# Incorporation of whole, ancient grains into a modern Asian Indian diet to reduce the burden of chronic disease

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*Refined carbohydrates, such as white rice and white flour, are the mainstay of the modern Asian Indian diet, and may contribute to the rising incidence of type 2 diabetes and cardiovascular disease in this population. Prior to the 1950s, whole grains such as amaranth, barley, brown rice, millet, and sorghum were more commonly used in Asian Indian cooking. These grains and other non-Indian grains such as couscous, quinoa, and spelt are nutritionally advantageous and may be culturally acceptable carbohydrate substitutes for Asian Indians. This review focuses on practical recommendations for culturally sensitive carbohydrate modification in a modern Asian Indian diet to reduce type 2 diabetes and cardiovascular disease in this population.*





## INTRODUCTION

Asian Indians and Asian Indian immigrants to the United States face a distinct transition in nutrition and dietary practices. Immigration is generally associated with higher caloric intake[1] and higher intake of refined and processed grains,[2] less physical activity,[3] and consequent weight gain.[1] For this population group, nutrition counseling should initially target reduction in caloric excess, reduction of refined, processed grains and added sugars, and include other interventions to promote weight loss and reduce disease burden.

Despite having low levels of obesity and overweight, Asian Indians are at greater risk for type 2 diabetes and other metabolic abnormalities.[4–11] The modern Asian Indian diet is particularly high in refined carbohydrates and low in protein, compared to other dietary traditions.[12,13] Recent studies in India have established strong positive associations between refined grain intake and type 2 diabetes and confirm the protective effect of fiber, which is contained in whole grains.[14] Observational studies have shown that whole grains[15–18] are associated with weight loss and reduced incidence of insulin resistance and type 2 diabetes. Carbohydrates are integral to Asian Indian dietary traditions,[19] and reintroduction of culturally acceptable, traditional, carbohydrate-rich grains with high nutrient density may be a prudent step towards reducing disease burden in this population.

Since the 1951 Green Revolution in India, refined grains such as white rice and refined wheat flour have become staples of the modern Asian Indian diet.[19] The Green Revolution was an attempt by the Indian government to avoid reliance on foreign food aid (following independence from British imperialism) by developing and subsidizing inexpensive, high-yield crops.[19] Prior to this nutrition transition in India, traditional meals and recipes were derived from whole-grain carbohydrates[14] and included amaranth, barley, millet, and other ancient grains that have been grown on the Indian subcontinent for the past few millennia.

This aim of the present article was to review the existing literature in order to provide recommendations

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on employing various ancient, whole grains as a preferred carbohydrate source in a modern Asian Indian diet, particularly an immigrant diet, to achieve a balance of macronutrients, micronutrients, fibers, and phytochemicals for optimal health promotion and in order to prevent chronic diseases such as type 2 diabetes, cardiovascular disease (CVD), and obesity. Use of these grains may also allow individuals to make healthful dietary changes that align with their cultural tradition, because Asian Indians place particularly high value on traditional diets and may feel more comfortable modifying their traditional diets rather than adopting a new, more Western-style diet.[20]

Providing more healthful and traditional whole-grain substitutes for refined carbohydrates can be one important aspect of therapeutic dietary modification undertaken by Asian Indian immigrants in the United States, in consultation with their healthcare providers, to achieve better health outcomes. The recommendations in this review can also be extrapolated and tailored to other Asian Indian diaspora populations around the world, and similar approaches to culturally sensitive recommendations for lifestyle and diet modification may be appropriate in other racial/ethnic groups in different regions of the world as well.

## ASIAN INDIANS AND CHRONIC DISEASE

Asian Indians, who comprise 18% of the Asian American population,[21,22] are at high risk of type 2 diabetes, coronary artery disease (CAD), and obesity, as compared to non-Hispanic whites (NHWs) and other Asian racial/ethnic subgroups in the United States. Approximately 70% of Asian Indians living in the United States are foreign-born.[22] Young Asian Indian men have been found to have significantly higher rates of CAD[4–7] and the highest mortality rates from CAD[4,6,7] compared to all other racial/ethnic groups in the United States, with similar findings reported in Canada[23] and the United Kingdom.[24] CAD remains the leading cause of death among Asian Indians in the state of California.[25]

The trend toward higher rates of insulin resistance[8] and type 2 diabetes[9–11] in this segment of the US population could possibly be explained by increased visceral fat distribution[26] and atherogenic lipoproteins.[8] In response to studies demonstrating higher adiposity per unit of body mass index (BMI) in Asian Indians[27] as well as other Asian subgroups, and increased risk of type 2 diabetes and CVD at lower BMI,[28] the World Health Organization (WHO) created Asian-specific BMI standards in 2002 that are lower than the traditional BMI cut-off points.[28] While these new BMI guidelines have received continual attention and have not completely resolved the connections among race/ethnicity, cultural tradition, and CVD risk factors, they do support the idea that predisposing genetic factors contribute to the propensity of Asian subgroups to develop type 2 diabetes and other risk factors for CVD at lower levels of body weight. These genetic factors make effective prevention efforts and successful lifestyle modification more challenging, but also more crucial in these groups.[28]

The traditional Asian Indian diet has generally been characterized as one that is high in saturated fat and refined carbohydrates.[12,13] Asian Indian immigrants and their families tend to incorporate meals heavy in refined carbohydrates into daily eating habits, with vegetables and protein (*dal*, meat, or fish) serving as subsidiaries to grains such as white rice and refined wheat. While Asian Indians are not unique in their cultural emphasis on diet, studies indicate that traditional diets are highly valued in Asian Indian communities.[20] Asian Indians who place emphasis on consuming a traditional diet may be discouraged by culturally irrelevant advice on diet modification, because they may feel it is impossible to eat healthy foods and adhere to cultural roots. Thus, they may feel more comfortable modifying traditional diets by altering specific ingredients or cooking methods, instead of adopting a new diet altogether.[20]

Clinicians seeking to make culturally sensitive recommendations on diet modification to Asian Indian patients can learn about the modern Asian Indian diet and the ways in which ancient, whole grains may be substituted for more widely-used refined carbohydrates.

## CARBOHYDRATES AND ASIAN INDIAN DIETS

Lifestyle changes, including diet modification (reduction of total calories, refined carbohydrates, and added sugars, and promotion of fiber-rich foods) have been shown to significantly decrease the progression of type 2 diabetes in Asian Indians, even in the absence of weight loss.[29] The typical Asian Indian diet is high in carbohydrates (70–80% of total daily caloric intake)[12] and low in protein (9–10% of total daily caloric intake),[12] making it higher in carbohydrate and lower in protein than recommendations from both the Indian Council of Medical Research (60% carbohydrate, 10–12% protein)[12] and the United States Institute of Medicine (45–65% carbohydrate, 10–35% protein).[30] Many studies have shown the benefits of lower carbohydrate (35–40%) and higher protein (20–30%) diets, including greater satiety,[31–33] weight loss,[32,34,35] and improvements in cholesterol[32] and insulin parameters.[32] These studies focused on varying the macronutrient composition (i.e., lower carbohydrate) rather than the macronutrient quality (i.e., better carbohydrate). Other studies have specifically studied macronutrient quality (i.e., substitution of whole grains) without varying macronutrient composition and found beneficial reduc-

*Table 1* **Nutritional content of white rice and healthier white rice substitutes.**[†‡]

| Grain type | Name in major Indian languages | Total calories (Kcal) | Total carbohydrate (grams) | Total dietary fiber (grams) | Total protein (grams) |
|---|---|---|---|---|---|
| White rice[49] | *Chawal* (Hindi) | 370 | 81.7 | 2.8 | 6.8 |
| Brown rice[49] | *Chawal* (Hindi) | 370 | 77.2 | 3.5 | 8.0 |
| Barley[49] | *Jau* (Hindi) | 352 | 77.7 | 15.6 | 9.9 |
| Whole-wheat couscous[49] | No Indian equivalent | 376 | 77.4 | 5.0 | 12.8 |
| Quinoa[49] | No Indian equivalent | 368 | 64.2 | 7.0 | 14.1 |
| Spelt[49] | No Indian equivalent | 338 | 71.2 | 10.7 | 14.6 |

[†] Values are based on 100 g (uncooked) portion.
[‡] Recommended serving size may vary, depending on the grain.

tions in risk factors for CVD, including BMI, insulin sensitivity, and type 2 diabetes.[36]

Asian Indians may doubly benefit from ancient whole-grain substitution by decreasing the overall amount of dietary carbohydrate and increasing carbohydrate quality. For example, as outlined in Table 1, if one serving of white rice is replaced with quinoa, the amount of carbohydrate decreases by 17.5 g and protein increases by 7.3 g. This carbohydrate substitution would serve to subtly shift the daily macronutrient balance to the recommended levels without conscious avoidance of carbohydrate or supplementation of protein in the diet. Additionally, quinoa contains 4.2 extra grams of fiber along with a host of other micronutrients, which is indicative of better carbohydrate quality. Gram for gram, ancient whole grains offer fewer carbohydrates and more protein, and additionally contain beneficial fibers, proteins, and micronutrients.

## Overall benefits of whole grains

It is well documented that consumption of whole grains, even without a reduction in overall carbohydrate intake,[37] reduces risk factors for CVD, including BMI, insulin sensitivity, and type 2 diabetes.[36] Various epidemiologic cohort studies have demonstrated that a 2- or 3-serving-per-day increase in whole-grain consumption is associated with a 20–30% decrease in type 2 diabetes, even after adjustment for confounders such as age, gender, and BMI.[16–18]

Several lines of evidence, including observational epidemiologic studies with humans, human studies of glycemic response, animal studies, and studies of adiponectin and lipids, have demonstrated the beneficial effects of a whole-grain diet. Brown rice (whole grain) intake has been associated with a lower risk of type 2 diabetes, while white rice (refined grain) intake is associated with higher risk.[15] Thus, risk of chronic disease could intensify as refined grains displace traditional whole grains, since the risk of type 2 diabetes increases as the ratio of refined-grain to whole-grain food intake increases.[38] An Indian study comparing pearl millet (*bajra*), barley, and corn found that glycemic response to pearl millet (*bajra*) and barley, but not corn, was significantly lower than glycemic response to white bread, particularly in individuals who did not already have type 2 diabetes.[39] For diabetic patients in India, it has been shown that wheat-based and millet-based formulations yield lower glycemic indices than rice-based formulations.[40] In a Japanese population, postprandial glucose and insulin levels were shown to be suppressed after replacing a serving of white rice with 30%, 50%, and 100% rolled barley.[41] When Japanese millet protein was fed to diabetic mice, several beneficial effects were observed: plasma levels of adiponectin and high-density lipoprotein cholesterol increased, while glucose and triglyceride levels decreased.[42] As a group, whole grains have been associated with lower total plasma cholesterol and/or low-density lipoprotein cholesterol.[43,44] Moreover, there is speculation that whole-grain foods, through their fiber, antioxidants, and other components, causally reduce the risk of coronary heart disease, because the inverse association between whole-grain consumption and coronary heart disease exists in a dose-dependent manner.[45]

## Benefits of fiber in whole grains

Some authors have postulated that the combination of compounds in whole grains (i.e., fiber, proteins, vitamins, phytochemicals, and minerals) may explain their protective effects.[46] Because they are digested more slowly than refined grains, which have been stripped of the germ and bran that cover the starchy endosperm, whole grains maintain a lower glucose and insulin response in the body than refined grains.[17,46] Soluble fibers in whole grains may contribute to the reduction of CVD, and their effects could be enhanced by the body's relatively slow digestion of carbohydrates in whole grains; additionally, insoluble fibers in whole grains promote bowel health by speeding intestinal transit time with less reabsorption of water.[17] Both adults and

children with high intakes of dietary fiber also exhibit lower blood pressure and serum cholesterol levels, reduced glycemia and insulin sensitivity, and lower risks of developing stroke, hypertension, type 2 diabetes, obesity, and certain gastrointestinal diseases.[47] Some have also hypothesized that beyond the fiber content of whole grains, the structure may affect carbohydrate metabolism; this is because the necessary breakdown of the germ and bran before reaching the starchy, inner endosperm could delay or render some starch unavailable for absorption, thereby reducing glycemic index in those who consume whole grains.[17] This is aligned with the idea that the food matrix, or the combination of naturally occurring components of foods, promotes health, rather than the individual constituents of food.[48] Therefore, promotion of whole-grain carbohydrate provides a less reductionist approach to clinical care than focusing on specific macro- or micronutrients.

## Benefits of protein and micronutrients in whole grains

Some authors have postulated that increasing protein in the diet increases satiety[34]; thus, while whole grains should not be considered the main source of protein in the diet, an individual who eats whole grains with relatively high protein content may benefit from this supplementary source of protein and consume fewer calories in a day. Some whole grains provide double the protein content of refined grains; for example, 100 g of uncooked white rice contains 7 g of protein, while the same amount of amaranth or quinoa contains 14 g (see Table 1).[12,49]

Whole grains also provide valuable micronutrients to the diet that refined grains may not, unless they are fortified or enriched with specific micronutrients after they have been stripped of their germ and bran layers. Whole grains, such as wheat, brown rice, barley, sorghum, and millet, provide large amounts of potassium, phosphorus, magnesium, iron, zinc, copper, and manganese, as well as the B vitamins, excluding vitamin $B_{12}$.[50] Iron is a particularly important mineral for Asian Indian vegetarians, because vegetarian diets may not provide the amounts of iron needed to avoid iron-deficiency anemia. When whole grains are eaten in appropriate quantities, so as not to displace other healthy foods such as fruits and vegetables, they provide certain essential micronutrients and their effects may be bolstered by the micronutrients available in other foods that are eaten at the same time.[50] For example, green, leafy vegetables may provide calcium and thus supplement the relatively low amounts of calcium available in whole grains.[50] Thus, the use of whole grains as replacements for refined grains in Asian Indian diets will provide a host of micronutrient advantages in addition to being a healthier carbohydrate alternative for patients.

## Ancient grains in the historic Asian Indian diet

Indian cuisine is often described as indescribable, because of its complexity and regional variety. The country's history of invasions, migration, and imperialism has not only shaped its social and political position in the world today, but it has also influenced food culture across the subcontinent. Since prehistory and through the periods of the Indus Valley civilization and the migration of Aryan tribes into the subcontinent in the one or two millennia BCE, dietary staples consisted of rice, millet, barley, wheat, and lentils.[19] As Hinduism developed around 1000 BCE, followed by Jainism and Buddhism, many Indians incorporated vegetarianism into their diets to align with the idea of *ahimsa*, or nonviolence.[19] Through the early to recent centuries CE, various ruling dynasties and migrations influenced Indian cuisine with Persian, Portuguese, Asian, and British influences until partition and Indian independence from the British in 1947.[19] Despite regional distinctiveness in cuisine, recent studies of diet in India generally reveal a high intake of refined carbohydrates (>60% of total daily caloric intake) in the form of white rice or refined wheat flour.[51]

Some historical analyses of Indian cuisine have mentioned the use of ancient whole grains, such as barley and millet.[19,52] Following Indian independence, however, India relied on foreign food aid, and one of the priorities for the Indian government was to develop high-yield strains of grains that could feed the country's inhabitants. As a result of this Green Revolution in 1951, per capita consumption of refined rice and wheat in India has nearly tripled. Today, India is one of the world's foremost exporters of rice and wheat, and these grains have eclipsed other, more healthful grains, such as barley and millet.[19] In addition, a negative perception now accompanies the use of certain grains, such as brown or red rice, which are perceived as inferior to white, basmati rice, which is considered "richer"[52] or more often consumed by the "upper class." In addition, the consistency and shorter cooking time of white, refined rice makes it more desirable in Indian dishes. Ancient grains that do not have an associated negative perception may thus be easier to incorporate into the modern Asian Indian diet in order to improve its healthfulness. Use of these grains may then promote cultural approval of serving and eating grains with high nutritional value, thereby reducing the negative perception associated with more commonly known whole grains, such as brown rice.

The five most common ancient grains that have the potential to be used more in Asian Indian cooking, along with brown rice as a replacement for white rice, are amaranth (*rajgira* in Hindi), barley (*jau*), pearl millet (*bajra*), finger millet (*ragi*), and sorghum (*jowar*) (see Tables 1 and 2). These grains have higher fiber and protein content

*Table 2* **Nutritional content of wheat and healthier wheat substitutes.**[12†‡]

| Grain type | Name in major Indian languages | Total calories (Kcal) | Total carbohydrate (grams) | Total dietary fiber (grams) | Total protein (grams) |
|---|---|---|---|---|---|
| White (refined) wheat flour[49] | *Maida* (Hindi) | 364 | 76.3 | 2.7 | 10.3 |
| Whole-grain wheat flour[49] | *Gehoo ka Atta* (Hindi) | 340 | 72.0 | 10.7 | 13.2 |
| Millet flour[49] | *Bajra* (Hindi) | 373 | 73.0 | 3.5 | 10.8 |
| Sorghum flour[49] | *Jowar* (Hindi) | 361 | 77.5 | 6.6 | 7.9 |
| Finger millet[12] | *Ragi* (Hindi) | 328 | 72.0 | 3.6 | 7.3 |
| Amaranth[49] | *Rajgira* (Marathi) | 371 | 65.33 | 6.7 | 13.6 |
| Spelt[49] | No Indian equivalent | 338 | 71.2 | 10.7 | 14.6 |

† Values are based on 100 g (uncooked) portion.
‡ 100 g (uncooked) of any of these wheat or wheat substitutes makes 2–4 chapatis, depending on the size of the chapati and amounts of other ingredients in the recipe.

and can be used to make the commonly eaten *rotis* and *chapatis*. Many Indian recipes that describe traditional preparations of these grains are available through oral tradition as well as commercial Indian cookbooks. The elderly generation alive today may also remember recipes using grains such as *bajra* and *jowar*. Even though younger, recent Asian Indian immigrants may not know how to cook these grains or have habitually eaten them in India, the idea of incorporating them into traditional recipes might be appealing. In addition, Asian Indians, especially those who live in Western countries and have access to more varied ingredients, may benefit from experimenting with ancient grains grown in other parts of the world. Couscous and quinoa, for example, are high-protein and -fiber substitutes for rice, as are amaranth and spelt for wheat. Though not native to India, these grains could be incorporated into traditional Indian cuisine and diets to allow for culturally acceptable and healthy dietary modification.

## The modern Asian Indian immigrant diet

While some Asian Indians are vegetarian, and some parts of India (e.g., the state of Gujarat) have more vegetarian inhabitants than others,[52] a majority of modern-day Indians are not vegetarian.[19] The dietary staple in India has been grain for the past few millennia, but the modern Asian Indian diet is predominantly filled with refined carbohydrates, to the point of displacing vegetables and protein.[13] Immigrants to the United States carry these food practices with them and may meld them with Western eating habits as well.

It is well documented that among immigrants to the United States, exposure to Western lifestyles, along with changes in access to healthcare, physical activity, and diet that accompany such a transition, increases risk for chronic diseases.[53] However, studies have indicated that the Asian Indian immigrant population is one that is particularly apt to maintain traditional eating habits rather than adopting a completely new, Western diet.[20] Bicultural eating patterns can emerge, in which individuals maintain traditional eating patterns at certain meals or occasions and incorporate host country eating patterns at other times.[53] Changes in the types of traditional foods that immigrants choose to prepare may also be a result of changes in food supply and availability, the prestige associated with certain foods, and the time or technological constraints of the food preparer.[54]

Food can be understood as a cultural construct in terms of the meanings and emotions it evokes in individuals. The preparation of traditional food is a marker for immigrant families and communities, and it serves as a fulcrum for historically constructed ethnic or nationalist identity.[55] Frequent preparation and consumption of culture-specific foods in immigrant communities may be reflective of a unique phenomenon, i.e., a shift in eating patterns, which include more frequent preparation of ethnic foods associated with periods of festivals or special occasions and not typically eaten as part of the daily diet in the immigrants' country of origin. Such "festival foods" are culture-specific foods that are traditionally prepared and are related to specific festivals or special cultural occasions, usually in amounts limited by cultural significance and food availability. Festivals and rituals have often been viewed as fertile soil for planting food-centered memories, and they evoke the positive emotional connection between food and comfort that immigrants may draw upon while coping with the stress of acculturation in a new country.[55]

In the case of Asian Indian immigrants to the United States, and perhaps even among Asian Indians in higher socioeconomic brackets living in India, it is possible that festival foods play a role in the disproportionately high prevalence of chronic disease. Fried foods, sweets (*mithai*), and other less-commonly prepared foods are becoming ubiquitous in the Asian Indian American diet, as ingredients and pre-prepared foods are cheaply and readily available at Indian and even other ethnic and gourmet grocery stores. However, foods that are perceived to be traditional and foods that are healthy need

not be mutually exclusive. In the same sense, foods that are traditional should not be equated with foods that always promote poor cardiovascular health; the negative association often attached to prominent foods in the immigrant diet should not result in a perceived need on the part of the individual to discard these traditional practices. Instead, alternative methods of preparation and ingredient modifications can make traditional foods and healthy foods one and the same, and refined grains could be saved for infrequent festival times, as in the early 1900s.

White rice is one of the main grains eaten in southern regions of India, and thus by many Asian Indian immigrants. It is usually boiled and served with *dal*, a generic term that describes a variety of lentils or pulses. Rice can also be ground, mixed with lentils, fermented, and then steamed to make dishes such as *idlis*, or spread on a griddle to make crispy *dosas*.[52] Table 1 includes nutrition information on white rice, as well as the ancient grains that could be substituted for it in many Indian recipes, i.e., brown rice, barley, couscous, and quinoa. The amounts of fiber and protein in these particular grains are much higher, and the ratios of carbohydrates to fiber and protein are remarkably lower, compared with those in white rice. While there are many different varieties of white rice, fiber and protein are available in greater quantities in whole grains; thus, substituting one variety of white rice for another is not recommended. Additionally, while glycemic index is a measure that is often used by nutritionists and clinicians working with diabetic patients, relying on glycemic index alone for these whole grain substitutions is not recommended. Glycemic indices for various whole grains are roughly comparable and other ingredients or components of the meal, such as fat and protein, may affect them substantially.

Wheat is the staple grain of the northern regions of India. It is often used to make dough that is then rolled out and cooked with butter or *ghee* (clarified butter) on the griddle to make a *roti* or *chapati*. This bread, along with many other varieties such as *parathas*, *puris* (deep fried), and *naan* (baked in a *tandoor* oven) is eaten with *dal* and other vegetables. While *rotis* and *chapatis* are made with whole-wheat flour, others such as *naan* are made with refined flour[52]; additionally, the unlabeled, whole-wheat flour available in Indian grocery stores in the United States may be mixed with other flour to dilute the whole-grain content. A further downside of consuming whole or refined wheat flour is that the process of milling whole wheat into flour may essentially achieve some of the digestion that would otherwise have promoted a longer period of satiety had it occurred in the digestive tract. Table 2 includes nutrition information on whole and refined wheat, as well as the ancient grains that can be substituted for wheat in many Asian Indian recipes, i.e., whole-grain wheat flour, millet, sorghum, finger millet, amaranth, and spelt. The amounts of fiber and protein in these alternate grains are much higher, and the ratios of carbohydrates to fiber and protein are remarkably lower, in comparison with refined wheat flour.

The basic combination of either rice or wheat with lentils (an equivalent to the Anglo meat and potatoes meal) provides certain amino acid and fiber combinations that are beneficial in some respects.[19] However, the central incorporation of white rice and/or refined wheat as the primary carbohydrate in this combination is believed to increase risk of chronic disease in a population that is prone to type 2 diabetes and other cardiovascular diseases.

While there has been much research into the efficacy of substituting whole grains for refined grains in several countries, including Mexico,[37] Japan,[41] and India,[39] few studies on the effectiveness of these substitutions, particularly in Asian Indian populations, have been performed. One recent study in India[56] showed that a higher fiber and protein *roti* was acceptable in taste and texture when compared to a refined wheat-flour *roti*. Future research should strive to translate these efficacy studies of whole ancient grains into effectiveness studies for Asian Indian populations.

## CLINICAL PRACTICE RECOMMENDATIONS

Asian Indians have a disproportionately high risk of developing type 2 diabetes and CAD. While many genetic, cultural, and environmental elements combine to create this higher risk, studies have shown that certain lifestyle changes can result in improved health outcomes.

Grains are the main source of energy in Indian diets, contributing as much as 70–80% of daily caloric intake of the majority of Indians.[12] This level of carbohydrate consumption is higher than what is recommended by both the Indian Council of Medical Research (60%) and the United States Institute of Medicine (45–65%). While a drastic reduction in the daily consumption of carbohydrates is not recommended here, replacing refined carbohydrates with healthier whole grains will subtly shift daily macronutrient composition slightly toward protein and away from carbohydrates. Also, it is important to educate patients that in addition to grains, vegetables and fruit should contribute substantially to the percentage of total daily calories that come from carbohydrates.

The use of whole grains in diet has been associated with reducing type 2 diabetes risk by almost one-third,[16] and clinicians may benefit from employing the following culturally appropriate and practical ways to encourage Asian Indians to adopt more of these whole ancient grains in their daily meals.

*Consultation on dietary habits.* Clinicians may find it helpful to ask Asian Indians about their region of origin and the carbohydrate-rich food sources they eat regularly, in order to provide more applicable recommendations on dietary changes. For example, in southern India, rice and rice dishes (*idlis* and *dosas*) are eaten more regularly, while in the northern parts of India, wheat (in the form of *rotis* and *chapatis*) constitutes the main grain in the diet.

*Recommendations for grain substitutions.* Asian Indians can replace white rice with brown rice, whole-wheat couscous, quinoa, or barley (Table 1). While these alternative grains have a different texture and taste than white rice, they are much more nutritionally dense and can dramatically reduce risk of type 2 diabetes. All rice dishes can be made with these grains, including the South Indian *idlis* and *dosas*. Barley, whole-wheat couscous, and quinoa have even more fiber and protein than brown rice, and they can also be incorporated into traditional meals. Whole-wheat couscous and quinoa are not considered ancient grains of the Indian subcontinent, but with some experimentation they may prove to be both easy to incorporate into Indian recipes and appetizing for an Indian palate. Refined wheat flour (*maida*) can be replaced with ancient grains such as millet, sorghum, whole-grain wheat flour, finger millet, amaranth, and spelt (Table 2). Some work has already been done in India comparing *roti* made from *atta*-mix (with higher protein and fiber content) to refined whole-wheat flour *atta* alone, and *atta*-mix has been found to be acceptable in terms of taste and texture.[56] Future work should strive to expand studies of this nature to ancient whole grains.

*Recommendations for modifying traditional recipes.* Recipes incorporating substitute grains are available through Indian cookbooks and websites[57] (http://townsquare.romasharma.com/authors/swaroopa?authorKey=agRyb21hchILEglVUkxfRW50cnkYztiwAgw and http://tarladalal.com/) as well as through oral tradition. For example, *rotis* and *chapatis* can be made with pearl millet and sorghum (*bajra* and *jowar*) instead of refined wheat, and other nutritious herbs such as fenugreek (*methi*) can be mixed into the dough. Also, *maida*, which is highly refined, can be substituted with whole-grain wheat flour and fortified with tofu or ground nuts to improve texture of *rotis*. Whole-grain finger millet (*ragi*) *dosas* are both traditional and nutritious, and may be readily readapted to the modern Asian Indian diet. Individuals can also try substituting commonly available high-fiber, whole-wheat tortillas for *chapatis*. Recipes may require some trial-and-error, particularly since some of the rice substitutes take longer to cook than white rice, but there are many recommendations available through Indian cookbooks and various websites on ways to avoid mistakes.

*Reduction of fat and salt.* Patients should be advised that whole grains should be cooked with minimal amounts of saturated fat and salt for maximal health benefits.

*Modification of serving size.* Sufficient attention should be paid to educating individuals on recommended serving sizes of the various grains mentioned. Individuals often consume far more calories than they realize, in large part due to distorted perceptions of appropriate serving sizes and proportions. For example, while it is common to consume several during a meal, a single 6-inch diameter *chapati* or *roti* is considered one serving.[58] Also, the recommended serving size for cooked white rice is ½ cup, which may be perceived to be a very small amount. Ancient grains, such as barley, may provide a good alternative in this sense since they are somewhat bulkier and provide more volume for perceived satiety. It is important to educate patients as to what an appropriate serving size of a given grain may be, depending on the patient's caloric needs and the proportion of carbohydrates in their diet. As described earlier, replacing refined carbohydrates, such as white rice, with the same amount or volume of more complex carbohydrates, such as quinoa, will automatically reduce the amount of carbohydrate (81.7 g to 64.2 g, respectively) and increase the amount of protein (6.8 g to 14.1 g, respectively) consumed.

*Adjusting daily values.* Asian Indians, on average, are shorter[59] than other racial/ethnic groups in the United States.[60] The WHO has consequently recommended a lower BMI goal (<23 kg/m$^2$) for healthy weight in Asian Indians.[28] Nutritional counseling should explicitly address the comparatively reduced caloric requirement. This is especially important in interpretation of the percent daily values on food labeling, which assumes a 2,000 calorie diet. Most Asian Indians will require 1,200–1,700 calories per day for weight maintenance based on their average height and desired BMI of 23 kg/m$^2$. Labels on food products in the United States will generally provide an underestimate of percent daily values for this population group, given their overall lower caloric requirements.

*Replacing carbohydrates with protein and fiber.* Asian Indians can replace some of their carbohydrates (e.g., *rotis*, *chapatis*, rice) with proteins (e.g., *dal*, tofu, egg whites, nonfat dairy products) to improve the balance of the daily diet. While *dal* is a potent source of protein, it also contains carbohydrates; thus, the typical Indian rice-and-*dal* combination can be very heavy in carbohydrates.

Clinicians can emphasize the importance of the protein and fiber in *dal*, but they can also point out ways in which Asian Indians can reduce portion sizes of carbohydrates and increase portion sizes of other parts of the meal, such as traditional vegetable or meat/fish recipes.

*Guidance on purchasing substitute grains.* Grains such as brown rice, millet, barley, and sorghum will most likely be available in Indian grocery stores. If these grains are not available in Indian specialty stores, they are also carried in mainstream and gourmet markets across the United States. Other ancient grains not native to the Indian subcontinent, such as couscous, quinoa, and spelt, will most likely only be found in mainstream or gourmet grocery stores. While these whole, ancient grains may be slightly more expensive than refined grains, individuals who adopt lower carbohydrate diets will not have to purchase the large quantity of carbohydrates to which they may be accustomed.

These recommendations should be made along with other routine recommendations, including reduction of sweets and fried festival foods; reduction of portion size, oil, added sugar and salt in foods; and an emphasis on physical activity, including both cardiovascular exercise and strength training.

## CONCLUSION

In order to appropriately address the specific issues facing Asian Indians in the context of chronic disease, clinicians must offer their patients practical tools they can incorporate into their daily lives. While an Asian Indian patient may be hesitant to adopt a completely new diet portrayed in a Western heart-healthy cookbook, she or he may be more willing to work with modifications to the traditional recipes and methods of food preparation in Indian culture. Asian Indian patients may also be more receptive to implementing such lifestyle changes because they can prevent type 2 diabetes or improve a lipid profile often without the need for medication. It is important to keep in mind, however, that Asian Indian diets are extremely varied, and Asian Indian immigrants to the United States may tend to eat a blend of traditional and Western foods.[61] Clinicians and their Asian Indian patients should thus work together to decide upon an individualized, culturally appropriate, healthy, proportionally balanced, and appetizing meal plan made with whole grains that can prevent and reduce the burden of chronic disease in this rapidly growing minority population. These strategies to incorporate traditional, ancient grains into a modern diet can also be extrapolated to other high-risk populations that may benefit from culturally sensitive clinical recommendations on diet modification.


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