Diet-related diseases:
Issues and solutions to nutrition transition and food programme policies in India

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Abstract

Epidemiological studies have reported India as one of several countries that face high prevalence of pathologies related to the metabolic syndrome, notably type 2 diabetes, dyslipidemia, obesity and cardiovascular disorders. Research indicates that these diseases are also impacted by dietary habits with a strong association between malnutrition. The nutrition transition in India has resulted in population shifts in dietary patterns, notably increase in rich energy-dense food intake, that raises the risk of metabolic disorders such as obesity type 2 diabetes, and cardiovascular disease. The changes in the diet patterns and the possible causes for such changes (which may show causative links with the onset of lifestyle diseases like obesity and metabolic syndrome) are examined in this chapter. It is speculated that several Indian government policies that were implemented to fight recurrent famines might have favored the cultivation of rice, wheat and other commercial crops, and may have contributed to the detriment of certain cereals such as millets and sorghum, and pulses. These crops have been recognized for their provision of micronutrients and their low glycemic index.

The focus of this article is on the government policies regarding agricultural production and food security. While the green revolution has improved high-yielding food products (e.g., rice/wheat), incentivizing and reviving the production of millets can improve nutritional value of the diet, diversify crops, and preserve biodiversity of the region. It will also contribute significantly to the reduction in the prevalence of food-related diseases when synergized with a massive public education on their use. Powerful and effective programs that utilize health professionals such as r dietitians and siddha practitioners who can play a relevant role to educate the public on the value of low-cost nutritious diets and diet therapy inpatients with metabolic disorders. Some of the resources presented in this article include the dietitians, NGOs involved in the rural development programmes as well as the traditional siddha practitioners.

Key words: India, metabolic diseases, micronutrient deficiencies, millet, rice, wheat, dietitian, Indian food policy, PDS, midday meal, anganwadi, siddha medicine

Introduction:

As per the global health reports, India is described as one of the countries in the world that has the highest prevalence of malnutrition (*6th report on the world nutrition* 2010; *Millenium Development Goals Reports 2011*). In these reports and in the Indian context, malnutrition is considered as the consequence of under-nutrition and implicitly a problem of destitute.

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Nevertheless, the food surveys conducted repetitively during the couple of last decades in all the states and population groups show that malnutrition is a global phenomenon which affects poor, 'low-castes' and tribes as well as the more affluent sections of the population. In India, not only does the country has the difficulty of reducing increasing malnutrition inherent to undernourishment (Gragnolati et al.2006; WHO 2000), but also confronted with a drastic increase in metabolic diseases which are rising sharply since 1970s. In global health reports, India is now classified among countries with the highest prevalence of metabolic diseases, notably regarding obesity, diabetes and coronary heart diseases (FAO 2006; Mackay et al. 2004; Wild et al. 2004). This has resulted in a double burden of malnutrition compounded with a high level of micronutrient deficiencies as well as emerging metabolic diseases due to the nutrition transition.

The *6th report on the world nutrition* (2010) states that, despite the strong interventionist food policy of India, malnutrition remains very high. The focus of this article will be on the government policies regarding agricultural production and food security. Rather than to increase yield of only few food products notably rice/wheat (to the detriments of others), it is suggested that incentivizing the production of other crops (e.g., millets) will not only help to improve the nutritional value of the diet but also contribute significantly to the reduction in the prevalence of food-related diseases when synergized with a massive public education on their use. Nevertheless, some powerful and effective human resources may be relevant to educate the public on the value of millets and to give awareness to program planners and decision-makers. This article examines the role played by dietitians, NGOs involved in the rural development programmes as well as by traditional medicine practitioners. Results from two studies are presented: the first study is a two-year collaborative study with an NGO in Andhra Pradesh (Sébastia forthcoming a),and the second is a five-year study based on a hospital specialized in siddha medicine, traditional medicine in Tamil Nadu (Sébastia forthcoming b).

The double-burden of malnutrition in India: some evaluations

The National Family Health Survey (NFHS) is a large-scale, multi-series survey that is conducted in a representative sample of households throughout India. The survey provides state and national information on health and nutritional status of adults and children in India. The National Health Family Survey was first carried out in 1992-1993 (NHFS-1) and subsequently in 1998-1999 (NHFS-2) and 2005-2006 (NHFS-3). Conducted under the stewardship of the Ministry of Health and Family Welfare and funded by International agencies (USAID, UNICEF, DFID, UNFPA), the NHFSs have collected data on rural and urban populations of almost all the Indian states[2] which are used in the International reports such as those of the WHO, the United Nation, the UNICEF. The NHFS-3 was the widest in terms of content as it included questions for both men and women, and of coverage as it integrated eight megacities for collecting data from urban residents and from slums (IIPS 2007). Although accuracy of some of the information provided by this survey concerning sensitive issues e.g., indifference of Indian laws (age of marriage and pregnancy), social determinants such as cultural opprobrium (pre-marital sexuality,

[2] The NFHS-1 and NFHS-2 (IIPS 2000) have collected data from 88562 and 91196 households respectively located in 25 states and Delhi (Union territory) among which 2/3 are rural. NFHS-3 (IIPS 2007) has collected data from 109041 households in 28 states (3 new were created in 2000 from the separation of another state: Chattisgarh, Jarkhand and Uttarakkhand) and Delhi. The Union Territories except Delhi have not been surveyed.

contraception/abortion), gender issues (marital violence, gender discrimination regarding education and feeding) or infection with HIV (Rajan et al. 2008) have been questioned, the NHFS provides however valuable information on the nutritional scenario of the different parts of the country[3].

In the literature on the nutritional status of populations, the levels of malnutrition and anemia are generally evaluated in standard deviation units of anthropomorphic measurements and on biological tests from the median of the reference population. The three standard indices of physical growth as defined by WHO to evaluate the nutrition status are underweight (weight-for-age), stunting (height-for-age) and wasting (weight-for-height) (WHO 2006) and the biological test used to evaluate anemia is the hemoglobin level. Malnutrition and anemia are interpreted as a result of low dietary intake and poor bio-availability of iron and folates in the diet. In the Indian context, this can be correlated to the incidence of chronic diseases such as diarrhea, parasite infestation, or liver disease. Confidence in the high prevalence of micronutrient deficiency as revealed in the NFHSs is increased due to similar confirmation by other surveys that estimate 75% of children under five years of age suffer from iron deficiencies and 57% from vitamin A deficiency (UNICEF and MI 2007). Table 1 shows that malnutrition in India tends to get worse and authors like Ashish Bose (2006) have pointed out that the anemia level was an underestimate in NFHSs as, according to the data of the FAO report (2006)[4], the rate of abnormal hemoglobin (severe ≤ 5g/l; moderate 5-7.9g/l; mild 8-10.9g/l) was as high as 92% in preschool children and 88% in pregnant women. However, despite the differences in data, the prevalence of malnutrition and anemia is high enough to confirm that a large part of the population is affected with causative links to food and nutritional deficiencies.

Insert table 1

Except for the prevalence of overweight/obesity (from the height and weight measurements), the NFHSs has failed to explore the risk factors for the development of the metabolic syndrome. Metabolic syndrome is a set of risk factors that includes: abdominal obesity, insulin resistance, dyslipidemia, hypertension, increased risk of clotting, and a pro-inflammatory state. People with this syndrome are prone to develop cardiovascular diseases and/or type2 diabetes (Gogia et al. 2006; Misra and al. 2005). There is numerous data on metabolic diseases in India but the differences in the parameters studied do not allow for astatistical interpretation of their prevalence (Shah et al. 2010)[5], and thus one may expect that, in the future, the NFHSs will include some parameters for assessing them. The WHO co-sponsored survey by the Indian Council of Medical Research (ICMR) from April 2003 to March 2005 offers the information on metabolic diseases. Conducted in rural, urban and slum areas of five states, Haryana-Tamil Nadu-Assam-Maharashtra-Kerala and in urban and slum areas of Delhi, it has collected data on glycemic and cholesterol levels, blood pressure, height-weight and waist

[3]Ashish Bose (2006) questions also increase in anemia in NFHS-3 compared to the previous rounds while the Indian economy is growing at 8% a year. Nevertheless, this deterioration of the nutritional status may be explained by the increase of food changes, change in consumption favouring expenditures for non food items and high food inflation.

[4] The statistics mentioned by *FAO Food and Nutrition Paper 84* are those of the District Level Household Survey, 2002-2003 (DLHS-2; a survey covering in average 11000 households per several districts selected in all the states and Union territories).

[5] The article presents a database of biological and anthropometric parameters considered as risk factors in cardiovascular diseases which has been collected from a selection of surveys carried out in various states between 2002 and 2008.

circumference measurements. The data are presented in the table 2 to which has been added the prevalence of overweight and obesity of the NFHS-3. Their important difference reveals the difficulty to get an accurate evaluation of these diseases.

Insert table 2

Type2 diabetes, obesity, dyslipidemia and blood pressure have been increasing in India since the 1980s (Desai 2009; Mohan and al. 2008). They may result from endocrinal disorders (hyperthyroidism, syndrome of Stein-Leventhal) or have a genetic or environmental origin. The phenotype of Indians is indeed characterized by the high percentage of fat cells localized mainly in the abdomen, and increased waist-to-hip (WHR) ratio for any given body mass index. This genetic prototype predisposes a person of Indian origin to diabetes and metabolic syndrome (Hariram et al. 2005, Ghosh 2006, Misra et al. 2004, Yajnik et al. 2004). The drastic rise in metabolic diseases still has their causative links with the rapid changes in food consumption called 'nutritional transition'. In epidemiologic studies on developing countries, 'nutritional transition' is defined as the shift away from a diet high in fiber and common complex carbohydrates towards a more energy-dense and low fiber diet associated. These changes have their roots in the transformation of food habits and a sedentary lifestyle, compounded by the urbanization movement. The nutrition transition refers specifically to population shifts in dietary patterns considered to increase the risk of obesity and chronic disease, including type 2 diabetes, hypertension, cardiovascular disease, and cancer, driven by three major etiologic factors: demographic changes in populations, urbanization, and changes in dietary trends as a result of shifts in food projection and marketing. Advances in transportation and communications are also important contributors as they promote the penetration of highly processed, energy-dense foods that influence food preferences in rural and urban India. More specifically, the food consumption changes are characterized by a decrease in whole grain cereals and increase in sugar, fat, dairy products, vegetables/fruits, eggs meats and fish intake. Furthermore, in the Indian context, the food changes scenario is slightly different as the consumption of egg-meat-fish stays low and that of cereals stays high due to the influence of vegetarianism lifestyle of the people.

Malnutrition and metabolic diseases: an inadequate diet in an aggravating environment

The Table 1 reveals that malnutrition is an overall issue and Table 2 shows that metabolic diseases affect all sections of the population at different levels. Malnutrition attributed to undernourishment in developing countries and many of the metabolic diseases with causative links to overnourishment may have synergistically contributed to the explosion of chronic diseases and long-term disease states.

The urbanization of Indian society, which, in turn, spurs the transformation of the organization of the family, including the nuclearization of the family and the changing status of women, plays a large role in change in food and nutrition. S. Allender and his colleagues (2010), in a study on Tamil Nadu, have shown that it favours the increase of metabolic diseases, notably supranormal blood pressure and obesity. This interrelation between urban life and development of metabolic diseases, is well marked in Table 2, is all the more important that the urbanization[6]

[6]Urbanization implicates increase in population living in urban areas. An urban area, according to the Census definition, is one that has 1-a minimum population of 5,000; 2-at least 75 per cent of the male working population

is increasing as revealed by the *Census of India 2001* and *2011*[7]. The urban/rural ratio of 25.7% in 1991 went up to 27.8% in 2001 and to 30% in 2010 (provisional) with a growth rate of population in rural and urban areas of 17.9 and 32.1% between 1991-2001 and of 12.18% and 31.80% between 2001-2010 respectively. The urbanization impacts on the nutritional situation of the citizens at different levels. For example, it reduces physical activity due to development of vehicular transportation and the mechanization of daily tasks. Women are particularly affected by the lack of physical activity. In traditional families with sufficient financial resources, very often the social structure demands that they do not take up a job, thus fostering a sedentary lifestyle. The studies by Padmini Balagopal et al. (2008) in a rural village in Tamil Nadu and by Patel (2010) in rural north-western Gujarat show that physical work is reduced to a low-level of household physical activities[8], and cooking is supplemented by the daily use of commercial foods and snacks (like high fat high sugar fried snacks, and sweetened tea or carbonated sodas). In more liberal milieus, in contrast, women take up jobs (which are usually low-physically active occupations), and consequently, have less time to prepare meals. Food diversity has also contributed to the transformation of food habits especially among the higher income populations. Other contributing forces to these changes include the influence from media about 'ready-to-eat' or processed foods, new trends in eating-out at fast-food joints (Indians and western[9]), and family restaurants[10]. These new consumption patterns tend to be gradually adopted by traditional families. Children, particularly those of high and middle classes, also play an important role in this process of transformation of eating habits because they are more receptive to information carried by their peers and the media besides being more vulnerable to new trends and innovations. Compared to urban people, those living in villages are less exposed to the change of foodstuffs and food habits as they have less access to 'modern' foods. Nevertheless, they gradually tend to adopt urban model of consumption so that, combined with reduction of physical activity resulting from transport development and agriculture mechanization, they are increasingly affected by metabolic diseases (Balagopal et al. 2008).

Although Indians are proud of the richness of their food heritage, their traditional daily meals have not been subject to frequent changes and has undergone very little variations over the centuries until currently. Generally speaking, cereals constitute the largest staple food which is served three times during the day: morning, noon and evening. It is accompanied by vegetables and green leaves, pulses and/or meat-fish-egg according to vegetarian/non vegetarian diet and the general eating patterns is also subject to religious fasting, especially among the older people. The data of NFHS-3 (*IIPS* 2007) estimates that 67% of women and 76% of men consume egg-fish-meat. However, the consumption of these foods is erratic in the older population but

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engaged in non-agricultural pursuits; and 3-a density of population of at least 400 per square kilometre (1,000 per square mile). With rise in population, the country's urban population also increased. The Census 2001 reports that almost 29 percent of Indians are urban.

[7] Last estimate (July 2011): http://www.indexmundi.com/india/demographics_profile.html, regarding urbanization, the estimate are calculated on data collected during 2010.

[8] Although the recourse to service caste is lessened, some works such as ironing, laundry, sewing, continue to be done by 'professionals'. However, the traditional organization of everyday life is transformed by modernization; washing machines, electric irons, vacuum cleaners and floor cleaning products have entered into middle class households. Adoption of modernity may create more work for women if they do not have a housekeeper.

[9] The advent of the globalised foods such as burgers, pizzas and soft-drinks, among people in large towns is further complicated by the entrance of Indian fast-foods which also use a lot of oil, salt and spices. Such foods have become available everywhere in all towns and slums and they are consumed by the large urban population.

[10] The variety of 'high class restaurants' is very large and many of them which are aware about metabolic diseases, serve healthy food or develop recipes suitable to the health condition of their clientele.

becoming more frequent among the younger age groups. The frequency of eggs, meat fish and even dairy are dependent on religious rules of fasting and economic constraints. The 61th round of the National Sample Survey evaluates the general consumption per capita per month at 1.19 egg, 200g of fish and 160g of meat (Gandhi et al. 2010). Although vegetables/green leaves and pulses intake is much more regular than egg-fish-meat, and concerns all castes and religions, it is also low. Notably in low income 'non-vegetarian' families, the dish of fish-meat very often replaces the pulses (e.g., dal) and vegetables. The Table 3 describes food consumed at least once a week by women and men using the NFHS-3 data (*IIPS* 2007); results show that the pattern of food consumption varies according to religion, residence, caste, and economic status. Table 3 gives a broad perspective of eating patterns and the co-existence of malnutrition.

Insert Table 3

The Table 3 shows that Buddhists, Christians and Muslims vary significantly on their food consumption of milk, pulses or beans, fruits, green leafy vegetables, eggs, fish, chicken/meat. Nevertheless, these three groups consumed less milk/curd than the other religious groups (Hindus, Sikhs, and Jains) which are more likely to be vegetarians. This difference can also be explained by the fact that vegetarians draw most of their protein needs from dairy products and pulses. The pulse intake of Buddhists and Muslims is similar to the other groups, but is lower in Christians. This result may be surprising as Christians adhere to a two-day minimum weekly egg-fish-meat abstinence. In regards to the caste/class category differentiation, tribes are those who have less diversified and rich diet but with low intake of all the food categories. The consumption of scheduled castes is better than that of the tribes, but as expected, lower than of upper castes except for eggs and meat intake which is similar; their consumption of fish is surprisingly high. Lastly, data on food consumption according to economic means confirm the strong relation between diversity of consumption and weight, except for the egg-fish-meat category as vegetarianism is more developed in upper castes than in scheduled castes. This relation is expected due to the high price of these foods which is subjective to a strong seasonal price fluctuation (vegetables, fruits, eggs, pulses) or a high inflation (milk, curd, fish, meat) oscillating in the past two years between 7.5% and 21%[11].

Beyond the difference of religion, residence place, caste, economic means, the data reveals that all groups do not regularly consume foods which are not subjected to proscription. The less eaten products are fruits consumed mostly by Jains[12] and by urban and high economic groups, followed then by milk/curd, pulses/beans and vegetables green/leaves. As these foods as well as egg-fish-meat category are rich in micronutrients, the irregularity of their consumption may contribute to anemia and malnutrition among communities that follow erratic or inconsistent eating patterns. Furthermore, due to high inflation of these products today, the middle class communities could be impacted in their food consumption of a balanced diet, placing them at an increased risk for malnutrition.

The Table 4 compares food frequency consumption between men and women; women show more erratic eating patterns with fruits being consumed less frequently and milk/curd the most rarely.

[11] For fluctuation of food prices, one may consult newspapers such as *Time of India* or *Business Standard* which report each week the inflation rate by food category compared to the week of the previous year. See also articles in *Outlook* July 12, 2010;*Frontline*, vol 28 (3) 2011; Chand (2010).

[12] Jains, in general way, are urban and form a rich community.

Table 4

The large difference in consumption patterns between women and men may result from a difference of taste: women have a preference of less non-vegetarian and more vegetarian products than men (Bedford and al. 2005). Other reasons which are based on cultural and societal practices must also be factored in. Many epidemiological studies have pointed out the difference of nutritional status between sexes, among children and adults. This is explained on one hand, by the traditional preference attributed to boys. Traditionally, the women in a household usually serve meals first to the men (husband, older sons, father-in-law, brother-in-law), and young children and mother-in-law, before they eat their meals. Due to cultural practices, in poor economic families where the availability of foods is limited, the high valued foods such as dairy and non-vegetarian products and fruits are less available to the women in a family. Economic or societal factors often restrict the women compensating their diet from income earned with outside employment. Except for attendance at social functions, family visits and tours, females eat rarely outside their house, while males frequently eat at restaurants with their friends and colleagues and drink tea and snacks at street stalls and vendors, thus increasing their dairy products and egg-fish-meat intake[13]. All these factors, therefore, favour a higher prevalence of anemia in girls and women, as clearly shown in Table 1. The rates of anemia are 55.8 and 30.2 for female and male adolescents and 55.2 and 22.8 for women and men respectively.

The overall prevalence of anemia is a particular concern for the government due to the economic burden in terms of lost of productivity, illness, and death; it was estimated in 1999 by the Work Bank to be at least US$10 billion annually. Anemia has been found to retard improvement in human development[14].Malnutrition plays a key role in infant mortality rates which despite a decline was still as high as 64‰ for children under five years of age in 2009, and maternal mortality which was 212 per 10,000 life births in 2008-2009 (Office of registrar General, 2011). It is also responsible of low birth weight (LBW) estimated in 2004 at nearly 8 millions of births, i.e., 40% of babies were born with low birth weight (< 2500gms) in the developing world (UNICEF and WHO 2004). This last estimate is particularly worrisome because it is recognized that infants born with LBW when consume high dense energy foods and gain weight during their adult years of life, known as Barker's hypothesis, have more risks to develop metabolic diseases such as diabetes, obesity and arterial hypertension (Barker 1995).

Nutrition transition, malnutrition and metabolic syndrome on cereal intake

The 'nutritional transition' of Indians fits partially to the general observations for developing countries as the consumption of high energy dense foods is increasing, although this may largely be in the consumption of foods high in fats, oils and refined sugar. Even though

[13] As some social scientists (Caplan 2008; Strumpell 2008) have mentioned and as I have often observed, some vegetarians can consume fish or meat outside, as long as it does not enter into the house. The underlying concept is to maintain 'purity' inside the house.

[14] See the URL:
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSDNET/0,pagePK:64885161~contentMDK:20012745~piPK:5929285~theSitePK:5929282,00.html (Retrieved on June 22, 2011)

there is an increase of dairy milk, vegetable/fruits and meat-fish-egg intake, their consumption largely depends on caste, religion and economic means. Reduction of cereal intake and its substitution with refined cereals had become a parameter of the 'nutritional transition' observable in most commercialized counties including India, despite the prevailing custom of eating large quantities of cereals and starches.

The intake of cereals is mostly wheat in the north of India and rice in the south and eastern coastal areas (West Bengal, Orissa). Other sources of starches are 'coarse cereals' (millet, sorghum and maize) and also tubers such as manioc, yam, sweet potatoes and potatoes eaten as vegetables (except for manioc). Except for maize which is increasingly being cultivated for the food and chemical industries and for animal feed, 'coarses cereals' are experiencing a strong reduction in consumption and cultivation as a consequence of the green revolution. Initiated to put an end to famines, malnutrition, and importation, the green revolution was promoted in 1967-1968. As a consequence, 18,000 tons of rice and wheat high-yielding seeds were dispatched to all the states and an economic policy was instituted aiming to maintain the prices of rice and wheat in order to facilitate access of farmers to loans (Deshpande 2005). This agriculture policy has led to the promotion of these two cereals which became the standard staple of urban people in the detriment of millets and sorghum.

In south India, the region where a few research projects has been implemented by the authors, the millet and sorghum fields seem to be slowly disappearing, notably in Tamil Nadu. Migration to towns has induced the adoption of rice, especially white rice, to the detriment of millets and sorghum, so that they are now stigmatized as coarse foods, 'foods of poor and villagers' and unappreciated because of their strong taste, dark colour, and also for their preparation that requires much time[15]. Even in certain festivals, such as those during the month of *āṭi* (mid-July to mid-August), during which devotees prepare 'cooling' foods[16] to offer to the deity, rice preparations are slowly replacing millet items in many temples located in towns. Is this new practice accepted by one and all? Old and middle aged people who ate these foods when they lived in villages, can be heard complaining about the loss of their food diversity and often attribute the rise of chronic diseases like diabetes to the concomitant disuse of traditional foods like millets. Studies on nutrient composition reveal that certain millets have a glycemic index lower than rice and wheat, and that millets like sorghum have a significantly higher fiber and micronutrient content than refined rice and wheat.

Food security: inadequacies of Indian programme and the solution brought by NGOs

Indian programmes: a focus on rice and wheat

While the previous section showed that green revolution has resulted in theshift in food consumption, the green revolution policy in India has contributed to the attainment of the level of

[15] In workshops organized by NGOs promoting millet consumption, time issue for millet-based preparations is always highlighted by women, mid-day workers and social workers.

[16] The month of *aṭi* is the hottest month in Tamil Nadu. In order to propitiate the deities, i.e., to propitiate the deity , devotees offer foods which are considered as cooling such as finger and pearl millet, rice curd or lemon rice. One of millet preparation is *kūḻrāki* 'gruel of finger millet' realized traditionally by adding onions, and *mōr*; the second one is *kampuruṇṭai*, a sweet bowl made up of grinded pearl millet, jaggery (unrefined cane sugar) and *nīm* leaves (*Azadirachtaindica*), a very bitter plant considered as cooling.

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auto-sufficiency in cereals during the 1990s. This has allowed massive storage capability to not only compensate food supply during yield reductions in bad years but also improve India's to export surplus food. However, for the past two or three decades, this policy had begun to show flaws including pollution of soils and water; lost of biodiversity; diminution of yields; and health issues related to pollution by pesticides and fertilizers and lack of food diversity. As this policy had encouraged the cultivation of rice and wheat and also commercial crops (sugar, oil seeds, cotton), the yield of coarse cereals, vegetables, fruits and pulses could not face up to the consumers' demand. Hence, the inadequacy of transportation system, rise of petrol price, failure in crops etc., synergistically contributed to new eating trends especially as the prices of these products fluctuated according to the availability on the domestic market and import cost. Liberalization of market after 1993 worsened the situation as the government did not actively control exportation of food products, (except for rice and wheat), while at the same time favouring economically commercial crops, like rice and wheat (Despande 2005).

To improve food security, the Indian government had initiated in 1970s the Public Distribution System (PDS), in continuity of the rationing system which was established in 1940s against the backdrop of the Bengal famine. According to the government, its objective was to assure 'availability, accessibility and affordability of food for all people and at all time'. This is existent until today. Food procured by the Food Corporation of India is distributed through the 4,60,000 fair price shops regulated by the government of each State or Territory Union (TU) to people holding a ration card: below poverty line (BPL) card for those below poverty line; APL cards for those above poverty line; Antyodaya Anna Yojna card for the poorest of the poor and card for people under Annapurna scheme who are indigent senior. The policy of PDS focuses mostly on food grains procurement, rice, wheat or coarse cereals according the staple food of States population. Compared to other subsidized foods in PDS (pulses, sugar, oil, salt, tea, etc.), rice and wheat are sold to AAY and BLP cards holders in large quantity (35kg) and at very low price, 2-3 rupees per kilogramme. A recent article by Pallab Kumar Sen (2010), listing the different items available in PDS, shows that for all States and UT, rice-wheat represent 36.8% of sales, sugar-edible-oil-kerosene 62.2%, whereas the sale of millets (available only in few states) and pulses represent only 0.8%, and 0.2% respectively. The low procurement of millets and pulses resulting from the high government support of wheat and rice, clearly illustrates that the low economic groups, who compose the large part of consumers of fair price shops, cannot afford these food grains once they have bought vital commodities. The PDS policy that has helped the indigent population to access staple cereals and its omission of extending to millets and pulses may have inadvertently compromised the nutritious composition of the diet that contributes to the malnutrition situation[17]. Numerous voices are heard to denounce PDS flaws but critics target more its malfunctions (corruption in card holders, low quality of products, lack of food availability, inadequate frequency and time of opening, deterioration of rice/wheat storage by rats or rain, etc.) than the poor choice of subsidized foods[18]. However, instigators

[17] The priority given to rice and wheat is well exemplified by politicians. The chief ministers of Pondicherry and Tamil Nadu elected in May 2011, in their electoral promise, distributed 35kg of rice free of cost. to AAY and BPL cards holders

[18] In the last version of the draft of the National Food Security Bill, September 2011, one notices no change in the procurement of foodgrains. Nevertheless, the draft mentions in the section schedule IV 'Provisions for advancing food security': "incentivising decentralised procurement including procurement of coarse grains".
http://fcamin.nic.in/dfpd_html/title.htm
This draft has been subjected to many revisions due to its inadequacies according to the Indian nutritional and poverty situation.

involved in agriculture, social and health development increasingly call for revising diversity of foods in PDS as well as in other government programmes devoted to children: mid-day meal and *anganwadi* schemes (Sébastia forthcoming a).

The mid-day meal scheme, firstly established in Madras presidency in 1925, was developed since 1974 to improve the nutritional status as well as to encourage poor families to enroll their children, notably girls, in school (Sharma et al. 2006). It is also under the responsibility of States or UT governments. During school days, children of government schools receive a meal made up of cereals, pulses, vegetables, oil, including in some states, one egg or banana per week. The quality of food is balanced as adheres to the nutritional needs and caloric composition of the children as defined by Indian nutritionists. However, once again, the cereals served are only rice or wheat according to the staple food of the States. On the other hand, in *anganwadi*, (crèche for preschool children of poor women workers), the financial constraints do not allow to pay for cookers and cooking fuel. Hence, when food is procured, it is ready-made foods supplied by food industries with low nutritional value and higher preservatives for shelf-life and profit/marketing motives. These foods are typically criticized (by mothers and *anganwadi* staff) for their taste and smell and are often rejected by children. Fortified with iron, zinc and vitamins, they are not only unpalatable, but may often cause health hazards due to the levels of micronutrients that are higher than permissive (*Deccan Herald* 2011; Dhuru 2009; *Tehelka 2011*)

NGOs: for the revival of millets and diversification of food

For the past couple of decades, many NGOs involved in the rural development are interested in reviving traditional foods, notably millets and some pulses and oil seeds (safflower). One of the NGOs documented in our study, is located in the north-west of Andhra Pradesh, one of the rice eating States. Founded in 1984, this NGO spans the population of 75 villages currently. Its main objective is to revive millets at two levels: in agricultural production and in dietary consumption of the villagers. In order to achieve its objective, the organisation encourages small and marginal farmers to cultivate their land that is often acquired through land distribution system. These lands acquired are often unused due to soil infertility, water unavailability during dry season, lack of economic means to buy bulls for ploughing, seeds, chemical fertilizers and pesticides. Millets grow in rain-fed lands with low nutrient needs and are resistant to pest infestation. Thus, they constitute ideal crops for these lands. By encouraging the cultivation of such lands, multiple objectives are served restraining financial alienation to fair price shops and the important diversification of the diet with crops with high nutritional value. To accomplish this objective, villagers, notably women who are traditionally in charge of selection and preservation of seeds, have been solicited to create a seed bank devoted to farmers interested to cultivate millets or to diversify crops, and to preserve biodiversity of the region. They have also been encouraged to document recipes of millet dishes from older populations who customarily use millets. In tandem a mill factory to powder millets to facilitate their use has also been set up.

Furthermore, this NGO organizes many workshops and educational meetings to develop awareness of millets. The workshops gather local farmers to review their cultivation methods, bring together NGOs involved in agriculture to share experiences and to initiate projects for publicizing millets among the decision-makers and the public. Meetings to get the local

politicians' support for introducing millets in food programmes are also conducted at the State level. These meetings gather politicians and scientists involved in the agriculture and in nutrition field including those working at the National Institute of Nutrition (NIN) at Hyderabad. The studies conducted by C. Gopalan (Gopalan 2007[1971]), ex-director of NIN, in continuity of his predecessors' researches begun in 1920s at the Nutrition Research Unit at Connor, and has helped to emphasize the high nutritious properties of millets which have a high content in fiber, and a low glycemic index and caloric content. This nutritional profile makes millets an excellent substitute cereal for people with diabetes (Pathak et al. 2000).

Table 5

Approaching local politicians is an essential step for the NGO which aims to assure their availability in PDS, mid-day meals and *anganwadi* schemes, and to plead the revival of millets at the State level through increased cultivation and availability.

Malnutrition and metabolic diseases: comparison between dieticians of western medicine and practitioners of traditional medicine

Dietitians: a profession in construction

In his article on the studies and debates on the nutritional situation in colonial India, David Arnold (1994) highlights that, since 1860s, the composition value of the diet attracted progressively the interest of the colonial doctors involved in the fight against the newly born concept of 'malnutrition'. Earlier, the British perceived 'coarse cereals' as an unhealthy food responsible 'of diarrhea and intestinal disorders'. But later, some British doctors began to promote millets: "*ragi* (finger millet) as having a nutritional status equal to, if not superior, thatof wheat" (*ibid.*: 11), and to denounce rice as a likely cause of deficiency diseases, including beriberi. Their correspondence shows that the replacement of millets by rice and wheat is not recent and became quite common before the green revolution. While millets and sorghum had never been commercial crops, rice and wheat yields were improved, thanks to irrigation development and rice was imported from other Asians countries, notably from Burma, the main supplier of low quality and cheapest rice which "catered to the taste of poorer section of South Indians" (Bansil 1960: 183). Their correspondence testifies also the large difference in perception of rice and millets: 'rice was the prestigious food of Brahmins and the higher castes – unlike *ragi*, the nutritious but despised food of the convict and labourer" (Arnold 2004: 11). From 1920s, with the establishment of the Nutrition Research Unit at Connor which began the National Institute of Nutrition, Hyderabad, studies were conducted to analyse the nutritional composition of foodstuffs which confirmed the low value of micronutrients of rice compared with wheat and millets or sorghum.

Despite the pioneer dietitians' studies denouncing rice-based diet as responsible of malnutrition, Indian dietitians have had very little influence to navigate the policies that can change the public health by altering the diet away from the easy availability of the newly subsidized refined cereals. This profession had emerged in the first decades of 20th century, but the article by Kathy J. Shattler (2004) reveals that professionals involved in this field are still not a large group. The Indian Dietetic Association founded in 1963 and presided by C. Gopalan

counts 3000 members in 2004 (*ibid.*) but only 300 are Registered Nutritionists. The low number of Registered Nutritionists may be due to the lack of opportunities including low salary that encourages these dietitians to emigrate as well as lack of awareness of the importance of nutrition therapy by patients and doctors that has resulted in most doctors who prefer to use only drugs for treatment instead of using it in tandem with recommend diet or referrals dieticians. Dietitians,like biomedical professionals, are available only in large cities; they work mostly in private and government hospitals. Many of those employed in government hospitals have been recruited more to control food preparation in canteens than to prescribe therapeutic diet to patients. However, the scenario is changing and the therapeutic role of dietitians is fully recognized, notably in private clinics specialized in diabetology and metabolic diseases.

According to Shattler (2004) the profession has to grow to treat malnutrition-related issues as well as to provide diet recommendations aimed to treat metabolic disease. Nevertheless, like biomedical professionals, dieticians mostly come from the upper economic class/caste sector of the Indian society and attend conferences for continuing education credits which are organized by nutrition institutions such as the Nutrition Society of India, Department of dietetics in Universities etc. Due to the lack of field knowledge of dietary intake of low socio-economic groups, some of the nutritionists may recommend a diet in reflection of their own dietary habits including rice and wheat (white colour and soft in taste) and dairy products, but proscribing egg-fish-meat that they justify by quoting epidemiological studies conducted in developed countries and notably in US where their consumption which is ten times higher than in India is considered asa risk factorfor the development of metabolic and cardiovascular diseases. The dietary recommendations of certain dieticians indeed may appear ill adapted for changing the nutrition scenario of India (*The Hindu* 2011b, see also Messler 1989).

Some comments in the *Dietary guidelines for Indians* published by the NIN in 2010 highlight certain inadequacies of diet recommendations. The Dietary guidelines for Indians highlights data on daily food consumption conducted by the National Nutrition Monitoring Bureau in 2006 to evaluate malnutrition and prevalence of metabolic diseases. The comparison between average consumption and the Recommended Dietary Allowances (RDA) reveals an important deficiency as the cereal/millet intake represents 86.2% of RDA; pulses, 68.6%; milk, 54.2%, vegetables, 82.7% and oil, 70.6%. The first observation about this guideline is on the omission of two important information: consumption of fish-meat and of eggs is no longer evaluated since 2002 and 2004 respectively; millet intake is not distinguished from cereal one while one may suppose that it is not high as it is not provided by the PDS and depreciated by people with economic means. The second observation is on recommendations provided to compensate for the deficiency according to RDA (2011:6): “The proportion of households with energy inadequacy is about 70%, while that with protein inadequacy is about 27%. Thus, in the cereal/millet-based Indian diet, the primary deficit is energy and not protein. This energy shortage in their diet can be easily overcome by the poor Indians by increasing the quantities of habitually eaten foods”. However, this recommendation does not take into account the high unbalance between cereal-vegetables and pulse-milk-millet and micronutrients deficiencies resulting of the low consumption of pulse, milk and millet. In low economic population, householders are often incapable to afford more rich foods such as pulses, milk and millets and thus these recommendations may seem weak. The dietary guidelines concludes that the nutritional scenario results from dietary inadequacy and unhealthy lifestyles and factors such as poor purchasing power, faulty feeding habits, large family size, frequent infections, poor health care, inadequate sanitation and low agricultural production. Unfortunately, it does not mention

the policies on food and agriculture and the high inflation which would be useful for reorienting policy decisions. So, the recommendations and conclusions of this guidelines may seem, in a certain way, counterproductive compared with its objectives.

On the other hand, ayurveda and siddha medical practitioners are more equipped to treat food-related diseases as they are aware of traditional foods and of the role of diet in health condition. The proposed example concerns siddha medicine, the traditional medicine which is practised in Tamil Nadu (Sébastia forthcoming b).

Traditional ayurveda and siddha practitioners: dietary prescription as a therapeutic tool

Siddha medicine is relatively similar in concepts and theories with ayurveda except for its philosophy based on a tradition of *cittar*('who has attained perfection'), yogis considered as the authors of medical texts including nosolography, nosology, botany, alchemy etc., and its *material medica* which includes more metals and minerals due to alchemical knowledge developed by *cittar*. The relation between food and health is expressed in a Tamil adage 'food is medicine and medicine is food', that siddha practitioners often quote to emphasize food intake rules. In siddha texts, foodstuffs are classified according to various properties (hot/cold; wet/dry; heavy/light; taste; potency) which condition the character, constitution and activity of the individual (Nitcher 1986, Uthamaroyan 2005). These concepts are used in dietary prescriptions provided by Jeyaram who runs an eighty-bed siddha hospital located in Kanniyakumari district and treat a large clientele. His dietary prescription follows the rules of *pattiyam/apattiyam* 'do/don't' and food conceptions in siddha as well as in biomedical dietetics.

Siddha Practitioners like Dr. Jeyaram of Kanniyakumari district ask their patients with diabetes to reduce their cereal intake, avoid sugar, sweets and oily items and increase intake of pulses, green leaves and vegetables. He encourages them to consume millets, sorghum, whole grain cereals, certain Indian vegetables such as bitter gourd and spices used in medicines for their antiglycemic proprieties (cumin, turmeric, asafoetida), and also dairy products that lower *pitta* in the body asking them to avoid high fat egg-fish and meat. In other words, they steer their patients towards a more plant-based diet. For anemia condition, he advices patients to consume millets, sorghum, whole grain cereals, pulse, vegetables, milk, *karuppatti*(sugar prepared from palm sap in which calcium has been added to avoid fermentation) and fish or egg that he considers as richer in micronutrients than chicken. Due to the focus on diet rich in traditional foods, notably millets, sorghum, pulses, green vegetables and leaves, traditional medical practitioners who are increasingly consulted by patients affected by food-related diseases, play an important role in the fight against malnutrition and metabolic diseases. Studies by Mani et al (1993) have shown that a diet with millets have a lower glycemic load than diets using refined cereals.

One may expect that the medical practice of traditional practitioners and NGOs involved in the food and agriculture fields to revive consumption of nutritious traditional food would be able to influence biomedical professional specialized in food-related diseases and decision-makers involved in agriculture and food security programmes. One may already notice an increasing collaboration between NGOs and nutritionists for improving health condition, and also, since these last years, a greater concern of biomedical doctors for millet, notably *ragi*, that they tend to recommend to their patients with diabetes. These patients play a role in the process of revival as they exchange their recommendations with other people affected by diabetes, so that millets are now increasingly available in shops of urban areas. Nevertheless, their prices are too high to be

affordable by all economic categories, and thus, to be reduced, support from the central and states government for supporting price and cultivation have been addressed.

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Table 1 Malnutrition and anemia profiles

	Preschool children		**Women 15-19/20-49**		**Men 15-19/20-49 (1)**	
survey	NFHS-2* 1998-1999	NFHS-3** 2005-2006	NFHS-2* 1998-1999	NFHS-3** 2005-2006	NFHS-2* 1998-1999	NFHS-3** 2005-2006
Underweight %	42.7(2) -2SD + -3SD (3)	40.4(2) -2SD + -3SD (3)	38.8/36.8	46.8/32.8(5) BMI< 18.5	–	58.1/28.7(5) BMI< 18.5
Stunted %	51.0 -2SD + -3SD (3)	44.9 -2SD + -3SD (3)	–	–	–	–
Wasted %	19.7 -2SD + -3SD(3)	22.9 -2SD+ -3SD(3)	–	–	–	–
Hemoglobin (g/l)	74.3(4) <11	78.9(4) <11	56.0/51.6 <12	55.8/55.2(5) <12	–	30.2/22.8(5) <13

(1) the nutritional status of men has been explored only in the third round of NFHS.
(2) children under 3 (3) Standard deviation - % of -2SD include -3SD (4) children age 6-35 months
(5) calculated from data of age classes 20-29, 30-39, 40-49
*International Institute for Population Sciences (IIPS) and Macro International, 2000, *National FamilyHealth Survey (NFHS-2),*
1998–99, Mumbai, IIPS and ORC Macro Maryland.
**International Institute for Population Sciences (IIPS) and Macro International, 2007, *National FamilyHealth Survey (NFHS-3),*
2005–06: India: Volume I, Mumbai, IIPS.

Table 2 Metabolic diseases

	Urban (%)		Slum (%)		Rural (%)	
	Men	Women	Men	Women	Men	Women
Diabetes* % glucosemia>126mg/dl	11.4	10.3	8.5	9.6	6.2	5.7
Cholesterol* >200mg/dl	31.7	32.8	18.1	23.4	19.5	26.4
Hypertension** >140/90	29.8	25.5	27.6	22.8	22.1	20.6
Overweight** BMI ≥ 25	25.5	27.7	14.3	19.6	8.3	11.5
Obesity** BMI ≥ 30	5.4	11.0	2.4	6.4	1.1	2.5
Waist circumference* Men > 90 cm women>80 cm	31.1	57.9	17.7	42.1	12.2	29.7
	Men 20-49		Women20-49			
Overweight*** BMI > 25	9.5(1)		11.7(1)			
Obesity*** BMI > 30	1.5(1)		6.9(1)			

(1) calculated from data of age classes 20-29, 30-39, 40-49

*unpublished data of the survey of Shah, Bela, 2003-2005, presented in the Table 2 in Bela Shah, Prashant Mathur, 2010, Surveillance of cardiovascular disease risk factors in India: the need & scope, *Indian Journal of Medical Research*.

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***International Institute for Population Sciences (IIPS) and Macro International, 2007, *National FamilyHealth Survey (NFHS-3), 2005–06: India: Volume I*, Mumbai, IIPS.

Table 3 Food consumed at least once a week by men and women according to religion, place of residence, caste and economic status

	Religion						Residence		Caste				Weight index		
Socio-demographical criteria	**H**	**M**	**C**	**S**	**B**	**J**	**Urb**	**Rur**	**SC**	**ST**	**oBC**	**O**	**Low**	**Mid**	**Hi**
Milk or curd %	62.7	52.1	55.8	81.5	52.1	87.5	68.9	57.8	52.7	37.7	67.1	65.6	37.1	62.1	88.7
Pulses or beans %	90.9	93.6	77.0	92.9	91.3	96.6	92.8	89.0	88.8	85.0	89.9	92.3	85.0	89.2	94.0
green leafy vegetables %	93.6	92.6	87.8	94.7	94.7	97.7	94.8	92.4	92.8	90.7	93.7	93.8	89.7	93.6	94.4
Fruits %	43.1	42.1	59.2	55.2	47.5	84.1	61.1	34.4	35.7	29.0	44.7	52.0	17.8	37.9	72.8
Eggs %	34.0	62.4	63.9	20.4	51.3	2.6	44.0	33.0	39.0	34.0	34.7	38.6	26.7	39.8	39.3
Fish %	27.4	42.3	57.6	7.2	40.1	1.4	33.2	28.0	61.8	28.7	24.0	35.5	25.1	30.1	30.5
chicken or meat %	21.9	44.1	55.5	10.8	46.6	1.2	34.2	20.9	24.9	24.0	25.0	31.5	14.0	26.9	31.1

These data have been calculated from tables on women's and men's food consumption NFHS-3 (2005-2006)
H: hindu M: muslim C: chritian S: sikh B: bouddhist J: Jain
SC: scheduled caste (intouchable) ST: scheduled tribe oBC: other backward caste (middle class) O: upper class

Table 4 Frequency of consumption of food categories by women and men aged 15-49 years including place of residence, religions, castes and socio-economic categories

	Women (n=124385)				Men (n=69751)			
Frequency of consumption	**Daily**	**Weekly**	**Occasionally**	**Never**	**Daily**	**Weekly**	**Occasionally**	**Never**
Milk or curd %	39.8	15.6	33.2	11.4	46.7	20.5	25.8	7.0
Pulses or beans %	52.7	36.8	9.6	0.9	52.1	38.6	8.4	0.9
green leafy vegetables %	64.2	28.7	6.8	0.3	59.1	34.5	6.0	0.4
Fruits %	12.7	27.2	56.6	3.5	13.1	34.4	50.0	2.6
Eggs %	3.5	28.8	32.9	34.8	5.2	36.1	35.3	23.3
Fish %	6.3	21.9	34.3	37.5	6.2	25.1	38.2	30.5
chicken or meat %	0.9	21.8	42.2	35.1	1.2	27.1	46.0	25.6

Source: NFHS-3 (2005-2006)

Table 5 Food composition of cereals

	Protein	Fiber	Mineral	Iron	Calcium	Carbohydrate	Energy
Rice	6.4	0.2	0.7	1.0	9	79.0	346
Wheat (whole grain)	**11.8**	1.2	1.5	**5.3**	**41**	**71.2**	346
Finger millet	7.3	**3.6**	**2.7**	**3.9**	**344**	**72.0**	**328**
Pearl millet	**11.6**	1.2	**2.3**	**8.0**	**42**	**67.5**	361
Foxtail millet	**12.3**	**8.0**	**3.3**	4.1	25	**60.9**	**331**
Proso millet	**12.5**	2.2	**1.9**	0.8	14	**70.4**	341
Kodo millet	8.3	**9**	**2.6**	0.5	27	NA	**309**
Little millet	7.7	**7.6**	1.5	**9.3**	17	**67.0**	341
Barnyard millet	6.2	**9.8**	**4.4**	**5.0**	20	**65.5**	**307**
Sorghum	**10.4**	1.6	1.6	**4.1**	25	72.6	349

Table composed from *Nutritive value of Indian foods* by C. Gopalan, B.V. Rama Sastri, S.C.Balasubramanian Hyderabad: NIN