

Princeton Metabolic Alternating Diet (MAD)

Edwin Heleniak, M.D.¹ and Shreedhar Shetty, M.D.²

Edwin P. Heleniak, M.D., author of the Princeton Plan was interviewed by Shreedhar Shetty, M.D. at a medical staff conference held at Lyons Veterans Administration Medical Center on the topic "Metabolic Alternating Diet - MAD " Princeton Plan.

What is the Princeton Plan?

The Princeton Plan is a weight control program that puts your body's "good fat" (BAT-Brown Adipose Tissue) to work burning away unwanted fat. It is a simple and flexible eating two day program that alternates high carbohydrate/high calorie/low protein days with low carbohydrate/low calorie/high protein days combined with alternating aerobic and anaerobic (weight resistance) exercises to maintain maximum metabolism and sustained weight loss without the "plateaus" associated with other weight loss plans.

Why do most diets fail?

Most calorie restricted diets do not work because they affect only the calorie input of the energy balance equation. Energy input (food intake) = Energy output or expenditure (calories burned). There is a defect in the 2nd half of the equation. Metabolism is slowed down so that less calories are burned. Within 24-48 hours of calorie reduction the metabolism is slowed causing the body to store fat. The body perceives famine or starvation when there is less food available.

What is energy expenditure?

Energy expenditure (burning calories) is done three ways: (1) resting metabolic rate (RMR), (2) thermogenesis, and (3) physical activity (work or exercise). RMR is the largest component of energy expenditure amounting to 73% of the total. It is the energy expended while resting in a neutral environment 8-12 hours after meals or physical activity. It is the energy (calories) required for the vital body functions such as lungs expanding, heart contracting, circulation, producing enzymes.

1.811 Madison Avenue, Dunellen, NJ 08812. 2.
216 Reynard Rd., Bridgewater, N.J. 08807.

Thermogenesis (production of heat) can account for as much as 15% of the 24 hour EE. Thermogenesis is the energy expended above RMR in the resting state. It includes the effects of food intake (diet induced thermogenesis, DIT) and cold exposure (cold induced thermogenesis).

How important is energy expenditure done by physical activity?

Physical activity represents only 12% of the total 24 hour EE in a sedentary adult individual. This can be expanded by increasing programmed exercises (calisthenics, jogging, biking, swimming) and lifestyle activities (using stairs, walking instead of driving, etc.)

What happens when you go on a calorie reducing diet?

Within 24-48 hours of calorie reduction, the metabolism is slowed causing the body to store fat. Our 2 day alternating diet of one day lower calories and the next day higher calories prevent this from occurring. Carbohydrates and low protein diets also stimulate the sympathetic nervous system which in turn stimulates thermogenesis (activating BAT). Essential fatty acids which form prostaglandins also stimulate thermogenesis. There are also metabolic stimulants that stimulate thermogenesis.

What is Brown Fat (BAT)?

Brown adipose tissue (BAT, brown fat) is where thermogenesis occurs in hibernating animals, cold adapted animals and all newly born mammals including man. It differs from white adipose tissue (body fat) in that the brown fat cell contains many droplets of fat. White adipose tissue (body fat) has only one large droplet of fat. BAT is brown in color because of many mitochondria (energy producing power plants of the cells). It also contains cytochrome enzymes and is surrounded by many capillaries. BAT is innervated by the sympathetic nervous system. It also contains thermogenin, a protein in the mitochondria, causing uncoupling of oxidative phosphorylation and activation of the proton conduction pathway. All this means is instead of forming ATP which can be stored as fat, energy

is dissipated as heat. Instead of storing fat, you burn it.

Does man have BAT? If not what happens to it?

Brown fat usually atrophies in man and warm adapted animals. Outdoor workers in Finland in contrast to office workers have increased BAT. In cold adapted soldiers elevated skin temperatures were found above the BAT areas (nape of neck, between shoulder blades, kidney area) when administered ephedrine.

What can we do to stimulate BAT?

Besides cold and carbohydrates, essential fatty acids activate BAT and cause weight loss. Prostaglandin E₁, a hormone like substance derived from essential fatty acids containing gamma linolenic acid promotes weight loss by activating thermogenesis. Metabolic stimulants such as ephedrine found in mahuang tea, caffeine found in coffee, and capsicum found in red hot peppers stimulate thermogenesis.

Middle chain triglycerides (MCT) containing 6 to 12 carbons result in weight loss by activating thermogenesis. Tryptophan and melatonin derived from tryptophan and synthesized in the pineal gland also activate thermogenesis.

Does the Princeton Plan include an exercise program?

The Princeton Plan includes an alternating exercise plan whereby aerobic exercises (those requiring oxygen - jogging, brisk walking, swimming, rowing, biking) are done on the high carbohydrate, high calorie (HC/HC) day using primarily body fat as its fuel. It also stimulates thermogenesis (activates BAT). After 15-20 minutes, the body is no longer using glucose or glycogen for its main metabolic source of energy but it is using fat. Therefore, the longer you walk the better.

What about anaerobic exercise?

Anaerobic (without oxygen) exercises (resistance training-weight lifting, isometrics) which are often called "Peak Performance" exercises, are done on the low carbohydrate, low calorie (LC/LC), high protein day. It uses the stored glycogen (animal starch) that was provided the day before (on the HC/HC day).

Thus, the fuel (food taken in) today provides the energy for tomorrow's activity. On the HC/HC days, we do aerobic exercises and we use fat as our energy source. The next day when we do our weight resistance exercises, we use the stored glycogen from the day before. In other words, we eat for tomorrow.

This has something to do with our selection of food. When primitive man went into the jungle, he captured animals for food. All men ate meat. For proof of this, we note man's teeth and eyes. Man has teeth (incisors, canine teeth) for chewing. Man has eyes in the front of his head for attacking. In the animal kingdom, all animals having eyes in front are attackers while animals with eyes in the side of the head are preyed upon. The deer has eyes on the side of the head while dogs and cats have eyes in front. Chickens and birds have eyes on the side but meat eating owls, hawks and eagles have eyes in front.

When our primitive ancestor, the hunter and gatherer, went out and killed an animal, brought it back and ate it, it stimulated a lot of neutral amino acids and that mainly prevented serotonin from being formed in the brain. Serotonin is formed from tryptophan. However, tryptophan cannot get into the brain when there are a lot of competing neutral amino acids like valine, isoleucine, leucine. When there is decreased competing amino acids, tryptophan gets into the brain and forms serotonin which enhances sleep, mood changes, and sense of feeling better. One day primitive man ate meat and the next day he ate vegetable matter like berries, nuts, shoots, leaves, seeds, fruits, vegetables, roots which stimulates the pancreas to produce insulin and insulin facilitates sugar reuptake by the liver and muscles, which also stimulates insulin reuptake of competing amino acids into the liver and muscles thus allowing more tryptophan to enter the brain to form serotonin.

Should persons on diets use nutritional supplements?

Nutritional supplements are necessary for several reasons. Some of these stimulate metabolism and help normalize insulin secretion (chromium and PgE₁) and improve insulin sensitivity which is decreased in obese individuals causing high insulin levels. This in turn increases lipogenesis (production and storage of fat).

The Food and Nutrition Board recommend vitamin and mineral supplements for those on reducing diets because it is not possible to obtain the RDA. Most Americans eating 40% fat and tons of sugar in all our processed foods, even on 2500-3000 calories probably cannot get the RDA and certainly on a reducing diet it is impossible.

Increased exercise depletes minerals and water soluble vitamins through sweating and urinary excretion. Potassium and magnesium are important to prevent cardiac arrhythmias and magnesium is important for blood vessel spasm prevention.

Antioxidants (Vitamin E, Vitamin C, beta-carotene) reduce glutathione and selenium. Animals treated with antioxidants frequently experience weight loss. Increased exercise also causes greater free radical formation. They prevent the lipid peroxidation enhanced by exercise. Most doctors knew about this 20 years ago but today particularly cardiologists know it is not just LDL but oxidized LDL that is important and the way to prevent that is by antioxidants. Neurologists know that a lot of neurological diseases (Parkinson's, Tardive dyskinesia) may be caused by free radicals.

Zinc, Vitamin A and C are needed for muscle tissue repair which occurs during strenuous exercise.

EPA (fish oil) and Vitamin E decrease PgE₂ which causes protein degradation.

Data suggest that zinc, chromium and/or selenium may stimulate metabolism in interscapular brown adipose tissue.

B vitamin us may increase 15 to 20 fold during a strenuous training bout because of their role as coenzymes in the oxidative process of cells. This may lead to decreased endurance and loss of stamina. Also, pantothenic acid is important for this.

Vitamin B₆ is essential for muscle building.

L carnitine found in red meats (lean meat is recommended on the LC/LC calorie cutting days) is important for the transfer of fatty acids into the mitochondria.

CoQ₁₀ found in the mitochondrial is important in the electron transport system of intracellular respiration. It also was found to cause weight loss in one human study.

Is the ratio of growth hormone to insulin important?

Review of nutritional literature stated that obese people have more insulin (hyperinsu-lemia) and less growth hormone (GH). Growth hormone is decreased and insulin is increased on obesity (excess body fat). Ornithine and Arginine (amino acids) are GH releasers. Also, the cholinergic system is important because this system is stimulated by choline, sleep, fasting, peak performance exercises which in turn stimulate GH. On weight lifting days eating high protein, low carbohydrate, low calorie would stimulate GH. PgE, increases GH release and decreases insulin release. Chromium picolinate besides increasing insulin receptor sensitivity causes an increase in lean body tissue. Perhaps it does it by decreasing the ratio of insulin to GH. There was a study by Dr. Gary Evans that showed weight lifters who took chromium picolinate found their muscle size increased and their lean body mass also increased and they lost much more fat. If you do a lot of heavy exercising after eating a lot of calories you will still not gain weight because you stimulate muscles, lean body mass. PgE₁ also stimulates BAT and GH.

Are the adrenal glands involved in obesity?

Adrenal corticosteroids activity is increased in obesity and adrenalectomy lowers rate of weight gain and lowers food intake to normal and increases SNS activity. In most obese studies the activity is increased but that does not mean the cortisone levels are high. What happens is that it is being produced at a high level and being metabolized so the level remains the same but it is very highly metabolic, highly active. If you take the adrenal glands out (Adrenalectomy) it lowers weight gain and lowers food intake to normal and increases SNS activity. But to normalize adrenal activity functioning Vitamin C, panthetine (active form of pantothenic acid) zinc picolinate, capsicum (red hot pepper) and melatonin should be given. Melatonin (chromoset) given at night stimulates BAT and thermogenesis.

GABA (gamma aminobutyric acid) activates thermogenesis, supresses food intake and body weight gain. It should be given on HC/HC days as protein interferes with transport of it into the brain.

Is there a variety of foods on the Princeton Plan or is it restricted such as on a high carbohydrate diet or high protein diet?

The Princeton Plan allows you to eat lean red meats, poultry with skin removed, fish, low fat dairy products and eggs. These are restricted in high carbohydrate diets. It also allows you to eat on the HC/HC day, whole grain pasta (spaghetti, macaroni), whole grain breads and cereals, potatoes, nuts and seeds, peas and beans, which are restricted on high protein diets. Incidentally, rats and rodents do not like white flour. They prefer the box or paper around it. Because it has good shelf life is why we make it. In fact, the enrichment of bread started in the 30's when Germany was promoting supermen eating whole wheat and rye breads. Americans decided to add 3 vitamins (thiamine, riboflavin, niacin) and iron calling it enriched but it is still a disaster.

Not only do you avoid the serious side effects of high protein and high carbohydrate diets but the Princeton Plan allows you to eat a variety of foods and palatability will help with staying on the diet. This and the decrease in slowed metabolism (causing plateaus) will lead to a steady and safe weight loss.

How does your diet compare with that recommended by the Food and Nutrition Board?

When you average the nutrients during the two days, it is close to or even better than that recommended by the Food and Nutrition Board. They recommend 55% carbohydrates, 15% protein and 30% fats. We also recommend 55% carbohydrates but less fat, 25% which is still enough to make the diet palatable, and slightly more protein 20% (which is necessary for calorie restricted diets). The fats are mostly polyunsaturated, not saturated.

What happens on a day when it is impossible to follow the Princeton Plan?

If you find it impossible to obtain the proper food when travelling, when too busy at work to get breakfast or lunch, with the children at special events, during family emergencies, the Princeton Plan LC and the Princeton Plan HC can be used. Both formulas contain chromium picolinate and MCT. They are not to be substituted for the largest meal of the day (dinner).

The powder mixture is very helpful in that it has the same thing as the Princeton Plan -the HC/HC LP day and the LC/LC HP day. You also have fructose which will decrease insulin. Fructose has only 20% of the glycemic index of sucrose. Fructose also stimulates BAT. The mixture also contains Guar gum which delays gastric emptying. Guar gum lowers cholesterol and lowers insulin. This powder mixture contains the essential fatty acids which form prostaglandin that stimulates brown fat. It also has chromium picolinate which decreases the insulin. Middle chain triglycerides is very important as it lowers BAT and lipoprotein lipase (LPL) which is the enzyme that increases when people go on diets. What happens when you go off the diet, LPL will increase the synthesis of fat and also the storage of fat.

What is a Yo Yo Diet?

Yo Yo dieting or repeatedly losing and regaining weight is very unhealthy and increases the risk of heart disease. Each time you go on the reducing diet, it takes longer to lose weight and less time regaining the weight. When you lose weight you lose fat, lean body mass (muscle) and water. When you regain it, it is mostly fat. The Princeton Plan will prevent this. Thus the yo yo diet leads to lowering of lean body mass (muscle) which is more metabolic active than fat tissue. Also, when you go on these diets, T_3 (the conversion to T_4 to T_3) is decreased and LPL is raised. Other changes occur as Beta endorphins are raised and BAT is decreased.

What are the disadvantages of High Protein/High Carbohydrate diets?

High protein diets like the Atkins, Stillman, Scarsdale, may impair kidney function because many obese people have diabetes, hypertension, hyperlipemia and cardiovascular disease, all of which can cause kidney impairment.

High protein fat diets low in carbohydrates can promote increase in cholesterol. One doctor recommends 3 pounds of meat and 3 egg omelets daily.

You can get constipation because it is low in fiber.

It causes excretion of water soluble vitamins, minerals and electrolytes (cardiac arrhythmias).

When glycogen is depleted for 2-3 days, the triglycerides are broken down and ketone bodies are formed. Increased serum ketoacids causes loss of organic acid radicals in urine accompanied by obligatory excretion of ketones such as ammonia, calcium, magnesium, potassium, sodium and titrable acidity. This all results in metabolic acidosis, ketosis which is dangerous in severe diabetes.

Uric acid is raised causing hyperuricemia which is due to renal excretion of keto acids producing a competitive excretion of uric acid at the tubular levels, thus you end up with an attack of gouty arthritis.

Orthostatic hypotension may result with dizziness, falls, impaired glomerular filtration and hepatic perfusion.

Hypometabolism (conversion of T_4 to T_3 is decreased) leads to rapid regain of weight. Carbohydrates and high calories raises T_3 to T_4 .

Hypoglycemia, lethargy, sluggishness with craving for carbohydrates and with a decreased desire to exercise. Depletion of glycogen decreases endurance.

The high carbohydrate/low fat and low protein diets such as the Pritkin, Macrobiotic diet and Dean Ornish diet, cause water retention with less initial weight loss which stops people from continuing with the diet. Only highly motivated patients (recent MI, recent cardiac bypass surgery) adhere to it.

It is not palatable because it is low in fat.

It does not satiate thus the dieter feels hungry a couple of hours later.

It is low in Vitamin B_{12} since this vitamin is only available in animal sources.

It is low in iron. Phytic acid in grains binds minerals (calcium, iron and zinc) so these minerals will be depleted, particularly if the calcium is not given as dairy products. A lot of macrobiotic diets lack dairy products.

It is low in complete protein (essential amino acids). You must be very careful in your combinations of vegetable protein. Legumes have lysine which have to be combined with grains and cereals which contain methionine.

Also, refined carbohydrates deplete chromium which is important for insulin receptor sensitivity.

High glycemic index foods (sugar, carrots, potatoes) will raise insulin, cause hyperinsulinemia, insulin resistance, impaired glucose tolerance and eventually lipogenesis which is

the storage of fat.

What is Syndrome X?

Syndrome X is a combination of risk factors for coronary artery disease including high levels of insulin in serum, high triglyceride level, hypertension, obesity (apple type), high LDL and low HDL.

Asian Indians are at very high risk for coronary artery disease. Epidemiologic and clinical studies have established the following risk factors may be of special significance among Asian Indians for increased incidence of CAD (coronary artery disease): (1) high triglycerides, (2) low HDL cholesterol, (3) high LDL cholesterol, (4) low Apolipoprotein A-I, (5) high Apo-B, (6) high lipoprotein A-LP(a), (7) high total cholesterol/HDL ratio (8) high LDL/HDL ratio, (9) high ApoB/ApoA-1 ratio, (10) dense LDL Trait, and (11) hyperapo-betalipoproteinemia.

Many people think carrots are great for diets, but carrots have lots of sugar and have a very high glycemic index. People with diabetes mellitus should stay away from carrots.

Other Asian countries eat a lot of tropical oils (palm kernel oil, coconut oil) which are saturated and very bad to health. Also, in India there is a product called "Ghee" which is a clarified heated butter, which is highly oxidized (peroxidized), very damaging.

In ancient India, sugar was eaten from sugar cane but now Indians are eating sugar just like Americans, white, purified and with all the minerals and vitamins depleted. In India the sugar cane was used as a tooth brush since it had so much fiber.

The Princeton Plan is also based on the Yin and Yang philosophy. Everything is a different shading of one affinity. Everything changes. Everything eventually changes into its opposite: Hot summer-cold winter, youth-old age, action-rest, mountain-valley, day-night, love-hate, rich-poor, life appears-life disappears, land changes to ocean, matter changes to energy, space changes to time. So, actually, the examples of Yin which is centrifugal force, tendency to expansion-aerobic, slower movement, jogging, walking, lighter weight, aerobic exercise, decreased body fat, cold temperature, darkness, both stimulate brown adipose tissue. (Yin = High Carbohydrate/Low Protein day.)

An example of Yang which is on the High

Protein/Low Carbohydrate day, is a contraction of muscles which is a resistance exercise (more active and faster movement). Sprinting is an example of anaerobic exercise. Weight lifting and weight resistance exercises increase lean body mass. Hotter temperature causes blood to flow to the muscles. Thicker density is an example of body builders, who have more contractive muscle and harder shape. Animal foods are higher in protein, and their organ structure is more compact and dense. The

parasympathetic nervous system is important in increasing growth hormone and muscle tissue.

The Princeton Plan fulfills the Yin-Yang theory of Chinese Philosophy, as well as the diet of our ancestors.

References

1. Heleniak E, Aston B: The Princeton Plan, New York: St. Martin's Press, 1990.
2. Heleniak E, Aston B: Prostaglandins, Brow fat and weight loss. *Medical Hypothesis* 28:12 33, 1989.