1. Macronutrient- Carbohydrates

Carbohydrates are the main constituents of the diet, especially in the vegetarian diet of the South Asians. An optimal amount of carbohydrates is essential for healthy metabolic and energy balance in the body. Carbohydrates play a vital role in:

- *Energy synthesis*– Carbohydrates are broken down to glucose in the digestive tract. Glucose is the primary fuel for synthesizing energy for the trillions of the body cells.
- *Protein (Muscle) sparing effect*– The body must get an optimal amount of carbohydrate for energy to save the protein for muscle building and repair. If the diet is deficient in carbs, proteins from the muscles will be broken down for energy. Muscles are the first reserve of available protein energy in the body, and the carbohydrate-deficient diets can lead to unwanted muscle loss.
- *Prevention of ketosis* – Very low carb, high fat and protein diets such as keto diets, cause accumulation of undesirable amounts of acidic breakdown products of fats called ketone bodies in the body. The normal state of the body is alkaline, the carbohydrate-deficient, high fat keto diets; therefore, are not optimal for health and not sustainable long term. The expensive alkaline water machines are getting in the news and the market. What population needs are the natural plant grown alkaline foods and not costly alkaline water units in their homes.
- *Sustenance of brain function* – The primary source of energy for the brain is glucose. The brain can use ketone bodies from the fat but must also have a consistent supply of glucose from carbohydrate intake to function normally.
- *Muscle function* – Glucose is the primary source of energy for muscle activity. Approximately, 70-80% of glucose absorbed from the digestive tract gets used by the muscles. A lifestyle of physical inactivity leads to a high level of unused glucose in the blood. This excess glucose in the body gets converted to reserve energy fat, which eventually leads to obesity.
- *Reserve energy*– Glucose derived from digested carbohydrates is the primary fuel for energy. Besides the energy for immediate use body also creates a store for reserve energy to be used when glucose from the digestive tract is unavailable. The hormone Insulin assists with the process of synthesizing energy in the body, both for immediate use and reserve energy for later use. The reserve energy is of two kinds:
    - Glycogen – It is a short term 24-36 hour reserve energy stored in the liver and muscles. The glucose absorbed from a meal provides up to 1-3 hours of the glucose fuel (based on the size and type of meal) supply for energy synthesis. Between the meals, the body uses glucose derived from glycogen stores. The glycogen breaks down to glucose rapidly and is as readily available as is cash

in the pocket. The capacity of the body to store glycogen is limited to about 150 gm in muscles and 90-100 gm in the liver. Professional athletes who have built endurance to work out long hours without eating can store 3-4 times more glycogen in their muscles “Up to 500 gm or even higher”.

- Fat reserve energy – Once the glycogen stores in the liver and muscles get filled up, the remaining excess sugar in the blood gets converted to fat reserve energy. Fat energy gets stored in the liver, in the abdomen, and under the skin. In contrast to glycogen, the capacity of the body to store fat is unlimited. That is why there is no limit to collecting fat in the body and the severity of obesity. When the body is making more than a healthy amount of fat reserves, the liver is the first organ which gets filled with fat. Fatty liver is the abnormality, which causes insulin resistance, and it is the starting point of diseases such as Type2 diabetes, High Blood pressure, Heart disease, high uric acid, and many more diseases. Insulin is the vital glucose utilization hormone in the body without which body cannot survive. Insulin resistance means insulin is unable to do its regular work of using up glucose in the body.

How much carbohydrate to eat: Focus on the quality and not on the quantity?

For centuries, the predominately vegetarian societies of India lived on carbohydrates as their primary food staple. However, the carbs were unrefined plant-based with a low glycemic index. The lifestyle was active, so energy input and output was in balance. Indian vegetarian population did very well on keeping themselves healthy, free from the food and lifestyle diseases such as obesity, Type2 diabetes, and heart disease. A significant shift in food and lifestyle of urban India took place with the economic and commercial food revolution of the 1970s. The food commercialization brought in a new brand of high glycemic processed and refined carbohydrate foods – white sugar, white wheat flour, and sugary drinks and fruit juices. Affluence and automation brought inactivity and easy access to processed high glycemic foods. The energy balance of the population favored the fat storage, and the epidemics of obesity and related diseases such as Type2 diabetes and heart disease surged as can be expected.

The deterioration in the quality of carbohydrates over the past 50 years has been the single most significant factor in the escalating epidemics of obesity, Type2 diabetes, heart disease, and related many other diseases.

“Turning back the wheels of time 50 years, on the quality of carbohydrates as well as that of fats, will enable the population at large to reclaim health. Education regards to healthy carbs and healthy fats, therefore, should become the priority for the health educators and the governmental regulators ”.

Glycemic Index and Healthy carbohydrates

Glycemic index is an easy tool to judge the quality of carbohydrates. A healthy carb is the one which produces lower levels of glucose in the blood. Dr. David Jenkins of Toronto University in Canada introduced the concept of Glycemic index in 1981.

Glycemic Index (GI) is the ability of a food item to raise blood glucose. A GI below 100 means the test food has less effect on blood glucose when compared to the equivalent amount of glucose (or white bread) ingestion. A higher number means the food will produce high blood glucose and will be considered unhealthy carbohydrate. A good example is a white bread, which has the same GI as that of glucose gram per gram.

A high GI carbohydrate requires the pancreas to produce high levels of the hormone insulin. Repeated intake of high glycemic foods results in persistently high levels of insulin in the body. The function of Insulin is to transport glucose into the cells for making energy. Higher levels of glucose and insulin mean too much glucose is getting transported into the body cells. Since high amounts of glucose fuel inside the cells are toxic, the body fights back by creating the protective phenomenon of the Insulin resistance. The Insulin resistance means the body cells fail to respond to insulin and do not allow a reasonable amount of glucose to get inside the cells for making energy. The starving body cells push the pancreas gland to produce more insulin. The cell starvation also increases food cravings in an attempt to bring more glucose to the body from more food. That sets up a vicious cycle of more glucose and more insulin in the body, which eventually leads to more insulin resistance. Insulin resistance and the collection of abnormal fat in the body go hand in hand. The Insulin resistance is at the root of all new food and lifestyle diseases such as obesity, Type2 diabetes, High blood pressure, heart disease, and cancer.

How to prevent or reverse Insulin Resistance?

The two critical factors responsible for disease-producing Insulin resistance are:

- High Glycemic carbohydrates
- Frequent eating opportunities – That causes persistent high glucose levels with a demand for insulin for most of the day. More insulin demand eventually leads to insulin resistance.

For minimizing insulin resistance, there should be more extended periods of low insulin levels during the 24-hour day. That requires spacing the meals and eating low glycemic foods. The ideal spacing of the meals for those with a healthy weight is 12 hours between night meal and next morning meal and 5-7 hours between day meals for a total of 3 meals/day. That is how our ancestors ate their meals 50 years back.

To conquer obesity, one has to build up a more extended low insulin period, by building up the duration between night meal and next morning meal for up to 16 hours to a total of 2 meals a day. This methodology is called Time Restricted Eating (TRE) or Intermittent fasting schedule. It is a perfect tool for managing obesity as well as Type2 diabetes without cutting off the regular total caloric intake/ day.

The three essential mantras which are critical to minimizing disease-producing insulin resistance and preventing new food and lifestyle diseases are:

- What to Eat (Eat low Glycemic Foods)
- When to eat (During daylight hours only when the body is most insulin sensitive)
- How often to eat (space the meals by using Time-Restricted eating schedule)

Food List by Glycemic Index

In general, processed foods which are rich in refined sugar and refined wheat flour, and deficient in fiber are high glycemic.

The natural foods of plant origin are rich in fiber and are mostly low glycemic.

Low Glycemic foods (Glycemic index less than 50)

(These foods are suitable for reversing Obesity, Type2 Diabetes, High blood pressure, and Heart disease).

- Low glycemic fruits - Apple, orange, all berries such as strawberries, gooseberries, and blueberries.
- All vegetables other than root vegetables
- Whole grains – Wheat Ragi (finger millet), Quinoa, Barley, Oats, Buckwheat, Millet, and Sorghum. Whole grain flours have the husk and endosperm and are rich in fiber, omega three oils, and vitamin B complex.
- Beans and Legumes

Medium Glycemic Foods (Glycemic Index 51-70)

- Fruits such as cantaloupe, watermelon, banana, and Guava
- Root Vegetables such as sweet potato, yam
- Corn, Tomato

High Glycemic foods (Glycemic index greater than 70)

- Fruits such as Mango, Grapes, Figs, Pineapple, Cheeku
- Fruit Juices of all kinds (because there is no fiber to slow down the absorption of fructose sugar present in the fruit in high amount)
- Refined grains – White Bread, Corn Bread, Wheat bread, all boxed breakfast cereals, instant oatmeal, quaker oats, and rolled oats.
- Milled wheat chapati flour and refined wheat flour (Maida)

- All baked goods made from white sugar and refined milled packaged wheat flour- Cake, pastries, muffins, doughnuts, and many more.
- All sugary beverages (sodas, sports drinks, sherbets)

Effect of cooking on the Glycemic index of the foods

Overcooking of grains and vegetables at high temperature and high-pressure raises the glycemic index. Good examples are- potatoes, rice, and cracked wheat (Dalia); which when pressure cooked become high glycemic versus when prepared by the regular boiling process.

Glycemic index of different rice varieties

When it comes to Glycemic index rice is not different from wheat grain. Despite this truth rice has gotten the notoriety of harmful grain. Some varieties of rice such as Thai Jasmine rice, Ponni rice from south India have a high glycemic index. Of the 235 types of rice available in the world, basmati rice has by far the lowest glycemic index. Polished rice has a higher glycemic index compared to unpolished rice. Rice is still considered medium or high glycemic grain based on its variety and method of cooking. Pressure cooking of the rice will raise its glycemic index. The best way to eat rice is to add half a cup of cooked rice to a big bowl of cooked lentils and legumes instead of pouring lentil and legume bowl on a plateful of rice (Dal mein chaval daliye ,na ki chaval mein dal).

Carbohydrate foods which are hazardous to Health

i. Commercial white and wheat bread

Commercial white bread, Pav, and wheat bread have become a staple meal of Indian city dwellers. These loaves of bread get made with refined wheat flour (the brown wheat bread colored by caramelized sugar). Gram per gram the refined bread is no different from regular table sugar when it comes to raising the blood glucose level. There are a few reasons why commercial bread is hazardous to health:

- The chemical process of bleaching and refining the wheat flour used for making bread removes the healthy elements of the grains such as husk and endosperm. These elements are rich in fiber, vitamin B complex, and minerals. The lack of fiber means rapid absorption of digested sugar-producing high glucose levels in the blood. The nutritional value of commercial bread, therefore, is none except for unwanted calories from refined sugar.
- The sugar and trans fats are added to the commercial bread to enhance its taste.
- Several preservatives and chemical are added to prolong the shelf life. The bread may lie on the shelf for more than a week and not get any fungus growth, because even the fungus does not like the chemical preservatives in it.

- The process of fermenting the dough by yeast in the bread-making process breaks down the starch molecule to easily digestible sugars. These are absorbed rapidly in the digestive tract producing high blood glucose levels.

The interesting satirical expression used for white bread is:

"The bread is like the sun - It rises in the yeast and settles at the waist."

"Whiter the bread, earlier it brings you the death."

High consumption of the commercial bread has contributed significantly to the modern epidemics of Obesity, Type2 Diabetes, and Heart disease amongst city dwellers of India. If one were to look back 50 years, the Indian population barely consumed the commercial bread, and these diseases were rare.

ii. **Commercial Sugary drinks**

White (sucrose) sugar or high fructose corn syrup – HFCS (chemical sugar from corn) are the sweeteners in the commercial drinks like carbonated beverages/sodas, sports drinks, pre-prepared teas, and many sweet drinks. The retail beverage industry has used cheap HFCS extensively. Consumption of these beverages has contributed significantly to obesity, Type2 diabetes, and related diseases. There are several reasons why sugary beverages are hazardous to health:

- Sugary drinks are not food – These drinks add on sugar calories without filling up the stomach. Excess sugar increases blood glucose and insulin, which causes excess fat synthesis in the body and disease-producing insulin resistance.

- Fructose sugar in the high fructose corn syrup (HFCS) – Corn sugar is the most widely used sweetener in the commercial sugary sodas and sports drinks. When it comes to adverse health effects, HFCS is far more dangerous than the regular white sugar from sugar cane (sucrose) sugar. Fructose sugar does not break down to glucose in the digestive tract like the regular sugar does, and it does not get distributed in the entire body as the glucose does. Unlike glucose, fructose sugar does not get handled by glucose utilization hormone insulin. Fructose sugar instead goes straight to the liver, where it gets converted into fatty acids. These fatty acids get used up for energy only when there is physical activity. If there is no physical activity, the fatty acids keep getting stored in the liver, causing fatty liver. Excess fat in the liver causes disease-producing Insulin resistance. Merely drinking one can of sugary soda daily for a few months, can lead to fatty liver. There is medical evidence supporting a correlation between HFCS consumption and prevalence of obesity and Type2 diabetes.

    - *(Bray GA et al. American Journal of Clinical Nutrition: 2004 and Jason Fung M.D. Author of the Books "The obesity Code" and "The Diabetes Code.")*

Health Hazard of High Sugar Consumption:

1. There is an association between high sugar intake, obesity, and the risk of cancer. In fact, according to the CDC (Center for Disease Control, USA), almost 15 cancers are linked to obesity.
    - *(Tasevska et al. Sugar in diet and risk of cancer in NIH-AARP Diet and Health Study. Journal of Cancer 2012)*
2. High sugar intake also increases the risk of Type 2 diabetes and dementia (loss of memory)
    a. *(Mercola et al. Journal Diabetologia,2018, and Pase et al. Sugar and artificially sweetened beverages and the risk of incident stroke and dementia.)*
3. Risk of tooth decay – Well known to increase the risk for cavities, gingivitis, and tooth decay are sweets, candies, chocolates, and desserts. Sugary sodas in this respect are worst, as these are highly acidic, rich in phosphoric acid and carbonic acid. The sugar itself breaks down to acids in the mouth. Sugary beverages, therefore, weaken the enamel on teeth and increasing the risk of cavities and gingivitis.

Fruit Juices – Fresh and commercially prepared boxed juices

The commercial boxed fruit drinks, as well as freshly squeezed fruit drinks, are abundant in the disease-producing fructose sugar. As described above, fructose sugar is more harmful to health than the regular white (sucrose) sugar, because the excess of it leads to fatty liver. Compared to fruit juices, which are the most concentrated form of fructose sugar, the whole natural fruits are healthy because they contain fiber and are absorbed slowly. Furthermore, there is an element of speed also. It will take an individual just 1-2 minutes to consume juice from 4 oranges with a rapid rise in the blood level of fructose sugar. Eating four oranges, on the other hand, is labor-intensive, takes a good 10 minutes to eat 2-3 oranges. Concerning the rise in blood fructose levels, therefore, whole fruit with its fiber is more healthy. There are a few sensible rules about eating fruit for good health:

- Eat fruit with all its fiber and not the fruit juices.
- Stay active for 2-3 hours after eating fruits to use up the fruit fructose energy, or else it will settle in the liver as fat. Eating fruit after dinner as a dessert or in

the late evenings is, therefore, not a good idea if you plan on not being active for a couple of hours after your dinner.

Artificial Sweeteners- Are these good for health?

By 1970s, the western populations started to become aware of the health hazards of excessive sugar consumption, especially in the sugary carbonated beverages and commercial foods. The concept of artificial sweetener was born and then spread rapidly globally. The food and beverage industry opened up to the idea of zero-calorie drinks and sugar-free foods to combat the growing epidemic of Obesity and Diabetes. Over the following four decades, diet sodas and sugar-free foods and sweets have dominated the food and beverage market place. Unfortunately, the epidemics of obesity and diabetes instead of going down as would be expected, have only multiplied. That goes to prove that the artificial sweeteners did not do any good at all for human health. The scientific reasons why the artificial sweeteners have failed the expectations are:

- Some artificial sweeteners raise the hormone Insulin levels without increasing the blood glucose levels. Insulin hormone places demands for sugar, so there are more hunger and food craving.
- Artificial sweeteners are several hundred times sweeter than the regular sugar, and the brain perceives these as sugar. Since there is no actual sugar in the body, the brain starts the sugar seeking behavior, causing overeating. Artificial sweeteners in simple language cause sweet addiction and over-eating from lack of satiation.
- Many of the artificial sweeteners cause side effects such as headaches, migraine, dizziness, abdominal pain, muscle cramps, hyperactivity, mood swings, and anxiety. Artificial sweeteners are also known to damage healthy intestinal bacteria and digestive health.

In short, artificial sweeteners have failed to meet the expectations of minimizing obesity and related food and lifestyle diseases.

Alternative natural sweeteners versus white sugar

Refined white sugar was introduced in the market about 200 years back, but its consumption amongst the general global population increased only during the past century. Before the invention of refined commercial sugar, humans consumed many other natural sweeteners. Since refined sugar has proved to be a disease-producing sweetener, the interest in the traditional natural sweeteners has been growing at a fast pace. It is good to have some working knowledge of many sweeteners available in the market.

Honey – Honey has held a favored place in the minds of many because it has the longest track record of being a health-promoting sweetener since ancient times. Unfortunately, pure honey is hard to get as most honey bee population in the world has perished from pesticide spraying of the plants. Sugar contamination is a common problem. It is good to be aware of the benefits and limitations of honey:

- It is challenging to get pure honey the honeybees are the fast disappearing species in the world).
- Costs are too high for everyday use as a sweetener, so used mostly for the medicinal benefits.
- In addition to glucose and fructose sugar, honey has few other nutrients such as amino acids, minerals, vitamins, and antioxidants.
- It is easy to digest honey because of the presence of natural enzymes.
- Anti-inflammatory properties -wound healing, sore throat.
- Nearly similar in calories compared to sugar.
- Honey has the same effect on blood glucose as the sugar with no benefit when it comes to the glycemic index.

Refined white sugar versus Jaggery

The conventional sugar alternatives available in India are Jaggery from the Sugar cane, Coconut, and Palm. The natural dark jaggery is not processed. Refined white sugar from the sugar cane, on the other hand, requires harsh processing with the chemicals such as sulfur dioxide, phosphoric acid, and bleaching agents. This processing removes all the healthy vitamins, minerals, and antioxidants. The natural, unprocessed dark brown jaggery contains several minerals such as iron, phosphorous, calcium, magnesium, selenium, zinc, sodium, and potassium. The mineral content of jaggery is 50 times greater than that of refined sugar and five times higher than that of the crystallized brown sugar. The color of Jaggery can range from light golden brown to darker brown. Darker the color, higher the mineral content. Although Jaggery has a better nutrition profile than sugar, it is high in sugar content and concerning glycemic index no different than sugar.