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The Undercurrents of Political and Scientific Logic

Imrana Qadeer
Sourindra Mohan Ghosh
P.M. Arathi

Council for Social Development

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Abstract

After making considerable increase in calorie intake in the early decades of post independence era and largely maintaining those levels in 70s and even in the 80s, the period of 1990s up to 2010 in India witnessed its gradual decline. An intense debate to interpret these trends ensued with two divergent views emerging. One deduced the declines in calorie intake post 1990s as symptomatic of increasing economic impoverishment. The opposing view saw it as a natural by-product of economic development, where increasing mechanization and lowered infection rates reduced human energy demands, and shift of preference quality food items gradually reduced calorie intakes. The latter became the basis of government policy prescriptions in India. Two rather recent developments are: in 2009-10, the Indian Council of Medical Research (ICMR) massively reduced the Recommended Dietary Allowances (RDAs) of calories for adults arguing that their earlier RDAs of 1990 were scientifically erroneous, in effect justifying the declines in calorie intake. The second development was reducing the average calorie norm – based on revised ICMR RDAs—which is used as cut-off to estimate incidence of poverty at population level by the Expert Group to Review the Methodology for Measurement of Poverty in 2012. This study was set up to review the mechanism through which the IMCR arrived at their RDAs and its subsequent policy implications.

Our study finds that there is a paucity of evidence and empirical data used by the ICMR to base its recommendations. For example, the calorie RDAs for heavy workers was based on the findings of just three studies on (a) agricultural labourers, (b) stone cutters and (c) textile mill workers of Bengal in the 1950s. The third one—textile mill workers– are not even considered heavy workers but as medium category of industrial workers assisted by machinery, in contrast to heavy work say, manual tillers of land. Expanding the empirical base before 2010 covering other important categories of heavy workers such as rickshaw pullers, mine workers like shovellers, drillers, trammers in addition to agricultural labourers and stone cutters gives us calorie RDA estimates much higher than the recent ICMR figures. Our estimates of calorie RDA for men doing heavy work comes to 3864 cal/day compared to 3490 cal/day recommended by the ICMR 2010. Similar under-estimations of RDAs, to varying degrees, for medium and sedentary category workers were also observed in our study.

The direct implication of our findings is on calculation of average calorie norm for poverty estimation: compared to estimates by 2012 Expert Group to Review the Methodology for Measurement of Poverty of 2155 calories and 2090 calories per day per head for rural and urban areas respectively, our estimates are 2310 calories and 2239 calories. The declining trend of calorie intake in India is indeed an alarming phenomenon. Existing literature shows that it is not only calories but intakes of proteins and micronutrients, that also declined during the same period with people increasingly

shifting towards lesser quality cheaper diets. On the other hand, in rare phases where wages/incomes increased substantially compared to rise in prices, calorie intakes also increased, like in 2011-12. This shows that peoples' food intake is constrained by their incomes and cutting on food is just a coping mechanism to survive increasing prices, particularly of essential non-food items which competes with ability to spend on food, when increase in income is inadequate. These real connotations of low food intake can neither be justified through rationalising it as a natural reduction in energy demands, welcoming it as a component of economic development or claiming peoples' greater preference for better quality foods. Reducing calorie RDAs/norms officially drastically impacts only the vulnerable, especially the heavy workers. Not only the numbers of the poor are reduced making targeting a feasible strategy, even their rights are undermined as is evident from the entitlements ensured by National Food Security Act (NFSA) 2013. At the same time private food consumption of the affluent is not curtailed as there is no control on markets. Furthermore, the concern over increasing obesity among the not so well off can hardly be tackled by reducing RDAs as it is not just an affliction of the affluent; it is also rooted in early age under-nourishment and lack of good quality diet. The thrust of policy should rather be to ensure adequate quantity and quality of food to the majority, which gets threatened by reduced RDAs and ensuing lowering of Below Poverty Line (BPL) family estimates, quantum of assistance through public programmes—e.g. food distribution through Targetted Public Distribution System (TPDS) and nutrition supplementation programmes. Hence, all these call for a review and a revised nutrition policy.

Introduction

Distribution of food has historically been a collective enterprise, either by groups' of food gatherers, or the family. Availability in more complex social formations was constrained by class and caste/ethnic positions and gender. Science entered the scene much later when the state emerged as a key actor and needed to ensure order in productive processes and a dependable stream of workforce in times of war and peace. Deciding on quantities, types of foods, and supply systems for the common man were a product of this striving. The concept of Recommended Dietary Allowances (RDAs) emerged only when the science of nutrition had identified the basic principles of human nutrition and could spell out human nutritional needs (presumably objectively) and composition of common foods. Thus, the RDAs, in principle, specified the diets necessary for balanced nutrition that would maintain the body mass and energy levels for a healthy human being. Over-consumption could be as unhealthy as under-consumption and both could be categorized as malnutrition. Despite this knowledge, insufficient food consumption has been a perennial problem for India even after Independence. And, despite the increase in average availability of grain at the level of the household, the period from the 1970s to 1980s saw evidence of a minor decline in calorie intakes, while the intake of proteins increased marginally. From 1990s onwards, the decline of calorie intake accelerated before coming to a halt in 2011-2012. The quality of diet, if judged by protein intake, also deteriorated (Table 1). The only exception was the lowest expenditure groups—in a quintile distribution of the Monthly Per Capita Expenditure (MPCE)—that showed resistance to this decline (Qadeer et al. 2016).

TABLE 1: Daily Per Capita Calorie and Protein Intake, Select Years

Year	*Calorie (Kcal)*		*Protein (gm)*	
	Rural	*Urban*	*Rural*	*Urban*
1972-73	2268	2107	62	56
1983-84	2240	2070	63.5	58.1
1987-88	2233	2095	63.2	58.6
1993-94	2154	2073	60.3	57.3
2004-05	2047	2020	55.8	55.4
2009-10	2020	1982	54.2	53.4
2011-12	2099	2058	56.5	55.7

Source: Compiled from Radhakrishna (2005); Deaton & Dreze (2009) and Qadeer et al. (2016)

The proportion of people with calorie intake less than the recommended levels increased continuously[1] from 1993-94 till 2009-10. The year 2011-12 marks a break from that trend (Qadeer et al. 2016). This low food intake of the Indian population, reflected in high levels of under-nutrition, is well acknowledged and the importance of higher RDAs for the Indian population has been stressed by Indian nutritionists (ICMR 1984). Since 1990 however, the thrust to push down calorie RDAs for adults becomes noticeable in official recommendations (Table 2). This is despite the fact that the recommendations for adolescents and pregnant and lactating women were raised.

TABLE 2: Calorie RDA of Adults, ICMR 2010 and its difference from ICMR 1989 RDA

Gender	*Category*	*Requirements Kcal/day, 2010*	*Difference from 1989 RDA Kcal/day*
Man	Sedentary	2318	– 107
	Moderate	2727	– 148
	Heavy	3485	– 315
Woman	Sedentary	1899	+ 24
	Moderate	2234	– 9
	Heavy	2854	– 71
	Pregnant	+ 350	+ 50
	Lactating 0-6 months	+ 600	+ 50
	Lactating 6-12 months	+ 520	+ 120

Source: Rao 2010

While the need for periodic revision of RDAs based on new data and changing realities of life is undoubtedly required, it is not clear what shifts in knowledge and the ground reality over 1990 and 2010 called for a reduction of RDA.

Could it be that revisions from time to time may not always, "reflect differences in techniques and theory, but may have more to do with political pressure or changing social valuation of the acceptability level of particular intake levels" (Pacey and Payne 1985: 22-23). In this paper we enquire into both these aspects to understand why the Indian nutrition experts opted for such categorical reduction of calorie RDA. Our search for an answer is strictly within a technical framework first, and then we examine how the decision making process fits into the broader political economy of the science of nutrition. This, we believe, is critical as today RDAs have acquired an important place in determining poverty and ensuring access to food through the Public Distribution System (PDS).

This paper has four sections. The first is a brief exploration of the history of ideas and institutions (global and local) and the shifts in the international theoretical understanding of RDAs in the twentieth Century. Section two reviews the revisions in calorie RDAs in the period of liberalization of the Indian economy and the available evidence that helps assess the technical logic behind this revision since 1990. It also summarizes our reasons for considering inadequate the technical basis of reduced

RDAs. The third section underlines the importance of being sensitive to evidence on living and working conditions if scientific recommendations are to influence the quality of life of large sections of populations. It is an exercise in calculating some alternative calorie requirements for adults if the underlying assumptions are changed. It helps to explore the possible degree of underestimation of Physical Activity Ratio (PAR) and Physical Activity Level (PAL) values due to single or combined errors of underlying assumptions regarding occupational and non-occupational activities and body weights. The fourth is a discussion on the politics of reduced RDA for calories (referred to as calorie RDA later), its implications for the problems of persistence of under-nutrition and malnutrition (overweight, obesity and micronutrient deficiencies), and its use for poverty estimation that further enhances both these problems.

I
Historical Background

Evolution of Institutions

It is said that, in the field of nutritional sciences, "Old and new ideas began to be tested in a quantitative, scientific way" at the end of the eighteenth century, only after the "Chemical revolution" (Carpenter 2003: 638). Knowledge of the main elements and methods of chemical analysis provided the necessary tools for the development of nutritional science which, till then, was a matter of conjectures and ingenious hypothesis with insufficient facts that could have applications in practice (Ibid). Others however show that, even over the nineteenth century, the application of the science of nutrition was often guided more by professional status of scientists and the economic interests of those in power, rather than the scientific content of theories and interventions. The use of gelatin and beef tea as food for the poor in Europe and the rationale for calculating adequate calories but reducing quality of proteins for workers in the United States of America (USA) in the early and late nineteenth century are valuable examples of this (Sathyamala 2016). In the late nineteenth and twentieth century, the link between nutrition science and the economic interests of nations became more evident, as efforts at protecting productivity, by feeding adequate but low cost diets to the industrial workers, soldiers, prisoners and the working classes in Europe, Britain and USA, became a central focus. This was particularly so within the constraints created by the pressures of war and the needs of industry and commerce (Sathyamala 2014). Subsistence and not health thus became the defining frame of population nutrition. The added compulsions of the Depression of the 1930's and its consequences induced the League of Nations Health Organization (LNHO) to step in and address the condition of nutritional status within the same overall framework, calling for centralized nutrition policies and supervision of the nutrition of the people. It set up committees to find out what the nutritional requirements of human beings were, how could these be assessed, met and measured? Its Technical Committee met in 1935 and 1936, and published a report on, 'The physiological bases of nutrition, proposing the first international table of calorie and protein requirements by age and sex. The United States Academy of Sciences published its own recommendations in 1943 (Allowances 1989).

Given the shortages created by World War II and the link between war and the role of agriculture, the Food and Agricultural Organisation (FAO) too stepped in for meeting nutritional needs. Its first recommendations for RDAs came in 1949; the World Health Organization (WHO) joined the initiative to acquire the greatest possible degree of accuracy in assessing the calorie and nutrient requirements of human beings in the 1950s; and they were followed by the United Nations University (UNU) in 1981

(WHO 2004: 1). From their original use as a guide to "nutrition problems in connection with national defense" (Allowances 1989: 10), the RDA has come a long way to serve varied purposes such as planning and procuring food supplies for the army, providing for civilian populations, and evaluating adequacy in meeting national nutritional needs etc. Along with the fast pace of economic development, the underlying concerns for the west shifted from subsistence needs to prevention of obesity, emphasis on micronutrients, and for the establishment of programmes aimed at improving food supplies for the member countries, as is reflected by the FAO/WHO expert committees and expert groups that worked from 1950s onwards. These concerns primarily emerged from the perspective of the developed world, not of the developing countries.

The treatment of the Indian subcontinent prior to independence was cursory, both by the international bodies that focused on western nations, and the colonial government that took care of the nutritional security of the British army (Harrison 1994: 62). Initially the general population was left to fend for itself and face the onslaught of colonial policies on its agriculture without any pre-emptive support for the agricultural economy, "before frank famine had declared itself" (Zurbrigg 2001: 183). Tracing the history of famines in Punjab, Zurbrigg pointed out that the drought relief policy became routine in 1908, and from 1920 farmers with crop losses due to flooding were also sanctioned relief. According to her, the Punjab famine code in 1930 made provision for relief simply on the basis of scarcity (whenever staple food price rose 40% above normal). The 1930s was also the period when RDAs were being debated and worked out in the west; in India however, not only the local agricultural and eating practices were blamed, but their requirements too were kept relatively low in the name of practicality. In 1937, Wallace R. Aykroyd (associated with LNHO and Director of Nutrition Laboratory, Coonoor), who later became the head of the Nutrition Division of FAO (Carpenter 2007), proposed the nutritional requirement for the Indian population and it was accepted at a level closer to the sedentary worker's requirements for the west—2600 Kilocalories (Sathyamala 2010: 20).

The recorded life expectancy of Indians had started declining steadily since the decade 1881-1891 indicative of the trends of absolute poverty and starvation of the majority of the population (Habib 2017). World War II created further complexities with its demands for food supplies, personnel, money and vast amounts of war materials for the Allied forces. The Viceroy's 'scorched earth' policy that destroyed all means of transport (including confiscating boats and bicycles) in the major coastal cities to stop the Japanese advance, disrupted distribution of supplies between 1940-42. In 1942, despite a good harvest of foodgrains in Bengal, due to transport of massive amounts of foodgrains to Ceylon and Britain, soaring prices, and failure to push supplies through public systems, the region faced widespread famine (Sen 1981). The colonial government pursued the policy of food exports and neglected famines till the deaths rose to at least 3 million in 1942 (Patnaik 2004). It admitted that out of fear of the Japanese invasion, rice was removed from some coastal districts but the people were not evacuated (Sen 2005). The citizens in fact had to bear the burden of supplies for Allied forces. During the Bengal famine, even in the cities, the prominence given to the urban industrial workers by opening cheap foodgrain shops did not help the poorer sections of the civilian population (Sen 1981).

The Indian nutritionists noted with regret that despite their full participation in FAO when the first dietary table was published in 1937, it did not even mention nutritional issues in India (Sen 2005). The first director of the Coonoor Nutrition Laboratory, McCarrison believed that 'malnutrition' could exist among plenty and was not caused by poverty alone; the second Director, Aykroyd accepted low calorie intakes due to poverty and focused on developing 'cheap and balanced diet for Indians' (Sen 2005). Later, in 1944, based on the recommendations of the LNHO in 1936 and the National Research Council USA in 1941, presumably with some limited evidence from India, the Nutrition Advisory Committee (NAC) of the Indian Research Fund Association (IRFA) proposed a requirement of 2400 Kcal for sedentary and 3600 Kcal for very hard work (Patwardhan 1960), which is closer to the RDAs prescribed in 1989 of 2425 and 3800 Kcal per day respectively (see Table 2).

The IRFA was re-designated as the Indian Council of Medical Research (ICMR) in 1948 and again revised calorie requirements through its expert groups. In 1958, the NAC not only revised the 1944 RDAs but also advised that, "The background document considered in detail should be published" (Ibid: unpaged). This special report series no. 35 of the ICMR provides the basis for revisions of net calorie allowances. The revisions were based on a summation of observed Energy Expenditures (EE) under different conditions. These included: first, the basal conditions from various countries; second, the EE of a 55 Kg man in light, moderate and heavy work according to the scale recommended by the LNHO and accepted globally (the calorie increments for different categories of work were up to 75 Kcal/hr. for light work, 75-150 Kcal/hr. for moderate and 150-300 Kcal/hr. for hard work); and third, by augmenting the sedentary worker's requirement by including calories for specific dynamic action. It also introduced the concept of differential calorie expenditure during moderate and heavy work as used today and underlined the small samples of the observation used. Also underlined was the pressing need for focused work in India on Basal Metabolic Rates (BMRs) across different ages, and energy costs of work done in household and industrial sectors (Ibid: 19). BMRs are of particular significance because they define the minimum amount of energy required by a person at rest—i.e. not doing any work[2]. In 1968 minor additions were made for pregnant and lactating women in heavy, moderate and light worker's category. Till 1990, the subsequent Expert Groups (EG) of ICMR retained these calorie allowances, as may be seen from the 1989 figures (Table 2).

The effort to create cheap balanced diets in independent India during this period up to the eighties were also combined with state policies of land reforms, price control, and PDS that went a long way in tackling mal-nutrition and severe forms of under-nutrition. However, instead of pursuing this effort to include larger numbers through balanced diets, cereal and pulse production, and expanding choices of variety in food for the people, the late eighties and nineties saw drastic policy shifts. With Structural Adjustment, market forces threatened food security. The trend of rising calorie intakes reversed in the late seventies (Radhakrishna 2005), but the initial success had diverted the nutritionists' attention to micronutrient deficiencies, fortification of cereals, and later to obesity. The declining calorie intakes could not recapture their attention and it was left to be interpreted as a 'puzzle' or as an indicator of dietary variations (Qadeer et al. 2016). The RDA for calories, in fact, saw downsizing of allowances through the last two ICMR Committees in the next two decades (ICMR 1990; ICMR 2010).

Theoretical and Methodological Shifts in Assessing Calorie RDAs

The concept of RDAs (based on EE)evolved over time in Europe and the USA in the aftermath of the World War II when, the FAO, WHO, and UNU set up a series of Joint Committees (JC) in 1950s, 1960 and 1970s, to guide national nutrition policies in handling the dietary scarcity. These guidelines were, presumably, to define nutritional requirements 'on a sound scientific basis'. The requirements were defined in terms of energy intakes needed to balance EE in order to maintain body size, body composition and a level of necessary and desirable physical activity. This 'physical activity' was to be consistent with 'economic necessity, social desirability and long-term good health'. Also added later were the requirements for growth, pregnancy, and lactation. The general method of approach used by the 1949 and 1956 meetings was to set the requirements for a reference man or woman under well-defined conditions and then to consider the variations introduced by factors such as physical activity, body weight, age, climate, pregnancy, and lactation with separate assessments for infants, children, and adolescents (WHO 1973). Hence, the initial key scientific concepts that evolved overtime, were the notion of a reference man and woman, differing needs of various population groups living in different environments, and differing calorie requirements of different working groups within them, and the importance of age and weight in measuring requirements (referred to as the factorial approach). The recommendations were recognized as provisional, tentative and open to re-examination periodically in the light of new information (Ibid).

It is important to underline here that the requirements of energy could be measured through weight gains, energy intakes, and EE. Till 1970, intakes of a healthy population guided recommendations but later, 'average energy expenditure was considered the most appropriate as a measure of the energy needs of the healthy persons' in a defined group. This is because physiological mechanisms exist in individuals that regulate energy balance, though not on a daily basis, and to maintain this balance, allowances/ needs must not exceed requirement over a period of time. Protein requirements, in contrast, satisfy the physiological and maintenance needs of nearly all in a specific group as no such physiological regulatory mechanisms exist in human beings (Ibid: 11). This difference between calories and protein metabolism was later refined as: (a) the Estimated Average Requirement (EAR), which meets the needs of nearly half the healthy population and is the RDA for calories; (b) This average population intake/ EE, that maintains the energy balance over long periods, is the single statistic (without intra-individual variations) referred to as the descriptor (WHO 1985: 7-8); (c) EAR is of limited use for small groups and requires anthropometric and clinical assessments to establish nutritional status. RDA for proteins includes safety levels (2 standard deviations over and above EAR). This safety level was not recommended for calorie RDA because intakes that exceed requirements are stored as adipose tissue over time- which may be harmful, as extra calories are not metabolized unlike proteins.

Through a series of consultations over the 1970s, several grey areas that needed resolution were recognized:

(i) It was recognized that specifying allowances for a healthy population was ideal but had to be reconciled with a country's context and available data bases (WHO 1985: 7).

(ii) A comparison of average population intakes with their RDA is a statement of risk of inadequacy; that is, the chance that the intake is inadequate to meet the actual requirement. It is a probability statement and is not a measure of severity of inadequacy. It is not possible to judge nutritional status of individuals on the basis of RDA as this can be done only through clinical, biochemical and anthropometric means. As such, RDA functions as a tool in assessing the adequacy or inadequacy of dietary nutrient intake of a population but not its degree in individual members.

(iii) It was also said that for energy, once an adult body is fixed and growth defined there is only one level of intake at which energy balance can be achieved; which then becomes the adult requirement (WHO 1985: 7).

(iv) It was also considered necessary to make a distinction between requirements estimated with a focus on universal biological priority for health and those that suit practical application by planners for certain social concerns of policy (WHO 1985: 8)[3].

Given these complex challenges, the last two JCs of the FAO/WHO/UNU followed a more evolved methodology. Their data bases were expanded to some extent by including surveys from developing countries such as Chile, Mexico, Guatemala, Brazil and Columbia (WHO 2004: 20). They emphasized that, for recommending calories, (i) balanced intake of calorie sources be ensured, given the critical interrelationship between calories and nitrogen balance[4]. (ii) Given the difficulties of measuring Total Energy Expenditure (TEE)[5] in large populations, the use of a comparative index, PAR[6] was introduced which could capture the impact of sources of variation[7] in the recommendations for calorie allowance for global use. The weighted average of PARs for 24 hours, where the weights correspond to different activities with different PAR, conducted during the 24 hours, was termed as the PAL[8]. (iii) For estimating PARs for occupational work, work: pause time ratio[9] was considered separately and the weighted average was termed as Integrated Energy Index (IEI)[10]. (iv) With this new methodology and the use of PARs, the 1985 JC reduced its calorie recommendations with a distinct western bias in the data base. (v) Yet, the importance "of addressing the high magnitudes of energy deficiency while prescribing RDAs for developing country populations was underlined consistently by the JCs set up in 1985 as well as 2001" (WHO 2004: 30).

There are some distinct differences of approach between these two latter FAO/WHO/UNU JC reports. JC 2001 highlighted twenty years of added scientific knowledge that backed its recommendations and made it more applicable globally by:

(a) The inclusive strategy of the JC 2001, that included data from developing countries, moderated the 1985 cuts in PAR values and recommended calorie allowances as a range of PAL values for different work categories to choose from (WHO 2004: 38), on the basis of local context and data. This mitigated to some extent the bias of the 1985 Report.The JC 2001 also argued that its methodology, "Intends to be prescriptive, in order to support and maintain health and good nutrition. The recommendations, however, are meant for well-nourished and healthy populations, as the correction of malnutrition—either deficit or excess—involves different energy requirements and dietary recommendations" (WHO 2004: 2).

(b) The JC 2001 shifted to using the life style method where high levels of discrete activities were given a due place in locating individuals, and people such as sports persons could be considered as heavy activity categories even if they were not defined as heavy workers. By doing so the JC transcended class, avoided isolating heavy workers, and made activity the basic criteria for assessing energy requirement and not the category of worker.

(c) The understanding of adaptation also changed in the JC 2001. The differences of nutritional status of population from low calorie intake regions had been explained by the JC 1985 primarily through the concept of adaptation: “a process by which a new or different steady state is reached in response to a change or difference in the intake of food and nutrients” (WHO 1985: 20). The concept of a steady state was discussed and considered relative by the JC 1985. It could be biological, genetic or social/behavioral, through which populations could maintain their nutritional status. Adaptation was understood as a biological adjustment process that could reduce size or activity and was affected by environmental factors; it could be reversed. It was implied that, “a range of steady states exist and it is impossible to define a single point within the range that represents the ‘normal’… The different adapted states will carry different advantages and penalties… A decision about which is optimal or preferable can only be made in the light of a particular set of values” (WHO 1985: 20). It was also said that if the criteria are life expectancy and freedom from disease in the early years of life, then perhaps the nutritional state in industrialized societies might be preferred to that of developing countries, but there may be other criteria of optimal functional capacity. “The concept of a range of adapted states, each with advantages and disadvantages, produces a dilemma: it implies respect for different biological and cultural situations, but it may also encourage the acceptance of double standards and the endorsement of the status quo” (WHO 1985: 21). It concluded that, “requirements cannot be specified on physiological grounds alone, such as the need to maintain balance….Consequently, value judgments are considered legitimate about the state that is considered desirable to achieve. The aim, therefore, has been to set out clearly the principles and the measurements on which the estimates are based, and to indicate as far as possible the areas of uncertainty, so that the estimates can be applied in a flexible way” (WHO 1985: 22). In believing so, they granted freedom to planners to make value judgments and to scientists to define the ‘desirable’ steady state of adaptation. JC 2001 on the other hand recognised that the risk of developing obesity and co-morbid diseases of a sedentary lifestyle were mostly associated with under nutrition early in life (WHO 2004: 2), followed by an inappropriate diet and low physical activity in childhood and adult life-especially in low-income groups in urban areas. It did not mention the range of ‘steady states’ and several possible ‘normals’ that call for value judgments. Prakash Shetty, the author of the introduction to this report, in a review paper emphasizes that, “metabolic adaptation to energy restriction is not an important factor that needs to be considered when recommending energy requirements for adults in developing countries”. He goes on to argue that, “Every adaptation has its cost and there is no such thing as a ‘costless’ adaptation” (Shetty 2005: 1001).

This play of biases in scientific processes that is recognized yet ignored, interests us as it reflects the values within which scientific endeavor operates. The question we ask next is, trained in the same tradition of reductionist nutrition science, working within a purely technical framework without evaluating levels of societal development, did the nutritionists succeed in building a socially contextualised frame for evolving rational and evidence based calorie RDAs for Indian adults? The exercises by the ICMR EGs provides the field for this exploration as they worked diligently on downsizing the calorie allowances for Indian adults living and working in a context quite different from the western nation interms of elimate conditons and nature of work. Thus influencing the stresses of work, and nutritional status of the population.

II
Indian Calorie Allowances Since 1980s

Due to the possible risks of life style changes, the FAO/WHO downsized its calorie RDA and identified a range for non-occupational activities in 1973, as RDA varied with the level of occupational activity (WHO 1973: 29, Tables 1 and 2). Considering this, and in view of research over the decades leading to a new understanding of nutrition, a special committee was set up by the ICMR under V. Ramalingasawami to review and update RDA if required. The 1984 report of this EG however, rejected any revision of the Indian calorie RDA arguing that life style changes were not sufficient in the Indian context to reduce the RDAs. The recommendations of the 1968 Committee were therefore retained as valid (ICMR 1984).

Just four years after this reiteration- when the levels of under-nutrition in the country were such that 49% adults had BMIs under 18.5 and 42% of the under-five years children were underweight (Saxena 2011)—another EG of the ICMR was set up in 1988. Its preliminary report considered a drastic downward revision of RDAs by assuming that PAR units for India were fairly close to the international levels. It used the same values as of the FAO/WHO/UNU JC 1985. The previous energy RDA for calories for heavy workers was also considered to be rather high by a draft report of this EG in 1989 on the basis of just one study of stone cutters in 1960[1]. This dependence on international PAR levels was partly based on insufficient national evidence in late 1980s. The final report (ICMR 1990) revised the 1989 preliminary draft report and only partially reduced the cuts proposed, adding several explanations for this. Yet another EG of 2010 , talked of new evidence and further reduced the recommended PALs (ICMR 2010) so that, despite improved reference weights compared to 1990, the RDAs were lowered.

The two ICMR EG reports of 1990 and 2010 are unique as they use the new methodology introduced by the 1985 FAO/WHO/UNUJC. The 1990 EG gave specific descriptions for calculating non-occupational PAR but did not detail the estimation method of occupational PAR. The 2010 EG gave details of its assumptions underlying occupational PAR and thereby its reduction from 1990 EG levels. We examine in the following sections the evidence and the logic of the underlying assumptions, especially focusing on the later EG report.

ICMR EG 1990

This EG changed the PAL values for heavy, moderate and light workers (male and female) from the initially proposed 2.10, 1.78 and 1.55 in the preliminary draft report of 1989, to 2.5, 1.9 and 1.6 (Table 3). It made explicit its reasons for keeping PAL values above those of the 1985 JC (WHO 1985). These were India's lesser mechanization, higher infection rates demanding higher energy intakes, and equal or more work done by women compared to men (ICMR 1990: 16). The paucity of empirical evidence persisted but was also recognized (Ibid).

TABLE 3: PAL used by ICMR and FAO/WHO

Average PAL by Institutions						
		ICMR			*FAO/WHO/UNU*	
		1989 (Draft)	*1990 (Final)*	*2010*	*1985*	*2001**
Men	Heavy	2.1	2.5	2.3	2.1	2.0-2.4
	Moderate	1.78	1.9	1.8	1.78	1.70-1.99
	Sedentary	1.55	1.6	1.53	1.55	1.40-1.69
Women	Heavy	2.1	2.5	2.3	1.82	2.0-2.4
	Moderate	1.78	1.9	1.8	1.64	1.70-1.99
	Sedentary	1.55	1.6	1.53	1.56	1.40-1.69

Source: ICMR 1989 & 1990; 2010; FAO 1985 & 2004

*The 2001 FAO/WHO/UNU JC Report gives range and not a single value for PAR

Non-occupational activity was broken into two sets by the 1990 EG:one as rest, personal needs, and moving around; and the other as house hold work, recreation, and exercise. These two components were allocated a PAR of 1.7 and 2.8 respectively and the assumed time allocation was 4.5 hrs and 3.5 hrs for the sedentary worker, and 5.5 hrs and 2.5 hrs for the moderate and heavy workers (ICMR 1990: 17-18). Non- occupational activity PAR was thus significantly lowered in 1990 for heavy and moderate workers compared to their sedentary counterparts (Table 4) without referring to specific data on energy expenditures or time motion studies for substantiating these assumptions.

TABLE 4: PARs used by ICMR over 1990 and 2010

Average occupational and non-occupational PAR of ICMR				
	Occupational		*Non-Occupational*	
	1990	*2010*	*1990*	*2010*
Heavy	4.5	3.8	2.0	2.1
Moderate	2.8	2.3	2.0	2.1
Sedentary	1.7	1.5	2.2	2.1

Source: ICMR 1990 and 2010

Thus, for the heavy workers, average PAL of 2.5 was compiled from a PAR of 1 for sleep, 2 for non-occupational work, and 4.5 for occupational work. Revising their preliminary (1989) assumption of parity of PAR with the western population for occupational activity, the 1990 final ICMR EG report accepted that Indian PALs will be higher and brought them slightly above the JC 1985 recommendations as in Table 3.

For the ICMR, till 1989, the reference men and women were 20-39 years of age and weighed 55 and 45 Kgs respectively.[12] This was changed in 1990 to 60 and 50 Kgs and in 2010 to 60 and 55 Kgs for men and women respectively, with their ages reduced to 18-30 (Table 5). Men's reference height was 173 cm (BMI 20.3) and for women of same age category the reference height was 161 cm (BMI 21.2).

TABLE 5: Reference Body Weights for Adults (Kg)-ICMR

	1968	*1990*	*2010*
Men	55	60	60
Women	45	50	55

Source: ICMR Expert Groups of respective years

The various calorie allowances recommended for Indians by the ICMR and globally by FAO/WHO/UNU over time are summated in Table 6. As the FAO/WHO/UNU provides only PALs for 1985 and 2001, these have been converted into calories using reference BMRs.

Two observations worth mentioning from Table 6 are: (a) in the FAO/WHO/UNUJC reports the cuts in calorie RDA initiated in 1973 (Périssé and Joint 1981) have been curtailed by the introduction of a range of PAR (for estimating calorie RDAs) in 2001 JC to accommodate the needs of different sets of populations. (b) The upper range of PAR/calorie RDAs for 2001 JC are kept sufficiently high, particularly for heavy workers, probably to accommodate the higher needs of certain populations or societies. The ICMR however introduces maximum cuts in RDAs for the heavy workers and offers no range for any category. It is worth mentioning that the ICMR has been gender sensitive and women have fared slightly better in this exercise as compared to JC 1985.

TABLE 6: RDAs for Calorie intakes over time by ICMR and JCs of FAO, WHO, UNU

		ICMR				FAO/WHO/UNU			
		1958	1968	1990	2010	1973	1985[a]	2001[a] [range]	
Men	Exceptionally active*					4000			
	Heavy	3900	3900	3780	3485	3500	3182	3030	3636
	Moderate	2800	2800	2878	2727	3000	2697	2576	3015
	Sedentary	2400	2400	2424	2318	2700	2348	2121	2560
Women	Exceptionally active*					3000			
	Heavy	3000	3000	2925	2854	2600	2259	2482	2978
	Moderate	2200	2200	2223	2234	2200	2035	2110	2470
	Sedentary	1800	1900	1872	1899	2000	1936	1737	2097

*A category exclusive to JC FAO/WHO (WHO 1973)

[a]The recommended calories for FAO/WHO/UNU for 1985 and 2001 are derived by multiplying the BMR of 'reference' man and woman of ICMR 2010 by the PALs recommended by FAO

Sources: ICMR & FAO various years; BSN Rao (2005)

Despite a reduction of RDA by the EG of 1990, the concern about assumed overestimation of EEs for some non-occupational activities as well as occupational activities within ICMR did not subside. In 2010 another ICMR EG further reduced the recommended PALs so that, despite improved reference weights compared to 1990, the calorie allowances for all categories were lowered (Table 6). B.S. Narasinga Rao, the former Director National Institute of Nutrition (NIN), much after the publication of the 1990 report, argued that, 'the maximum level of sustained activity can be carried out only at 35% of VO_2 max[13] (4 Kcal/kg/hr)' (Rao BSN 2005). Neither the total period of 'sustained work'—specified by most other researchers as eight hours of consistent work (Astrand 1967; Saha et al. 1979)—nor the time division between low and high activity, or the maximum possible EE during the latter, was mentioned by BSN Rao. Instead, he added that, "the VO_2max among Indians is also reported to be lower than among Americans and Swedes. Hence the maximum work they can do is also limited" (Rao BSN 2005: 102). Thus he was more inclined towards accepting lower EE for Indians rather than finding empirical evidence for the variations of EE and VO_2 max for different kinds of work, body weights, and environmental temperatures at work places. M.N. Rao et al. (1961), who are quoted by BSN Rao, did say that Indians have 48 and 57% of the working capacity of Swedish and American subjects, but also pointed out that this difference, "could be accounted by subnormal physical fitness due to poor nutrition and adverse effects of tropical climate"[14] (Rao MN et al. 1961: 94). This relativity is well recognized in literature and the dependence of work capacity (energy cost) on aerobic fitness, environmental temperature, nutritional status, body composition, nature of work and its continuity or discontinuity are sufficiently recognized (WHO 1973: 22-28; Allowance 1989: 19). In other words the difference between work capacity as Kcal/Kg/hr., and total work output (EE) that is standardised by body-weight and time constraints, was ignored by BSN Rao while making this comment.

Irma Astrand, quoted by BSN Rao, defined the relationship between aerobic work capacity, as measured in the laboratory, and the occupational work-load level over a period of eight hours as, 'spontaneously chosen by the individual' and states that this level, 'corresponds to about 40 per cent of the individual maximal capacity' (Astrand 1967). Saha, through his study of young adults performing continuous work for eight hours, has shown that a relative load of 35% VO_2 max could perhaps be reasonably considered as the 'acceptable work load' for sustained work (Saha et al. 1979). These studies indicate that 35-40% VO_2 max may be the 'acceptable' or 'preferable' level of sustained work-load in laboratory conditions. In real life where workloads may surpass the ideal as for the Indian worker, acceptability or preference may not be the guiding principle. But they did not say anything of the sort that, "the maximum level of sustained activity can be…only at 35% of VO_2 max", as BSN Rao (2005: 102) interpreted from one of the above studies.

In addition to these incorrect deductions, which give the impression that Indian calorie RDAs were too high, the studies cited by BSN Rao to justify lower occupational PAR values of 3.9 for heavy workers (hugely reduced from 4.5 in 1990 ICMR—Table 4) were not appropriately used. One was of textile industrial workers with a PAR of 3.8 (Banerjee et al. 1959), who are in any case not considered heavy but moderate workers; and the other was a study of coal miners from Scotland (Garry et al. 1952), whose data was not even presented. The studies on agricultural workers with a PAR of 4.03 (Ramanamurthy et al. 1966) and stone cutters with PAR of 3.97 (Ramanamurthy and Dakshayani 1962) were the only suitable representatives. But PARs drawn from these studies were diluted to serve as a guide to specifying RDAs for heavy workers.

Last, but not the least of BSN Rao's concerns was recommending calories to adults according to the observed body weights (even if low) and not the reference body weights for specific age groups. He categorically discouraged use of reference weights, citing a study on coal miners by Satyanarayana et al. (1972) as evidence for risk of obesity (Rao BSN 2005). This cited study did show that diet supplementation increased body weight but did not yield an increase in coal output. However, its authors attributed the lack of increase in coal output to poor and inherently restrictive working conditions and recorded significantly lower weights of the workers. These factors were not mentioned while citing the study; and the fact that the workers were reported to have said that they would be able to work more with nutrition supplementation, provided that working conditions improved, was sidelined; the most crucial conclusion of the study that 88 per cent of the workers felt more energetic and healthy and fit due to diet supplementation was also ignored (Ibid: 1805-6). The basic fact was that the subjects of this study by Satyanarayana et al. (1972) had an average height of 161.6 cm and average weight of 48.3 Kg and hence, a BMI of 18.7. They barely escaped being under-weight (BMI<18.5). If they could become 60 Kg, i.e. the body-weight of ICMR 2010 reference man, their BMI would be 23.1, which is not obese. Hence, the concern that, "(P)roviding additional energy [to] corresponding to reference body weight for adults with lower body weight may…lead to obesity" (Rao BSN 2005: 107) is misplaced and not grounded in reality.

These biases and gaps in assessment were crucial and the 2010 EG of ICMR was expected to address the same. However, the EG was chaired by BSN Rao and the PAR values suggested by him and his paper of 2005, in effect, became its background paper helping further lowering of PAR by the ICMR EG 2010.

ICMR EG 2010

This group builds its case for reducing the recommended calorie intakes by critiquing the 1958 recommendations. Some of the sections on the critique of 1958 report are copied from the 1990 report (para 4, page 13 to para 5, page 14) without even mentioning its deliberations. Repeating the earlier report's rather ambiguous Table 4.1 (ICMR 1990: 17), the 2010 EG report (ICMR 2010: 24) reasserted parity of Indian and international PARs. It then used this parity for lowering PAR values in all work categories compared to EG 1990 except for sedentary, pregnant and lactating women (Table 2). While specific activities using similar tools and equipment may have comparable PARs, the actual working conditions in the two situations are not necessarily comparable. Hence, comparability does not take away from the importance of selecting appropriate PARs. For example, PAR for mechanized agricultural work would be appropriate for western cultivators while for the Indian counterparts we need to use PAR for non-mechanised agricultural work. This was recognized by the 1990 EG report, which at least mentioned "non-availability of substantial new information" (ICMR 1990: 14), and the view that most heavy workers require higher energy (a PAR of 4.5) for occupational activity. But the 2010 EG, without any serious review of the evidence and arguments presented by the 1990 EG, rejects its proposition of differences in the conditions prevailing in India and the west. Assuming similarity of conditions of work of the heavy and moderate workers with the west, it simply stated that the heavy work involving 4.5 PAR lasts only for 3-4 hours and the average PAR value may be 3.8. It did so in the same vein in which BSN Rao reviewed his evidence in 2005, without paying attention to details or to new evidence on work: pause time ratio and their respective PAR values for accuracy. There is only a minor reorganization and an insertion of an old study of stone cutters (Ramamurthy and Dakshayani 1962) as an addition to the evidence on very heavy workers, despite its claims of considering new evidence.

As a consequence we see a chronological reduction of occupational PAR values for heavy work from 4.5 by EG ICMR 1990 to 3.9 (by BSN Rao 2005) and finally to 3.8 by EG ICMR 2010 without presentation of adequate evidence gathered between 1990 and 2010—a period over which the reality of falling calorie intakes and increasing proportion of people with insufficient calorie intake was unfolding.

Evidence available by 2008, infact, suggests that the IEI for occupational work hours for heavy work could not be as low as the 3.8 suggested by the ICMR EG 2010. Two prior studies on manual shovelers (Dey et al. 2006a) and drillers (Saha et al. 2008) in Indian coal mines had already estimated the work-loads in terms of Working Heart Rate[15] (WHR). Both these studies have presented their data for workers of two age groups (less than 40 years, and 40 years and above). Keytel et al. (2005) estimated the predictive equation to calculate EE for males from heart rate (HR), which is as follows.

$$\text{EE (KJ/min)} = -55.0969 + 0.6309 \times \text{HR} + 0.1988 \times \text{Weight} + 0.2017 \times \text{Age}$$

Using this equation to calculate the EEs for work hours we calculated the PARs and IEIs for different heavy workers assuming 60:40 work:pause time ratio. The calculations are shown in Table 7.

TABLE 7: Estimation of average occupational PAR (i.e. IEI) from HR data of miners

	Age Group[a]	*Average Age*[a]	*Average Weight*[a]	*HR*[a]	*HR to EE (kcal/min)*[b]	*BMR (kcal/min)*[c]	*Occupational PAR (EE/BMR)*	*IEI*[d]
Shovelers	< 40	32.9	57.0	130.4	10.8	1.01	10.7	7.1
	≥ 40	43.9	53.7	138.2	12.4	0.98	12.5	8.1
Drillers	< 40	34.2	60.8	122.5	9.9	1.04	9.5	6.3
	≥ 40	48.9	56.8	124.0	10.6	1.01	10.5	6.9

[a]Data of shovelers from Dey et al. 2006a and for drillers from Saha et al. (2008)

[b]Calculated from predictive equation estimated by Keytel et al. (2005)

[c]Estimated from body weights by predictive equations provided by ICMR 2010: BMR (kcal/day) = 10.9 × Weight + 833

[d]60:40 work:pause time ratios assumed

There are five other studies on–rickshaw pullers (Banerjee et al. 1959; Pradhan et al. 2008), coal mine trammers (Dey et al. 2006b), stone cutters (Ramanamurthy and Dakshayani, 1962) and agricultural workers (Ramanamurthy et al. 1966)—which give actual energy expenditures[16] for occupational work. From the age and body-weight data provided in these studies, we have estimated BMR and accordingly calculated average occupational PAR (i.e. IEI). These values range from 3.9 to 8.3 and are presented in Table 8 along with the IEI of shovelers and drillers calculated in the previous paragraph.

TABLE 8: Occupational PAR—Various Heavy Worker Categories

Worker Category	*Reference Study*	*Average Occupational PAR*
Rickshaw Pullers	Banerjee et al. 1959	8.30
	Pradhan et al. 2008	6.16
Mine Trammers	Dey et al. 2006b	3.90
Stone Cutters	Ramanamurthy and Dakshayani 1962	3.97
Agricultural Labourers	Ramanamurthy et al. 1966	4.03
Mine Shovelers[a]	Dey et al. 2006a	7.1
Mine Drillers[a]	Saha et al. 2008	6.3

[a]The figures are taken from the younger of the two age groups

The value of PAR (3.8) assumed by ICMR EG 2010 does not touch even the lower limit of this range. Even if it is granted that Rickshaw pullers have very high PAR values among heavy workers, the average PAR of the rest of the group comes to 5. In that context, the 4.5 PAR assumed for heavy workers by ICMR 1990 does seem to be closer to available evidence. Given the fact that agricultural workers are the biggest component of heavy workers in India, the least that the ICMR EG 2010 could have done was to consider the value of PAR for non-mechanised agricultural labourers proposed by 2001 FAO/WHO/UNU (a PAR of 4.1) as the representative value for the category of heavy workers in India.

Irrespective of the evidence, both old and new, of negative energy balance among coal miners and stone cutters (Satyanaryana et al. 1972; Ramamurthy and Dakshayani 1962), and without any concrete logic for ignoring the high stress in the real life of workers, or any corrective allowances in RDAs to compensate for energy deficit, the ICMR EG 2010 arbitrarily reduces the average occupational PAR values, and hence the PAL values for heavy workers to 2.3.

For moderate workers, the ICMR 2010 assumes an occupational IEI of 2.3. This value too appears to be extremely low in the range of moderate occupational activities people engage in (James and Schofield 1990: 136). In the compilation of database in James and Schofield, 1990 (a source widely quoted in FAO/WHO/UNU JC reports on RDA), the occupational IEI for the activities listed ranged from 2.34 to 3.32 for men and 2.45 to 3.35 for women (Ibid: 137). For activities involving industrial work (who form the majority of moderate workers), the occupational IEI ranged from 2.7 to 3.02. For Indian textile workers, this value can be as high as 3.8 (Banerjee et al. 1959). Our calculations from the data provided by a recent study of brickkiln workers (Ray 2014) show that the average occupational PAR for men and women workers can be as high as 4.12 and 4.96 respectively. These PAR values are quite high for work that would be conventionally categorised as moderate, and the male workers have very long working hours (Table 9).

TABLE 9: Per-Hour Energy Expenditure of Brick Kiln Workers by Types of Work, India

	EE (kcal/hr.)		*Time (hr./day)*		*No. of Workers*		*IEI*[a]	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
Moulders	219.3	232.4	13.0	8.0	27	27		
Loaders	260.4		9.5		8	0		
Layers	252.3		9.0		5	0		
Coverer		219.4		3.5	0	2		
Removers	236.8	228.1	7.8	7.8	10	10		
Weighted Average	211.5	231.2					4.12	4.96

[a]The average age of men and women workers were 28 and 25.6 years with average body weight of 49.1 and 46.1 Kg respectively. The BMRs are calculated from the predictive equations of ICMR.

Source: Ray 2014, Calculations by authors

These evidences reflect the need for considering available guidelines (occupational IEI of at least 2.7, the standard used by FAO/WHO/UNU (WHO 1985)as well as fresh studies of calorie expenditure among Indian factory workers (particularly the informal sectors) for accommodating their reality in our assumptions.

Among the category of moderate workers, working for longer hours (over 8 hours per day) is quite a common practice and is increasing. According to a Government of India online Report,[17] about 21% of men and 17% of women factory workers work for more than 8 hours in a normal working day. Our calculations from the India Human Development Survey (IHDS) data for 2005-06 also show that 25% of workers in the moderate work category such as fishery, forestry, plantation and other farm labour, metal-work, boiler etc. work 9-10 hours in usual working days and this has been totally ignored by the EG 2010.

Among the activities that James and Schofield (1990) list as sedentary work, a value of 1.5 lies at the extreme lower end of the occupational IEI for men; for women in fact, the minimum IEI listed is 1.6 (Ibid: 136-37). Compared to this, the occupational IEI of 1.5 assigned by the ICMR 2010 for sedentary workers is again low.

Such reductions of the calorie RDAs by the ICMR 2010 create a curious situation where the calorie recommendation for adolescent boys and girls (13-15 years of age) is significantly higher than for sedentary male and female workers (by more than 400 Kcal for both). This may be acceptable to a certain extent, but the calorie RDA for adolescents is higher than for moderate category workers as well such as industrial workers, plantation labourers etc. This difference is marginal in men and boys (21 Kcal) but noticeable for women and girls (94 Kcal). These fallacies only point out to the problems and arbitrary nature of calorie RDAs prescribed by the ICMR 2010.

The ICMR EG 2010 also expressed concern over dangers of consuming more than the required calories (but not for low protein intakes) and referred to a concern for obesity and overweight individuals in the west (ICMR 2010: 3). This again is perhaps drawn from Rao (2005), who discouraged recommending higher calorie RDAs for underweight adults due to the fear of obesity but never underlined its link to under-nutrition in early life. It is important to underline some conceptual and technical flaws behind the exercise of rationalising cuts in calorie RDA for all categories of workers, and the isolated concern for overweight and obesity without understanding its link to under-nutrition. It is that which we take up now.

Flawed Conceptual Arguments

In the absence of empirical evidence that could back the reductions of calorie RDAs, the ICMR EG 2010 put forward some conceptual arguments in its self-defense. All three objections (ICMR 2010: 22-23) are copied from the ICMR 1990 EG without acknowledging it (ICMR 1990: 13-14). These are:

1. Non-occupational energy expenditures estimated in 1958 were higher "…due to the use of higher values for some of the non-occupational activities—no distinction has been made in this respect between sedentary individual on the one hand and the moderate and heavy activity categories on the other. The latter categories would normally spend less energy during non-occupational activity period than a sedentary person" (ICMR 2010: 22).
2. The energy expenditure for occupational activity for heavy work, appears to be an over estimation as from the available evidence based on EE of miners it cannot be higher than 4.5 Kcal/kg/h. Also the sustained activity of heavy work can be carried out only at 35% VO2 max (Ibid). In addition it also said that the recommendations of 1989 took the average heavy worker's occupational energy expenditures as 4.5 PAR which is difficult to maintain for 8 hours. "Heavy work involving 4.5 PAR is usually carried out only for 3-4 h and the rest of the time is spent in resting or performing lesser intense activity; therefore on the average, the PAR value may be 3.8 units when considered for all the 8 h" (Ibid: 40).
3. Their third argument is regarding the seasonal variations in work and breaks. This requires that we allow for the reduced levels of activity for vacations or periods of no agricultural activity through the year. The ICMR experts suggest that "If these seasonal variations in intensity of activity are taken into consideration and the daily energy expenditure is averaged over the entire year, it will roughly correspond to 75% of the energy spent during active working period or season" (Ibid: 23). This corroborated the view expressed by the FAO, WHO, UNU publications (FAO 1957).

These explanations, when scrutinized, reveal that there are too many grey areas that undermine their validity. These conceptual flaws are dealt with one by one.

TEE for non-occupational activities

Skirting the recommendations of ICMR EG 1990 and critiquing the calorie RDAs of ICMR EG 1958, the ICMR EG in 2010 claims that heavy workers will spend less energy as compared to sedentary workers in some of the non-occupational tasks. Ignoring the reductions introduced in 1990 (see Table 2), the non-occupational PAR for heavy and moderate workers is in fact raised slightly over 1990 and those of sedentary workers reduced. The 2010 EG report blames the use of higher values of PAR for some non-occupational activities but provides neither evidence nor any detail as to which were those and gives no explanation as to why heavy workers will spend less energy on non-occupational tasks. There could possibly be only two explanations for this. The first is that the heavy workers cut some of these activities fully or partially to sleep and rest longer due to excessive energy depletion at work, or inadequate diets[18] leading to exhaustion. The other possibility is that they can't do much household work because their occupational work span is more than 8 hours a day. The report however, gives no evidence for either possibility. Over and above this, it goes on to allocate equal PAR values for non-occupational work for all three categories of workers (ICMR 2010 Table 4.10: 42), equally distributes time for occupational and non-occupational work among them, and offers insufficient evidence on types of non-occupational activities.

In the Indian social and economic context, the category of heavy workers—who come from poorer strata—would generally do more household work than richer sedentary workers who get their household chores done by paid domestic help. The break-up of non-occupational activities by ICMR EG 2010 seems to fit more the sedentary workers of FAO/WHO/UNU JC 2001 which considered 'driving car to and from work'—not walking with a PAR of 2 (WHO 2004), whereas ICMR EG 2010 includes 'commuting to work by bus or by vehicle or by walk' with an assigned PAR of 2 only. The assigned PAR for heavy workers for walking at various speeds is 3.2 in the JC (Ibid) and 2.8 to 3.8 in ICMR EG itself, while the PAR value for cycling is 5.6 for males (ICMR 2010: Table 4.7d: 36). For work such as 'cooking', 'collecting water/wood' and 'non-mechanized domestic chores', the JC (WHO 2004) has assigned different PARs of 2.1, 4.4 and 2.3 respectively, which averages as 2.9. The ICMR EG 2010 clubs them all as 'general household and other activities', and assigns it a PAR of 2.5. Given the conditions of the majority in India—if general house hold activity means what JC 2001 has covered separately as cooking, collecting water and wood and non-mechanised domestic chores—this value of PAR also appears to be too low. Staying on the conservative side, even if

TABLE 10: Break-up of Non-occupational Activities and PAR, ICMR and FAO/WHO/UNU

Non-occupational activity details	*ICMR-2010*		*FAO/WHO/ UNUJC -2001*		*Modified values by authors*	
	Hr	*PAR*	*Hr*	*PAR*	*Hr*	*PAR*
Personal care	1	2.3	1	2.3	1	2.3
Eating	1	1.5	1	1.4	1	1.5
Commuting to work by bus or by vehicle or by walk	1	2			1	2
General household or other activities	2	2.5			2	2.9
Walking at various speeds without load	1	3.2	1	3.2	1	3.2
Light leisure activity	2	1.4	4	1.4	2	1.4
Cooking			1	2.1		
Collecting water/wood			1	4.4		
Non-mechanized domestic chores			1	2.3		
Average	8.0	2.1	10.0	2.1	8.0	2.2

Source: ICMR 2010 and WHO 2004.

we ignore the reduction in PAR by the ICMR EG for 'commuting to work by bus or by vehicle', and replace only the average PAR for 'general household and other activities' by that recommended by JC 2001 (a PAR of 2.9) the non-occupational PAR increases from 2.1 to 2.2 (Table 10). With these considerations, the non-occupational PAR of 2.1 for the heavy and moderate workers as suggested by ICMR EG 2010 remains problematic, even though it may be better compared to the assessment of ICMR EG 1990.

Thus, despite increasing the non-occupational EE recommendations for moderate and heavy workers over 1990 recommendations, the ICMR EG 2010 report, by comparing its recommendations only to those of ICMR EG 1958 report, appears to put forward a theoretical proposition of the need to lower non-occupational energy requirements for moderate and heavy workers.

TEE of occupational work for heavy workers

The EG 2010's assumption of a low PAR for heavy workers, as pointed out earlier, has perhaps come from BSN Rao's views on the lower work capacity of Indian heavy workers compared to that of the west and his misunderstanding of the evidence which prompted him to lower the occupational activity PAR for heavy workers below ICMR preliminary draft report levels (ICMR 1989) in his paper (Rao BSN 2005). In the previous section we have already examined in detail the gaps in his analysis. He ignored the fact that work capacity is a function of body weights, working conditions, and compulsion to earn (work under stress), and the possibility of longer work hours as demonstrated by the available fresh evidence. This limited vision guided and formed the basis of ICMR's 2010 recommendation for occupational IEI of 3.8 for heavy workers.

The ICMR EG 2010 infers (from work done five decades earlier) that, "From the available evidence based on observed energy expenditure of miners [Rao et al. 1961], [that], it [i.e. average energy cost] cannot be higher than 4.5 Kcal/Kg/hr" (ICMR 2010: 22). Firstly, this study is misquoted as it does not provide any information on EE of miners. The subjects for whom maximum work capacity and breathing capacities were measured, were healthy young sedentary workers. Secondly, using EE in terms of Kcal/Kg/hr. requires that weights be specified; the EG does not do so. If the body weights of the heavy workers referred to is 60 Kg, then the PAR equivalent (of 4.5 Kcal/Kg/hr) would be 4.3.[19] The confidence with which the occupational IEI is confined to a much lower value of 3.8 is belied by the evidence reviewed so far.

Seasonal variation in work

The third argument about seasonal variations is only hypothetical. Despite building an argument of seasonal breaks in work that rationalizes lowering dietary requirements, in the actual estimation of RDA this consideration has not been incorporated by the ICMR recommendation. It is however, even as an idea, misleading and needs to be reasoned against evidence. The ICMR group accepts the logic put forward by the FAO in 1957 that only 75% of the estimated total average EE over a year (calculated through field based work time studies), is actually spent on occupational work. This requires an understanding of the distribution of work through the year.

The reduction in EE due to breaks in work will depend upon the earnings of the workers, the availability of employment, stability of work, and the structure and nature of the economy that makes employment, adequate wages, or breaks as vacations possible. All these may differ widely in the Indian scenario in comparison to the west. For agricultural workers in India, where wages are low and crop cycles make the breaks mandatory, in the off-season they have to either look for harsher alternatives or migrate for non-agricultural occupations as they cannot afford to survive without work. Thus, they continue with heavy or moderate work, or suffer deprivation due to under-employment or unemployment. Our own calculation from IHDS data shows that, nearly one-third of those who work on family-farms, also work as agricultural or non-agricultural wage labour, at some point of time in the year. For the informal sector worker in urban and peri-urban areas, the same argument holds true as workers are forced to continue as contract labour for years without being made permanent and they work consistently all through the year on low wages without leave and security of job or vacation (Jha 2014; Sengupta et al. 2007; GoI 2012). For them too, there is no food (energy) unless they work, and the alternate work is not necessarily less energy consuming.

There is further evidence to suggest that the level of work over the year does not vary or, if it does, using it to reduce average intakes and then prescribing RDAs would be incorrect. National Sample Survey (NSS) data shows no significant seasonal variation in calorie intakes in India (Table 11). This is also validated by studies based on data from other countries (Van Staveren et al. 1986; Ma et al. 2006). It indicates that either (a) work intensity does not actually vary so much round the year, for reasons discussed above;or, (b) even if it does, the absence of variations in food consumption indicates that high-work periods are also periods of actual food deficit to a larger degree—even the highest average daily per-consumer unit intake of 2624[20] Kcal amongst four seasons (in rural areas) indicates calorie deficiency against the minimum requirement of 2727 Kcal. So even in high work periods, inadequate incomes must be constraining food intakes and the lean work periods are involuntary unemployment or under-employment. Allowing for this to prescribe RDAs would not be appropriate.

TABLE 11: Seasonal Variation in Per Consumer-Unit Calorie Intake, All India 2011-12

	Rural		*Urban*	
Sub-Rounds	*Calorie Intake*	*% Diff. From Average Yearly intake*	*Calorie Intake*	*% Diff. From Average Yearly intake*
July-Sept	2609	0.2	2507	–1.0
Oct-Dec	2621	0.7	2535	0.1
Jan-March	2624	0.8	2570	1.5
April-June	2556	–1.8	2513	–0.8
Year Round Average	2603		2532	

Source: Authors' calculation from NSS unit data, 2011-12

Methodological and Technical Imperfections

In contrast to ICMR, the FAO/WHO/UNU JCs have been more precise and logical in making explicit the procedure adopted for calculating PARs. The pause time (sitting or standing) during specified activities are generally considered as 75% of total work-time for light activities, 25% for moderate activities, and 40% for heavy activities (WHO 1985; James and Schofield 1990). The PARs for pause periods are considered to be 1.54 for males and 1.68 for females (Ibid). Hence, the period of heavy work would be 4.8 hours in 8 hours of total work and pause time would be 3.2 hours. ICMR EG 2010 on the other hand extends the time for pause, but gives no specific hours or the assumed PAR values for pauses and specific activities; it simply assigns an occupational IEI of 3.8—identical to the assessment of JC 1985 for heavy workers (WHO 1985, Table 8: 76) and closer to the PAR value of 3.9 suggested by BSN Rao (2005). [21]

Secondly, on the basis of the literature reviewed it can be said that in real life situations the very high VO_2 max and EE values indicate the need for longer breaks, and are equally indicative of very high levels of work load and EE spells beyond the optimum level for avoiding severe stress. Longer breaks help avoid cardiac stress, energy depletion, and negative nutritional balance for workers with high levels of EE without lowering IEI. ICMR EG's extended pause periods but prescription of a lower occupational IEI negates this logical relationship.

Thirdly, JC 2001 Report taking non-mechanized agricultural workers as representative for heavy work suggests an occupational IEI of 4.1 (WHO 2004, Table 5.1: 36). To arrive at this value with a 60:40 work: pause time ratio, means a PAR of 5.81 for the specific heavy activity component of work for a man. However, the Indian experts chose to ignore the working conditions, types of heavy work and the available evidence of high energy cost of heavy work spells (Saha et al. 2007), and the nutritional status of this section and proposed a lower value of PAR for heavy work. This was so when the Eleventh Plan itself noted that, "absolute weights and heights of Indians on average have not shown significant improvement over the last 25 years…A mean weight deficit of 1.4-1.6 Kgs at one year and of 9 Kg at ten years worsens to 13–18 Kg when adults... In addition, about 30% of all adults have BMI<18.5 (33% of women and 28% of men), which defines adult malnutrition" (Planning Commission 2008: 129). The FAO experts in 1985 were worried about the increasing levels of obesity in the west and prescribed Energy RDAs to protect populations from this calamity, which even they found regressive and reversed it later to a certain extent (Table 1).

Fourthly, the ICMR EG 2010, using the 1996-97 National Nutrition Monitoring Bureau (NNMB) survey data, concludes that, "the proportion of population engaged in heavy work is quite small" (ICMR 2010: 41). This misrepresentation is due to the fact that NNMB provides no indication as to how the categories of heavy workers were derived from the occupational data provided by it in Table 7.12 (NNMB 1999). Tables 8.2 and 8.3 (on food intakes of adult males and females) of this report quoted by the EG of ICMR 2010 are themselves inaccurate and probably wrongly label individuals as 'households' (Ibid: 33-34). Only 48 out of 4047 men and 14 out of 4411 women in these tables are identified as heavy workers when 57% of the population surveyed was in agriculture according to table 7.12 of the NNMB itself. Thus, not only the simple fact that the NNMB sample has a certain bias and is not nationally representative, even the basis for categorization of activity level is not explicit and certainly does not conform with their own occupational classification. All this was lost on the ICMR experts who went ahead with their unrealistic conclusion. The reality is that around 80% of the heavy workers in India are in the agricultural sector which provides sustenance for 58% of the population and is the main source of income for 40% of the population (NSSO 2014). In the light of this reality, claiming to make the recommended energy requirement more "appropriate for…many of the usual types of heavy work like earth digging, manual agricultural labour, stone cutters etc." (ICMR 2010: 23), the ICMR EG 2010 actually does the opposite. The population estimates of EG 2012, set up by the Planning Commission (PC) to review the methodology for measurement of poverty, which were done from Census and nationally representative NSS data showed a much higher proportion of heavy workers compared to the composition of the NNMB sample (GoI 2014).

It is our contention that even an IEI of 4.1 for heavy work would still be low on three counts as it is arrived at from a PAR of 5.81 for specific work activity with a time ratio of 60:40 for work: pause. Firstly, while a 5.81 PAR for specific activity might be appropriate for the majority of heavy workers, it would still be quite low for very heavy workers such as loaders, rickshaw pullers etc. as their PAR varies in the range of 6-9 (Vaz et al. 2005). Secondly, there is evidence to show that a significant proportion of workers[22] work for more than 8 hours a day (Table 12). The third critical issue is the methodology of assessing hours of work. For assessment of work:pause time ratio, the required time and motion studies are not being used. Qualitative studies show that the 8 hour work regimes may be true for the organized sector but not the informal industry or the agricultural sector in India. An important reality that needs to be factored in is the rise of the informal sector in India since the 1991 census. The working hours in this sector are much over the assumed 8 hours (Messenger et al. 2007). The unorganized/ informal sector today holds not only agricultural workers but also almost 90%

TABLE 12: Work Hour per Day in a Typical Working-Day, Heavy and Moderate Work for Pay (except own-farm cultivators)—All India 2005-06

Moderate and heavy workers who are in wage Occupation	*Rural*				*Urban*			
	Median	*75th percentile*	*90th percentile*	*95th percentile*	*Median*	*75th percentile*	*90th percentile*	*95th percentile*
Animal farmers	8	10	12	12	8	8	10	10
Ag labour	8	8	8	10	8	8	9	10
Plantation lab	8	8	8	9	8	9	10	12
Other farm labour	8	8	10	12	8	9	10	12
Forestry	7	8	8	9	8	10	12	12
Fishermen	7	9	10	12	11	12	15	16
Miners	8	8	9	10	8	8	8	10
Metal workers	8	8	10	12	8	10	12	12
Stone cutters	8	8	9	9	8	10	12	12
Construction	8	8	9	10	8	8	10	10
Boilermen	8	8	8	8	8	10	10	12
Loaders	8	9	10	10	8	9	12	12
Other Manual Labour	8	8	8	10	8	8	10	10

Source: Authors' calculation from IHDS-I, 2005-06 of the industrial labour (National Statistical Commission 2012: 26). IHDS data of 2005-06, Table 12, also shows the hours of work put in per day of moderate and heavy wage workers. More than 8 hours of work in a typical working day is reported there for a considerable proportion of workers.

Last but not the least critical is the issue of reference body weight which is important for all categories of workers.

Reference Body Weight for BMR Prediction

In the Indian context, where under-nourishment (and hence under-weight) is an important aspect of the nutritional problem, the use of appropriate body weights is a very critical determinant of energy requirement estimates for all kinds of activities. The 1958 ICMR Committee considered the recommendations of the LHNO (1936) and the standards set by IRFA in 1944 for the body weights of adults, to make its recommendations. These were no doubt considered tentative, to be evaluated further.

The 1978 ICMR recommendations used the small but authentic surveys of healthy children and adolescents, which corresponded to the National Centre of Health Statistics (NCHS) (US) standards, but the standards of adults continued as before. In 1990 the discrepancy between adolescent and adult weights was recognized and reference adult weights were changed to 60 and 50 Kg for men and women to harmonize with adolescent weights (ICMR 1990: 6), and it was recommended that anthropometric surveys of well-nourished and well-to-do children be conducted to evolve reliable standards. The surveys were not done; instead, in the name of overcoming the limitations of small numbers, the ICMR EG 2010 chose the 95th percentile values from a compilation of data from 2000–2001 NNMB surveys and 1996-2002 District Nutrition Surveys. This data is a little outdated as later data of the NNMB itself showed higher body weights, particularly for men. This compiled weight data of all age groups reported in ICMR 2010 had a mean of 50.8 Kg and 44.5 Kg for men and women of the standard age group (18-30 years), while the average weight of 95th percentile population for this age group, comes to 60.5 Kg for men and 54.8 Kg for women (hence the experts took a weight of 60 and 55 respectively for them) (ICMR 2010: 27). A later 2012 NNMB repeat survey shows increased mean weights of 53.6 Kg and 45.3 Kg respectively;a simple interpolation from ICMR 2010 weight data translates into 64 Kg and 56 Kg for 95th percentile population of men and women respectively for 2012 (NNMB 2012).

The NNMB, according to national nutrition policy, was a surveillance strategy to monitor and prevent under-nutrition in view of the widespread nature of the problem (GoI 1993). Its sample, instead of using healthy and well-off Indian population, was the rural population ensuring the inclusion of the marginalized section (NNMB 1999: 1-2) that is nutritionally disadvantaged. The exclusion of the urban population and higher disease load in the rural population does not make 95th percentile of the NNMB data either representative or a standard population.[23]

A multi-centric ICMR task force study on peak bone mineral density of adults, published in 2010 (Shatrugna et al. 2010) evaluated the weights and heights and socio-economic backgrounds of older adults. Using this data, its first principal investigator provides some revealing results on the weight and height distribution of the study population in three socio-economic groups reproduced as Table 13 (Shatrugna 2013).

Given the higher weights of the age group studied, compared to 18-30 years of the standard age group, we have used the necessary adjustments. The average weight of 95th percentile population for the standard 18-30 years age group comes to 60.5 Kg for men and 54.8 Kg for women;for the age group 50-54 years the weights were 66.6 Kg and 60 Kg for men and women respectively in ICMR 2010 EG database. Using this ratio of 1.1, it can be safely inferred that the weights in 2010 of the healthy and well off (standard age population) would be closer to 70 Kg for men and 60 Kg for women. These weights being on the higher side (especially for women), are also associated with higher BMIs. Therefore, revising the reference weight to 65 Kg and 58 Kg for men and women would perhaps be more appropriate, which sits well with the body weights of middle income group men and women reported by Shatrugna in 2013 based on the ICMR task force study (Table 13) and is quite close to the weights of 64 Kg and 56 Kg respectively which we had derived above by interpolation of older weight data (compiled and reported in ICMR 2010 EG Report). For reference height of 172 cm and 161 cm for men and women by ICMR 2010 standards, these respective body-weights (65 Kg and 58 Kg for men and women) would translate into BMI of 22.0 and 22.4 which are well within the acceptable BMI limits of normal.

TABLE 13: Heights and Weights of Populations from 3 Socio-economic groups and from 4 centers in India

		Age (Years)	*Height (cm)*	*Weight (Kg)*	*BMI*
Men	High Income Group	51.5	168.6	76.6	26.9
	Middle Income Group	47.4	165.9	68	24.6
	Low Income Group	45.1	161.8	55.8	21.3
Women	High Income Group	50.1	154.7	67.3	28.1
	Middle Income Group	45.8	151.8	59.6	25.9
	Low Income Group	44.3	149.7	52.2	23.2

Source: Shatrugna 2013

Thus, change in weights would impact the predicted BMR and the TEE will change for a healthy well-nourished population. The essence of this suggestion is that the reference body-weight is the desirable body-weight (which is deemed as healthy) and not observed body-weights, which may reflect under-nourishment or over-nourishment with or without imbalanced diets. This view was also expressed by Durnin in the October meeting of a Joint FAO/WHO/UNU Expert Consultation on 'Energy Protein Requirements', who opined that,

'If use is being made of BMR measurements—as opposed to predictions—on populations suspected of being undernourished, an increase in the calculation should be made to allow for this. Similarly, an addition to the body weight of such populations may be needed to produce 'desirable' BMR values. The implications of such manipulations are complex and both care and considerable knowledge are required to make valid re-assessments in such situations' (Durnin 1981).

Based on our analysis it appears that not only is the official empirical evidence patchy and selective and sometimes inappropriate, even the conceptual arguments of ICMR EG 2010 in support of reduction in calorie RDAs and the methodology used are unconvincing. The fear too that increasing obesity is solely due to excess intakes is also misplaced, as we will see later. The central issues with the ICMR 2010 calorie RDA revisions can be summarised as follows:

- Indian studies done before 2009 and reviewed here indicate that the occupational PAR values are well above the levels set by the ICMR EG 2010, though the exact difference may be debated. So is the upper limit fixed for sustained work capacity at 35% VO_2 max, which in contrast is referred to in the literature as either 'freely chosen by subjects' or is considered 'acceptable' or 'safe' for 8 hours of total work without taking real life work stress into account. Additionally, in a highly informal economy such as in India, a considerable section of the population works for more than 8 hours a day and has a greater energy demand compared to populations with an 8 hours working day that guides the RDA.
- The recommended non-occupational PAR of 2.1 is an outcome of arbitrary exercise of assigning these values. The recommended PAR value seems to be definitely lower.
- The methodologies used by ICMR EG—that were assumed to be the ones offered by FAO, WHO and UNU—did not actually follow the specific steps required. In short, despite years of investments in institutional growth for nutrition research in independent India, the kind of data required for specifying calorie RDAs for adults did not become a priority for contributing to policy.
- The expert groups contributing to policy, at times, made incorrect claims such as very small number of heavy workers, long periods of rest during work by heavy workers with uneconomical and impractical pause: work ratio in occupational activity, and the importance attributed to seasonal variations, thereby lowering RDA in the Indian context. Most new research referred to in the chapter on Energy such as Borgonha et al. (2000) or Shetty et al. (1986), either referred to the validity of calorimetric measures of EE compared to Doubly Labeled Water (DLW) techniques to measure EE or to Indian BMR studies and nutritive values of Indian food, but never to the very limited but then available studies on EE of healthy Indians. It even misquoted Patwardhan (1961) to show that he critiqued the 1958 report when he in fact prepared the background paper for it, underlining the need for such research in the country.
- Fixing body weights for reference man and woman using inappropriate population samples lowers population BMRs. Instead of using the data for healthy middle class population, the use of NNMB data pushed the weights of reference adult man and woman somewhat below the ideal, and lowered calorie RDA reflecting the unstated understanding that adult undernourished man or woman does not need allowances in addition to RDAs based on their normative weights as it would lead to overweight. This fits the now discarded adaptation theory framework where the value judgment is that such a population must retain its adapted body size rather than correct it by rebuilding muscle mass. Some of the EE studies reviewed earlier revealed that the significantly underweight heavy and moderate workers gained

weight when given additional food without becoming overweight or obese. We have discussed these in detail and the explanations for falling calorie needs have already been contested elsewhere (Qadeer et al. 2016).

These major criticisms have a value for evolving a constructive critical view of the challenge of persistent under-nutrition and increasing obesity since the 1970s. It also helps us develop an alternative assessment and seek its validation.

III
Alternative Calculations of PAR and Energy Requirement

The criticism summarized in the previous section, based on our review and analysis, encourages us to explore correctives for factors used to estimate energy requirement of different categories of workers and offer possible alternatives.

Heavy Workers

A. Occupational IEI: To correct the arbitrary use of occupational IEI of 3.8 (for reasons discussed above), we believe that the 'non-mechanised agricultural work' category of the JC 2001 (WHO 2004) will be a more suitable representative for heavy work category in the Indian context for which this JC considered an IEI of 4.1.

B. Non-occupational PAR: Our earlier discussion shows that PAR for non-occupational activities, particularly work related to household chores, is under-estimated by the ICMR 2010. An imputation of non-occupational activities under household chores from the JC 2001 specification increases the non-occupational activity PAR from 2.1 to 2.2 even when the EE on 'to and from work' is left untouched (Table 10). This difference arises because the activity of carrying water/wood—a common daily chore of women falling into the class of heavy work category—was omitted by ICMR 2010 from the list of household chores but was recognized by the JC 2001, which makes this adjustment necessary.

C. Reference body weight: An increase in the body weight of reference man and woman based on recent data for the well-off Indian population, calls for using reference body-weights of 65 Kg for men and 58 Kg for women.

Based on these corrections in a gradual manner, Table 14a and 14b show the alternative calculations of energy requirements for heavy workers.

Moderate Workers

Similarly, based on our critique, the following corrections are proposed to work out the alternative calorie requirement for moderate category workers in Tables 15a and 15b.

A. Occupational IEI: The occupational IEI of 2.3 assumed by the ICMR 2010 for moderate workers, as seen earlier, is quite low. According to the existing studies occupational IEI for various activities ranged from 2.34 to 3.32 for men and 2.45 to 3.35 for women; so the ICMR value of 2.3 does not even touch the lowest value in these ranges. In fact, for industrial workers—who form the bulk of the moderate

TABLE 14a: Alternative Calculations of Energy Requirement (Heavy Worker—Men)

	Occupational Avg. PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
ICMR-2010 standards	3.8	2.1	1	2.30	1515	3485
All ICMR-2010 Standards, except body weight (65 Kg)	3.8	2.1	1	2.30	1588	3652
All ICMR-2010 standards, except occupational IEI of 4.1 from FAO/WHO/UNU-2004 for agric. worker	4.1	2.1	1	2.40	1515	3636
All ICMR-2010 Standards, except non-occupational PAR of 2.2	3.8	2.2	1	2.33	1515	3535
All ICMR-2010 standards, except occupational IEI of 4.1 and non-occupational PAR of 2.2	4.1	2.2	1	2.43	1515	3687
All ICMR-2010 standards, except occupational IEI of 4.1 and body-weight 65 Kg	4.1	2.1	1	2.40	1588	3811
Occupational IEI of 4.1, 65 Kg body-weight and non-occupational PAR 2.2	4.1	2.2	1	2.43	1588	3864

TABLE 14b: Alternative Calculations of Energy Requirement (Heavy Worker—Women)

	Occupational Avg. PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
ICMR-2010 standards	3.8	2.1	1	2.30	1241	2854
All ICMR-2010 Standards, except body weight (65 Kg)	3.8	2.1	1	2.30	1283	2951
All ICMR-2010 standards, except occupational IEI of 4.1 from FAO/WHO/UNU-2004for agric. worker	4.1	2.1	1	2.40	1241	2978
All ICMR-2010 Standards, except non-occupational PAR of 2.2	3.8	2.2	1	2.33	1241	2896

	Occupational Avg. PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
All ICMR-2010 standards, except occupational IEI of 4.1 & non-occupational PAR of 2.2	4.1	2.2	1	2.43	1241	3020
All ICMR-2010 standards, except occupational IEI of 4.1 and body-weight 65 Kg	4.1	2.1	1	2.40	1283	3079
Occupational IEI of 4.1, 65 Kg body-weight and non-occupational PAR 2.2	4.1	2.2	1	2.43	1283	3122

TABLE 15a: Alternative Calculations of Energy Requirement (Moderate Worker—Men)

	Occupational Avg.PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
ICMR-2010	2.3	2.1	1	1.80	1515	2727
All ICMR-2010 Standards, except body-weight 65 Kg	2.3	2.1	1	1.80	1588	2858
All ICMR-2010 Standards, except Occupational IEI 2.7	2.7	2.1	1	1.93	1515	2929
All ICMR-2010 Standards, Non-Occupational PAR 2.2	2.3	2.2	1	1.83	1515	2778
All ICMR-2010 standards, except occupational IEI of 2.7 & non-occupational PAR of 2.2	2.7	2.2	1	1.97	1515	2979.5
Occupational IEI 2.7, Non-Occupational PAR 2.2 and body weight 65 Kg	2.7	2.2	1	1.97	1588	3123
All ICMR-2010 Standards, except Occupational work-time 10 hrs.	2.3	2.1	1	1.82	1515	2752
Occupational IEI 2.7, Non-Occupational PAR 2.2, body weight 65 Kg and Occupational work-time 10 hrs.	2.7	2.2	1	2.01	1588	3189

TABLE 15b: Alternative Calculations of Energy Requirement (Moderate Worker—Women)

	Occupational Avg.PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
ICMR-2010	2.3	2.1	1	1.80	1241	2234
All ICMR-2010 Standards, except body-weight 65 Kg	2.3	2.1	1	1.80	1283	2309
All ICMR-2010 Standards, except Occupational IEI 2.7	2.7	2.1	1	1.93	1241	2399
All ICMR-2010 Standards, Non-Occupational PAR 2.2	2.3	2.2	1	1.83	1241	2275
All ICMR-2010 standards, except occupational IEI of 2.7 & non-occupational PAR of 2.2	2.7	2.2	1	1.97	1241	2441
Occupational IEI 2.7, Non-Occupational PAR 2.2 and body weight 65 Kg	2.7	2.2	1	1.97	1283	2523
All ICMR-2010 Standards, except Occupational work-time 10 hr.	2.3	2.1	1	1.82	1241	2254
Occupational IEI 2.7, Non-Occupational PAR 2.2, body weight 65 Kg and Occupational work-time 10 hr.	2.7	2.2	1	2.01	1283	2577

workers in India—the occupational IEI range is even higher—from 2.7-3.02. Hence, considering occupational IEI of at least 2.7 for moderate workers instead of 2.3 would be a reasonable standard. Incidentally, this is the standard used by FAO/WHO/UNU 1985.

B. Non-occupational PAR is changed to 2.2 as was done for heavy workers.

C. Reference body weight was also changed to 65 Kg for men and 58 Kg for women.

D. Working hours: Considering that many of the moderate workers work around 10 hours a day, we also take that for an alternative calculation.

Sedentary Workers

Similar exercise for sedentary workers uses the following criteria and is presented in tables 16a and 16b.

A. Occupational IEI: Similar to the moderate workers, occupational IEI of 1.5 assumed by ICMR 2010 for sedentary workers is also too low. An international compilation of studies shows that it ranges from 1.54 to 1.78 for men and 1.68 to 1.85 for women (James and Schofield 1990: 136-37). We assign an occupational IEI of 1.6 instead of 1.5 for sedentary workers.

B. Non-occupational PAR: As for other categories, non-occupational PAR is changed to 2.2.

C. Reference body-weight assigned is same as for others- 65 Kg for men and 58 Kg for women

TABLE 16a: Alternative Calculations of Energy Requirement (Sedentary Worker—Men)

	Occupational Avg.PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
ICMR-2010	1.5	2.1	1	1.53	1515	2318
All ICMR-2010 Standards, except body weight 65 Kg	1.5	2.1	1	1.53	1588	2430
All ICMR-2010 Standards, except Occupational IEI 1.6	1.6	2.1	1	1.57	1515	2374
All ICMR-2010 standards, except assuming 2.2 non-occupational PAR	1.5	2.2	1	1.57	1515	2374
All ICMR-2010 standards, except occupational IEI of 1.6 & non-occupational PAR of 2.2	1.6	2.2	1	1.60	1515	2424
All ICMR-2010 standards, except occupational IEI of 1.6 and body-weight 65 Kg	1.6	2.1	1	1.57	1588	2488
Occupational IEI of 1.6, 65 Kg body-weight and non-occupational PAR 2.2	1.6	2.2	1	1.60	1588	2541

TABLE 16b: Alternative Calculations of Energy Requirement (Sedentary Worker—Women)

	Occupational Avg. PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
ICMR-2010	1.5	2.1	1	1.53	1241	1899
All ICMR-2010 standards, except body weight 58 Kg	1.5	2.1	1	1.53	1283	1963

	Occupational Avg. PAR/IEI	*Non-Occupational PAR*	*Sleep PAR*	*PAL*	*BMR*	*Total Energy = BMR × PAL*
All ICMR-2010 standards, except Occupational IEI 1.6	1.6	2.1	1	1.57	1241	1944
All ICMR-2010 standards, except assuming 2.2 non-occupational PAR	1.5	2.2	1	1.57	1241	1944
All ICMR-2010 standards, except occupational IEI of 1.6 & non-occupational PAR of 2.2	1.6	2.2	1	1.60	1241	1986
All ICMR-2010 standards, except occupational IEI of 1.6 and body-weight 58 Kg	1.6	2.1	1	1.57	1283	2010
Occupational IEI of 1.6, 58 Kg body-weight and non-occupational PAR 2.2	1.6	2.2	1	1.60	1283	2053

With each additional corrective in calculations, the estimates of calorie RDAs increase. Considering standard healthy body weight (not actual body weights of under-nourished population) is as crucial for estimating RDAs as are occupational IEI and non-occupational PAR values. All three were too low in ICMR estimations: these three factors need to be simultaneously taken into account in proposing alternative RDA estimates. Allowing for these correctives, what came out as reasonable standards of calorie requirements for different categories of workers was the following. For men and women heavy workers 3864 Kcal and 3122 Kcal, for moderate workers 3123 Kcal and 2523 Kcal and, for sedentary workers 2541 Kcal and 2053 Kcal respectively. The difference with the ICMR 2010 levels is quite significant for heavy and moderate workers; 380 and 396 Kcals for men heavy and moderate workers and 268 Kcal and 214 Kcal for women. The difference with ICMR 2010 levels for sedentary workers is 223 Kcal and 154 Kcal for men and women respectively. These differences highlight injustice in reducing RDA for calories. They also reveals both abdication of state responsibility and abandonment of scientific responsibility.

IV
Discussion

The evidence presented above compels us to question the validity of the recent lowering in calorie RDAs, especially for the heavy and moderate workers. It also indicates that a generation of experts contributing to policy, like Gopalan and Ramalingaswami, were resistant to the idea of lowering the RDAs for Indians given the conditions and the poor nutritional status of the majority till 1984. Only later, not only the expert committees were reconstituted, but these Committees[24]—without insisting on creating adequate local evidence—chose to go beneath the lower limits set even by the global guidelines for PAR and PAL values in the JC 2001. The global experts based their recommendations on data biased towards work experiences of the western countries. Their 2001 report that attempted to correct this bias by expanding its data base and giving a range of PAL values, was used by the official Indian experts in a way that the PALs chosen for Indian adults came from within the international range suggested (WHO 2004: 38) but lowered the calorie RDA compared to the recommendations of ICMR 1990 (Table 3). The unfinished agenda of ensuring food security, a component of human development with social justice, was thus sidelined and moderate and mild under-nutrition became the way of life for a large section with little effort made to improve the quantity and quality (with variety) of their diets.

The estimation of RDA in India required to be consolidated within a perspective that balanced economic compulsions and the need of a nutritionally healthy population. It had to be based on Indian reality by generating evidence from within the country. As a guideline it was meant to tackle the issue of provisioning of food for different sub-groups and induce corrective policies for production and supplies within the larger framework of India's food security system. The challenge of evolving appropriate calorie RDA in itself became an uncomfortable entity.

What lies behind the transformation of this socio-biological tool from a simple guide for ensuring food availability to sections of people (with differing needs) into an instrument of scientific control and exploitation is worth unraveling; and for this, there are three remaining aspects beyond what we have already discussed. These are: firstly, what could be the political and economic reasons behind calorie RDA reductions? Secondly, what are the economic and social implications of this reduction? And last but not the least, given the seriousness of the problem of under-nutrition as recognized by most official documents and glaring available evidence, can the fear of rising obesity compel policy makers to ignore the problem of under-nutrition and handle over-weight and obesity through lowering RDAs?

Politics that Compelled RDA Reduction

It was only in the initial years of planning that the government of independent India showed the will to reach out and ensure minimum food requirements and subsistence, even though it was through cheap but balanced diets. The period over 1970-1992 saw widespread entitlement failures and mini famines leading to heightened mortality rates and fall in conception rates—both indicators of biological stresses (Chakravarty 2001). Though it largely went unnoticed, it was linked to the unrealized promises of freedom and the reassertion of caste and class in the politics of appropriation. The Economic Reforms that followed—instead of arresting stress among the poor—added to it, especially for those who carried the burden of Reforms. This era of Reforms shared several features of the colonial Raj, such as its blatant lack of concern for the problems of the majority, focus on economic growth at the cost of agriculture, with food security playing a second fiddle to economic and/or political interests of the sections that belong to the power elites. International 'guide lines' played a key role everywhere: for RDA, these were used initially for lack of local evidence, but later, for less valid and more biased reasons, being a reflection of the strategies of Reform. Thus, while in colonial India the concern for population nutrition was rooted more in the local needs of the army and demands of food for troops participating in World War II, during Structural Reforms, the interests of industry, Indian agri-business, and revenue from cash crops overshadowed the importance of food security. The two consecutive governments during the period of Reforms, despite claiming to be the guardians of the National Food Security Act (NFSA), 2013, failed to strengthen it to control the hunger that stalked the countryside and urban slums (Patnaik 2015). While the resident nutritionists of the Raj either held the people and their practices responsible for their plight, or focused on the cheapest possible balanced diets, the official nutrition experts of the Reform period had no hesitation in reducing the calorie RDA—the scientific norms—on the basis of distorted science. Similarly, making food available to people was barely considered a State responsibility during the Raj till the 1930s and 40s when the famine code, rationing of food grains in cities, price control, and building food stocks emerged as concerns within colonial policy. These established features that became a part of the policy of food security in independent India, were declared wasteful and inefficient in the 1990s in favour of market mechanisms for the distribution of basic foods and food grain trade liberalization, envisaged as a part of food and nutrition security by the 9th Five Year Plan (PC 1997 Vol. 2).

Reforms then had a profound implication for nutritional health by drastically lowering the growth rates of employment and wages and increasing prices of consumables. In the name of efficiency, they also altered the supply and demand of food grains; especially the former, where need itself could be reinterpreted according to this new definition. Thus, on the one hand it declared wasteful and inefficient the very measures considered critical for food security, such as food grain production, procurement, and distribution; and on the other hand, redefined need 'scientifically' in terms of RDA. Vastly critical in freeing the State from its responsibility towards food security for specific groups according to their energy needs, excessive reduction of calorie RDA became an innovative tool of planning. It was not as easy for the affected to comprehend this shift as compared to shifts in wages, work, rations, and the decaying food stocks, so it also ruled out protests.

The Eighth Five Year Plan was launched at a turning point in both the international and domestic economic environments. Its task was reorienting the public sector towards efficiency and surplus generation, and to "give up activities which are not essential to its role" (PC 1992 Vol. 1 chap. 1: para 4). Thus quietly, Structural Adjustment Policies (SAP) were ushered in with a focus on economic growth, withdrawal of State support for welfare, and expansion of market mechanisms. The Ninth Plan proposed basic minimum services of drinking water, Primary Health Care, primary education, mid-day meals, houses for the unsheltered, and road connectivity for the unconnected villages. It transformed PDS into the Targeted Public Distribution System (TPDS), claiming thereby to sharpen the anti-poverty thrust of social security. But, despite putting forward a strong case for liberalizing the trade not only in foodgrains but also in all other agricultural commodities, food security remained a concern (PC 1997 Vol. 2). So it emphasized developing strategies to integrate food production and distribution systems with employment and poverty alleviation and focused on convergence of policies on atleast four fronts: production, buffer stock operations, and imports and exports of foodgrains. Starting in 1997 with 10 Kg of cereal per family, TPDS increased its provisioning to 20 Kg per family at 50% cost in the Tenth Plan (PC 2002 Vol. 2: 320), and Antodaya Anna Yojana (AAY) gave 25 Kg of cereals per month to the poorest family at Rs. 2 per Kg for wheat and Rs. 3 per Kg for rice (PC 2002 Vol. 2: 290).

However, this was the beginning of a process of slow but steady dismantling of welfare. The Tenth Plan proposed restricting TPDS only to the Below Poverty Line (BPL) families, and provisioning of rice and wheat at subsidized prices. For a family of 5.5 (calculated on the basis of the 1991 Census) the requirement came to 73 Kg per month. But TPDS could cover only part of this need (PC 2002 Vol. 2: 320). Thus, the sources of cheap calories, especially pulses, got further restricted for those below the poverty line, while those on it or just above it were left to fend for themselves with higher issue prices. The Plan itself acknowledged that, "In the last five decades, the mortality rate has come down by 50% and the fertility rate by 40%, but the reduction in under nutrition is only 20%" (PC 2002 Vol. 2: 290). It recognized the need to minimize the, "potential adverse consequences of globalisation on domestic production, employment and price stability of food commodities" (PC 2002 Vol. 2: 316). Yet, it continued along the market-friendly path by proposing a relook at minimum support prices, decentralizing procurement and distribution, amending the Essential Commodities Act, 1955, competitive grain procurement, de-licensing of all agro-based and food processing industries, and removing restrictions on export of agricultural commodities and ban on future trading. The obvious tension between the food security system and agricultural reforms for globalization, as reflected in these opposing recommendations, revealed the limits of intervention for food security.

The Tenth Plan opened a second door for reform through an unusually extended chapter on food and nutrition security. It talked of a paradigm shift from food security to targeting the individuals for nutrition security; a move away from looking at under and mal-nutrition as socio-economic problems. This brought them into the fold of problems amenable to technology to be handled through fortification, micronutrient distribution and, at best, feeding programmes or TPDS. This shift to a techno-centric perspective reflects a tension between the economic pressures of SAP and a holistic approach to food security where nutritional health was at the core. Once nutrition is shifted out of food security system to individual management, the connections with wages, prices, PDS, procurement stocks, and trade become less visible. A hypothetical, technical suggestion could then be made of a possible overestimation of the RDAs—and the need for their review and possible reduction. Apart from opining that the energy needs of adults as well as children in India are likely to be lower than the 1990 ICMR recommendations, it also claimed that, "Over the last few decades there has been a reduction in the physical activity and hence reduction in the energy needs in all the age and weight categories" (PC 2002 Vol. 2: 324). Though no evidence is offered for this generalization, these assumptions were supported by some academic conjectures based on estimating requirements on consumption data (Rao 2000), not EE as required by the ICMR. The Planners considered it essential that appropriate recommendation for the RDA for Indians is evolved and opined that, "This has to be done quickly as the country is entering an era of dual disease burden of non- communicable diseases and infection" (PC 2002 Vol. 2: 325). This very innovative move went unnoticed by health practitioners and nutritionists alike, and helped the economic reforms move into the arena of human nutrition. Appropriation was now possible not only through all the supply side cuts mentioned earlier, but also by constraining people's right to adequate quantities of basic food.

The Tenth Plan did put forward two critical proposals. One was for epidemiological data collection with a commitment to monitor the vulnerable sections and the undernourished as a part of future research (Ibid. Vol. 2: 314). The other was for a review of RDAs. For the first, no specific time line was fixed and no strengthening of the existing schemes was envisaged. In fact NNMB got restricted to selected states and then stopped altogether by 2012. The second proposal however, was detailed in a long section on the principles of nutrition science intermixed with assumed Indian realities. Here it was revealed that, "During the Tenth Plan, review of the RDA for Indians will be taken up on a priority basis. The ICMR has reconstituted its Expert Committee on RDA which will take all the above factors into consideration and come up with an appropriate recommendation regarding the dietary intake of Indians" (PC 2002 Vol. 2: 324). These compelling 'all the above factors', are highlighted below.

- The Plan accepts the 1985 FAO/WHO/UNU Joint Committee's definition of energy requirement and the fact that, "This intake will allow for the maintenance of economically necessary and socially desirable physical activity" (PC 2002: 324). While the physiological reasons behind social desirability for higher energy requirements of children and pregnant/lactating women were detailed, the social desirability of a healthy workforce and an appropriate energy (food) distribution—based on the principle of, to each according to their needs, between class and gender- was not mentioned. The priority of profit and growth as economic necessity over nutritional health revealed a well-entrenched value judgment about the secondary status of the work force in the Plan perspective.
- Despite repeating the principle of using healthy population and basing the RDA on energy expenditure, the Plan stated that, the NCHS data of well-to-do children used by ICMR was higher for the majority of adolescents and children. This however, was refuted in 1990 by the ICMR EG that showed that the presently available anthropometric data on well-to-do Indian children corresponded to NCHS standards (ICMR 1990: 6). Similarly, ICMR's 'reference man' as 60 Kg and

'woman' as 50 Kg were said to be higher in weight than the majority of Indians whose average weight in men is 52 Kg and women 44 Kg. Hence, Indian energy requirement in real life was considered to be substantially lower. These arguments are contrary to the accepted principles of RDA assessment.

- The catch-up growth needs of children and the need of undernourished adults to regain lost weight are ignored even when it is acknowledged that the use of higher NCHS weights for children, 'enable catch-up growth' (PC 2002 Vol. 2: 324). Also ignored was the fact that most heavy workers fall in low consumption groups[25] and suffer from underweight (Ramanamurthy and Dakshayani 1962; Satynarayana et al. 1972).
- The fact that the ICMR's (1990) RDA is higher than that recommended by the FAO/WHO/UNU (1985) is highlighted without explaining the obvious reasons. It is also highlighted that Indians have about 5% lower BMRs than those predicted on the basis of FAO/WHO/UNU equations. The reasons are said to be under-nutrition with low body weight and low BMI (weight in Kg/height in meter square). Thus, the basis of planning for better nutrition of an underfed population is undercut by arguing that an underweight population requires less nutrition!
- One of the priority areas of research was to be studies defining the BMR and energy requirement of healthy adult Indian men and women, adolescents, children, and the elderly. Even in 2010, this data was not available to the ICMR EG. However, the energy cost of work done computed in terms of PAR are said to be similar to FAO/WHO/UNU values without any evidence and despite the criticisms offered by the 1990 report. The issue of working hours for adults is not even touched!
- Falling levels of physical activity and deposition of extra calories was considered to contribute to obesity and increasing levels of non-communicable diseases requiring RDA revision. The factors of declining quality of food (specially falling proteins) and the lack of pulses in TPDS however, were ignored (PC 2002 Vol. 2: 325).

The Tenth Plan, after a rather conflicting exposition on theoretical and factual assumptions, declared that, "In view of these, it is likely that the energy requirement of Indians is likely to be substantially lower than the current ICMR recommendations" (PC 2002 Vol. 2: 324). The die is thus cast in favour of reduction of RDA with the experts within the advisory body for the Tenth Plan providing not-so-scientific justifications for it. The handling of these facts is certainly indicative of how the grey areas in nutritional knowledge about Indian populations could be used for promoting a specific set of values. The ICMR committee set up in 2008 did exactly this. Its framework seems to have been designed by the PC itself with the help of select and senior experts.

The value of our alternative calculations of Calorie RDA lies in their potential to reveal the possible extent of increase in formal deprivation of the needy if availability decreases with the lowering of RDAs. It raises the probability of higher rates of under-nutrition, especially among the heavy and moderate workers. The calorie additions required by our correctives are significant at least for these two categories of workers.[26] This is after not even considering the longer work hours for at least some. This simply shows that only by ignoring the realities, the PAR and PAL values have been fixed at such a low level that it adds to the problem of under-nutrition rather than tackling it.

Under these circumstances, the use of RDA for policy becomes questionable even though it has played a significant role over time in serving defense and then food policies of the State. Calorie RDAs of the ICMR today have a very specific economic application with social implications. They have been used to estimate the average calorie requirement of the population, which then became the standard to define poverty; those with calorie intake below the estimated average are considered poor. We will now briefly examine our second question, how the shifts in RDA by the ICMR affected estimations of poverty in India.

Implications of RDA Shifts: Impact on Poverty Estimation

Since the late nineteen seventies several official committees reviewed the methodology to estimate poverty or provide the estimates for streamlining policies for it. Without going into the wider debate on poverty, we limit ourselves to illustrate the implications of the shifts in the ICMR RDAs on poverty estimates by examining two of these committees that used calorie RDAs to set norms for poverty estimation.

Task Force of 1977

The ICMR RDA on calories became the cornerstone for calculation of poverty lines in India. In 1977 a Task Force was set up by the PC (1977 Task Force henceforth) for projection of basic minimum needs and effective consumption demand (PC 1979). The defined basic minimum need would then become the focal point for estimation of poverty. Drawing from earlier works on poverty in India (Dandekar and Rath 1971; Rudra 1974; Bardhan 1973), the 1977 Task Force considered calorie requirements as the basic minimum need. To allow for differentials in calorie needs of the population, the sixteen person categories of the Nutrition Expert Group of ICMR 1968 was considered. These comprised of five categories for children formed on the basis of age, three for adolescents in terms of sex and age, and six for nineteen years or more of men/women workers (three each for men and women engaged in heavy moderate and sedentary work respectively). The rest two were one each for non-working men and women. To these calorie requirement prescriptions for ICMR person categories, population weightages of these categories-derived from the Census, 27th Round NSS employment data etc.—are applied to arrive at average calorie requirements for the entire population. Separate calculations were made for rural and urban areas and average per-capita daily requirement of 2400 Kcal and 2100 Kcal respectively were arrived at. The monetary equivalent—the MPCE from the NSS data (27th Round) that empirically corresponded to these levels of calorie intakes—was considered the poverty line for that year and, below that MPCE level, a household was considered as poor.

The beginning of the 1990s saw an upheaval in the policy regime. The welfare role of the State got increasingly diluted and benefits of the State welfare schemes were restricted. From being universal, the criteria of being poor became the basis of targeted eligibility for most State welfare schemes. Hence poverty estimates assumed much greater significance than before—from a measure of success/failure of State welfare policy, they became the determinant of its implementation. And the methodology of poverty estimation became a contested terrain in academic and policy discourse.

After the initial official estimation of poverty line in 1977, fresh poverty lines for the later years were not calculated from the then available Consumer Expenditure Survey data (using the 1977 Task Force procedure) on the following grounds:

> [This method] allows for changes in the consumption basket provided the food items meet the calorie norm. Thus, while the calorie norm remains unchanged, the consumption basket associated with that calorie norm would change. Hence, if there is a change in the consumption behaviour due to shift in individual preferences…[this] method…would not give results comparable overtime. (Dandekar et al. 1993)

The 1977 Task Force on the question of estimation of poverty in the future had recommended that the initial poverty line MPCE be updated through price indices. This, they argued, would maintain comparability of poverty estimates over time as the poverty line commodity basket remains the same over time, while price indexation would reflect the amount of money needed to afford that same basket. Subsequent estimations of poverty lines (till 2009) used this method to update the original poverty line over time. However, some crucial contradictions arose out of this practice for the subsequent poverty estimates. Those who questioned the official poverty estimates pointed out that not only actual average daily per-capita calorie intake at poverty level MPCE for the later years were much less than the 2400/2100 Kcal rural/urban levels, but consumption of a host of other items such as clothing, foot-wear etc. also diminished (Patnaik 2013). Hence, over time the reference consumption basket associated with the poverty line in the base year did not remain fixed, it infact diminished. In view of these emerging contradictions, the PC decided for a fresh estimation of poverty line and an EG was set up in 2012 for this purpose.

Estimation of Poverty Line by EG 2012

In 2012, for the first time since 1977, an EG to Review the Methodology for Measurement of Poverty considered calories (among other things) as a direct basis for calculating poverty line and estimation of poverty (GoI 2014). This EG followed the same methodology adopted by the 1977 Task Force to calculate average per-capita daily calorie requirement for rural and urban areas separately. Two factors—the altered calorie recommendations of the ICMR and the changed age-sex-occupational structure—caused the rural average per-capita daily calorie requirement to come down to 2155 Kcal from 2400 Kcal. The urban requirement, however, remained almost the same (2090 Kcal) because of "pronounced shift in the age-distribution towards adults with higher calorie requirements" (Ibid: 57) that balanced out the diminishing factors.

The EG of GoI 2012 observed that lowering of the age-sex-activity specific calorie norm of the ICMR is responsible for 60% of the reduction in the calorie requirement of the rural population between 1979 and 2011. The remaining 40% of the reduction in the calorie requirement is due to a change in the structure of the population during the period (Ibid: 57). Hence, in absence of ICMR's RDA reductions of 2010, the urban average per-capita daily calorie requirement would in fact have seen a significant increase.

Using our alternate calorie RDAs and the population age structure used by the EG of GoI 2012 we show that alternative calorie RDAs for age group 15-59 years alone would increase the average calorie requirement to 2310 Kcal and 2239 Kcal in rural and urban areas respectively Table 17.

TABLE 17: Alternative Calculations of Average per capita daily calorie requirement

Age (yr.)	*Gender*	*Activity*	*Population Proportions*		*Calorie RDA*	
			Rural	*Urban*	*ICMR 2010*	*Alternative*
less than 1			1.79	1.44	585	585
1-3			6.07	4.83	1060	1060
4-6			6.7	5.19	1350	1350
7-9			6.65	5.24	1690	1690
10-12			7.33	5.85	2100	2100
13-14	male		2.22	1.92	2750	2750
	female		2.06	1.76	2330	2330
15 -59	male	sedentary	3.67	13.66	2320	2541
		moderate	12.78	9.03	2730	3123
		Heavy	7.93	3.84	3490	3864
		non worker	5.35	7.31	2320	2541
	female	sedentary	1.05	3.43	1900	2053
		moderate	5.45	1.64	2230	2523
		Heavy	4.03	1.53	2850	3122
		non worker	17.78	24.84	1900	2053
60 & above	Male	Sedentary	4.32	4	2320	2320
	Female		4.47	4.11	1900	1900
2012 EG Average Calorie			2155	2090		
Alternative Average Calorie			2310	2239		
Under-estimation of Average Calorie requirement by 2012 EG			155	149		

The estimated under-calculation of 155 and 149 calories in rural and urban average calorie requirements indicates how urgent is the need for a formal official review of the methodology of RDA assessment.The least that could be done to begin with is to fix the norm of an average minimum requirementof 2300 Kcal for rural and 2200 Kcal for urban areas.

Some additional Methodological and Conceptual Issues

Distinct from the problem of using lower RDAs, and hence under-estimation of poverty levels, there are some other issues which one needs to be mindful of while using RDAs for poverty estimates:

(a) Though an average calorie requirement gives the energy requirement of a population however, determining poverty status of an individual is not possible through this method. This is because age, sex, work-status etc. determine calorie requirement of a particular individual which the average requirement cannot truly reflect.

(b) By the same token, calculating the magnitude of calorie deprivation of an individual is also not possible from average calorie requirement. For example, requirement of a heavy category worker is much more than what the population's average requirement suggests. Hence, a heavy category worker, while calorie-sufficient by the population average requirement norm, might actually be calorie-deficient, and it could be just the opposite for a sedentary worker. This would give us inaccurate estimates of the number of people who are poor.

(c) Both the 1977 Task Force and 2012 EG have recommended that reducing the average requirement by 10-25% than the actual estimates would be justifiable on the grounds of adaptation and other variations (PC 1979: 10; GoI 2014: 58). The latter report adds that average heights/weights of Indians being much lower than the ICMR's reference man/woman, the 'actual' calorie requirement is lower (GoI 2014: 57). Both of these arguments have been univocally rejected in the field of nutrition science as mentioned earlier. The FAO/WHO/UNU 2004 specifically warns against accepting the argument of adaptation to lower RDAs and states in no uncertain terms that, not 'actual' anthropometry but reference weights/heights should be applied to calculate RDAs. Use of such arguments to lighten the impact of using unjustifiably reduced RDA does not make these poverty estimates more respectable.

Implications of Reducing the Poverty Line

Having reduced the numbers of the poor, targeting was made to appear more feasible. The problem of identification of the BPL households however, remained. Changing cut-offs over 1980, 1992 surveys using income criteria (based on calorie-based indexed poverty lines); then, in 1997, dropping the criteria of exclusion and, in 2002, using again 13 indicators for the identification of the BPL families, the identification of the poor remained unsatisfactory (Mehrotra and Mander 2009). The NFSA legislated that 5 Kg/person/month be given to all BPL and 7 Kg to AAY families. The rationale behind this entitlement was not clear though some analysts argued that the Act is not aimed at eradicating hunger, but aims to provide basic support to fulfill a substantial share of requirement (Jha 2014). Jha points out that the NFSA coverage for food grains is just about half of the actual consumption of the lowest household expenditure group (10 per cent of the rural and urban population), according to the NSSO 2011-12, who consumed 10 Kg and 9.4 Kg of cereals a month, respectively. National consumption of cereals stood at 11.2 Kg and 9.3 Kg per person in rural and urban regions, respectively (Jha 2014). Apart from the inappropriate methodology of using consumption data for estimating requirements, this inadequacy deepens when seen against the balanced diets prescribed by NIN, as the average for a man and woman comes to 9.6 Kg, 11.7 Kg and 16.2 Kg per-person per month for sedentary, moderate and heavy category of workers. For the latter two categories the entitlements are not even half. Secondly, the cereal of the healthy diets (NIN 2011, Dietary Guidelines for Indians Manual, ICMR Centenary Year, annexure 2: 86) come with adequate quantities of pulses, milk, vegetables, fruits fat etc. with or without non-vegetarian items. The reality, as reflected by the NSSO 2011-12 estimates of food intakes, is that 69.5% and 65% of the population in rural and urban areas were calorie deficient and 56.0 and 58.4% respectively were deficient in protein as well (Qadeer et al. 2016)with low protein intakes. This underlines the dangers of using intakes to assess requirements, which then fall artificially with declining intakes. Also, quality does not relate to micronutrient deficiency alone. It has been argued that an important challenge is to support sustainable ways to ensure diets that are adequate in quantity and quality (Narayanan 2015), but the challenge of evolving differential entitlements based on ICMR work categories of the population has not been recognised. This inadequacy in the NFSA-2013 further undermines the entitlements of the poor as the heavy and the moderate workers, needing calories much above the weighted averages calculated by experts, fall mainly in the targeted population of the NFSA. The shifts to TPDS and the push for cash transfers may further undermine these entitlements by excluding large sections of needy population, under compensation, allowing inflation and delays in correctives to further undermine entitlements and still retain the possibility of leakage (Ghosh and Qadeer 2017).

Can Obesity be tackled by lowering Calorie RDA

Our last concern is the use of the increasing obesity levels to rationalize the urgency for calorie RDA modification. The ICMR EG 2010 in its introduction points out the concern expressed by the international experts about adult over-weight and obesity in the west that guided their recommendations of reduced energy requirements (ICMR 2010: 3). It also emphasized the fact that, "energy intake far above the actual requirement is harmful" (ICMR 2010: 21). There is no doubt that higher calorie intake without physical activity leads not only to over-weight and obesity but also to multiple morbidities. The recent National Family Health Survey (NFHS) figures showing 19 and 21% of men and women respectively as overweight and obese may appear to rationalize lowering of RDAs. However, this would adversely affect 20 and 23% of men and women who are underweight. In addition, over 50% of women and children with anaemia (aggravated by helminthic infections)—noticed by the ICMR EG 2010–persist even in 2015-16. According to NFHS 2016, 53% women (age 15-49) and 58% children under five years of age are anaemic and 38% children are still stunted (MoHFW, undated). This brings into focus the emphasis laid by the JCs reports (WHO 1985 and 2004) on the need to tackle complex and mixed patterns of under- and mal- nutrition with sensitivity.

This rise in the number of overweight and obese persons is certainly due to consumption of calories in excess over the required or given levels of activity. It is worth noting however, that most of these people are also from higher MPCE groups and have low physical activity (Kalra and Unnikrishnan 2012). Apart from the consumerist sections of the well-off, overweight and obesity may also be the outcome of shifts in dietetic patterns added to reduced calorie requirements among those experiencing shifts in their occupational structures. These could be the urban migrants or rural agricultural labour shifting to other kinds of rural wage labour using cheaper quality of food within limited resources. An epidemiological study of obesity points out that dietetic shift or nutritional transition[27] hampering traditional dietetic patterns based on whole plants are conducive to obesity and associated morbidities particularly in transitional societies with increasing urbanization that is known to reduce calorie requirement (Singh et al. 2014). Rural populations moving out of heavy work into less rigorous labour or urban areas are consuming diets less balanced with excess of refined carbohydrates with low protein and poor quality fats that are not easily oxidised and tend to get deposited as abdominal and subcutaneous fat. These shifts have occurred in rural areas as well (Qadeer et al. 2016) replacing the traditional oils with cheaper palmolein and sunflower oil and use of single oils thereby reducing quality (Narasimhan et al. 2016). The relatively higher ratio of n-6: n-3 polyunsaturated fatty acids and levels of trans-fatty acids have been identified as risk factors and complex carbohydrates, Resistant Starch (RS), lente carbohydrate and whole grains can positively influence weight gain, fat oxidation, and insulin sensitivity. Thus, dietary carbohydrate quality and the interaction between fat and carbohydrate subtypes, is known to be critical for the prevention of obesity (Brown et al. 2010; Mani and Kurpad 2016). The issue of variety as a component of quality of diet (that makes subtypes of fats and carbohydrates available) therefore is critical for obesity as it is the balance of nutrients provided by the variety that also counts, and not just measuring excess calories and lack of micronutrients that are often overemphasized (Waijers et al. 2007). The authors also warn against simplistic assumptions of diets based on plants being superior to animal foods-based diets as cheap vegetarian diets do not include nuts and fruits that constitute an important component of traditional plant-based diets and may have excess of sugar and not adequate vegetables as shown by Satija et al., (2015). It is not surprising then that India, despite its vegetarian diets, is known to have significant levels of metabolic syndrome where hypertension and insulin resistance, with associated higher fat intakes and risk of abdominal obesity, have been demonstrated in urban South India (Rajendra et al. 2015; Narasimhan 2016). Yet other factors being counted are the 'Indian phenotype' prone to metabolic syndrome (Kurpad et al. 2011; Geetha et al. 2011) and the impact of pre-natal and early maternal and childhood under-nutrition leading to adiposity in children and abdominal obesity in later life (Lee 2015). Epidemiological and experimental studies indicate that maternal under-nutrition during early pregnancy in relation to a low birth weight and uterine growth restriction may adversely influence metabolism and health in off-springs by altering metabolic pathways. These lead to adiposity and obesity in later life with an increase in BMI (Lee 2015; Baird et al. 2017).

A significantly high level of stunting is prevalent in India, 38.4% children under five years of age (MoHFW, undated). Much of it leaves its imprints in adult life as reflected in adult heights, especially among women. Hence the use of BMI to measure obesity makes the stunted even more vulnerable to obesity. In most Indian families, the men as bread winners often have priority over women and children, especially if the family procures less than what is needed for all. The women, especially the adolescent and the young girls and children, suffer the most. Despite some small studies from urban areas showing equity in food distribution between genders and age groups (Pradhan 2013), the national data, especially from rural areas, reveals biases against women (Sen and Sengupta 1983; Zimmermann 2012; Harris-Fry 2017; Kishore 2016). These relatively higher levels of stunting increase their vulnerability to obesity in later years when they are no more undernourished.

Thus, the probable cause and complexity of the problem of overweight/obesity in fact requires to be tackled through improved quality of diets by adding pulses, greens and animal proteins in diets to provide the option for rebuilding muscles and not store calories as adipose tissue. If the lowering of RDA is a strategy to protect the population against this scourge of obesity by lowering calorie intakes, then it is counter-productive.

Obesity then, appears to be more of a social disease born out of differentials of income and mal-distribution of food at different levels, the neglect of pregnant women and under-nutrition among young mothers and growing children, and gender bias, especially against young girls, that leads to persistence of stunting among them and renders them vulnerable to obesity in later years. It is more complex than simple excess of calorie RDA as has been pointed out earlier (Khandelwal et al. 2013).

A related aspect is that calorie RDAs guide only the appropriate supply for different groups of people, not the actual intake, which is a function of access, price, wage, and priority of needs of a household. Lowering RDA then negatively affects that supply through TPDS, as well as the planning for production and procurement of food grain, and hence its availability. The result is that those in the upper MPCE groups, who can buy and eat in excess, become vulnerable to weight gains or obesity as a majority of them have easy access and are mostly sedentary workers with low activity levels. The heavy and moderate workers—mostly from middle and lower MPCE groups—requiring relatively higher calories, have to eat within the constraints of wages and prices of food. As a consequence, they either eat less than what they need, or the quality of their diet declines to make up for falling food expenditures in real terms (Ghosh and Qadeer 2017). In minimizing this reduction in their calorie intakes and energy deficiency through consumption of poor quality cheap diet, they compromise balanced with unbalanced diets as a survival strategy. These shifts may cause ill health and malnutrition including overweight or obesity among those who are affected by structural changes in occupations but continue with calorie-dense unbalanced cheap diets (this is an area we are exploring in a separate paper).

What needs to be underlined is that the lowered RDA for calories now guiding social policy actually puts constraints on quality of diet of the lower MPCE groups, who are compelled to buy food outside the TPDS. TPDS, now limited to cereals, makes the task of improving food quality even more difficult for the less privileged, having no option but to purchase cheap poor quality cereals and oils.

In brief, the nutritional tragedies are rooted in lack of work, poor wages, quality of diet, childhood under-nutrition, dwindling welfare and a crumbling agrarian economy where dependence on aid and external markets is increasing. The receding welfare sector only adds to the problem as lack of health services, education, drinking water supplies, and drainage systems contribute to rising morbidities that contribute to under-nutrition. Lowering calorie RDA does not help obesity resulting from diets of poor quality cereal and oils insufficient in nutrient, when market prices make access to healthy foods out of reach and TPDS provides only cereals. Those habituated to over-eating and free access to markets will in any case need strategies other than RDA reduction.

There is then an underlying dialectic of political and economic interests of the State and its ruling elite that appears to be influencing scientific decision about calorie RDA. In the period that we review, the diets for the poor were primarily a matter of subsistence as far as State planners were concerned. Even in the initial three decades of Independence, when national commitment to rebuilding India was at its best, cheap and balanced subsistence diet was the target. As soon as the extreme forms of nutritional deprivation could be tackled, even this target became peripheral. With time the biological priority of nutritional health has been over-shadowed by the socio-economic priority of increasing productivity and revenues. The latter demanded that wages of workers (agricultural as well as industrial) be contained and markets allowed to operate without controls. The SAPs were to do exactly this over the 8th and the 9th Five Year Plans with a promise of social security net for the poor. Despite going back on this promise and a gradual withdrawal of subsidies since 1992, the state failed to sustain a high economic growth rate till 2003-04. A growth impulse following restructuring measures by domestic industry, overall reduction in domestic interest rates (both nominal and real), improved corporate profitability, benign investment climate, amidst strong global demand and commitment to rules-based fiscal policy led to the real Gross Domestic Product (GDP) increase averaging upto 9% per annum over four years (Mohan 2008). It was then that, to fuel the engine of growth further, the economic planners got on board with the nutritionists to propose lowering of calorie RDA leading to a wide range of implications.

Evidently, without appearing to touch wages for the workers, the appropriation of their right to a full meal is achieved by manipulating/adjusting scientific norms that the workers cannot decipher and therefore challenge. As we have argued earlier, calorie RDA was first used to lower the poverty line and then, as it determines supplies not purchases, the next cut came about legally through blatantly low levels of entitlements sanctioned in TPDS, exclusion of a large section by calling them 'above poverty line' population in most states, and limiting entitlements to cereals alone. The suggested cash transfers were to further curtail entitlements. Thus, policy focuses only on cereals it ignores lack of other foods, and the issue of quality of diet as well as the increasing proportion of people with declining calorie intake in the lower MPCE groups. It pays no attention to the large majority of the moderate and heavy workers with higher energy needs who are from these lower expenditure groups. The depth of this insensitivity is revealed by the fact that, despite targeting the higher activity specific needs of the targeted groups are ignored. Secondly, the TPDS entitlement is limited to less than half of the average 'actual consumption' and not even the prescribed weighted average.

If technology could be defined as theory, methods, systems, and devices which are the result of scientific knowledge being used for practical purposes in society then, within a presumably democratic and civilized society, the currently prescribed Indian calorie RDA is a partisan and distorted device to veil appropriation of the right of the poor to food security. With their limited earning capacities they are being forced to access the open grain market due to inadequate entitlements- neither sufficient nor balanced. This sabotage of science underlines the need to recognize the inseparable nature of the technical and the social and the underlying power play. Only then can the concerned scientist be alert to its inherent biases and the urgency for course correction.

Notes

1. This increase in the%age was from 70 per cent and 65 per cent in rural and urban areas respectively by 2009-10 (Qadeer et al. 2016).
2. BMR is measured under standard conditions of immobility in the fasting state, with an environmental temperature of 26-30°C, which ensures no activation of heat generating processes.
3. For example, these policy concerns for FAO/WHO apart from assessing requirements globally, also addressed adequate supplies to areas under economic stress and later obesity in the developed countries.
4. Protein if not utilized for maintenance, or growth, is either broken down into calorie or excreted.
5. TEE is the energy requirement computed for all activities, including rest, over a 24 hour period. The techniques for measuring EE include the 'gold standard' method (the doubly labeled water (DLW) method), direct and indirect calorimetric chamber, indirect calorimetric measures through respirometry, heart rate and EE relationships, questionnaires and activity recall etc.
6. When EE on physical activity is expressed as a factor of BMR, it is called PAR. EE = factor × BMR, EE estimate is therefore affected by the BMR.
7. Underlying sources of variations of TEE are factors ranging from the environmental temperatures, nutritional health and structural aspects of activities including work , its nature, organization, technology, working conditions and socio- cultural and demographic factors all of which affect physical activity and TEE.
8. Hence, the food energy requirement for 24 hours for a specific individual can be calculated as PAL × BMR. When average values for a population are used, then EAR = PAL × BMR
9. In occupational work, a person does not work continuously during the entire working hours; he/she has a certain break in work (pause/light work); this is referred to as work: pause time ratio.
10. The IEI, in contrast to TEE over 24 hours, is calculated for a particular time period as (energy cost of an activity for the time period)/ (basal metabolic rate for the same period)
11. Ramanamurthy and Dakshayani 1962 as quoted in the draft report of ICMR 1989: 22.
12. For different populations the reference standard varies depending upon the state of health of the healthiest sub-set. For this reason revisions of standards are required.
13. This is defined as the maximum or optimum rate at which the heart, lungs, and muscles can effectively use oxygen during exercise; used as a way of measuring a person's individual aerobic capacity.
14. M.N. Rao (1961), suggests that lowered VO2 max despite comparable pulse rates in Indian subjects could be due to larger blood flow to skin to keep temperatures low in hot climates, shunting oxygen away from the muscles. An added reason is their lower haemoglobin level.
15. Working Heart Rate is defined as heart rate during the working phase. http://www.humanergology.com/old/jhe20060/Dey%20Vol35.pdf accessed on 2.2.2018
16. The last two studies were also cited by BSN Rao 2005.
17. An online document of the GoI (2004), Report on Factory Act 2000, http://labourbureau.nic.in/FA2K%20Chap%204.htm accessed on 28.12.2017
18. If a person with 8 hours of occupational work and 8 hours of sleep requires further rest in the remaining 8 hours of the day and cannot have normal household activities, then she/he must be energy deficient.
19. Total EE for 8 hrs for a 60 Kg man at the rate of 4.5/Kcal/Kg/hr. equals to (4.5 Kcal/Kg/hr. x 60 Kg x 8 hr.), or 2160 Kcal. The BMR of 60 Kg man for 8 hrs is 505 Kcal. Hence, PAR= EE /BMR is 2160 Kcal/505 Kcal or 4.28.
20. A unit of consumption equals a 20-39 year old adult man, and all others are adjusted accordingly.
21. Assuming a PAR of 1.54 (for male workers) during low activity, the IEI for the total time spent in occupational work is calculated. In 1985, the FAO/WHO/UNU considers a 5.36 PAR for heavy work specific activity and accordingly a 3.8 IEI was arrived at.
22. Table 12 shows that almost all workers in 90^{th} percentile and some even in the 75^{th} percentile work for more than 8 hours a day.
23. NNMB sampling follows the NSSO sample till the village, but the household sample is a cluster sample including at least one each of SC, ST clusters thereby ensuring their inclusion for monitoring.

24. 1990 ICMR EG with Varadarajan. S. as, chairman and BSN Rao as member Secretary followed by EG 2010 with BSN Rao, (former director NIN) as chairman and Sesikeran B (Director NIN)as member secretory with several other eminent nutritionists constituted these committees.
25. This is despite the presence of eminent nutritionist—the then director NIN, ex-Director NIN BSN Rao, and Advisor Planning Commission Dr. Prema Ramachandran—in the advisory body of the 10th Plan.
26. The increase for heavy and moderate men workers is 380 and 396 Kcals and 268 and 214 for women.
27. Refined grains replacing lentils, fruits and vegetables , from brown to white rice, nonuse of course grins, potato and fried food in excess with nil or low nuts and milk and milk products, use of processed and fast foods has been reported by Singh Pramil N et al. (2014).

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This working paper explores the origins, evolution and the 'scientific basis' of India's calorie RDAs through an examination of it history and scientific evolution over time. The use of the calorie RDA has played a significant role in the planning of the country's strategy to move towards freedom from the double burden of mal-nutrition. The paper offers insights into scientific traditions and, political and economic influences on these and shows how these shape the use of science. It suggests that policies based on the current calorie RDAs be reviewed and a new strategy be put in place for ensuring food security.

Imrana Qadeer
Distinguished Professor
CSD, New Delhi

Sourindra Mohan Ghosh
Research Consultant
CSD, New Delhi

P.M. Arathi
Assistant Professor
CSD, New Delhi

Council for Social Development

Sangha Rachna
53, Lodi Estate, New Delhi – 110003.
Phones: 91-11-24615383, 24611700, 24616061, 24693065, 24692655
Fax: 91-11-24616061 • **Email:** csdnd@del2.vsnl.net.in, director@csdindia.org