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Incorporation of Whole, Ancient Grains into a Modern Asian Indian Diet: Practical Strategies to Reduce the Burden of Chronic Disease

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Abstract

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, in an effort to reduce type 2 diabetes and cardiovascular disease in this population.

Keywords

Asian Indian; whole grain; nutrition; diet; chronic disease

INTRODUCTION

Asian Indians and Asian Indian immigrants to the United States (U.S.) 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] 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 normal weight, Asian Indians are at higher risk for type 2 diabetes and other metabolic abnormalities. [4–11] The modern Asian Indian diet is particularly high in refined

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Please refer to the Palo Alto Medical Foundation's Prevention and Awareness for South Asians (PRANA) Wellness Program for free, publicly-available information and recipe recommendations: www.pamf.org/prana.

carbohydrates and low in protein, when 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, reduced insulin resistance and type 2 diabetes. Carbohydrates are integral to Asian Indian dietary traditions,[19] and re-introduction of culturally acceptable, traditional, carbohydrate-rich grains with high nutrient density may be a prudent step in 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 paper seeks to review and provide recommendations 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 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 diet altogether.[20] Providing more healthful and traditional whole grain substitutes for refined carbohydrates can be thought of as one important aspect of therapeutic dietary modification. Asian Indian immigrants in the United States and their healthcare providers can collaboratively use this information to achieve better health outcomes. These recommendations can also be extrapolated and tailored to other Asian Indian diaspora populations around the world; 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 a 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 U.S. 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 U.S., with similar findings in Canada[23] and the United Kingdom.[24] CAD remains the leading cause of death among Asian Indians in the state of California.[25]

Studies have also shown higher rates of insulin resistance[8] and type 2 diabetes[9–11] among Asian Indians compared to both NHWs and other Asian racial/ethnic subgroups in the U.S. This trend 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 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 may feel more comfortable modifying their traditional diets by altering specific ingredients or replacing certain cooking methods, instead of adopting a new diet altogether.[20] Asian Indians who place such emphasis on consuming a traditional diet may be discouraged by culturally irrelevant advice on diet modification, because they may feel that it is impossible to both eat healthily and adhere to their cultural roots.

One way that clinicians can help Asian Indian patients reduce their risk of chronic disease—without sacrificing cultural traditions—is to make culturally sensitive recommendations on diet modification. Clinicians can learn about the modern Asian Indian diet and the ways in which ancient, whole grains could be substituted for the more widely-used refined carbohydrates that currently take center stage in typical Asian Indian meals.

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]. The current Asian Indian diet is 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 U.S. Institute of Medicine (45–65% carbohydrate, 10–35% protein). [30] Many studies have shown the benefits of lower carbohydrate (35–40%) and higher protein diets (20–30%) 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). There are other studies that have specifically studied macronutrient quality (i.e. substitution of whole grains) without varying macronutrient composition and found benefit through the reduction 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 both decreasing overall amount of carbohydrate and increasing carbohydrate quality. For example, in Table 1, if one serving of white rice is replaced with quinoa, the amount of carbohydrate decreases by 17.5 grams and protein increases by 7.3 grams. 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, 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 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: 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] Postprandial glucose and insulin levels have been shown to be suppressed in a Japanese population, after replacing a serving of white rice with 30%, 50%, and 100% rolled barley.[41] When Japanese millet protein was fed to diabetic mice, they experienced several beneficial trends: their plasma levels of adiponectin and high-density lipoprotein (HDL) cholesterol were increased, while glucose and triglyceride levels were decreased.[42] As a group, whole grains have been associated with lower total plasma cholesterol and/or low-density lipoprotein (LDL) cholesterol.[43–44] Further, there is speculation that whole grain foods, through their fiber, antioxidants, and other components, causally reduce the risk of coronary heart disease (CHD), because the inverse association between whole grain consumption and CHD exists in a dose-dependent manner.[45]

Benefits of Fiber in Whole Grains

Some have also postulated that the combination of compounds in whole grains—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 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 have lower blood pressure and serum cholesterol levels, reduced glycemia and insulin sensitivity, and lower risks of developing stroke, hypertension, type 2 diabetes, obesity, certain gastrointestinal diseases.[47] Some have also hypothesized that outside of the whole grain fiber content, the structure of whole grains may affect carbohydrate metabolism: 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 have also 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 both 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-grams of uncooked of white rice contains seven grams of protein, while the same amounts of amaranth and quinoa contain fourteen grams (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, and 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 replacement for refined grains in Asian Indian diets will provide not only healthier carbohydrate alternatives for patients, but also a host of other micronutrient advantages.

Ancient Grains in the Historic Asian Indian Diet

Indian cuisine is often described as indescribable, because of its complexity and variety across the different regions of the country. A history of invasions, migration, and imperialism has not only shaped India’s social and political position in the world today, but also its food culture across the subcontinent. Since prehistory, through the Indus Valley civilization and the Aryan tribes who migrated into the subcontinent in the one or two millennia B.C.E., dietary staples consisted of rice, millet, barley, wheat, and lentils.[19] As Hinduism developed around 1000 B.C.E., 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 C.E., 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 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] However, after Indian independence in 1947, India relied on foreign food aid, and thus 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] A negative perception now accompanies the use of certain grains: white, basmati rice is considered “richer”[52] or more often consumed by the “upper class” than brown rice (or red rice, which is consumed in some parts of South India), and its consistency and shorter cooking time makes white, refined rice more desirable in Indian dishes. Thus, the use of ancient grains that do not have an associated negative perception may provide an easier way to incorporate more healthful grains into the modern Asian Indian diet. Use of these grains may also promote cultural approval of serving and eating grains with high nutritional value, thereby reducing the negative perception associated with 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 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. It is likely that the elderly generation alive today may remember recipes using grains such as *bajra* and *jowar*, while younger recent Asian Indian immigrants may not know how to cook these grains. However, the idea of using traditional recipes incorporating whole grains might appeal even to those Asian Indian immigrants who may not have habitually eaten these grains in India. Using traditional Asian Indian recipes with familiar mixtures of spices or vegetables may be a more attractive option for Asian Indians than new recipes that come from a Western cultural background. In addition to incorporating ancient grains that were grown in India into their diets, 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 are high protein and fiber substitutes for rice, as are amaranth and spelt for wheat. These grains, though not native to India, could be incorporated into traditional Indian cuisine and diets to allow for culturally acceptable and healthy dietary modification.

The Modern Asian Indian Immigrant Diet

Today, while some Asian Indians are vegetarian, a majority are not.[19] The prevailing stereotype that Asian Indians—or specifically, Hindus—are all vegetarian is not necessarily correct, although there are some parts of India (e.g. the state of Gujarat) that have more vegetarian inhabitants than others.[52] However, it is clear that for the past few millennia, the dietary staple in India has been grain. The modern Asian Indian diet is predominantly filled with refined carbohydrate consumption, to the point of displacing vegetables and protein.[13] These food practices are carried over by immigrants from India to the U.S., where they may be melded with Western eating habits as well.

It is well documented that exposure to Western lifestyles increases risk for chronic diseases in immigrants to the U.S., resulting from the changes in access to healthcare, physical activity, and diet that accompany such a transition.[53] However, studies have indicated that the Asian Indian immigrant population is one that is particularly apt to maintain cultural eating habits rather than adopting a completely new, Western diet.[20] Bicultural eating patterns can emerge, during which individuals maintain traditional eating patterns at certain meals or occasions and incorporate host country eating patterns at other times.[53] Changes in 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: a shift in eating patterns which include more frequent preparation of ethnic foods that are associated with periods of festivals or special occasions and not typically eaten as part of the daily diet in the immigrants' country of origin. "Festival foods" are culturally 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 U.S., and perhaps even Asian Indians in higher socioeconomic situations 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 preparations and modifications can make traditional foods and healthy foods one and the same. For example, everyday traditional recipes could be prepared with ancient, whole grains that provide more nutritional value, saving the refined grains for infrequent festival times, as had been done 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—and 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 white rice in many Indian recipes. Brown rice, barley, couscous, and quinoa could be substituted for white rice in many of these recipes. 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, as compared to 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, we do not recommend substituting one variety of white rice for another. 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 substantially affect the glycemic index.

Wheat is the staple grain of the northern regions of India, used often 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 U.S. may also 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. Whole-grain wheat flour, millet, sorghum, finger millet, amaranth, and spelt can be substituted for refined wheat in many of these recipes. The amounts of fiber and protein in whole-grain wheat flour, millet, sorghum, finger millet, amaranth, and spelt are much higher, and the ratios of carbohydrates to fiber and protein are remarkably lower, as compared to refined wheat flour.

The basic combination of either rice or wheat with lentils—an equivalent to the Anglo "meat and potatoes"—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 work in the efficacy of substitution of whole grains for refined grains in several other countries including Mexico,[37] Japan,[41] and India[39] there are few studies on the effectiveness of these substitutions, particularly in Asian Indian populations. 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 elements combine to create this higher risk—genetic, cultural, and environmental—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 U.S. Institute of Medicine (45–65%). While we do not recommend a drastic reduction in the daily consumption of carbohydrates, 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 percent of total daily calories which come from carbohydrates.

The use of whole grains in diet has been associated with a reduction in 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:

- Clinicians may find it helpful to ask Asian Indians about the carbohydrate-rich food sources they eat regularly, in order to provide more applicable recommendations on dietary changes. For instance, for those that consume primarily white rice, Table 1 offers good substitutes, while for those that consume primarily roti or chapathi made from refined wheat flour, Table 2 offers appropriate alternatives.
- Asian Indians can replace white rice with brown rice, whole wheat couscous, quinoa, spelt or barley. 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*. Recipes may require some trial-and-error, as some of these grains take longer to cook than white rice, but there are many recommendations available through Indian cookbooks and various websites[57] on ways to avoid beginners' mistakes. 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, with some experimentation they may prove to be both easy to incorporate into Indian recipes and appetizing for an Indian palate.

- Recommendations on replacing white rice with ancient grains such as finger millet, brown rice, barley, whole wheat couscous, and quinoa may be more relevant to those who hail from southern India, where rice and rice dishes *(idlis* and *dosas*) are eaten more regularly. Whole grain finger millet (ragi) *dosas* are both traditional and nutritious, and may be readily re-adapted to the modern Asian Indian diet.
- Recommendations on replacing wheat with ancient grains such as millet, sorghum, whole-grain wheat flour, finger millet, amaranth, and spelt may be more appropriate for those individuals who come from the northern parts of India, where wheat (in the form of *rotis* and *chapatis*) constitutes the main grain in the diet. 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 clinical effectiveness studies of this nature to ancient whole grains.
- Asian Indians can use grains such as millet, sorghum, barley, amaranth, and spelt in their wheat-based dishes, along with replacing refined wheat with whole-grain wheat. Recipes for these grains are available through Indian cookbooks[58–59] 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 also be mixed into the dough. Also, atta, which is highly refined, can be substituted with whole-grain wheat and flour fortified with tofu or ground nuts to improve texture of rotis. Individuals can also try substituting commonly available high fiber, whole wheat tortillas for chapatis.
- Whole grains should be cooked with minimal amounts of saturated fat and salt for maximal health benefits.
- 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 recommended 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. [60] Also, the recommended serving size for cooked white rice is 1/2cup 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 (81.7g to 64.2g respectively) and increase the amount of protein (6.8g to 14.1g respectively) consumed.
- Asian Indians on average are shorter [61]than other racial/ethnic groups in the U.S. [62] The WHO also recommends a lower BMI goal (<23 kg/m2) for healthy weight in Asian Indians.[28] Nutritional counseling should explicitly address the comparatively reduced caloric requirement. This is especially important in interpretation of "percent daily value" food labeling, which assumes a 2000 calorie diet. Most Asian Indians will require 1200 to 1700 calories per day for weight maintenance based on their average height, and desired BMI of 23 kg/m2. U.S. food labels will generally

provide an underestimate of percent daily value given these overall lower caloric requirements.

- Asian Indians can replace some of their carbohydrates (e.g. *rotis*, *chapatis*, rice) with proteins (e.g. *dal*, tofu, egg whites, nonfat dairy products), in order to reduce the proportion of carbohydrates and increase the proportion of proteins eaten in the daily diet. Individuals should manage portion size according to their specific caloric needs. 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 that 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. Clinicians should be aware that there are many different types of *dal*, the most common of which are *masoor* (red *dal*), *moong* (green *dal*), *toor* (yellow *dal*), and *urad* (black *dal*).

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 within the realm of chronic disease, clinicians must offer their patients practical tools to 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 within the traditional recipes and preparation methods of Indian culture. Asian Indian patients may also be more receptive to these lifestyle changes because they can prevent type 2 diabetes or improve a lipid profile often without the use of medication. It is important to keep in mind, however, that Asian Indian diets are extremely varied, and Asian Indian immigrants to the U.S. may tend to eat a blend of traditional and Western foods.[63] Clinicians and their Asian Indian patients should 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.

Finally, in order to truly enact efforts against chronic disease on a meaningful scale, governments must change the ways their policies shape consumer choices. Thus, we also urge national governments to consider re-evaluating their subsidizations of crops that may have deleterious effects on the health of their populations.

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Table 1

Nutritional Content of White Rice and Healthier White Rice Substitutes *†

Name of grain	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

* Values are based on 100g (uncooked) portion

† Recommended serving size may vary, depending on the grain

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Table 2

Nutritional Content of Wheat and Healthier Wheat Substitutes[12*†]

Name of grain	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]	*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 100g (uncooked) portion

†100g (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.