Dietary approach to management of dyslipidemia in Asian Indian subjects

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Abstract

India is undergoing rapid nutritional transition, resulting in excess consumption of calories, saturated fats, trans fatty acids, simple sugars, salt and low intake of fiber. Such dietary transition and a sedentary lifestyle have led to an increase in obesity and diet-related non-communicable diseases (type 2 diabetes mellitus [T2DM], cardiovascular disease [CVD], etc.) predominantly in urban, but also in rural areas. In comparison with the previous guidelines, these consensus dietary guidelines include reduction in the intake of carbohydrates, preferential intake of complex carbohydrates and low glycemic index foods, higher intake of fiber, lower intake of saturated fats, reduction in trans fatty acids, slightly higher protein intake, lower intake of salt, and restricted intake of sugar. The lipid lowering functional foods can also be included in daily diet. While these guidelines are applicable to Asian Indians in any geographical setting, they are particularly applicable to those residing in urban and in semi-urban areas. Proper application of these guidelines will help curb the rising "epidemics" of obesity, the metabolic syndrome, dyslipidemia, hypertension and CVD in Asian Indians.

Key Words

- Dietary guidelines
- Dyslipidemia
- Asian Indians
- Cardiovascular disease

Introduction

Asian Indians (people of Indian origin living in India or living in other countries) have become more affluent, urbanized and mechanized during the previous decade. Hectic lifestyle and easy availability of convenience foods has led to irregular meals and frequent snacking on energy-dense fast foods[#] including ready-to-use gravies and soups, packaged salty snacks, readymade cookies, and commercial fast-foods rather than traditional home-cooked food.[1] Further, consumption of animal foods, sweetened carbonated drinks, sugar and sweeteners has also increased.[2] In addition, traditional Indian energy-dense foods continue to be consumed. Overall, this nutritional transition, has resulted in high consumption of calories, saturated fats, trans fatty acids (TFAs), simple sugars, salt, along with low intake of fiber, monounsaturated fatty acids (MUFAs) and n-3 polyunsaturated fatty acids (PUFAs).[1] The pattern of nutritional intake in Asian Indians is diverse and influenced by several factors including socio-economic status, region, religion, and easy availability of certain food groups.

It may be hypothesized that the excess dietary fat is deposited in the metabolically active intra-abdominal and truncal subcutaneous adipose tissues[3], which are in excess

[#]"Fast foods" refers to energy-dense foods prepared and sold commercially by roadside vendors and food outlets; prepared either by deep frying or with preheated or precooked ingredients. These foods typically have low nutritional value and preparation time.

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in Asian Indians and play an important role in inducing insulin resistance. The presence of hyperinsulinemia and dyslipidemia, along with obesity and an imbalanced dietary pattern, in Asian Indians is of concern and predisposes them to a high risk of T2DM, the metabolic syndrome, and coronary artery disease.[4–6] Some previous studies also indicated that a high intake of energy, mainly constituting carbohydrates, was responsible for post-prandial hyperinsulinemia and dyslipidemia in Asian Indians.[1,6]

Dietary modification is a powerful non-pharmacological strategy for improving blood lipids. The goals of nutrition management are to maintain or improve quality of life, nutritional and physiological health, and to prevent and treat dyslipidemia and associated co-morbid conditions. In general, nutrition advice for people with dyslipidemia is the same as that for all Asian Indians. For individuals with dyslipidemia, attention to food portions and weight management combined with physical activity may help improve the condition. Nutrition in all forms of dyslipidemia management should be individualized.

Search strategy

The literature search has been carried out using the terms, obesity, dietary guidelines, dyslipidemia, nutrition, international dietary guidelines and developing countries, in the medical search database PubMed (National Library of Medicine, Bethesda, MD) from 1966 to June 2013. A manual search of the relevant quoted references was also carried out from the retrieved articles.

Data have also been taken from nutritional surveys in different developing countries and websites and published documents of the World Health Organization (WHO) and Food and Agricultural Organization (FAO). In total around 800 articles were searched and 35 have been considered for these guidelines. We have mainly considered here the consensus dietary guidelines developed in 2011 for Asian Indians.[7^]

Energy

Energy intake should be limited to the amount of energy needed to maintain (or obtain) a healthy weight, i.e., a BMI 23 kg/m^2. It should be enough to support energy needs, yet allowing for a 5%–10% body-weight loss, if indicated. Energy requirement for any individual is calculated by multiplying the activity factor by ideal body weight of that individual (please see the Tables 1 & 2 below). For example, an Asian Indian man with medium built frame, 165 cm tall, should ideally weigh 62 kg and would require 1850 Kcal to maintain healthy weight if he is sedentary. Ideal body weight should be aimed to maintain a body mass index (BMI) between 18–23 kg/m^2.

^with permission from Diabetes Technology and Therapeutics for Misra A, et al. Consensus dietary guidelines for healthy living and prevention of obesity, the metabolic syndrome, diabetes, and related disorders in Asian Indians. Diabetes Technol Ther. 2011;13(6): p. 683–94.

Table 1: Calculation of ideal body weight

Build	Women	Men
Medium	100 lbs (45.5 kg) for first 5 ft (152 cm) height, plus 5 lb (2.3 kg) for each additional inch	106 lbs (48 kg) for first 5 ft (152 cm) of height, plus 6 lbs (2.7 kg) for additional inch.
Small	Subtract 10%	Subtract 10%
Large	Add 10%	Add 10%

Source: Adapted from Committees of the American Diabetes Association Inc. and American Dietetics Association, 1977
A Guide for Professionals: The Effective Application of "Exchange Lists for Meal Planning." New York: American Diabetes Association; Chicago: American Dietetic Association, 1977.

Table 2: Calculation of energy requirement

Energy requirement (Kcal/Kg IBW/day)			
Activity	Obese	Normal	Underweight
Sedentary	20–25	30	35
Moderate	30	35	40
Heavy	35	40	45–50

Source: Williams, 1989
Williams SR: Nutrition and Diet Therapy, 6th ed. St. Louis: Times Mirror/Mosby, 1989.

A quick and easy guide for use in the clinical setting is the Broca Index. This measurement relates weight in kilograms to height in centimeters, but makes no allowance for sex.

The Broca Index: Height (cm) – 100 = Ideal weight (kg),

For example: A patient whose height is 162.5 cm tall. Ideal weight = 162.5 – 100 = 62.5 kg

Brodsky[8] has modified the Broca Index to allow for sex based on the premise that females have a higher ratio of fat tissue compared to total body weight.

The Modified Broca Index: Male: Height (cm) – 100 = Ideal weight (kg) Female: Height (cm) – 105= ideal weight (Kg).

Carbohydrates and Fiber

Recommendations

1. The daily carbohydrate intake should be approximately 50–60% of the total calorie intake. For example, in an 1800 and 2000 calorie diet, the carbohydrate intake for a sedentary to moderately active individual should be 225–270 g/day and 250–300 g/day, respectively.

2. The primary source of complex carbohydrates in the diet should be cereals (whole wheat, brown rice, etc.), millets [pearl millet *(bajra),* finger millet *(ragi),* great millet *(Jowar)],* pulses [red gram *(tur dal),* green gram *(sabut moong),* etc.] and legumes [soya, horse gram *(kulthi)]*. Complex carbohydrates should be preferred over refined carbohydrates and its products, e.g., whole grain bread over white *(maida)* bread.

3. Low GI carbohydrate foods, e.g., oats *(jai),* unpolished rice, parboiled rice, whole pulses, beans *(fali)* and legumes *(sabut anaz),* some whole fruits (like guava, apple, etc.) should be preferred. High GI foods [refined flour, root vegetables such as yam (sooran/shakarkand), potato, tapioca (a type of *shakarkand*), colocasia *(arbi),* etc.] should be consumed in moderation.

4. The total dietary fiber in daily diet should be 25–40 g/day [e.g., 100 g of apple (1 small apple) gives 1.0 g of fiber; 100 g of whole wheat flour gives 1.9 g of fiber]. Whole grains, cereals, pulses, vegetables and fruits contain high dietary fiber. Diets higher in soluble fiber lead to total cholesterol reductions of 5% to 19% and low density lipoprotein cholesterol (LDL-C), reductions of 8% to 24%.[9–11] Foods high in soluble fiber include oat bran, oatmeal, beans, peas, rice bran, barley, citrus fruits, strawberries, and apple pulp.[12]

5. A minimum of four to five servings per day of fruits and vegetables are recommended, i.e., approximately 400–500 g/day including 3 vegetable and 2 fruit portions. [e.g., 100g (one *katori*) raw vegetables, e.g., cauliflower, brinjal, etc. = 20–30 Kcal, 100 g fruit, e.g., one apple = 59 Kcal]. Fruits should be eaten whole preferably with the skin whenever feasible instead of fruit juices.

Simple sugars like crystalline sugar, sugarcane juice, sweetened carbonated beverages, fruit juices and sugar syrups should be avoided.

While deciding for carbohydrates, the glycemic index (GI) of foods should also be considered. GI is a measure of the effects of carbohydrates on blood sugar levels. Carbohydrates that break down quickly during digestion and release glucose rapidly into the bloodstream have a high GI, whereas carbohydrates that break down more slowly, releasing glucose more gradually into the bloodstream, have a low GI. Emerging research, globally and from India, has shown the relevance of GI in the Indian context.[13] Foods having GI of 55 or less are considered to have low GI; between 56–69 as medium GI; and 70 or above as high GI. Along with GI, glycemic load (GL) of the food should also be considered, which depends on the amount of carbohydrate consumed. The glycemic load of a food is calculated by multiplying the GI and the amount of carbohydrate (in g) provided by a food and dividing the total by 100. For one serving of a food, a GL lower than 10 is considered low; between 11–19 is considered medium, and 20 or more is considered high. GI of some commonly consumed foods has been provided in Table 3.

Fats

Dietary fat includes both unsaturated and saturated fatty acids. The substitution of unsaturated fatty acids (including both polyunsaturated and monounsaturated) for saturated fatty acids leads to decreased LDL-C levels; slightly greater LDL-C reductions are observed with polyunsaturated fatty acids than with monounsaturated fatty acids.[14,15] While high intake of polyunsaturated fatty acids may reduce high density lipoprotein cholesterol (HDL-C) and triglyceride levels, the substitution of monounsaturated fatty acids for saturated fatty acids has a minimal effect on HDL-C values and does not raise triglyceride levels.[14–18] Dietary intake of trans fatty acids is associated with both increased LDL-C and decreased HDL-C levels.[19] Combined with evidence from epidemiologic cohort studies, these effects indicate that diets high in trans fatty acids are associated with an increased risk of coronary artery disease (CAD); current evidence indicates that, on a per calorie basis, risk with trans fatty acids is higher than with any other macro nutrients.[19]

A high dietary intake of fat has been reported in Asian Indians.[20,21] Fat consumption ranged from 13 to 59 g/d in different regions and states in India. Further, individuals in rural areas in India consume lower (17 %) energy intake from dietary fat as compared with urban residents (22%).[22] Even though it has not been well investigated in healthy individuals, long-chain n-3 supplementation clearly lowers levels of serum triglycerides.[23] Furthermore, these investigators have shown that South Asians had a higher proportion of total fatty acids as n-6 PUFA and a lower proportion of long-chain n-3 PUFA in plasma and cellular membrane phospholipids as compared with white Caucasians.[24] It has been suggested that an imbalance in

Table 3: The average glycemic index of common foods derived from multiple studies by different laboratories

High-carbohydrate foods	GI	Breakfast cereals	GI	Fruit and fruit products	GI	Vegetables	GI	Dairy products and alternatives	GI	Legumes	GI	Snack products	GI	Sugars	GI
White wheat bread§	75 ± 2	Cornflakes	81 ± 6	Apple, raw‡	36 ± 2	Potato, boiled	78 ± 4	Milk, full fat	39 ± 3	Chickpeas	28 ± 9	Chocolates	40 ± 3	Fructose	15 ± 4
Whole wheat/ whole meal bread	74 ± 2	Wheat flake biscuit	69 ± 2	Orange, raw‡	43 ± 3	Potato instant mash	87 ± 3	Milk, skim	37 ± 4	Kidney beans	24 ± 4	Popcorn	65 ± 5	Sucrose	65 ± 4
Unleavened wheat bread	70 ± 5	Porridge, rolled oats	55 ± 2	Banana, raw‡	51 ± 3	Potato, French fries	63 ± 5	Ice cream	51 ± 3	Lentils	32 ± 5	Potato crisps	56 ± 3	Glucose	103 ± 3
Wheat roti	62 ± 3	Instant oat porridge	79 ± 3	Pineapple, raw	59 ± 8	Carrots, boiled	39 ± 4	Yogurt, fruit	41 ± 2	Soya beans	16 ± 1	Soft drink/ soda	59 ± 3	Honey	61 ± 3
Chapatti	52 ± 4	Rice porridge/ congee	78 ± 9	Mango, raw	51 ± 5	Sweet potato, boiled	63 ± 6	Soy milk	34 ± 4			Rice crackers/ crisps	87 ± 2		
Corn tortilla	46 ± 4	Millet porridge	67 ± 5	Watermelon‡, raw	76 ± 4	Pumpkin, boiled	64 ± 7	Rice milk	86 ± 7						
White rice, boiled§	73 ± 4	Muesli	57 ± 2	Dates, raw	42 ± 4	Plantain/green banana	55 ± 6								
Brown rice, boiled	68 ± 4			Peaches, canned‡	43 ± 5	Taro, boiled	53 ± 2								
Barley	28 ± 2			Strawberry jam/jelly	49 ± 3	Vegetable soup	48 ± 5								
Sweet corn	52 ± 5			Apple juice	41 ± 2										
Spaghetti, white	49 ± 2			Orange juice	50 ± 2										
Spaghetti, whole meal	48 ± 5														
Rice noodles‡	53 ± 7														

Adapted from: Atkinson FS, Foster-Powell K, Brand-Miller JC. International tables of glycemic index and glycemic load values: 2008. Diabetes Care. 2008 Dec;31(12):2281–3
Data are mean ±SEM. § Low GI varieties were also identified. ‡average of all available data

dietary n-6 and n-3 PUFA may be important for the development of insulin resistance and dyslipidemia in South Asians.[25]

Recommendations

1. Fats should provide not more than 30% of total energy/day and SFAs should provide no more than 10% of total energy/day. For individuals having LDL cholesterol of ≥100 mg/dl, SFAs should be <7% of total energy/day.

2. Essential PUFAs [linoleic acid (LA)] should provide 5–8% of total energy/day.

3. α-linolenic acid (ALA) should be 1–2 % of total energy/day.

4. Optimal ratio of LA/ALA should be 5–10.

5. Long chain n-3 PUFAs should be obtained from fish/walnuts/flaxseeds/canola oil, etc.

6. *Cis* MUFAs should provide 10–15% of total energy/day.

7. TFAs should be <1 % of total energy/day.

8. Cholesterol intake should be limited to 200–300 mg/day.

The lower limit of fat should be adequate for the energy needs (15% of total energy), should prevent essential fatty acid deficiency (LA – 3% of total energy; ALA – 0.5% of total energy), and should facilitate optimal absorption of fat-soluble vitamins.[39]

Food-based guidelines to ensure optimal fat quality in Asian Indian diets

1. Since complete dependence on just one vegetable oil does not ensure optimal intake of various fatty acids, use of 2 or more vegetable oils is recommended.

2. The recommendation for oils are as follows[26]:

    a. Preferred vegetable oil(s) along with ALA containing oil(s) or vegetable oil containing high LA along with moderate or low LA containing oil(s) are listed below. However, the latter combination would ensure moderation in LA intake only and is recommended when other dietary components provide high ALA or fish is consumed. Improvement of n-3 PUFA nutritional status in Indian adults has been shown with two of these oil combinations (groundnut oil/sunflower oil and canola).[26]
    b. Consumption of butter and *ghee* (clarified butter) should be kept to minimum.
    c. Use of PHVO *(Vanaspati),* as cooking medium should be strictly avoided.
    d. sCoconut oil, palm kernel oil, palm oil and palmolein or their solid fractions should be substituted for PHVO in foods that require solid fats (bakery fats, shortening, etc.). These oils are high in SFAs but are TFA free.

3. To ensure correct balance of fatty acids from dietary components other than visible fat, the following dietary guidelines are recommended[26–28]:

    a. Regular consumption of foods with high ALA content (wheat, pearl millet, pulses, green leafy vegetables, fenugreek, flaxseed, mustard seeds).
    b. Partial substitution of visible fat and invisible fats from animal foods with whole nuts such as pistachios and almonds.
    c. Moderation in the use of animal foods containing high fat, SFAs and cholesterol.

        i. For non-vegetarians, consumption of 100–200 g fish (4–6 pieces)/week.
        ii. Minimizing consumption of premixed, ready-to-eat, fast foods, bakery foods and processed foods prepared in PHVO (hydrogenated fat) like savory *(namkeen)*.

    d. Choose low fat dairy foods such as double toned milk (fats <1.5%) or curd prepared from such milk. The preference of low fat dairy foods would also reduce ruminant TFAs.

Complete dependence on just one vegetable oil does not ensure optimal intake of various fatty acids.

Combination/blend of 2 or more vegetable oils (1:1) is recommended.

Some recommended oil combinations are:

- Groundnut/sesame/rice bran/cotton seed + Mustard/Canola/Soyabean
- Safflower/sunflower + mustard/ olive/Groundnut/ Rice bran

To limit the intake of trans-fats avoid the use of partially hydrogenated vegetable fat (*vanaspati*/margarine) for cooking/frying/baking.

While low-fat diets are generally recommended, it is important to recognize that decreases in dietary fat intake may lead to increased carbohydrate consumption and subsequent weight gain.[16,17,29,30] Patients at risk for the insulin resistance syndrome are advised to avoid excessive carbohydrate intake and to consume diets that include relatively more unsaturated fats.[14,31] A diet high in carbohydrates (>60% of total energy) will increase triglycerides, while a diet that replaces saturated fatty acids with monounsaturated fatty acids will not.[14]

Proteins

1. Protein intake should be based on body weight. This should be 1 g/kg/day, considering the quality of protein in a usual Indian vegetarian diet.

2. In conjunction with energy intake, the protein intake should provide 10–15% of the total calories/day in sedentary to moderately active individuals.

3. Recommended protein sources:

   a. Non-vegetarian: Egg white, fish, and lean chicken.
   b. Vegetarian: Soya, pulses, whole grams (c*hanna, rajma,* green gram, etc.), milk and low fat dairy products.

Salt

1. Salt intake should be less than 5 g of sodium chloride (or about 2 g sodium)/day.[32]

2. Addition of extra salt at the dining table should be avoided.

3. Dietary intake of sodium from all sources (pickles, *chutneys, namkeens, papads* bakery items, potato chips, popcorn, salty biscuits, preserved meat products, other pre-prepared and preserved foods, soups, cheese, fast foods) should be limited. Avoid processed foods that have high salt content.

4. Reading of food labels to determine sodium content of the commercial foods should be encouraged. Sodium, in such foods may be added in such foods in the form of sodium benzoate, monosodium glutamate, baking powder, and baking soda.

Sugar and artificial sweeteners

1. Free sugars should be less than 10% of total calories/day, which includes all added sugars and sugars present in honey, syrups and fruit juices.[32]

2. Alternatives to sweetened beverages can be water, skimmed buttermilk, tender coconut water, low fat milk.

3. Indian sweets, *halwa* (a gelatinous sweet dish made from grain flour, *ghee,* sugar and nuts), *kheer* (a sweet dish made from boiling rice with milk, sugar, cardamoms, saffron and nuts), puddings, ice creams, sweetened biscuits, cakes, pastries and baked goods are high in added sugars and should be restricted.

4. Encourage reading of food labels to determine sugar content. Some of the names in the ingredients list for the presence of added sugars include: brown sugar, corn syrup, dextrose, honey, malt syrup, sugar, molasses and sucrose.

5. Artificial sweeteners could be used in moderation. However, these do not contain any beneficial nutrients and long–term health benefit, if any, is not clear in non-diabetic individuals. The Food and Drug Administration (FDA) has approved 5 artificial sweeteners; saccharin (Sweet 'N' Low, Sweet Twin, Necta Sweet), aspartame (Equal, Sweetex, Sugar free, Sugar free gold), acesulfame-K, neotame (both are used in beverages, dairy products, pharmaceutical products, chewing gum etc.), and sucralose (Splenda, Zero, Sugar free natural) as safe.33,34 Although doubts have been raised regarding safety of saccharin, however, FDA has approved it to be used in limited quantity due to low price, good shelf life and heat stability. Stevia (Stevi0cal, Gwiser) and some sugar alcohols (Sorbitol, xylitol, mannitol, maltitol, etc.) have been approved by FDA under GRAS (Generally Recognized as Safe) status.

Alcohol

According to guidelines of National Cholesterol Education Program, Adult Treatment Panel III (NCEP, ATP III, 2001)[35] and American Heart Association (AHA, 2006)[36], alcohol intake should be limited to one drink/day (equivalent to 30 ml whisky/gin/vodka or 120 ml of wine or 300 ml of beer) for women and 2 such drinks/day for men. However, alcohol should not be taken if serum triglycerides are 500 mg/dL or above[37] and in presence of significant liver dysfunction. Most of these studies have evaluated white Caucasian subjects, and whether these results can be extrapolated in Asian Indians, who already have high prevalence of fatty liver, is not clear.

Recommendations

Regular excessive intake of alcohol is harmful. Till more

data are available for Asian Indians, non-consumers of alcohol should not have alcohol; however, individuals taking small quantity of alcohol should not be discouraged.

Lipid lowering foods

There is also a need to identify and include foods which have been reported to have lipid lowering properties.

Following are some of the food items that have been documented to have lipid lowering effect:

1) Oats[38–40]
2) Nuts[41–45]
3) Psyllium husk[46]
4) Cinnamon[47–49]
5) Flaxseeds[50,51]
6) Fenugreek[52,53]
7) Soy[54–56]
8) Amla[57]
9) Garlic[58]
10) Finger Millet[59]
11) Terminalia arjuna[60]

Long term studies are required to evaluate the effect of these food items and appropriate dosage for Asian Indians.

Conclusion

In comparison to previous guidelines, the Consensus Group recommends a reduction in the intake of carbohydrate (50–60% of total energy/day), preferential intake of complex carbohydrates and low GI foods, higher intake of fiber (25–40 g/day), lower intake of saturated fats (less than 10% of total energy/day) optimal essential fatty acids/day (LA 5–8% and ALA 1–2 % of total energy, *cis* MUFAs 10–15%, TFAs <1% of total energy), slightly higher protein intake (10–15% of total energy/day), lower intake of salt (5 g/day), and restricted intake of sugar (less than 10% of total energy/day). Although these guidelines are applicable to Asian Indians in any geographical setting, they are particularly applicable to those residing in urban and in semi-urban areas. Proper application of these guidelines will help curb the rising ''epidemics'' of the metabolic syndrome, T2DM, dyslipidemia, hypertension and CVD in Asian Indians.

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