Effects of different diets on the body and brain

Foods containing Lipids, Proteins and Carbohydrates provide the energy needed by the body. These nutrients are broken down and changed into fuel which provides the energy enabling the body to function. Taking a vitamin may be beneficial, but will not increase energy levels. These nutrients are termed macronutrients, basically meaning that large amounts of them are needed to sustain healthy functioning of the body. (Thompson JL, Manore MM, Vaughan LA, 2008)

Carbohydrates, or carbs, as they are referred to these days, are not all the same, they may be similar, but there are differences. Carbohydrates are a series of chemical compounds, they are composed of carbon, the carbo, oxygen and hydrogen in equal proportion to water, the hydrate. Simple carbohydrates are sugars; complex carbohydrates are starches and fibres. Carbohydrates can be quickly broken down into sugar (glucose) by the body and used for energy; potatoes, bread and pasta are high in carbohydrates. (Grosvenor MB, Smollen LA, 2006, p 117)

Lipids or fats as they are more commonly known, as well as providing energy, give our food taste, aroma and texture. Fat can be obvious in our food but much of it is invisible and less considered as a source of fat. Fat can determine the healthiness or otherwise of our diet and there are many different types. Fats in our bodies, called triglycerides, are formed when three fatty acids are connected to a glycerol molecule. A chain of carbon with an acid group at the end forms a fatty acid. The term saturated fat is used to describe fats saturated with hydrogen; they are normally solid at room temperature and mainly come from animal fats. Trans-fatty acids on the other hand are unsaturated, but crucially the alignment of the hydrogen

atom makes it more akin to saturated fat. The necessary lubrication for the body is provided by lipids; they also provide insulation to shock and help to keep the bodies temperature stable. They also form part of the membrane structure of cells and help with synthesise eicosanoid molecules and hormones. Lipids are a concentrated form of energy, ready for immediate use but can also be stored for use later. Foods high in fat include meat, eggs and dairy products. It should be remembered that the body needs fat and that foods high in saturated fat, trans-fatty acids and cholesterol increase the risk of heart disease, whilst those foods high in omega-6 and omega-3 polyunsaturated fatty acids reduce the risk of heart disease. (Grosvenor MB, Smollen LA, 2006, p 152)

Protein comes from both animal and plant sources. More prosperous populations usually consume more animal protein sources. These tend to be higher in iron, zinc and calcium as well as saturated fats and cholesterol. Plant sources of protein are higher in unsaturated, fat, fibre and phytochemicals (chemical compounds found in plants, beneficial to the body) the building blocks of proteins are amino acids. Some of these amino acids which the body can’t produce in sufficient quantities are referred to as essential amino acids and are therefore required to be part of a healthy diet. Chains of amino acids form different proteins and the shape of these proteins dictate their purpose. Amino acids from both the body and the diet are utilised by the cells to react with proteins as instructed by DNA. Amino acids are also used to interact with glucose and other non-protein molecules to provide energy. The need for protein is calculated by looking at the consumption of nitrogen in dietary protein and the protein waste excreted by

the body. The RDA (Recommended Daily Allowance) of protein for a healthy adult is 0. 8 grams per kilo gram of body weight. The requirement can increase depending on the state of the body, for instance pregnancy, breast feeding a baby, growth, physical activity, physical injury or illness. It is recommended that 10 to 35% of calories are taken from protein to maintain a healthy diet. Foods high in protein include chicken, beef, salmon and legumes.

Vitamins are vital to our efficient physiologic processes; they are organic compounds that are important in the health of our muscles and bones. They also boost the immune system enabling us to avoid illness and disease. They also have a beneficial effect on vision and efficacy of blood. Vitamins do not have any energy of any calorific value; they do however have a vital part to play in how the body uses lipids, carbohydrates and proteins. The body only needs small amounts of vitamins (and minerals) and are denoted as micronutrients. Their effectiveness are easily reduce by exposure to light, heat, air and over-cooking. They are destroyed in an alkaline environment. Vitamins are grouped by their ability to be water soluble or fat soluble, this characteristic determines how they are transported, absorbed and stored in our bodies. Most vitamins cannot be produced by the body and therefore need to be taken in our diet. Water and fat soluble vitamins are found in many varied foods. A normal balanced diet will provide all the vitamins needed by the body.

Minerals do not contain carbon and are referred to as inorganic substances. Important minerals to health are iron, zinc, magnesium, calcium, potassium and sodium. They differ from vitamins and macronutrients in that digestion

does not degrade or break them down nor are they destroyed by heat or light. Independent of their environment minerals maintain their structure, for example the calcium in milk is the same calcium in our bones and the sodium in household salt is the same sodium in our cells. Physiologically minerals are vital to many functions including the regulation of bodily fluids and the production of energy, they are essential in maintaining healthy blood and bones. They aid metabolism by riding the body of harmful by-products. They are ordered by the body’s need for them in our diet, and how much of them are found in the body. They are ordered into two categories, Major Minerals and Trace Minerals. Those minerals that our body’s need to consume a minimum of 100 mg per day are termed Major Minerals and are found in the body in amounts of 5000 mg or more. Calcium, magnesium and phosphorus play a critical role in bone maintenance. Energy production is enhanced by magnesium and calcium boosts muscle efficiency. Chloride, potassium and sodium help in fluid balance, sulphur is seen as an active constituent of certain vitamins and amino acids. Major mineral sources are numerous and include meat, fresh fruit, dairy produce and nuts. Chromium, fluoride, iodine, selenium, magnesium, copper, zinc and iron are main trace minerals. They are called trace minerals because the body needs 100mg or less per day. Iron is deemed to be important in keeping blood healthy enhancing the amount of oxygen transported round the body. Reproductive health and cell growth and development are maintained by zinc whilst selenium, copper and magnesium are antioxidants controlling free radicals. Iodine is effective in the production of hormones which regulate body temperature as well as metabolic rate and growth. Fluoride fights tooth decay and helps strengthen bones and the body needs chromium for the

correct metabolism of fats and carbohydrates. Trace mineral sources are generally the same as major minerals.

Water which plays a key role in our health is an inorganic substance providing support to all organs of the body enabling then to function correctly. It is consumed in various forms such as pure water, soup, juices, drinks and other liquids. It is also present in fruit and vegetables. Water intake must be adequate to maintain the balance of fluid in and out of our cells, helping the function healthy body temperature, muscle efficiency, nerve impulses, transport of nutrients and elimination of waste products.

The chemical action and reaction and the physiological progressions in the body are hugely complex. They are all influenced and kept in harmony by all six of the above nutrients. This harmony is called homeostatis. Blood pressure and blood sugar level and hundreds of other considerations are kept in balance and constancy.

The nutrients provide the conditions that result in homeostatis, water controlling body temperature by sweating when the body is hot. Proteins and lipids regulate the hormones which start and stop various body functions. Vitamins, proteins and minerals control chemical actions throughout the body. This balance, this equilibrium this harmony this homeostatis is health, any inability of the body to control imbalance, inequality or disharmony, is illness. (Thompson JL, Manore MM, Vaughan LA, 2008)

Effects of glucose on the brain

The mitochondrial area of the brain is the engine room where brain power is centered. This brain power is fuelled by glucose which is supplied to the

brain in the bloodstream. The brain cells needs a steady supply of glucose, the brain cannot store the glucose so an adequate supply is vital to the functioning of the brain, learning, concentrating and memory. The body obtains glucose from carbohydrates, fruit and vegetables, grains and legumes. (Very few animal foods are a source of carbohydrate, dairy products being the exception. Over supply of carbohydrates or sugar can restrict the brain's use of glucose, resulting in a degraded brain function, although the brain activity needs a lot of energy. (http://www. fi. edu/learn/brain/carbs. html)

Effects of a high protein diet

Generally a high protein diet isn't harmful in the short term, up to four months at most, and can be effective in losing weight. However in the long term and in conjunction with a reduction or elimination of carbohydrates can result in various health difficulties

Nutritional Deficiency. A lack of fibre can result in constipation even diverticulitis and cancers

Heart Disease. A diet rich in protein, red meat and dairy for example can increase the risk of heart disease.

Kidney Problems. A protein only diet can aggravate kidney problems causing difficulty in the kidney processing waste products of the metabolism of the protein.

If a person wants to try to lose weight on a high protein – low carbohydrate diet they should be advised to try it in the short term only, the protein

chosen should be lean meat, fish, skinned chicken and low fat dairy production. Anyone with diabetes, liver or kidney disease or on long term medication should be advised against it and to at least speak to their doctor.

(http://www. mayoclinic. com/health/high-protein-diets/AN00847)

Cellular respiration is a metabolic reaction where cells convert nutrients into energy with waste being a by-product. These reactions can be catabolic (production of energy by breaking down nutrient molecules) or anabolic (the consumption of energy and building of molecules) Cellular respiration is an important way for a cell to acquire energy enabling cellular regeneration (Campbell, Reece, Urry, Cain, Wasserman, Minorsky and Jackson, 2008)

Definitions of calories and energy

- Calories

Heat or energy can be measured in calories. The definition of a calorie is “ the amount of heat it takes to raise the temperature of 1g of water by 1o C” the converse is of course also true, a calorie is ” is the amount of heat 1g of water releases when it cools by 1o C. (Campbell, et al 2008). It is as well to note that the ‘ calories’ on food labels are in fact kilocalories.

The joule (J) is also a unit of energy, with one joule being equal to 0. 239 calories. One calorie is equal to 4. 184 joules.

- Energy

The definition of energy is that ability or capacity to alter things, particularly to do work against a resistive force. (Campbell et al, 2008)

The statement “ calorie free energy drink” is a contradiction in terms in that anything that has energy must have calories and of course vice versa. The label is therefore totally misleading (Campbell et al 2008)

Part 2 – Metabolism and Detox

Definitions of Obesity

The medical definition of obesity is having a body mass index (BMI) of 30 or more. BMI is the ratio between height and weight and although it is widely used it is at best a ‘ rule of thumb’ In Scotland BMI is the guide used in primary care to say if a patient is obese or not. Its use has been criticised as being inaccurate and that other techniques give more useful indications of obesity:

- Body fat measurement using callipers
- Waist hip ratio
- Bioelectrical impedance
- Wrist measurement
- Water displacement

The problem with these techniques is that they can be cumbersome, time consuming and expensive, whereas BMI can be read from a simple table.

Overnourishment, overeating, consuming more food than the body needs for normal activity are the main causes of obesity but genes, physical activity and environment have a part to play as well. (Thomson JL et al 2008)

Set Point Theory

The theory of ‘ Set Point’ intimates that a person’s weight is restricted within confines pre-determined by the body. When a person’s weight fluctuates, up

or down, the body automatically compensates physiologically by altering the Basal Metabolic Rate (BMR). It appears that this is all part of the body's blueprint/DNA in the maintenance of homeostatis. This goes to explain why dieters routinely fail to keep any weight loss after they stop dieting.

Yes, if toxins are present in the bloodstream they can have a direct influence on where the set point is set. Metabolism and body size are related. Metabolic rate is roughly proportional to body mass. Homeostatis is also proportional to body mass, the larger the mass the wider the parameter that homeostatis works within. (Campbell, et al, 2008)

Changes to metabolism

Metabolism is all the body's chemical reactions, which have both anabolic and catabolic pathways, they husband the energy and material assets of the body.

The conversion of food and drink into energy by the body is a function of metabolism. This complicated chemical process, the calories in the food and drink combine with oxygen to provide the body with the energy it needs. Even when the body is inactive the body stills consumes energy maintaining those instinctive functions such as, repairing cells, blood circulation, hormone production, body growth and breathing. The body therefore needs a certain number of calories is carry out these functions and is called the basal metabolic rate (BMR). Age, gender and body mass determine an individual's BMR

Age. As the body ages, muscle mass decreases and fat becomes a higher component of body weight. This slows down calorific expenditure.

Gender. Males generally have less body fat than females, muscle is greater in men than women as well.

Body Mass. The larger the body mass, then the greater the calorific burn.

Generally, if more calories are consumed than expended then the body will store the excess and result in weight gain. Of course set point theory, an individual's metabolism and predisposition to weight gain or loss comes into play. Energy needs for the body's basic functions stay fairly consistent and aren't easily changed. The basal metabolic rate accounts for about 60 to 75 per cent of the calories that are burnt every day. (Grosvenor MB, Smolin LA, 2006)

Effect of muscle growth on metabolism

Yes, increasing muscles increases the body's resting metabolism, which in turn consumes more calories. The larger the muscle the more cells, the more cells the more energy required. Muscle mass is increased by strength training (Campbell, et al, 2008

Diurectics

A diurectic is a drug that increases the excretion of accumulated water in the body. This can be beneficial in the treatment of certain illnesses, but can also have serious side effects. The diurectic effect of drugs and some herbal remedies can have a superficial effect on weight loss, as the body is predominately made of water any reduction gives an immediate loss in body weight. The serious side effect on the homeostatic fluid balance in the body, causing the kidneys to filter more water out of the blood resulting in

dehydration and potassium loss, muscle pain, stomach ulcers, impotence and painful enlargement of the breast in men.

(Campbell, et al, 2008)

How toxins are cleansed from the body

The body uses major systems to cleanse the body of toxins; they are the sweat glands, the digestive system, the urinary system and the liver. These systems remove more toxins than all other systems put together. Keeping these systems in good order (water is vital to them all) enables the body to prevent disease and illness.

In this modern age we are all more and more at risk from the thousands of toxins in our environment ranging from, cleaning agents, pesticides, car exhausts, pollutants in the air we breathe and toxic compounds in everyday objects and materials. They are all chemically different, some are more toxic to the body than others, they can be breathed in, ingested, absorbed through the skin or cuts and abrasions they have even been shown to cross umbilical divide and enter the unborn child

Toxic contamination can cause the production of body fat in the body, this is because the body tries to counteract the toxic substances by cleaning them from the organs of the body and storing them in the safer area of body fat, another example homeostatis.

(Thomson JL et al 2008)

Types of body image issues

Mitchel is at risk of developing a body image problem, mainly by peer pressure and he should take seriously the advice given. Body image problems can lead to eating disorders with calamitous results, the two most common eating disorders are;

Anorexia nervosa. The refusal or physiological inability to sustain body weight.

Bulimia nervosa. Binge eating then vomiting, purging or overuse of laxatives.

(Thomson JL et al 2008)

Hormones and Homeostatis

Sugar

Sugar is one of the most common foods, it is also a simple carbohydrate, meaning that the body can process it very quickly into energy. Complex carbohydrates are slower to release the glucose our body uses for energy. When we eat sugar our blood sugar levels increase and we get an energy boost. Sugar is derived from carbohydrates. (Youngson R 2000)

Types of blood sugar diseases

Blood transports sugar round the body to where it is required. The endocrine system controls hormone levels in the body these hormones affect many different functions in the body but as far as blood sugar levels are concerned, when blood sugar levels rise the endocrine system stimulate the pancreas to secrete insulin which reduces the sugar level to normal. Diabetes is caused when the pancreas cannot produce insulin resulting in blood sugar levels being unregulated. Consequently, the absence of insulin,

muscle protein cannot be utilised resulting in muscle wastage, also sugar accumulates in the blood and the kidneys have to process it and excrete it, the sweet smell of a diabetics urine is a result of this, for the kidneys to excrete the sugar it needs large amounts of water, which give rise to two of the symptoms of diabetes, raging thirst and excessive urination.

Hypoglycaemia is a medical condition indicated by lower than normal blood sugar levels, one of the most serious implications of hypoglycaemia is less than adequate supply of glucose to the brain which impairs body function, from feeling unwell to seizures, unconsciousness and even brain damage. The ravages of too much or too little sugar in the blood can be very serious; therefore the body and its endocrine system are mechanisms to keep the body homeostatic, in balance, in kilter. Hypoglycaemia is most often a result of diabetic treatment going wrong. Ingestion of carbohydrates/sugar will raise the blood sugar level. (Youngson R 2000)

Types of hormones

The hormonal glands in the body regulate appetite, these glands produce several appetite regulating hormones:

Gherlin is a hormone which stimulates the appetite, whilst PYY another hormone in the digestive system, signals the brain when the body has had enough to eat, similarly, another hormone leptin, regulates appetite by causing the hypothalamus to suppress appetite. Leptin may also trigger the body to burn stored fat. Research is still on-going but who knows, maybe one day these hormones could be used in the treatment of obesity. (Wadden TA and Stunkard AJ, 2002)

Effect of restricting carbohydrates

A diet restricting carbohydrates will reduce blood sugar level reducing the supply of glucose to the brain, which cannot store glucose, this sugar is used in by the brain in cell management. A scarcity of glucose to the brain would certainly cause headaches fatigue, the body’s homeostatic function may well cause carbohydrate cravings. (Youngson R 2000)