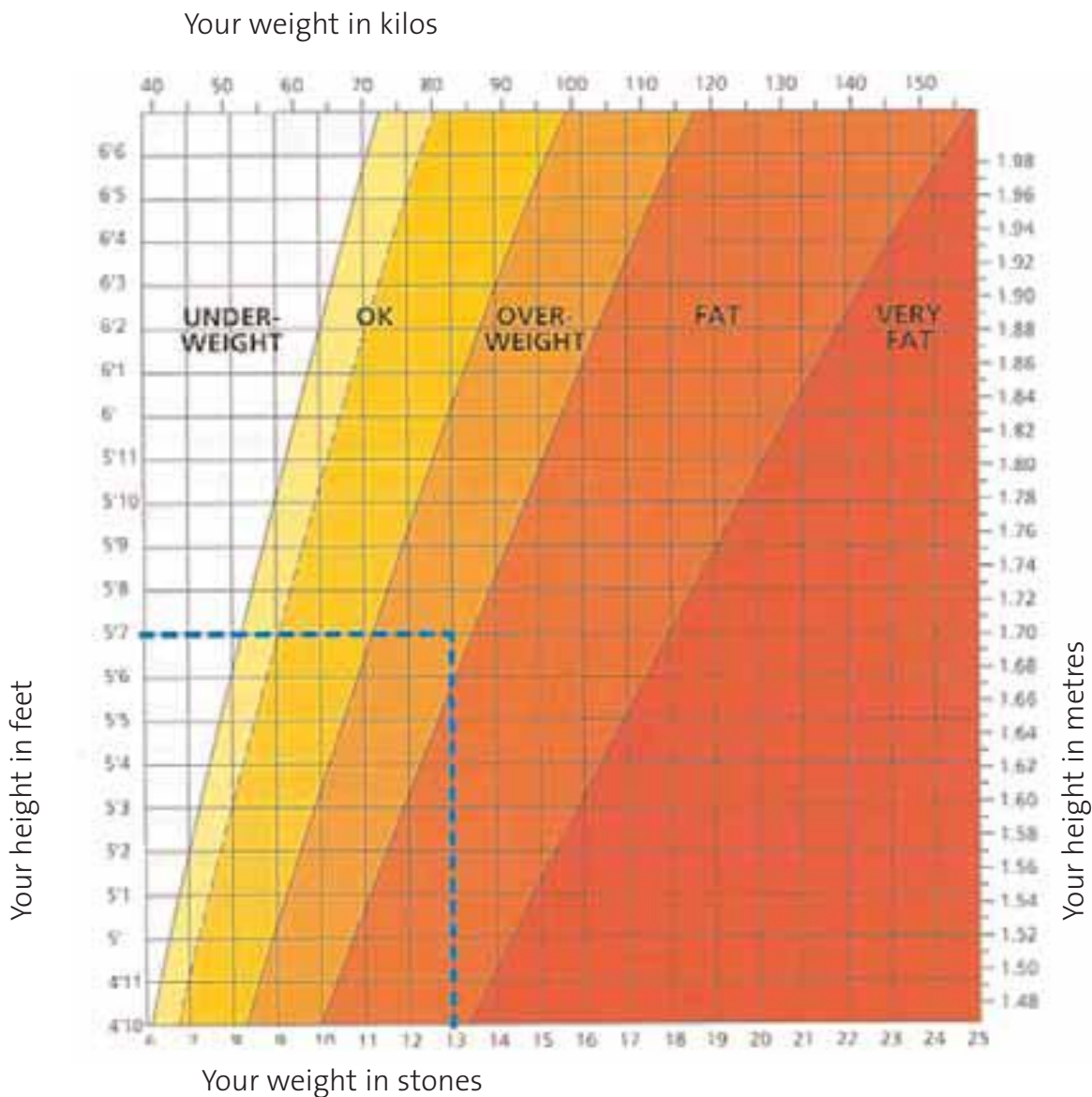
- Your BMI is equal to your weight in kilograms, divided by your height in metres squared (height in metres x height in metres).
- For instance, if you weigh 82kg and are 1.72m (172 cm) tall, your BMI is equal to

$$\frac{82}{1.72 \times 1.72} = \frac{82}{2.96} = 27.7$$

BMI	Classification
<18.5	Underweight
18.5 - 24.9	Healthy Weight
25.0 - 29.9	Overweight (Grade 1 Obesity)
30.0 - 39.9	Obese (Grade II Obesity)
>40.0	Morbidly/Severely Obese (Grade III Obesity)

World Health Organisation; Classification of Obesity by Body Mass Index (11)-

This information is also available in chart form.



Are you a healthy weight for your height?

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BMI is not an absolute measure of obesity and should be used with caution. Athletes may find that they fall into the 'overweight' category - when this is obviously not the case because they have a high lean body mass and low body fat. However, BMI is a good indicator for underweight individuals and, consequently, those at risk of malnutrition. If your BMI is between 18.5 and 25 kg/m², you are at less risk of becoming ill or dying prematurely (12).

NUTRITION RELATED MEDICAL CONDITIONS

OBESITY

It is well known that obesity is on the increase in Britain. In 1998, the number of male and female adults classed as 'obese' was 17% and 21% respectively (13). There are no statistics held on obesity within the UK Military, but this is not because there aren't any obese Service Personnel! Obesity occurs when energy intake is greater than energy output. An individual's Basal Metabolic Rate (BMR) and Physical Activity Level (PAL) (see section 1 - Calculating Individual Energy Requirements) determine energy output. Obesity increases the risk of heart disease, hypertension, diabetes, respiratory disorders, back pain and joint pain.

'Tips for a Balanced Diet' (Section 1) should be followed to help to reduce weight, aiming to lose 0.5kg - 1kg weight per week. Dieting should be discouraged. Personnel who do have a severe weight problem should be referred to a qualified dietician through their Medical Officer.

Diabetes

What is it?

Raised blood glucose levels.

Treatment:

Diet alone, diet and oral medication, diet and insulin therapy.

Dietary Intervention:

Reduction of simple carbohydrates, adequate intake of complex carbohydrate, and reduction of fat intake. Weight loss is encouraged in the overweight person.

Service personnel with diabetes need to be under the care of a Medical Officer. Dietary intervention is essential and referral to a dietician for individual dietary advice is strongly advised.

Raised Lipid Levels

What are they?

High levels of fat (cholesterol or triglycerides) in the blood.

Treatment:

Diet or a combination of diet and drug therapy.

Dietary Intervention:

Reduction of fat or a combination of fat, sugar and alcohol in the diet. Consumption of saturated fat should be kept to a minimum.

Coeliac Disease

What is it?

An intolerance to gluten.

Treatment:

Diet.

Dietary Intervention:

Avoidance of all gluten-containing foods and products. Gluten is found in wheat, barley, rye and oats. Gluten-free foods are available on prescription. Coeliac disease is medically diagnosed by a blood test and a jejunal biopsy. Referral to a dietician is crucial to ensure the individual has a balanced diet.

Food Allergies and Intolerances

What is it? Food Allergy - abnormal immune response to certain foods.
Food Intolerance - reproducible, unpleasant reaction to a food.

Treatment: Diet with or without medication.

Dietary Intervention: Avoidance of the food(s) that initiate a reaction. Allergies and intolerances are diagnosed by blood tests, skin tests, elimination diets, and controlled food trials carried out by Medical staff.
Reactions can range from mild, e.g. a rash, to anaphylactic shock - which can be fatal. Those who have extreme reactions should carry medication (adrenaline) with them at all times.
Common allergies and intolerances include: gluten, wheat, dairy, fish, soya, egg, nuts, shellfish, sesame.

Many individuals claim to have food allergies and intolerances based on the fact that they feel better when this food element is removed from their diet. This is known as 'food aversion', as the avoidance and intolerance of specific foods is psychological. Up to 20% of the population in the UK feel they have a food allergy or intolerance; in fact, 1-2% adults have a true food intolerance and <1% have a correctly diagnosed food allergy (14).

Constipation

What is it? Formation of hard stools which are difficult to pass.

Treatment: Diet and/or bulk-forming preparations and laxatives.

Dietary Intervention: Increase of dietary fibre (of cereal and vegetable origin) in the diet. Fluid intake should also be increased.

Irritable Bowel Syndrome

What is it? Gastrointestinal disturbances - varying in type and severity.

Treatment: Diet and/or bulking agents, laxatives and anti-spasmodics.

Dietary Intervention: Depends on symptoms reported, e.g. low residue or high fibre diets.

MALNUTRITION

Certain groups within the population are at risk of malnutrition: adolescents, vegetarians/vegans, individuals from cultural minorities, and individuals from lower socio-economic groups.



Malnutrition occurs when the diet is deficient in one or more nutrients over a period of time, resulting in a clinical deficiency within the body which can be detrimental to physical and mental health.

Adolescents

Growth spurts in adolescents result in an increased requirement for nutrients, which must be met. Along with these physical changes are a number of psychological changes. Work patterns and social pressures can result in changes in dietary intake and eating patterns, which can be detrimental to health. These include strict dieting, becoming vegetarian/vegan, purporting to have food allergies or intolerances, and developing a heavy reliance on fast/convenience foods.

Many recruits will be adolescents and their dietary requirements must be met. The growth spurt is usually accompanied by an increase in appetite, and the subsequent increase in food consumption usually meets the increased requirement. However, studies undertaken on the energy intake and energy expenditure of UK military recruits (e.g. 9) have shown that there is often an imbalance, due to factors such as insufficient food availability, inadequate time to eat, lack of education, and menu fatigue.

This issue of meeting the nutritional needs of adolescents is currently being addressed by MOD, e.g. assessment of the energy and nutrient requirements of Army recruits undergoing basic training, the introduction of the equivalent of a fourth meal, and assessment of the nutritional requirements of Officer Cadets. Young recruits provide a good opportunity to stress the importance of a balanced diet and to encourage the development of good eating habits. Experience suggests that nutritional advice is most likely to be accepted if it addresses the immediate concerns of recruits, i.e. meeting physical performance criteria, rather than longer term aims, e.g. health. Education should therefore emphasise the link between nutrition and physical performance and, in females at least, possible links to injury. Of course, an additional benefit is that advice given now will also help to prevent ill health in later years.

Vegetarians

If meat and animal products are eliminated from the diet and not replaced with suitable alternatives, nutritional deficiencies can occur. Common deficiencies are protein, iron, calcium and vitamin B12. B12 is an important vitamin involved in the formation of red blood cells and the production of energy, and a lack of B12 contributes to anaemia.

Alternative sources of protein include: eggs, milk, cheeses, yoghurt, soya beans, soya products, lentils, chick peas, baked beans, nuts, and oats.



Sources of iron include: eggs, fortified breakfast cereals, dark green leafy vegetables, pulses, dried fruit, breads made with wholemeal flour, nuts and seeds.

Sources of calcium include: milk, cheese, yoghurt, fromage frais, fortified cereals and bread, dried apricots, spinach, kale, nuts, sesame seeds, fortified soya milk and tofu.

See Appendix 3 for calcium content of foods.

Vitamin C helps with the absorption of iron and, therefore, sources of vitamin C should be eaten or drunk at each meal e.g. citrus fruit and their juices, other fruits e.g. raspberries, strawberries, blackcurrants, melon, pineapple, mangoes, pears, peaches, bananas, and all types of vegetables.

Sources of B12 include: fortified soya milks, fortified breakfast cereals, dairy foods, eggs, yeast extracts, e.g. Marmite, Vegemite.

Cultural Minorities

Individuals from cultural minorities may be at risk of malnutrition. Due to their religious beliefs and background, they may avoid foods provided at meal times because they do not know:

- how the food has been prepared
- how the food has been cooked
- the ingredients used within a composite dish

To eliminate this problem, the individual should make him/herself known to the Catering Manager.

Eating Disorders

Eating disorders are common in young females, although the incidence in young males is rising. Adolescence is a time of major transition and establishment of individual identity. Those with eating disorders feel their self-worth is dependent upon their shape and weight. This need for perfection is magnified through the exercise and fitness environment, as an individual who is slightly overweight will be perceived to be unfit. Peer pressure amongst such groups is very common.

Staff should be aware of the following signs:

- Anorexia nervosa: mood swings, denial, thinness, fad eating, excessive exercise/activity, poor sleep
- Bulimia nervosa: mood swings, problems concentrating, low self esteem, teeth abrasion, avoids eating with others.

Individuals with eating disorders are at great nutritional risk - professional psychiatric help should be sought.

Socio - Economic Groups

Anecdotal evidence suggests that most new recruits are from socio-economic classes IV and V (15). It is known that those from these classes are less likely to eat fresh fruit and vegetables than those from the higher socio-economic classes. They are also less likely to drink skimmed or semi-skimmed milk. Poor fresh fruit, vegetable and dairy consumption was cause for concern in a recent study on UK army recruits (10). Diet also varies from region to region. For instance, males who live in the north tend to eat less fruit and vegetables and to drink more than the recommended amount of alcohol than males who live in the south (16). Poor intake of fruit and vegetables can lead to deficiencies in vitamins, minerals and fibre.

Lack of knowledge regarding nutrition leads to misconceptions regarding the basis on which inappropriate/inadequate diets are consumed. In a recent study (17), recruits were given four meals a day in order to meet their energy requirements, as a previous study had shown them to be in negative energy balance (10). It was noted that female recruits expressed concern at having to attend 4 meals per day, as they felt that this would lead to an increase in weight. Yet they did not associate the consumption of generally high fat, low-nutrient snacks, consumed in between meals, with weight gain. They had no conception that the snacks were higher in energy content than the fourth meal itself. Education of troops on the importance of good nutrition is absolutely vital.

COMMON DIETARY DEFICIENCIES

Calcium

Calcium is the main constituent of bones and teeth. Calcium intake is important during adolescence as it is required for the growth of bones and to increase bone density. Peak bone mass (PBM), reached at 30-35 years old, is important for the prevention of osteopenia (low bone mineral density) and the more serious osteoporosis (brittle bone disease). Calcium intake is critical in achieving PBM and maintaining bone density and strength. Osteoporosis is most common in middle aged women but can also occur in men or young individuals. Low bone mass is associated with an increased risk of injury: see section on Malnutrition and Musculoskeletal Injuries.

Calcium containing foods include: cow's milk (full-cream, semi-skimmed, skimmed); cheese (except cottage cheese and cream cheese); yoghurt, fromage frais; bread (white flour is fortified with calcium); breakfast cereals fortified with calcium (check label); nuts, sesame seeds, dried apricots, spinach; pilchards, sardines; fortified soya milk, and tofu.

See Appendix 3 for the calcium content of foods.

Iron

Iron is required to transport oxygen around the body. It also plays an important role in metabolism. Inadequate intake of iron can result in iron-deficiency anaemia. This results in a decrease in physical performance. Anaemia develops slowly and individuals find it harder to maintain their usual level of physical activity. Females are at particular risk as they have a higher requirement for iron due to menstrual bleeding.

Common symptoms of anaemia are: general fatigue, breathlessness on exertion, giddiness, headache, insomnia, abnormally pale skin, palpitations, and pins and needles in the fingers and toes. One study suggests that male recruits achieve the RNI for the average UK individual (16), but others have reported inadequate iron intake by female military recruits (18).

Iron containing foods include: all types of meat, offal e.g. liver, kidney, heart, black pudding, pate, faggots, oily fish, eggs, fortified breakfast cereals, dark green leafy vegetables, pulses, dried fruit, breads made with wholemeal flour, nuts and seeds.

Vitamin C helps with the absorption of iron, and therefore, sources of vitamin C should be eaten or drunk at each meal, e.g. citrus fruits and their juices, other fruits e.g. raspberries, strawberries, blackcurrants, melon, pineapple, mangoes, pears, peaches, bananas, and all types of vegetables.

Tea and coffee should not be drunk with meals as they inhibit the absorption of iron.

Folate

All women of child-bearing age who may become pregnant are recommended to consume at least 400 micrograms (μg) of folate per day to minimise the risk of neural defects (such as Spina bifida) in a baby during pregnancy. This is because the vitamin folate is important at a time when many women do not realise they are pregnant. It is particularly important prior to conception, and during the first twelve weeks of pregnancy.

The easiest way to achieve this is to take a daily supplement of 400 μg folic acid (the manufactured form of folate), as it is difficult to achieve the extra folate needed through diet alone. Folic acid supplements are widely available from chemists and supermarkets. Note however that pregnant women should avoid supplements containing vitamin A. Multivitamin supplements aimed at pregnant



and lactating women, and women planning a pregnancy, tend to contain the right amount of folic acid and do not include vitamin A, but always check the label.

It is also important to consume foods that are naturally good sources of folate e.g. green vegetables such as spinach and broccoli, asparagus, peas, avocado, citrus fruits and their juices such as oranges, and rye bread, as well as foods that have been fortified with folic acid e.g. some breads and breakfast cereals.

Catering

The UK Defence Catering Group policy states: 'Every effort is to be made to feed all personnel serving with HM Forces, regardless of race, creed, medical need or belief.' (19). This applies to catering both in barracks and on operations. It is therefore essential that individual requirements are brought to the attention of the Catering Manager in good time.

NUTRITION AND INJURY

There is a high incidence of musculo-skeletal injuries (MSI) during military training in the UK, particularly amongst recruits undergoing basic training, and especially females (20). Stress fractures are a particular problem. A number of factors influence a soldier's risk of injury: exercise and terrain, smoking, previous injury, training status, age, race and gender. The role of nutritional status is still not entirely clear, but it is evident that good nutrition can reduce the risk of injury by delaying the onset of muscle fatigue. As muscles become fatigued, they are less able to absorb the forces generated during exercise, and the bones and joints are subjected to greater impact. This is made worse in military personnel by load carriage.

In the long-term, nutritional status plays an important role in preventing injury, particularly in females. Energy intake, calcium intake, and hydration status, are all important in preserving muscle function and bone density. In females, a combination of physical training and inadequate energy intake produces hormonal and metabolic changes that are known to reduce bone formation and increase bone absorption. This can result in a decrease in bone mineral density, an increased risk of stress fractures, and an increased risk of osteoporosis in later life. There is emerging evidence that carbohydrate may play an important role in preventing these changes. There is little evidence to support the use of antioxidants (e.g. vitamins A, E, C, and beta-carotene) in preventing muscle soreness and damage.

To help prevent injury:

- Encourage personnel to attend and eat meals
- Encourage the consumption of carbohydrate and fluids
- Encourage consumption of high calcium foods, particularly by females – see Appendix 3 for the Calcium Counter.

Section 4: What about nutrition in the field?

KEY POINTS

- Military personnel should be encouraged to consume as much of their ORP as possible
- Selection of appropriate ORP for military operations
- Gastrointestinal complaints are common in the field

Food is not only necessary for the provision of nutrients. It plays an important role in maintaining morale, which is of particular importance in the field. Commanders and caterers should co-operate to ensure sufficient and appropriate foods are available to support the operational exercise/mission. Freshly cooked food is not always available and Operational Ration Packs (ORP) have to be used.

ORP are designed to provide one day's worth of food for the individual. Various types of ORP are available depending on the mission, tactical scenario, location, and availability of food service equipment and personnel.

ORP CURRENTLY USED IN THE UK

- 24 hour General Purpose (GP) Ration Pack – Hot Climate Variant
- 24 hour Ration Pack – Vegetarian Version
- 24 hour Ration Pack – Sikh/Hindu Version
- 24 hour Ration Pack – Halal Version
- Dehydrated Patrol Ration Pack
- 4 Man Operational Ration Pack
- 10 Man Operational Ration Pack



ENCOURAGING CONSUMPTION OF ORP

ORP are intended for use for up to 30 days, and aim to supply the individual with adequate nutrition to sustain physical and mental performance. However, weight loss is very common in the field. Military personnel will often eat 20% - 40% less than their actual energy needs (4). It is therefore important that personnel are encouraged to consume as much of their ORP as possible.

- Educate personnel to believe that adequate nutrition and hydration are essential for maintaining their 'fitness to fight'
- If possible, mealtimes should be scheduled to allow sufficient time for consumption of meals
- Leaders should be aware of what their personnel are eating and what they are discarding

The UK MOD is currently funding a review of UK rations, including an assessment of, i) current guidelines, ii) the composition of UK rations, iii) user acceptance, and iv) how well they meet the requirements of current UK operational scenarios.

GASTROINTESTINAL COMPLAINTS

Gastrointestinal complaints are reported by military personnel in the field – diarrhoea and constipation being the most common. These conditions can be debilitating in the extreme and precautions to reduce the risk of them occurring should be taken. They can be caused by a change in diet, stress, dehydration and poor sanitation.

- Avoidance of all local foods is recommended; they should be considered unsafe to eat
- Although conditions may not be ideal, hygiene standards should be adhered as far as possible
- Early reporting by personnel of diarrhoea/constipation should be encouraged so the problem can be addressed as soon as possible

APPENDIX 1 – REFERENCE NUTRIENT INTAKES

These recommendations are for the general population in the UK. The USA and Australia have specific recommendations for their military personnel; these have yet to be determined in the UK.

Reference nutrient intakes for vitamins.

Age/ years	Thiamin mg/d	Riboflavin mg/d	Niacin mg/d	Vit B6 mg/d	Vit B12 µg/d	Folate µg/d	Vit C mg/d	Vit A µg/d	Vit D µg/d
Males									
15 - 18	1.1	1.3	18	1.5	1.5	200	40	700	-
19 - 50	1.0	1.3	17	1.4	1.5	200	40	700	-
Females									
15 - 18	0.8	1.1	14	1.2	1.5	400	40	600	-
19 - 50	0.8	1.1	13	1.2	1.5	400	40	600	-

Extracted from (2) Table 1.4

Reference nutrient intakes for minerals.

Age/ years	Calcium mg/d	Phosphorus mg/d	Magnesium mg/d	Sodium mg/d	Potassium mg/d	Chloride mg/d	Iron mg/d	Zinc mg/d	Copper mg/d	Selenium mg/d	Iodine mg/d
Males											
15 - 18	1000	775	300	1600	3500	2500	11.3	9.5	1.0	70	140
19 - 50	700	550	300	1600	3500	2500	8.7	9.5	1.2	75	140
Females											
15 - 18	800	625	300	1600	3500	2500	14.8	7.0	1.0	60	140
19 - 50	700	550	270	1600	3500	2500	14.8	7.0	1.2	60	140

Extracted from (2) Table 1.5



APPENDIX 2 – FIBRE CONTENT OF FOOD

The following is a list of foods containing fibre together with an estimate of how much fibre they contain.

The average recommended intake of fibre per day is 18g.

2 slices wholemeal bread	6g
2 Digestive biscuits	1.5g
2 Ryvitas	2.5g
Apple	2g
Banana	3.5g
5 dried apricots	9.5g
1 tablespoon of raisins	2g
2 Weetabix	5g
Porridge - medium portion - large portion	1.5g 2g

Wholewheat spaghetti (cooked) - medium serving - large serving	9g 11g
Brown rice (boiled) - medium portion - large portion	3g 4.5g
Sweetcorn - average portion	5g
Jacket potato with skin - medium potato - large potato	3.5g 4.5g
Baked beans - 1 tablespoon - 1 large can	3g 31g
Handful of mixed nuts and raisins	3g
Small bag of peanuts	2g

APPENDIX 3 – CALCIUM CONTENT OF FOOD

CALCIUM COUNTER

The average recommended intake of calcium varies between 700-1000mg per day depending on sex and age (see Appendix 1). This table shows foods high in calcium and the serving required to supply 200mg.

Dairy Products	200mg Calcium
Milk - Full fat Semi-skimmed Skimmed	170ml 160ml 160ml
Camembert cheese	52g
Cheddar type cheese	25g (1oz matchbox size)
Yoghurt	125g pot
Ice cream	3 x scoops

Other Sources	200mg Calcium
Bread - medium white medium wholemeal	6 slices 10 slices
Cheese Scone	x 2
Sardines in tomato sauce	2 x sardines
Dried apricots	x 3
Oranges	x 4
Calcium Enriched Orange Juice	164ml
Spinach boiled	1 tablespoon
Sesame seeds	2.5 tablespoons
Calcium Enriched Water	666ml
Milky pudding	200g



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Prompt cards (TAM inserts)

PROMPT CARD #1A : CALCULATING DAILY ENERGY REQUIREMENTS

Commanders' Guide Prompt card 1 side A

Daily energy requirements = Basal Metabolic Rate (BMR) x Physical Activity Level (PAL)		
BMR Kcal/day		
Males	10-17 years	BMR = 17.7W + 657
	18-29 years	BMR = 15.1W + 692
	30-59 years	BMR = 11.5W + 873
Females	10-17 years	BMR = 13.4W + 692
	18-29 years	BMR = 14.8W + 487
	30-59 years	BMR = 8.3W + 846
W = body wt (kg)		

- Calculate your BMR using the numbers above. For example, if you are a 23 year old male weighing 72kg, you BMR is equal to your weight multiplied by 15.1 (15.1 x 72 = 1087), added to 692 (1087 + 692 = 1779). Your BMR is 1779 kcal per day.
- Calculate your PAL using the table below. Find the activity level that corresponds to your job, and find where this column intersects with your leisure activity level. For instance, you may have a moderate level of activity at work, but be non-active outside of work, giving a PAL of 1.6
- Your daily energy requirement is BMR x PAL (e.g. 1779 x 1.6 = 2846).

	Activity at Work					
	Light		Moderate		Heavy	
Activity level	M	F	M	F	M	F
Non-active	1.4	1.4	1.6	1.5	1.7	1.5
Moderately Active	1.5	1.5	1.7	1.6	1.8	1.6
Very Active	1.6	1.6	1.8	1.7	1.9	1.7

Adapted from (2), table 2.3 M = Male; F = Female

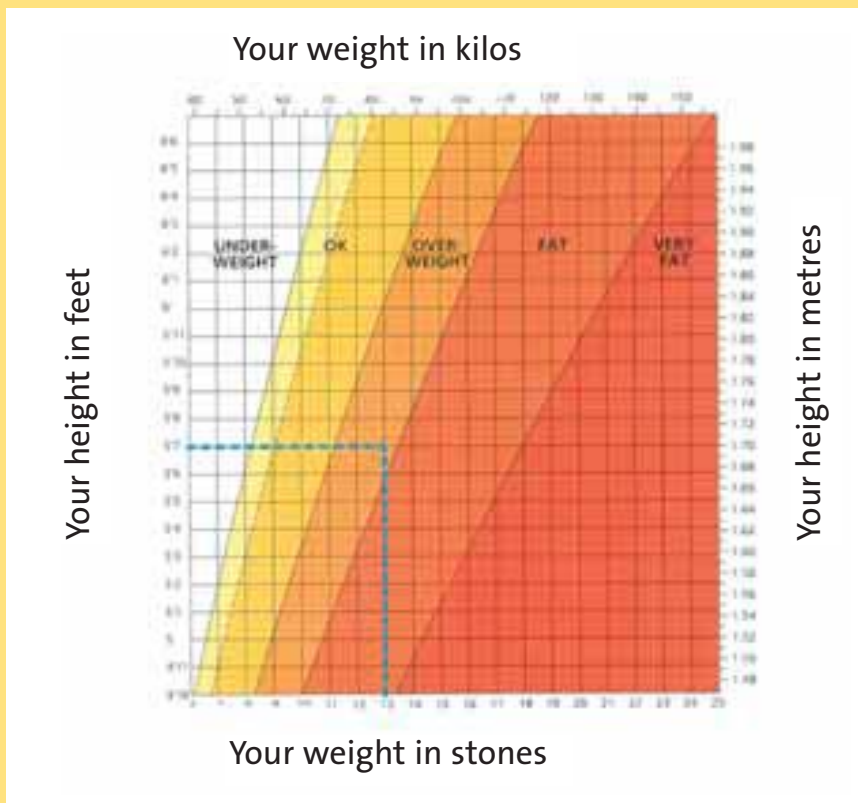
PROMPT CARD #1B: BODY MASS INDEX

Calculating your body mass index (BMI) is a useful way of monitoring your weight. BMI is not an absolute measure of obesity and should be used with caution. Athletes may find they fall into the overweight category although this is obviously not the case – this is because they have a high lean body mass and low body fat.

Your BMI is equal to your weight in kilograms, divided by your height in metres squared (height in metres x height in metres).

World Health Organisation;
Classification of Obesity by
Body Mass Index (8).

BMI	Classification
< 18.5	Underweight
18.5 - 24.9	Healthy Weight
25.0 - 29.9	Overweight (Grade I Obesity)
30.0 - 39.9	Obese (Grade II Obesity)
> 40.0	Morbidly/Severely Obese (Grade III Obesity)



PROMPT CARD #2A : NUTRITION FOR GOOD HEALTH

side A

Commanders' Guide Prompt card 2

A diet providing adequate carbohydrate, fat, protein, vitamins and minerals, fibre and fluid is essential for maintaining body composition and providing energy. Under or over consumption of any nutrient can be detrimental to health and performance.

Tips for a Balanced Diet:

- Consume a diet that is low in fat, especially saturated fats.
- Eat plenty of complex carbohydrates.
- Increase fibre intake.
- Avoid high sugar foods and drinks
- Limit alcohol consumption.
- Minimise salt consumption.
- Ensure adequate fluid intake.
- Read food labels.

Aim for an intake of 5 portions of fruit and vegetables a day (fresh, frozen, dried or tinned). They contain anti-oxidant vitamins and can protect against some cancers and heart disease.

One portion is:

- single piece of a medium sized fruit e.g. apple, banana, orange
- a cup of small fruit such as grapes or raspberries
- a couple of very small fruits
- half a grapefruit, a wedge of melon, a couple of rings of pineapple
- 2-3 tablespoons of cooked or canned fruit
- 1/2 - 1 tablespoon of dried fruits e.g. dates, sultanas, prunes, apricots
- at least two heaped serving spoonfuls of raw, cooked, frozen or canned vegetables



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PROMPT CARD #2B: FIBRE AND CALCIUM CONTENT OF FOOD

The following is a list of the foods containing fibre together with an estimate of how much fibre they contain. The average recommended intake of fibre per day is 18g.

2 slices wholemeal bread	6g
2 Digestive biscuits	1.5
Apple	2g
Banana	3.5g
5 dried apricots	9.5g
1 tablespoon of raisins	2g
2 Weetabix	5g
Porridge - medium portion	1.5g

Wholewheat spaghetti (cooked) - medium serving	9g
Brown rice (boiled) - medium portion	3g
Sweetcorn - average portion	5g
Jacket potato with skin - large portion	4.5g
Baked beans - 1 tablespoon	3g
Handful of mixed nuts and raisins	3g
Small bag of peanuts	2g

The table below shows foods high in calcium and the serving required to supply 200mg. The recommended intake of calcium varies between 700 – 1000 mg per day, depending on age and sex.

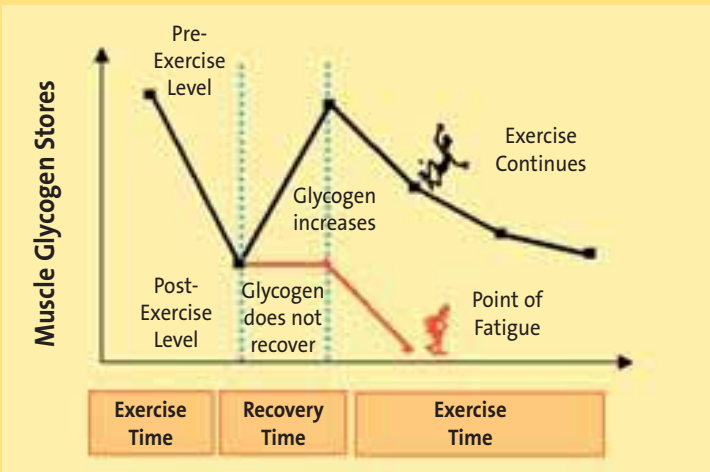
Milk- Full fat	170ml
Semi-skimmed	160ml
Skimmed	160ml
Camembert cheese	52g
Cheddar type cheese	25g (1oz-matchbox size)
Yoghurt	125g pot
Ice cream	3 x scoops

Bread- medium white	6 slices
medium wholemeal	10 slices
Cheese Scone	x 2
Sardines in tomato sauce	2 x sardines
Dried apricots	x 3
Oranges	x 4
Calcium Enriched Orange Juice	164ml
Spinach - boiled	1 tablespoon
Calcium Enriched Water	666ml
Milky pudding	200g

PROMPT CARD #3A: CARBOHYDRATE AND PHYSICAL PERFORMANCE

At any exercise intensity, carbohydrate is one of the main fuels for muscular work. It is recommended that carbohydrates contribute 60% of daily energy intake for anybody undertaking regular physical exercise.

Practical Recommendations	
Less than 30 min before training	Eat one of the following: <ul style="list-style-type: none"> • 1 large banana • 400ml isotonic sports drink (6% carbohydrate) • 1 slice of bread with 1 tablespoon of jam • 1 low fat cereal or fruit bar
If exercising for more than 90 min	Consume one of the following every hour: <ul style="list-style-type: none"> • 1000ml isotonic sports drink • 1000ml diluted fruit juice (1:1) • 2 x energy bar (e.g. Power bar) • 100g chocolate bar • 3 handfuls dried fruit
Within 2 hours after	<ul style="list-style-type: none"> • Eat or drink carbohydrate as soon as possible after exercise • Aim to consume 1g carbohydrate per kg body weight
Post activity	<ul style="list-style-type: none"> • It takes 20 hours to fully replenish carbohydrate stores after exercise • Meals should be based on complex carbohydrates



side A

Prompt card 3

Commanders' Guide

The potential for enhancing endurance exercise performance with carbohydrate is greatest in operations that involve moderate to high intensity physical work sustained for longer than 2 hours. The heavier the workload, or the longer the operation, the greater the need for supplementary carbohydrate.

Practical Recommendations	
Before Operational Exercise	<ul style="list-style-type: none"> • During the week prior to deployment, increase carbohydrate to 65-70% of total energy intake (at least 500g per day). • 4-5 hours before deployment, eat a light meal providing 70% energy from carbohydrate. • Eat 100g carbohydrate 30 min before the start of sustained activity.
During Operational Exercise	<ul style="list-style-type: none"> • 50-60g of carbohydrate should be consumed every hour (e.g. 250ml of a 6% carbohydrate/electrolyte drink every 15 min). • If drinks are not available then solids (e.g. energy bars) should be eaten with water.
Immediately After Operational Exercise	<ul style="list-style-type: none"> • Aim to eat 1g of carbohydrate per kg of body weight within 30 min after exercise. • A carbohydrate drink is preferable to solids as it speeds up delivery of glucose.
Post activity	<ul style="list-style-type: none"> • Meals should be based on complex carbohydrates.

- Operational Ration Packs (ORP) are intended for use for up to 30 days and aim to supply the individual with adequate nutrition to sustain physical and mental performance.
- It is important that military personnel are encouraged to consume as much of their ORP as possible.
- Educate personnel to believe that adequate nutrition and hydration are essential for maintaining their 'fitness to fight'.
- Leaders should be aware of what their personnel are eating and what they are discarding; Military personnel often eat 20-40% less than their actual energy requirements.
- Gastrointestinal complaints are common in the field – military personnel should be encouraged to report symptoms as early as possible.

