



Newsletter

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WEIGHT CONTROL THROUGH METABOLIC CONTROL

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INTRODUCTION

It is estimated that 10 to 25 percent of the children and 25 to 50 percent of adults are overweight in the United States, and these figures appear to be rising. The current view of why people are overweight is simplistically stated to be caused by overeating. That is, individuals take in calories beyond those required for normal metabolic, muscular, and digestive activity on a daily basis, which are then stored as fat. The cause of overeating has many theories ranging from emotional, metabolic, genetic, and appetite, hunger, or satiety disorders.

Weight control or weight loss has largely been directed at limiting caloric intake and increasing energy expenditure. Statistically this approach has not been significantly effective since over two-thirds of the individuals who lose weight by this method usually regain what they have lost and more. Research has shown that the resting metabolic rate is responsible for up to 75% of the total energy expenditure over a 24-hour period in individuals with normal physical activity. (1) As an example, an adult female whose total energy needs equal 2000 calories per day will use 1300 to 1500 calories maintaining her basal metabolic activities. (2) Since a large amount of our daily caloric intake is required to maintain normal metabolic processes, a slight deviation in the metabolic rate can have a significant impact upon one's weight. A 10% reduction in the resting metabolic rate would equal a negative energy expenditure of over 50,000 calories per year, or a weight gain of over 14 pounds per year (3500 calories = 1 pound). Since such a large amount of calories are normally used at rest, obviously more attention should be directed toward the metabolic side of the energy equation.

Individual Metabolic Characteristics

Evidence strongly suggests that individual metabolic characteristics affect weight gain. This was emphasized in an experiment called the Vermont Study (3) (4) in which overfeeding experiments of non-obese volunteers over several months resulted in a wide variation of responses. All subjects did not gain weight as predicted from the excess calories consumed. Some gained more weight than others, and some gained more readily than others.

Individual metabolic characteristics are also apparent from weight distribution patterns in different individuals. This variation is influenced by hormonal and neurological factors. It is common to see that some individuals will develop excess fat deposition peripherally (on the hips and thighs), while others develop excess fat distribution centrally in the stomach region or torso). Most overweight conditions are associated with peripheral fat deposition.

Many factors can influence metabolic efficiency and the resting metabolic rate -including neurological and endocrine activity, foods, vitamins, and minerals. The purpose of this paper is

to explore the factors that influence metabolic efficiency affecting weight, particularly peripheral weight gain.

Calories

Calories are derived from protein, fats, and carbohydrates. However, calories from these different sources have different effects upon the metabolic rate. Foods have a dynamic action that affects the metabolic rate when consumed. Protein has the highest dynamic action, next fats, and carbohydrates the lowest. Following a meal containing large amounts of carbohydrates, a person's metabolic rate usually increases about 4% for the duration of about four hours. A meal containing mostly fat normally raises the metabolic rate about 4 to 10% for seven to nine hours. A high-protein meal raises the metabolic rate over 30% for 10 to 12 hours. (5) We can see from the specific dynamic action of various foods that the type of calorie becomes important when attempting to control weight.

Some authors have stated the daily caloric intake during weight control programs should equal 10 times the ideal weight. However, 10 to 15 would be more appropriate. As an example, if an individual's ideal weight is 150 pounds, his daily intake should be approx. 1500 to 2250 calories. These are good general estimations since fasting and caloric restriction have an effect of reducing sympathetic activity, thereby slowing the metabolic rate. Studies by Welle et al., have shown that overfeeding healthy volunteers for a period of 20 days produced an increase in the basal metabolic rate ranging from 1 to 18%. The resting metabolic rate post-prandial was 8 to 40% higher. (6) It seems logical that adequate caloric intake is essential for weight loss in those individuals with peripheral fat distribution (pear-shaped body structures).

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Caloric Ratio

Lean protein, having the highest dynamic action, should make up a substantial portion of the daily diet, followed sequentially by carbohydrates and fats. The caloric ratio should be protein, 40%; carbohydrates, 40%; and fats, 20%. However, many weight loss diets make a mistake of recommending too much protein relative to carbohydrates. A diet consisting of 80 to 90% protein, for example, contains inadequate amounts of carbohydrates, which are required for immediate energy and aiding in protein utilization. A lack of carbohydrates would therefore, result in a weight loss of more protein than fat and would also not have a protein-sparing effect on the body. On the other hand, a diet high in carbohydrates and low in protein would provide for immediate energy but in turn would spare body fat.

In order to simplify the percentage of calories per day, the caloric value can be converted to weight. One gram of protein or carbohydrate equals 4 calories, and one gram of fat equals 9 calories. Again, using 150 pounds as an ideal weight, the daily intake of 2000 calories would be an average. Using the 40-40-20 ratio, 800 calories should come from protein and carbohydrates (40% of 2000). This would be 200 grams (7.14 ounces). However, due to the water and fiber content, of carbohydrates and proteins, which is over 50 percent in some foods, the gross weight should be approximately doubled. This would then require 10-13 ounces of protein sources and 10-13 ounces of carbohydrates per day.

Food Sensitivity and Weight Loss

Within the last decade clinical research has shown that many individuals suffer from food sensitivity or intolerance, often referred to as food allergies. These sensitivities can give rise to a variety of clinical disturbances including obesity or inability to lose weight. Recognition and elimination of offending foods produce very favorable weight loss results. Brennan reported the outcome of an elimination or rotary diet on women suffering from premenstrual syndrome (PMS). An obese group of nine women with PMS who followed the rotation diet for a period of three months lost an average of 16 pounds (ranging from 8 to 30 pounds). The weight loss occurred during the intake of a well-rounded diet consisting of 2500 calories per day.(7) Other improvements were also noted including a marked increase of energy.

Glycemic Indexing of Foods

A new area of research has emerged measuring differences in plasma glucose and insulin response to various foods termed the glycemic index. Studies are being performed on normal individuals, insulin dependent diabetics (IDD), and non-insulin dependent diabetics (NIDD). Foods are categorized as percent (%) of GI. The higher the GI, the higher the insulin and glucose response. Foods are compared to glucose which has a 100% GI.

Jenkins and co-workers reported the effect on glucose of 62 commonly eaten foods when fed individually to a group of healthy volunteers. (8) (9) Below is a list of foods found to have a high GI. Only those foods with a GI of 50 or higher are listed.

GRAINS AND CEREALS

buckwheat	51	bread (white)	69
millet	71	bread (whole meal)	72
rice (brown)	66	spaghetti (white)	50
rice (white)	72	sweet corn	59
cornflakes	80	all-bran	51
shredded wheat	67	wheatabix	75
oatmeal	54		

VEGETABLES

lima beans	70	frozen peas	51
carrots	92	parsnips	97
potatoes (instant)	80	yam	51
potatoes (baked)	135	swede/turnips	72
beets	93	corn	87

FRUITS

grapes	62	banana	79
orange	66	raisins	64
orange juice	67	fruit cocktail	66

BREAKFAST CEREALS

cornflakes	80	all-bran	79
shredded wheat	67	wheatchex	75
oatmeal	54		

Other studies have measured the insulin as well as glucose response to various foods. Crapo, et al. reported the ingestion of potatoes elicited a high GI index with a glucose and insulin response almost identical to that of dextrose.

High GI foods have been reported to produce their effects in mixed meals with protein and fats. (10)(11)(12) Processed and manufactured foods show a higher GI response than most unprocessed whole foods.(13)(14)(15)

An interesting study has been reported on the effects of phytic acid and calcium on the GI of foods. (16)(17) The GI increased when phytic acid was removed and calcium was added. Removing calcium and adding phytic acid considerably decreased the GI.

Neurological Effects on Weight Control

The autonomic nervous system, consisting of the sympathetic and parasympathetic branches, has a significant influence on the metabolic rate. The sympathetic branch has a stimulating effect and the parasympathetic branch a sedative effect. Evidence shows that dominance of either branch will affect body fat distribution.(18) It is interesting to note that fasting and caloric restriction suppresses the sympathetic or stimulatory branch,(19) thus antagonizing weight loss (20) in the majority of individuals. This could also account for the yo-yo effect (regaining more weight than was lost) associated with weight loss through caloric restriction.

Endocrine Effects

Like the autonomic nervous system, the endocrine glands can also be categorized by their stimulatory or sedative effects. The stimulatory endocrine glands include the thyroid, adrenal cortex (glucocorticoids), adrenal medulla, and anterior pituitary. The sedative glands include the parathyroid, adrenal cortex (anabolic hormones), pancreas, and posterior pituitary.

The stimulatory glands correspond to the sympathetic nervous system and the sedative glands to the parasympathetic nervous system. The stimulatory glands oppose the sedative group. When the sympathetic system is dominant in an individual, usually so are the stimulatory endocrines. When the parasympathetic nervous system is dominant, the sedative glands are also dominant. The resting metabolic rate is affected by hormones, particularly those of thyroid and adrenal origin.

Insulin is an anabolic hormone that promotes fat deposition (lipogenesis) and opposes catabolic hormones that break down fats (lipolysis). Insulin therefore plays a major role in contributing to weight gain. The most common endocrine abnormality found in obesity is hyperinsulinemia.(21) Several factors affect insulin release and contribute to excess insulin production in the body.

Increased Insulin Production

Chromium facilitates insulin at intracellular sites. A deficiency of chromium produces an increase in the requirement and production of insulin. The chromium content of food is markedly depleted by processing and refining. As much as 90% is lost in some foods. Excess insulin production also contributes to the loss of chromium. The effect of prolonged excess insulin production on weight gain is commonly seen in individuals who have adult onset diabetes. Insulin levels are commonly elevated with this condition and therefore contribute to excessive fat deposition. Conversely, individuals who suffer from insulin deficiency or Type 1 diabetes are usually very thin in comparison.

Pregnancy produces a diabetogenic state caused by insulin resistance, resulting in excessive insulin secretion. (22)(23) It is likely that increased estrogen levels during pregnancy

contribute to increased insulin production since insulin and estrogen are highest during the last trimester. Estrogen therapy is also known to increase insulin production.(24)(25)

Parathormone is considered an anabolic hormone; therefore, its action or effects may be shared with or enhance the effect of insulin. It is also known that parathyroid secretion is enhanced by estrogen.(26)

Thyroid

The thyroid hormones have a major responsibility in regulating the resting metabolic rate;(27) therefore, the thyroid can have a significant impact on weight control. Maximum activity of the thyroid can raise the metabolic rate as high as 40 to 80% above normal. In individuals with hypothyroidism, the basal metabolic rate can be reduced as much as 50% below normal.

A number of nutritional and endocrine factors can affect thyroid expression and thereby contribute to a lowering of the resting metabolic rate. As mentioned previously, the thyroid is a stimulatory gland that usually corresponds with sympathetic neurological activity. Therefore, the thyroid can oppose and/or be opposed by the sedative or parasympathetic neuro-endocrine system.

Parathyroid hormone (PTH) appears to oppose the action of the thyroid. Patients with hypothyroidism are frequently found to have increased levels of PTH.(28)(29) Conversely, hyperthyroidism appears to antagonize the parathyroid.(30)(31)(32) There also appears to be a mutual competition between the thyroid and insulin.(33) Insulin is known to be competitive with thyroxine.(34) The prevalence of thyroid failure in insulin-treated diabetic patients has been reported.(35)

Milk can be a significant source of insulin, and is found in human breast milk in amounts similar to plasma levels.(36) Jovanovic-Peterson, et al., reported that the insulin level in breast milk was higher in hyperinsulinemic women than in normal control subjects.(37) These findings may account for childhood obesity in families of diabetic mothers, especially those who were breast fed.

Estrogen decreases thyroid stimulating hormone (TSH) production by the pituitary.(38) It is well known that thyrotoxicosis is relieved in pregnancy and that during pregnancy when estrogen levels normally rise, thyroid enlargement is common.(39)

Long-term alterations in the hormonal environment have been detected following pregnancy. Serum estrogen levels are increased significantly and have been found to remain elevated for at least 19 months after delivery.(40) The serum dehydroepiandrosterone elevation may remain more than 12 years following delivery. This prolonged hormonal change can account for the increased weight gain in many women following pregnancy.

It is interesting to note that fasting and caloric restriction suppresses the sympathetic or stimulatory branch,(19) thus antagonizing weight loss(20) in the majority of individuals. This could also account for the yo-yo effect (regaining more weight than was lost) associated with weight loss through caloric restriction.

Estrogen, insulin, and PTH are anabolic hormones and can be considered synergistic with each other. Therefore, collectively or singularly if in excess, they may compete with normal thyroid activity. This antagonism will ultimately result in a lowered metabolic rate with ensuing weight gain.

If the thyroid itself first becomes insufficient, these hormones could, in turn, become subtly dominant and remain sub-clinically elevated for many years. Danforth suggests that there may be a major difference between lean and obese individuals in the thyroid response to nutrition. Therefore, nutritional factors associated with hypothyroidism deserve special emphasis.

Nutritional Deficiencies Associated with Hypothyroidism

A number of nutritional deficiencies have been found in association with hypothyroidism. Iron deficiency can impair thyroid function, and iron status may reflect thyroid activity.(41) The incidence of anemia is estimated to affect of 60% of those patients with hypothyroidism.(42) Iron deficiency alone is known to result in a lowered metabolic rate and reduced body temperature, therefore reducing caloric expenditure.

Vitamin A (43) and zinc (44) deficiencies in patients with increased incidence of goiter formation have been reported in Keyvani's study of Iranian subjects. After age 18, females had a higher incidence of goiter formation than males, a fact that may be explained by the increase in tissue estrogen sensitivity in the presence of vitamin A deficiency.(45)

Other nutritional deficiencies associated with hypothyroidism include protein, vitamins C, B1, B5, and B6, and phosphorus, magnesium, potassium, manganese, chromium, and sodium.(46)

Nutritional Factors that Inhibit Thyroid Function

Nutritional factors can affect weight control due to their adverse effect upon the thyroid. A review of these factors may help in recognizing the cause of frequent slow response of patients on weight loss programs or among patients receiving thyroid preparations.

Calcium and vitamin D are closely related, and both have an influence on endocrine activity. Studies have shown the hypothyroid effects of calcium,(47) which in excess can lower thyroid function. During hypothyroidism calcium absorption and retention is increased.(48) Vitamin D also increases calcium absorption and retention. Serum vitamin D3 metabolites are found to be elevated in hypothyroid patients (49) and reduced in hyperthyroidism.(50)

Calcium is known to mediate the release of insulin,(51) and vitamin D enhances the synthesis of insulin.(52)(53) Conversely, insulin also enhances the synthesis of vitamin D.(54)

Copper is considered a thyroid antagonist due to its close relationship with estrogen. Generally when estrogen levels rise, copper levels increase proportionately. Copper also antagonizes iron and zinc.

Hypothyroidism is a common side effect of lithium therapy. Lithium, which also stimulates parathyroid activity,(55) contributes to a calcium - phosphorus disturbance.(56)

Cobalt and vitamin B12 are closely related; therefore, either can adversely affect the thyroid.(57) The antagonistic effect of cobalt upon the thyroid has been noted in patients being treated with cobalt for anemia.(58)

PABA has been used in the treatment for thyrotoxicosis. The use of PABA in the treatment of tuberculosis was found to produce goiter formation.(59)

Thyroid Inhibitors in Foods

Naturally occurring goitrogens and progoitrogens are found in brassica and cruciferous plants containing cyanogenic glucosides and thiocyanate. These include yams, cassava, sorghum, peas, maize, lima beans, apricots, prunes, cherries, almonds, bamboo shoots, cabbage, broccoli, brussels sprouts, cauliflower, mustard, and kale. Soybeans, known to

possess goitrogenic activity, are used extensively in baby foods and formulas and have been reported to produce goiters in infants. (60)(61) Soy is also becoming a popular protein source for much of the adult population.

Water intake may also affect thyroid function. Hard water contains high amounts of calcium, and some water may have high levels of copper due to the use of copper tubing. Fluoride found in many water sources has also been implicated as a goitrogen.(62)

Monitoring the Effects of Weight Loss

Obesity is commonly thought to contribute to a number of health problems such as diabetes, hypertension, atherosclerosis, and arteriosclerosis. However, it may be just as valid to assume that many of these conditions can contribute to obesity, especially diabetes.

Before any weight control regimen is begun, it would be efficacious for the patient to submit to an examination including blood sugar, blood pressure, thyroid (TSH), cholesterol, and triglyceride. Even insulin levels could be tested before and during the regimen to follow the beneficial effects of weight loss.

Hair Tissue Mineral Analysis (HTMA)

A plausible model for assessing metabolic status can be presented through macro and micro mineral patterns in biopsied human hair, the tissue of choice for obvious reasons: It is easily obtained and transported, and laboratory testing is economically feasible. Evidence indicates that mineral concentrations in the hair reflect intake and that HTMA is applicable for evaluating body stores of minerals.(63)

As with any diagnostic test, there are limitations, and laboratory results have to be interpreted carefully. The value of HTMA for determining toxic mineral excesses is well known, but its value in determining relative nutrient imbalances has only recently been appreciated.(64)(65)(66) Determinations based on mineral ratios are as important, if not more so, as evaluation of levels alone.

In hypothyroidism intestinal calcium absorption is increased (67) and renal reabsorption is increased.(68) This can result in an elevated tissue calcium to phosphorus ratio [Trace Elements, Inc., (T.E.I.) ideal Ca/P = 2.63]. Therefore, the tissue calcium/phosphorus ratio may prove to be a good indicator of metabolic activity.

An elevated calcium/magnesium ratio has been known to affect insulin release.(69)(70) An elevated HTMA calcium/magnesium ratio (T.E.I. ideal = 7.1) is a common finding in patients with adult onset diabetes. This pattern in conjunction with an elevated calcium/phosphorus is also suggestive of increased parathyroid activity. The parathyroids enhance renal calcium reabsorption and retention.(71)

Elevated tissue magnesium levels in conjunction with calcium may indicate decreased adrenal function. Magnesium exerts a suppressing effect upon the adrenal glands, (72)(73) contributing further to a lowered metabolic rate.

An increase in tissue copper can also indicate adrenal insufficiency and a lowered metabolic rate since adequate adrenal function contributes to the excretion of copper.(74)(75)

HTMA in conjunction with other laboratory and clinical data may serve as a useful barometer of individual metabolic status. It may also serve as a guide for following metabolic response to therapeutic weight changes in the above-mentioned HTMA ratios. Further research in this area would be most welcomed.



Conclusion

To summarize, eating patterns for weight loss should be designed to improve the metabolic rate, thereby increasing energy levels and caloric expenditure. This can be accomplished by:

- a) maintaining adequate caloric intake, which improves satiety and reduces feelings of constant hunger,
- b) consuming foods in a balance or proper ratio with emphasis on those having a high dynamic action,
- c) avoiding high GI foods and those that are known to antagonize thyroid activity, and
- d) following a rotation regimen.

These recommendations should help to eliminate the many pitfalls encountered with caloric restriction and starvation. As stated by Rubel, "Obesity is a neuro-endocrine nutritional imbalance and should be treated as such."(76)

