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Vitamin A Deficiency – Overkill

C. Gopalan

The achievement of optimal nutritional status calls for an adequate intake of nutrients (macronutrients, micronutrients and phytonutrients), all of which can be derived from a balanced diet based on a judicious combination of available, traditional foods. Nutrition scientists from the time of McCollum and McCarrison had recognised the importance of such balanced diets and had promoted their intake as the sure way of achieving optimal nutrition.

In recent years, however, with the advent of modern technologies for manufacture of synthetic nutrients in bulk, there have been attempts to promote some individual nutrients perceived as being of special importance. Following the "protein fiasco" and the subsequent welcome dissolution of the Protein Advisory Group (PAG), the nutrient that has been occupying centre stage in the international nutrition scene, for over three decades, has been vitamin A.

Vitamin A is undoubtedly an important essential nutrient, involved in quite a wide range of metabolic functions. Ensuring optimal vitamin A nutrition is, therefore, important. Vitamin A is, however, one of several scores of nutrients that also perform important functions with respect to health promotion and disease prevention. The near-exclusive emphasis on vitamin A should not obscure the need for a sensible food-based approach towards ensuring the well being of populations. There is considerable information today on the inter-relationships among micronutrients. Exclusively pushing the intake of a single micronutrient in a population suffering from multiple micronutrient deficiencies could lead to undesirable results.

Keratomalacia, arising from vitamin A deficiency, aggravated by respiratory infections (often consequent to an attack of measles) and protein-calorie malnutrition (PCM) was a major public health problem in India till the late 1960s. Keratomalacia was a clinical emergency and the use of synthetic vitamin A in the treatment of this acute and fulminant form of vitamin A deficiency was justified. Keratomalacia, like kwashiorkor, ceased to be a major public health problem from the late 1970s. What is now being seen is a mild form of chronic vitamin A deficiency (Bitot's spots) among the populations in some highly malnourished pockets of the country. Data from National Nutrition Monitoring Bureau (NNMB)[1,2] and Indian Council of Medical Research (ICMR)[3] micronutrient surveys indicate that over decades there has been a reduction in the prevalence of Bitot's spots.

Pro-vitamin A carotenes and carotenoids such as alpha carotene, beta carotene and cryptoxanthins that are present in fruits and vegetables are good sources of vitamin A. Earlier claim[4] that pro-vitamin A carotenoids are not bioavailable, have been effectively contradicted in a series of subsequent studies[5,6,7,8]. A comprehensive and elegant study by Tanumihardjo[9] has shown that not only are pro-vitamin A carotenoids bioavailable, but because of bio-regulation of conversion of carotenoid to vitamin A depending on vitamin A levels in the liver, their intake does not result in vitamin A toxicity, unlike when pre-formed vitamin A is administered. Thus, the food-based approach has been clearly shown to be a safe, sure and sensible way of preventing vitamin A deficiency.

Massive-dose Vitamin A Prophylaxis

Long after the disappearance of keratomalacia and serious forms of vitamin A deficiency, a programme of massive-dose vitamin A prophylaxis was promoted following the claims from a study by Sommer et al.[10,11] that this approach would reduce child mortality. In a series of articles[12,13,14,15,] I had adduced arguments to show that this claim is unsustainable and unacceptable. The claim regarding the benefits of massive-dose vitamin A rests mostly on findings from studies conducted by one school and its collaborators. Other important institutions like Harvard[16] and the National Institute of Nutrition (NIN)[17] in India have reported negative findings in respect of the impact of massive-dose on mortality. In these studies, contrary to the claims of studies carried out by Sommer et al and collaborators, massive-dose vitamin A administration did not bring about any reduction in child mortality.

One of the largest studies exploring whether massive dose of vitamin

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A administration is associated with a reduction in childhood mortality was taken up in 72 blocks in Uttar Pradesh in India between 1999-2004. In this study, children from different areas were given six-monthly massive dose of vitamin A, six-monthly deworming, or both or neither. About 1 million children were followed and mortality rates in 1-6 years were recorded. There was **no** significant difference in the death rates between children who received the massive dose of vitamin A and those who did not[18].

The NIN had carried out studies on the massive-dose approach in the early 1970s (long before Sommer), when keratomalacia was a major public health problem, and found it ineffective as a public health programme. Periera and Begum[19] from the Christian Medical College Vellore had also reported the ineffectiveness of this approach.

A powerful partnership of pharmaceutical agencies and some international organisations has strenuously tried to promote the massive-dose approach. Many of our national decision-makers and health agencies seem to have been successfully co-opted to endorse this approach. As a result, it is distressing that, in India, this approach has been permitted as a "universalised" public health policy. Between the ninth and 36th months of life, a child receives massive doses totalling 9,00,000 I.U. This is a 'universal' programme, involving all children. There is now a proposal to raise this further to 17,00, 000 I.U. to cover all children up to six years of age!

It is well-known that massive doses of vitamin A can lead to acute toxicity symptoms in a certain proportion of cases. These toxic symptoms consist of signs of increased intracranial tension. De Francisco et al.[20] had observed that even with relatively lower doses of vitamin A (25,000 I.U. or 50,000 I.U. as against 200,000 I.U. which is now given in the massive-dose prophylaxis), a considerable number of children develop fontanelle bulging, indicating increased intracranial tension. Administration of a massive dose of 200,000 I.U. vitamin A after fontanelle closure can be expected to lead to significant increase in intracranial tension lasting for the next few days. Subjecting children to repeated increase in intracranial tension could retard brain development that takes place in the postnatal period. There have also been several instances of fatalities in children following the inappropriate use of massive-dose vitamin A in field programmes. For instance, an unfortunate episode in Assam in which several children died as a result of massive-dose vitamin A attracted severe censure and condemnation from the judiciary. Apart from such acute toxic effects, repeated administration of massive doses could also result in chronic toxicity.

Vitamin A & Vitamin D Antagonism

DeLuca and colleagues[21,22] have demonstrated that vitamin A antagonises the action of vitamin D. Massive doses of vitamin A have been shown to intensify the severity of bone demineralisation and to inhibit the ability of vitamin D to prevent such demineralisation. Increasing amounts of retinyl acetate were shown to produce progressive and significant decreases in total bone ash and increases in epiphyseal plate width. Increasing the levels of retinyl acetate abrogated the ability of vitamin D to elevate the level of serum calcium.

Comments of Dr. Hector F. DeLuca

Harry Steenbock Research Professor, Department of Biochemistry, University of Wisconsin, Madison

"I have read Dr. Gopalan's paper on the practical problem of combating vitamin A deficiency in Indian children with great interest. I entirely share his view of the danger of using massive vitamin A to combat this practical problem. We are not at all clear what large amounts of vitamin A will do, and we certainly do not know what large amounts of vitamin A will do to the metabolism of other nutrients. Clearly vitamin D activity is suppressed with large amounts of vitamin A. The antagonism is small but nevertheless significant. With low doses of vitamin D, it is very clear that large doses of vitamin A can induce rickets in the rat. Presumably, this also occurs in people. I read with great interest the fact that many Indian children might be borderline vitamin D deficient because of insufficient exposure to sunlight. Their vitamin D deficiency would certainly be greatly aggravated by the provision of large amounts of retinol. I am pleased that this basic science study of vitamin D/vitamin A antagonism really finds some practical use in considering how to treat the deficient children in India."

Currently, 38 percent of Indian children are stunted, with linear growth levels below-2 SDs of the international standard. The prevalence of stunting in India is higher than that in Sub Saharan Africa. These findings are widely accepted and published by all international agencies. Yet there has been no significant dent in the problem of stunting in Indian children during the last several years.

Detailed studies have shown that, in children of poor communities, the downward deviation from normal growth sets in during the third and fourth months of infancy and progresses till the fifth year of age. It is precisely during this critical phase of growth, when stunting sets in, in the poor socio-economic groups, that the massive dose of vitamin A prophylaxis is also delivered to the children!

In poor families, there is a high prevalence of deliveries of low-birth-weight infants because of maternal malnutrition. Vitamin D content in breast milk is low. These very young children get hardly any exposure to sunlight in their dingy houses. Their calcium intake is also low. There are no public health programmes designed to address these deficiencies. Apart from vitamin D deficiency, there is also the possibility that zinc deficiency, which is already present in these children, could be aggravated by massive doses of vitamin A. Under these circumstances, the administration of massive doses of vitamin A to children who are deficient in a multiplicity of vitamins including vitamin D, and also deficient in zinc, could have the effect of aggravating growth retardation.

The possible role of the ongoing programme of massive-dose vitamin A prophylaxis in the aggravation and persistence of stunting in our poor children requires serious consideration. Unlike India, South Asian countries have avoided the massive-dose approach to vitamin A deficiency prophylaxis, and in the children of those countries stunting is not a major problem.

The comments of Dr. DeLuca, internationally well known for his work on vitamin D, on this aspect are given in the box.

Distorted Priorities

According to available survey reports of the NNMB[1,2] Bitot's spots, the mild form of vitamin A deficiency, is seen

in just 0.7 percent of children under five years of age in India. This figure of 0.7 percent is an average, and does not necessarily indicate that 0.7 percent of children of all regions of the country and in all seasons show Bitot's spots. Moreover, the NNMB survey covers only part of the country. In fact, a survey by the ICMR[3] had shown that Bitot's spots are present to a significant extent only in isolated pockets of the country.

As against the reported 0.7 percent prevalence of Bitot's spots, there are reports to show that 90 percent of children suffer from anaemia[23]; it may be safely asserted that children suffering from Bitot's spots, if properly investigated, will show deficiency of several other micronutrients. Nothing much is being done to combat these deficiencies. Under the circumstances, the near-exclusive emphasis on vitamin A deficiency reveals the distorted priorities of health agencies arising from the pressure of commercial sources. In effect, what we are seeing is **commercial exploitation of poverty and undernutrition.**

Ethical Issues

There is also an ethical issue. Though the programme is labelled as "universal", in actual practice, it is the children of the poor who are being subjected to this procedure and not the children of the affluent and the policy makers. In short, this programme, which carries the risk of acute toxicity, is not for "our children" but for "their children"– the children of the poor. This raises serious ethical and moral issues.

Commercial Exploitation of Poverty and Undernutrition

Apart from the massive dose of vitamin A prophylaxis in children, *vanaspati* (hydrogenated fat), the main source of edible fat for poor populations, is also fortified with vitamin A. Now there is strong political pressure for vitamin A fortification of milk.

A Mid Day Meal Programme for school children had been initiated by the Government of India. There was recently a move on the part of commercial agencies to hijack this Programme. In place of the fresh hot cooked meal which had been proposed to be given to the school children, some political and commercial interests had sought to substitute biscuits containing some synthetic micronutrients. Fortunately, due to the alertness and timely intervention of public-spirited citizens, this ill-conceived move was stopped. There are also ongoing attempts at capturing supplementation programmes of Intergrated Child Development Scheme (ICDS); "sprinklers" containing some arbitrary cocktail of micronutrients are being sought to be introduced in some the supplementation programmes.

Concluding Comments

- Public-spirited citizens must ensure the scrapping of the massive-dose vitamin A prophylaxis approach. This will not only avoid the considerable unnecessary expenditure which the Government is incurring on the programme but, more importantly, will save our children from undesirable side-effects.

- Vegetables and fruits are a good source not only vitamin A but also of several other micronutrients. A balanced diet that includes adequate amounts of a variety of vegetables would be the surest way of preventing micronutrient deficiencies. An intensive, well-structured programme to promote the consumption of locally available inexpensive fruits and vegetables should be mounted as a major National Programme and given high priority. The services of the chain of Home Science colleges throughout the country should be enlisted for a sustained programme of Nutrition Education targeted to the rural households and aimed at increasing the intake of locally available vegetables and fruits as part of household diets. The ongoing wastage of vegetable and fruits due to poor processing and storage facilities in the countryside must be prevented by promoting village-based technologies for processing and storage of fruits and vegetables.

- As part of our Rural Health Mission and ICDS programmes, children who exhibit Bitot's spots or who have just recovered from an attack of measles could receive synthetic vitamin A in recommended daily doses (not massive doses) for a fortnight, while simultaneously promoting adequate daily intake of vegetables and fruits.

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References

1. National Nutrition Monitoring Bureau (NNMB). NNMB Reports. National Institute of Nutrition, Hyderabad. 1979-2006
2. NNMB National Nutrition Monitoring Bureau. NNMB Micronutrient Survey. National Institute of Nutrition, Hyderabad. 2002.
3. Indian Council of Medical Research (ICMR). Micronutrient Profile of Indian Population. New Delhi. 2004.
4. de Pee S, West CE, Muhilal, Karyadi D, Hautvast JG. Lack of improvement in vitamin A status with increased consumption of dark-green leafy vegetables. Lancet 346:75-81. 1995.
5. Tchum K, Newton S, Tanumihardjo S, de Benoist B, Owusu-Agyei S, Arthur F, Tetteh, A. Evaluation of the indigenous leafy vegetable supplementation for Ghanaian postpartum mothers using MRDR assay. In: Kalambaheti Y, Charoenkiatkul S, eds. Bioavailability: Optimizing dietary strategies for better health in developing countries. Thailand. p. 35, 2006
6. Furr HC, Green M, Haskell M, Mokhtar N, Nestel P, Newton S, Ribaya-Mercado J, Tang G, Tanumihardjo SA, Wasantwisut E. Stable isotope dilution techniques for assessing of vitamin A status and bioefficacy of provitamin A carotenoids in humans. Public Health Nutrition 8:596-607. 2005.
7. Tang G, Gu X, Hu S, Xu Q-M, Qin J, Dolnikowski GG, Fjeld CR, Gao X, Russell RM, Yin S-A. Green and yellow vegetables can maintain body stores of vitamin A in Chinese children. Am J Clin Nutr 70:1069-76. 1999.
8. Tang G, Qin J, Dolnikowski GG, Russell RM, Grusak M. Spinach or carrots can supply significant amounts of vitamin A as assessed by feeding with intrinsically deuterated vegetables. Am J Clin Nutr 82:821-8. 2005.
9. Tanumihardjo, SA. Food - Based Approaches for Ensuring Adequate Vitamin A Nutrition. Comprehensive Reviews in Food Science and Food Safety (in press).
10. Tarwotjo I,. West KP, Sommer A, Tilden R, Dfunaedi B, Mele L, Hawkins B. 113th Annual Meeting of the American Public Health Association, 1985.
11. Sommer A, Tarwotjo I, Hussaini G, Susanto D. Increased mortality in children with mild vitamin A deficiency. Lancet (ii): 586, 1983.
12. Gopalan C, Vitamin A Deficiency and Child Mortality, NFI Bulletin. 7 (3). 1986.
13. Gopalan C, Vitamin A and Child Mortality, NFI Bulletin, 11 (3). 1990.
14. Gopalan C, Child-Mortality Reduction With Vitamin A Now the "Bellagio Declaration" !, NFI Bulletin. 13 (3).1992.
15. Gopalan C, Efficacy of Megadose of Vitamin A, Prevalence of Diabetes in Indians, NFI Bulletin. 14 (1). 1993.
16. Herrera MG, Nestel P, Amin AE, Fawzi WW, Mohamed, K.A., Weld, Leisa: Vitamin A supplementation and child survival. Lancet, 340:267-271. 1992.
17. Vijayraghavan K, Radhaiah G, Prakasam BS, Sarma KVR, Reddy V. Effect of massive dose vitamin A on morbidity and mortality in Indian children. Lancet, 1990, 336:1342-45.
18. Awasthi S, Peto R, Read S, Bundy D. Six-monthly vitamin A from 1 to 6 years of age DEVTA: cluster-randomised trial in 1 million children in North India. www.ctsu.ox.ac.uk/projects/devta/istanbul-vit-a-lecture.ppt
19. Pereira SM and A Begum. Prevention of vitamin A deficiency. Am J Clin Nutr, 22: 858, 1969.
20. De Francisco A, Chakraborty J, Chowdhry HR, Yunus M, Baqul AK, Siddique AK, Saok RB. Acute toxicity of Vitamin A given with vaccines in Infancy, Lancet 342:526-527, 1993.
21. Rohde, C.M., C.E., Manatt, M., Clagett-Darne, M. and DeLuca, H.F.Vitamin A Antagonizes the Action of Vitamin D in Rats. J. Nutr.129:2246-2250.1999.
22. Rohde CM, DeLuca HF. All-trans Retinoic Acid Antagonizes the action of Calciferol and Its Active Metabolite, 1,25-Dihydroxycholecalciferol, in Rats. J. Nutr. 135:1647-1652, 2005.
23. IIPS District Level household Survey – II. Nutritional Status of children. IIPS Mumbai 2006.

Dietary Intake, Physical Activity and Nutritional Status of Indian Adults

Prema Ramachandran

Introduction

Over the last six decades, India has undergone a slow but sustained demographic, social, economic, agricultural, nutrition and health transition. There has been a steady if slow economic growth, which is accompanied by reduction in poverty throughout the second half of the last century. During the last decade, the gross domestic product (GDP) growth rate has accelerated but there has not been commensurate decline in poverty ratio. In spite of increasing per capita income and reduction in poverty, Indian diets remain predominantly cereal based; dietary diversity is seen mainly among the affluent. Though there has been reduction in poverty and improved access to food at subsidised cost undernutrition rates continue to be high.

Over the last decade, there has been a progressive increase in overnutrition. In the urban affluent segments there has been an increase in energy intake from fats, refined cereals and sugar; simultaneously, there has been a reduction in physical activity. As a result, there has been a rapid increase in overnutrition in adults from the affluent segments of the population. Reduction of physical activity rather than increase in energy intake appears to be the major factor behind the progressive increase in overnutrition in other segments of the population. Currently, overnutrition rates are low in the rural population and among poorer segments of the population in urban areas. The changing pattern of dietary intake and physical activity in adults and the impact of these on nutritional status of adults are reviewed in this paper.

Dietary Intake

NNMB[1] surveys provide data on time trends in dietary intake (by 24 hour dietary recall) and nutritional status of the adult population in eight states from 1975 to 2005. The India Nutrition Profile (INP)[2] survey provides data on dietary intake (by 24 hour dietary recall) and nutritional status of adults in non-NNMB states in the mid-1990s.

Data from NNMB and INP surveys show that in the mid-1990s, average intake of cereals was near the recommended dietary allowance (RDA). The reported intake of foodstuffs is higher in INP states as compared to NNMB states (Table 1 and Figure 1); this is attributable to higher intake of cereals and pulses in the non-NNMB states, which were covered in the INP. Intake of pulses, vegetables and fruits is low among both men and women in all states (Table 1). NNMB data showed that over time there has been an increase in fats and oil intake; there has been a reduction in average intake of cereals among both men and women, especially, since the mid-1990s (Table 1).

Nutrient Intake

Data on time trends in nutrient intake from available NNMB surveys are shown in Table 2. Data from NNMB surveys show that energy intake was high in the mid-1990s and subsequently there has been a small decline in energy intake. There has been some decline in intake of most of the nutrients among both men and women over the last three decades. Inspite of increasing oil and fat intake, the proportion of dietary energy from fat remains lower than 15 percent. Dietary intake of iron in Indian dietaries has always been low. The steep decline in iron intake reported in the last NNMB survey can be attributed to different estimation methods, which showed that absorbable iron was 50 percent less as compared to earlier values.

Source of Dietary Energy

Data on time trends in total energy intake, percent of energy intake from fat, carbohydrate and protein from NNMB (9 states) and data on total energy intake, percent energy intake from fat, carbohydrate and protein from all the major states from INP for adult men and women show that carbohydrates remain the major source of energy in the Indian diet. Data from NNMB surveys suggest that dietary intake has not undergone any major shift towards increase in the consumption of fat/oils, sugar and processed food; neither has there been any increase in energy intake. Since the mid-1990s there was a reduction in the percent of energy from cereals. There was increase in percentage of energy from fat till 2001, but subsequently there

Table 1: Average intake of food among adult men and women (g/day)

			Cereals & millets	Dairy products	Pulses & legumes	Vegetables	Green leafy vegetables	Others (includes tubers)	Fruits	Fats & oil	Sugar & jaggery
NNMB	Men	75-79	495	66	37	59	13	55	14	11	18
		88-92	531	86	32	51	9	53	23	16	23
		96-97	541	74	35	56	17	54	31	15	21
		00-01	457	85	34	75	18	57	28	14	17
		05-06	418	94	31	68	17	63	27	16	15
	Women	75-79	386	56	31	51	11	47	11	9	16
		88-92	445	92	32	40	8	45	30	14	23
		96-97	434	72	29	53	16	49	24	13	21
		00-01	389	67	26	69	18	50	20	12	16
		05-06	365	80	27	63	18	52	26	13	14
INP	Men		543	119	41	112	41	81	20	17	19
	Women		468	113	37	101	37	72	19	26	18
RDI	Men		460	150	40	50	40	60	*	20	30
	Women		410	100	40	50	100	40	*	20	35

*Source: Reference 1 & 2. * data not available.*

Table 2: Average intake of nutrients: NNMB & INP

			Protein (g)	Total Fat (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)	Vit A (ug)	Thiamin (mg)	Ribo (mg)	Niacin (mg)	Vit. C (mg)
NNMB		1975-79	55.7	20.3	2065	98	26	142	1.3	0.8	13	28
		1996-97	60.1	27.4	2418	421	27	172	1.1	1	14	36
	Adult Men	2000-01	58.7	34.4	2225	523	17.5	242	1.4	0.8	17.1	51
		2004-05	54.8	26.9	2000	511	16.9	267	1.3	0.7	16.1	50
		1975-79	45.4	17.1	1698	330	21	118	1	0.7	11	24
	Women	1996-97	49.9	24.5	1983	382	22	148	0.9	0.8	12	32
		2000-01	48.2	27.6	1878	445	14.1	220	1.2	0.6	14.9	44.7
		2004-05	46.5	21.8	1738	443	13.8	254	1.1	0.6	14.2	47
INP	**Men**	1995-96	79.7	35.2	2592	716	26.1	397	2.12	1.2	22.6	66.8
	Women	1995-96	70.8	32.1	2293	659	23	376	1.84	1	20.3	62.6

Source: Reference 1 & 2

was a reduction in percent energy from fat. However, even in 2001, the percent energy from fat was below 15 percent (WHO/FAO /UNO)[3].

Nutritional Status of Adults

NNMB surveys provide data on time trends in nutritional status of adults in rural areas and urban slums National Family Health Survey (NFHS) 2[4] provides data on nutritional status of women in reproductive ages and NFHS-3[5] provides data on nutritional status of men and women in all major states. All these surveys show that the prevalence of undernutrition in adults is higher in rural areas as compared to urban areas. Prevalence of overnutrition is higher in urban areas. Over the last three decades, there has been a progressive decline in undernutrition and some increase in overnutrition both in urban and in rural areas. Prevalence of both undernutrition and overnutrition is higher in women as compared to men (Figures 2 and 3).

All the available data from National Sample Survey Organisation (NSSO) and NNMB surveys show that from the mid-1990s there has been a progressive reduction in the energy intake. In spite of this there has been a progressive increase in overnutrition rates. This is most probably due to changes in lifestyle, reduction in physical activity and consequently, reduction in energy requirement.

NFHS-3 data showed that the prevalence of overnutrition (ON) is four fold higher in urban as compared to rural areas. There is a progressive decline in the prevalence of undernutrition (UN) and progressive increase in the prevalence of overnutrition in adult women with increase in age (Figure 4).

Interstate Differences in Nutritional Status of Adults

Data from NFHS-3 show that all the states in India have entered the dual nutrition burden era (Figures 5 and 6). Prevalence of both under- and over-nutrition in women is higher than men (Figures 5 and 6). Populous states like Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan and Orissa have high under-nutrition and low overnutrition rates. States like Delhi and Punjab has low undernutrition and high overnutrition rates. However, there are states like Goa, Tamil Nadu and Himachal Pradesh have relatively high undernutrition and overnutrition rates.

Data on energy intakes in different states from the NSSO survey (2004-05)[6] and undernutrition in women in different states from NFHS-3 were plotted and are shown in Figure 7. There are

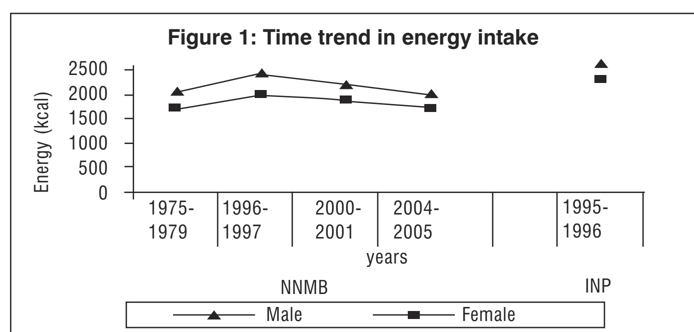


Figure 1: Time trend in energy intake

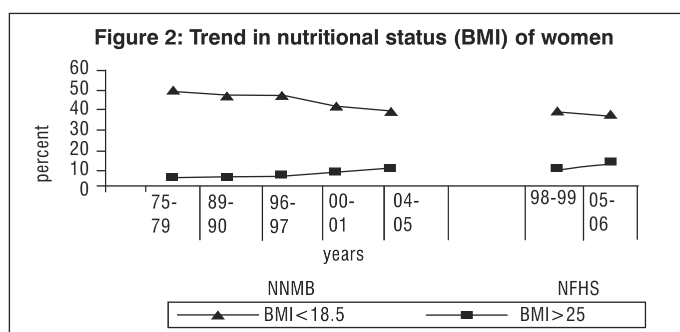


Figure 2: Trend in nutritional status (BMI) of women

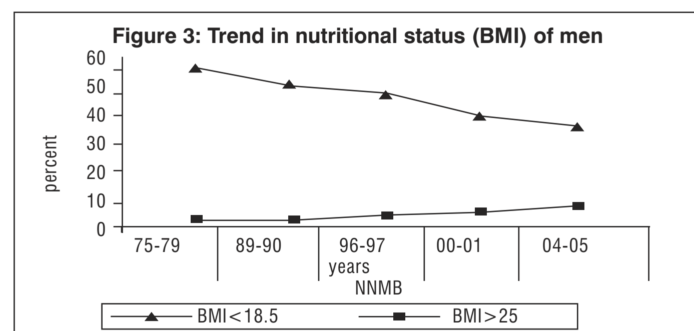


Figure 3: Trend in nutritional status (BMI) of men

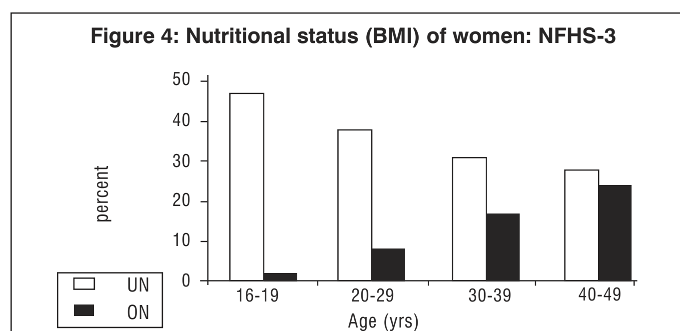


Figure 4: Nutritional status (BMI) of women: NFHS-3

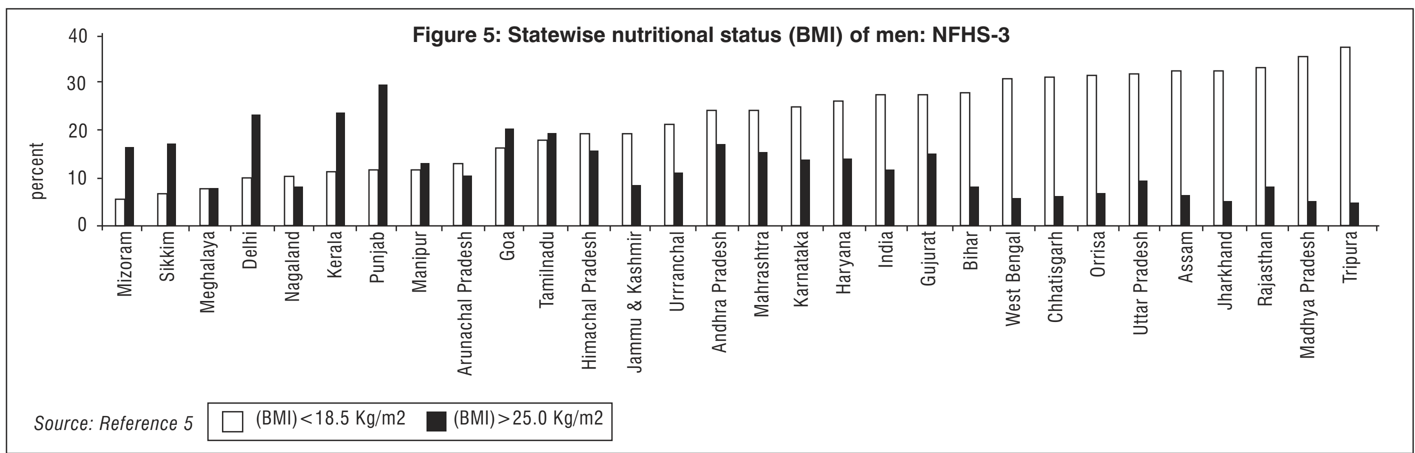


Figure 5: Statewise nutritional status (BMI) of men: NFHS-3

Source: Reference 5

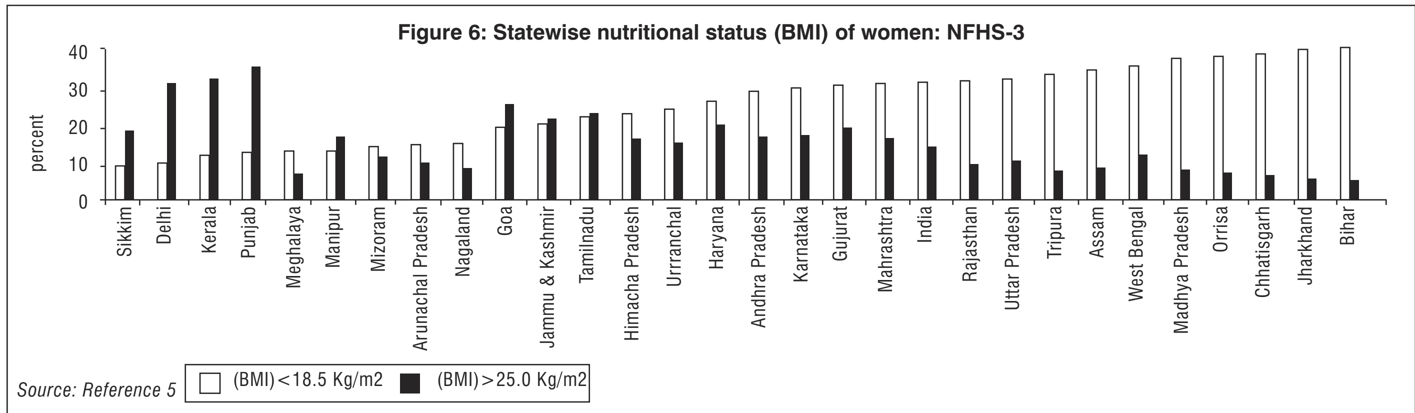


Figure 6: Statewise nutritional status (BMI) of women: NFHS-3

Source: Reference 5

substantial interstate differences in the energy intake and prevalence of undernutrition in women (Figure 7). In states with low energy intake (e.g Bihar), undernutrition rates are high. In states with high-energy intake, e.g. Punjab, undernutrition rates in women are lower. However, there are exceptions to this. In Orissa, in spite of high energy intake, undernutrition rates are high. In Tamil Nadu, in spite of low energy intake, undernutrition rates are low. Kerala, with relatively low energy intake, has undernutrition rates comparable to Punjab. Lower physical activity due to levels in occupational and household activities, better availability of transport, fuel and mechanisation in Kerala and Tamil Nadu may account for the low undernutrition rates in adults in spite of low energy intake.

Physical Activity

Physical activity is one of the major determinants of energy requirement. Physiologists recognise four domain of physical activity; work, domestic, transport and discretionary activity. Until two decades ago in most developing countries including India, physical activity in work, domestic and transport domains were very high. As a result, majority of the population expended very little energy in discretionary physical activity. Because of the high physical activity level in daily chores, the majority of the population was moderately active and hence energy requirement was that of moderately active population. They enjoyed the health benefits of moderate physical activity without any discretionsary physical activity (Figure 8).

The last two decades witnessed a tremendous change in lifestyle. The availability of transport, both personal and publics has improved several fold (Figure 9)[7] and energy expenditure in reaching places of study/work has become a fraction of what it was two decades ago. This is also reflected in the consumption expenditure pattern. The NSSO surveys have shown a steep increase in expenditure on transport. Better access to water and fuel both in urban and rural areas has resulted in a substantial reduction in energy spent by women on collecting water and fuel.

During the last decade, some well-planned studies have been initiated for investigating physical activity patterns in urban and rural areas and in different income groups. The Prospective Urban and Rural Epidemiological (PURE) India study

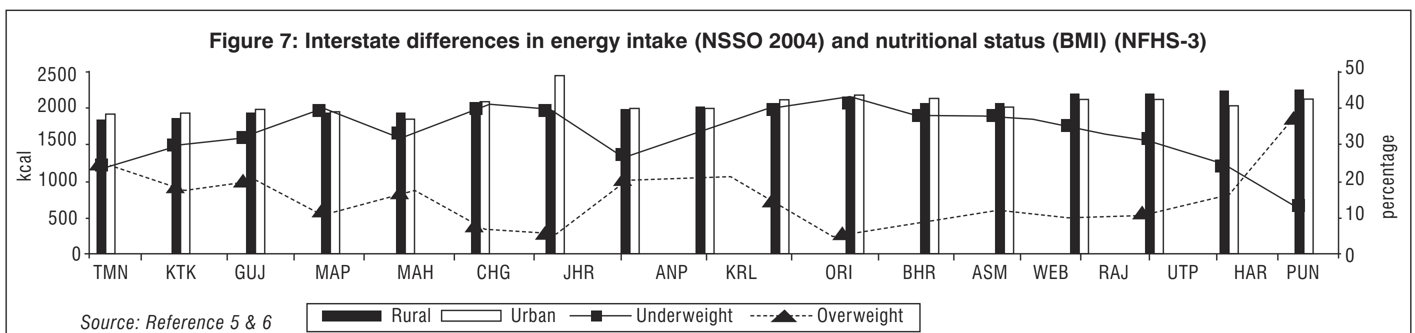
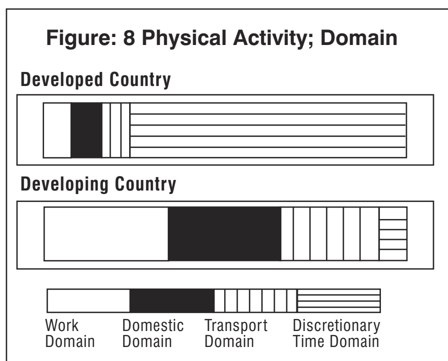
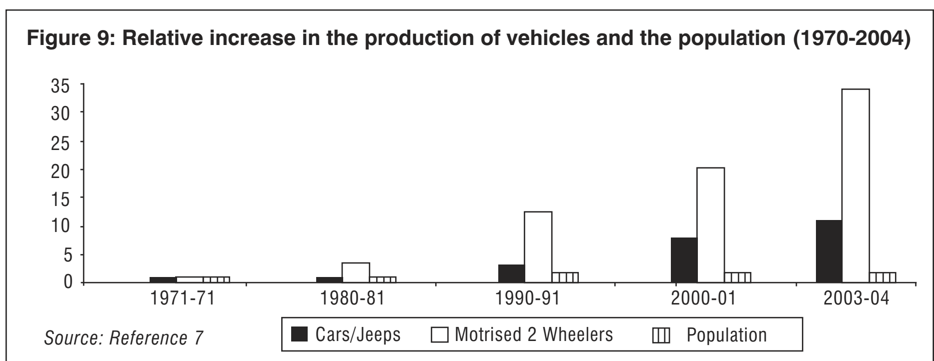


Figure 7: Interstate differences in energy intake (NSSO 2004) and nutritional status (BMI) (NFHS-3)

Source: Reference 5 & 6





documented level of mechanisation for transport and domestic activities in urban and rural areas (Table 3)[8]. It is obvious that in urban areas, transport as well as household activity is highly mechanised. A majority of the urban population working in white- or blue-collar jobs, where occupation related physical activity levels are low. As a result even though urban men and women spend time in domestic and occupation related activities, their energy expenditure for these activities is low (Figure 10). Their discretionary activities (TV watching, computer games, etc.) are associated with very low energy expenditure. Unlike people in the developed countries, Indians do not undertake energy intensive discretionary activities; and as a result there has been a steep reduction in their energy requirement. Unchanged dietary intake, reduced physical activity and consequent reduction in energy requirement appears to be responsible for an increase in overnutrition.

Table 3: Level of mechanisation in urban and rural populations (% household ownership)

	Rural	Urban
Monthly Household income (Rs)	1860	12674
Transport		
Motorized two-wheelers	7.9	78.2
Car	0.2	12.2
Household appliances		
Washing machine	0.1	41.4
Kitchen mixer / blender	4.5	95.2
Leisure		
Television	24.9	98.2

Source: Reference 8

Energy Balance

During the last three decades, there has been a progressive decline in the poverty ratio and a steep increase in per capita income. Economic improvement inevitably results in improved purchasing power, ability to purchase a variety of food items and consume many of them. This, in turn, can lead to some increase in energy intake. Simultaneously, there is a reduction in physical activity. The combination of all these factors might be responsible for the rapid increase in overnutrition in segments of the population who have just emerged from poverty. This situation might also apply to rural migrants who had settled down in urban areas.

A cross sectional study on energy intake and expenditure in affluent housewives in the age group of 30-70 years in Delhi showed that their energy intake was between 2100-2300 kcal/day. In each age group, the energy expenditure was lower than the intake by about 70-100 kcal/day. This positive energy balance was associated with a weight gain of about 5 kg per decade (Table 4). These women did not make any conscious effort to increase physical activity or take up a regular exercise regime until they were over 60 years of age or had health problems. It is possible that a similar situation exists among men in these segments of population. A small but persistent positive energy balance appears to be the major factor responsible for the slow but steady weight gain in adults among affluent segments of population.

Summary and Conclusions

Over the years, there has been a reduction in poverty; food grains are available at subsidised cost to the poorer segments of population. Data so far presented indicate that over the last three decades there has not been much change in dietary intake of adults; while macronutrient intake nearly meets the RDA, micronutrient

Table 4: Energy intake and expenditure in urban affluent housewives

Groups	Weight (Kg)	BMI (Kg/m2)	BF%	TDEI (Kcal)	TDEE (Kcal/day)	Energy Balance (Kcal)	Measured RMR (Kcal/day)	PARRMR (TDEE/ measured RMR)
D3 (30-39y)	59	24.8	32.8	2,134	2056+238.7	+78	1562+ 260	1.33+0.14
[n=22]					1724.5-2665.5)		(1166-2059)	(1.12-1.59)
D4 (40-49y)	64	26.4	36.5	2,264	2191+306.6	+73	1779+ 273	1.24+0.10
[n=20]					(1785.4-2817.3)		(1267-2304)	(1.10-1.49)
D5 (50-59y)	69	28.6	40.3	2,195	2146+173.1	+49	1752+ 274	1.24+0.12
[n=20]					(1849.4-2494.0)		(1224-2203)	(1.06-1.51)
D6 (60-69y)	66	29.3	44.0	2,065	1971+118.4	+94	1457 +154	1.36+0.14
[n=14]					(1770.0-2144.3)		(1224-1742)	(1.16-1.69)
D7 (70-88y)	56	24.5	38.5	1562	1736+162.8	-174	1292+ 108	1.35+0.14
[n=07]					(1553.0-2012.0)		(1152-1454)	(1.15-1.52)

Source: Reference 9

BMI: Body Mass Index BF%: Body Fat percent TDEI: Total Dietary Energy Intake TDEE: Total Dietary Energy Expenditure RMR: Resting Metabolic Rate

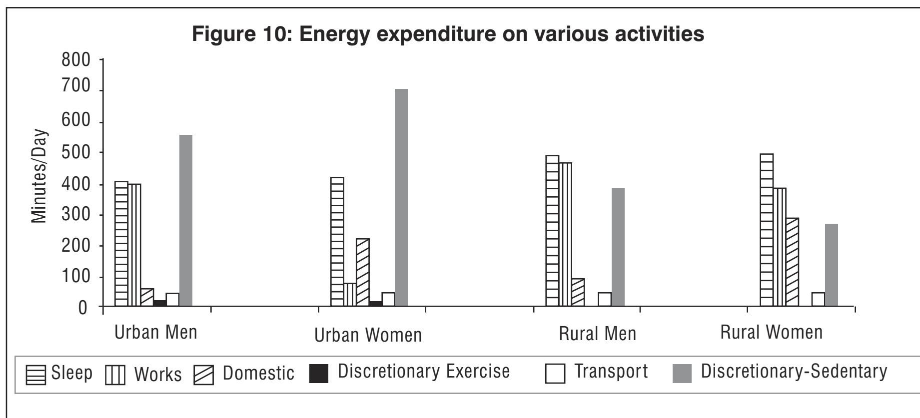


Figure 10: Energy expenditure on various activities

intake is very low because of low intake of vegetables. There has been a reduction in physical activity due to increased mechanisation of transport, agricultural and industrial tasks; improved access to water, cooking fuels and mechanisation of household chores has resulted in reduced physical activity in household chores in women.

Unchanged dietary intake with a reduction in the energy requirement has resulted in a slow but steady decline in undernutrition and increase in overnutrition both in men and women. Undernutrition rates continue to be high among rural poor while overnutrition is emerging as a major problem in affluent segments of population, especially, in urban areas. Prevalence of both undernutrition and overnutrition are higher in women than men. Huge interstate differences exist in terms of dietary intake, physical activity and nutritional status.

Nutrition education that adults should eat a balanced diet with just adequate energy intake and lots of vegetables should be communicated to all. If they follow this advice there will be improvement in undernutrition and micronutrient deficiencies. Health education that exercise has to become a part of the daily routine to promote muscle and bone health as well as prevent development of adiposity have to be beamed regularly through all channels of communication. As the urban affluent segments access information and services readily, they can be persuaded to reverse their recently acquired unhealthy lifestyle, and regain their normal nutrition and health status. The fact that they are trying to change their lifestyle will act as a powerful incentive to stimulate the other segments of the population to follow suit and thereby combat the trend towards increasing overnutrition in middle income group population. The emergence of the dual nutrition burden should therefore be considered as an opportunity to improve nutritional status of the population by combating both under- and over-nutrition through nutrition and health education.

The author is Director, Nutrition Foundation of India.

References

1. NNMB National Nutrition Monitoring Bureau. NNMB Reports: National Institute Of Nutrition, Hyderabad. 1979-2006.

2. Department of Women and Child Development. India Nutrition Profile. Government of India, New Delhi, 1995-96.

3. Human energy requirements, Report of a Joint FAO /WHO /UNU Expert Consultation, Rome 2004.

4. National Family Health Survey (NFHS-2): http://www.nfhsindia.org/india2.html; last accessed on 24/09/07

5. National Family Health Survey (NFHS-3): http://mohfw.nic.in/nfhsfactsheet.html; last accessed on 24/09/07

6. National Sample Survey Organization NSSO. 1975-2000; http://mospi.nic.in/mospi_nsso_rept_pubn.htm; last accessed on 24/09/07

7. Economic Survey of India 2003-04: http://indiabudget.nic.in/es2006-07/esmain.htm; last accessed on 24/09/07

8. PURE Prospective Urban and Rural Epidemiological Study: http://www.ccc.mcmaster.ca/pure/index.html; last accessed on 24/09/07

9. Vasuja M and Siddu A: Energy intake and expenditure in urban affluent housewives PhD Dissertation, Delhi University, 2003.

FOUNDATION NEWS

- **Director's Engagements**

Made a presentation on "Emerging dual nutrition burden: opportunities and challenges" at the inauguration of Technical Sessions of the National Nutrition Month in Sri Lanka as a WHO consultant on June 2, 2008.

Participated in the Project Review Group (PRG) Meeting of the ICMR on May 29, 2008 at ICMR Headquarters, New Delhi.

Delivered a lecture on "Obesity in children and adolescents: issues and challenges" at a meeting organised by the Ministry of Women and Child Development on April 24, 2008 in New Delhi.

- **Deputy Director's Engagements**

The 6th International Conference on Nutrition, Fitness and Health

The Conference was held on May 15-7, 2008 at Athens, Greece. Dr. Sarath Gopalan made a presentation on "Low birth weight and increased susceptibility to type 2 Diabetes Mellitus – A long term effect of growth retardation in early childhood" in the Session on "Nutrition and Diabetes". He also moderated the Session on "Nutrition and Cancer" at the Conference. He has also been elected as a Member (Indian Representative) to the World Council on Genetics, Nutrition and Fitness for Health.

- The Annual General Body Meeting of the Foundation was held on June 26, 2008.

- **Study Circle Lectures**

"Bio-ethics: Recent Developments" by Dr. Vasantha Muthuswamy (Head, Division of BMS and RHN; Sr DDG, ICMR, New Delhi) on April 30, 2008.

"Energy Expenditure Measurement: A Challenge" by Dr. Anupa Siddhu (Director, Lady Irwin College, University of Delhi, New Delhi) on May 30, 2008.

- **Symposium**

NFI organised a Symposium on "National Nutrition Policy: Essential Elements" on June 27-28, 2008 at India International Centre. This symposium reviewed the existing and emerging nutrition problems, past experiences in implementing interventions. Some essential elements, which must be addressed in the National Nutrition Policy, were also discussed.

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