

Social Infrastructure and Women's Undernutrition

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We examine whether access to aspects of social infrastructure, such as toilet facilities, drinking water on the premises and clean cooking fuels, leads to a decline in the incidence of undernutrition among women, which remains quite high in India. The analysis, based on the National Family Health Survey-3 (2005-06) unit-level data, suggests that access to these three aspects of social infrastructure is likely to enhance women's nutrition in India. Of these three aspects, the influence of access to clean cooking fuels remains quite significant. The findings, which assume importance from multiple angles, underline the importance of policies and programmes that ensure access to social infrastructure to the poor, in general, and poor women, in particular.

This paper deals with one of the pressing issues of human development in India: the malnutrition of women. It tries to assess the role of social infrastructure in reducing the incidence of undernutrition among women, which remains quite high, in India. Specifically, it examines whether access to toilet facilities, drinking water on premises and clean cooking fuels leads to a decline in the incidence of undernutrition among women in India. The question that arises here is: how does lack of access to each of these aspects of social infrastructure impair women's nutrition?

Lack of access to sanitation, for instance, makes women vulnerable to infections, whereas cooking by biofuels exposes women to toxic pollutants and fetching drinking water from far away sources drains women's physical energy severely. Additionally, lack of access to clean cooking fuels and drinking water on the premises serves to sustaining the gender-biased regressive roles and tasks which undermine women's well-being, including nutrition, in substantive ways. These multiple implications, along with the higher incidence of women's undernutrition in India, make the present attempt important and relevant.

Women's Malnutrition: Consequences

The ability to be well-nourished, or freedom from malnutrition, is one among a relatively small number of centrally important human freedoms (Sen 1992: 44). Being a centrally important element of well-being, adequate nutritional attainment is essential "equally" for women and men. However, women's nutrition assumes greater significance due to its critical association with other aspects of their well-being and human development in general. These aspects, discussed below, call for according an order of priority to the nutrition of women than that of men. Yet, it is women's nutrition which is much less cared for, or discriminated against, due to a complex web of factors.

How important is women's nutrition for their well-being? How does it affect human development? Maternal malnutrition tends to increase the risk of maternal mortality. Maternal short stature and iron deficiency anaemia, which increase the risk of death of the mother at delivery, account for at least 20% of maternal mortality (Black et al 2008). In Asia, although haemorrhage is the leading cause of maternal mortality, anaemia is the second leading cause accounting for about 13% of maternal deaths (Khan et al 2006).

Maternal malnutrition is associated with an elevated risk of intrauterine growth retardation leading to the birth of low birth weight (below 2,500 grams) babies (Barker 1995; Black et al 2008). Though poor foetal growth is rarely a direct cause of death, it can make a child vulnerable to malnutrition

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and mortality (Black et al 2008). An analysis suggests that the higher incidence of low birth weight babies is primarily responsible for the higher prevalence of child malnutrition in south Asia (Osmani and Bhargava 1998). Malnutrition – which makes a child susceptible to, and enhances the progression of, infections – is responsible for 60%, 52% and 45% of child deaths from diarrhoea, pneumonia and measles, respectively (Caulfield et al 2004).

Also, maternal malnutrition relates intricately to the rising burden of chronic diseases, and thereby, lends credence to the “foetal origin of adult disease” hypothesis, in south Asia. The hypothesis postulates that maternal malnutrition during pregnancy forces the baby in uterus to adapt to survive, but with a permanent disadvantage at the later life (Barker 1995). The evidence, though far from conclusive, suggests that intrauterine growth retardation leads to fatal, often irreversible, health outcomes. These include, inter alia, cardiovascular diseases, type-2 diabetes, blood pressure and some forms of mental illness during adulthood or later. Far more vulnerable are children who are undernourished in the first two years, but who put on weight rapidly in childhood or adolescence (Osmani and Sen 2003; Victora et al 2008).

How does India fare in these aspects of human development? Though India’s maternal mortality ratio (540) was lower than that of the whole of south Asia (560) in 2000, the number of maternal deaths (1,36,000) was the largest in the world, accounting for about 26% and 66% of world’s and south Asia’s maternal deaths, respectively (WHO 2004: 24-27). Also, nearly 7.8 million children born in India in 2000 have had low birth weights, accounting for more than 40% of low birth weight births in the developing world and more than half of those in south Asia (UNICEF and WHO 2004: 8).

India continues to have a higher level of, even by the recently revised methodology on, child malnutrition: 48% of children under-five years of age are stunted in 2005-06 (IIPS and Macro International 2007: 271). Though India ranks 54 in under-five mortality rate, the number of child deaths (24,02,000) in 2000 was the largest in the world (Black et al 2003). Chronic diseases account for 53% of deaths and 44% of disability-adjusted life years lost in 2005 in India (Reddy et al 2005). It is important to note here that women’s malnutrition is *not* singularly responsible for these torments of old and new. Yet, its role, both individually and cumulatively, is no less significant either.

These aspects prompt us to ask: What is the extent of under-nutrition among women in India? The National Family Health Survey-3 (NFHS-3) carried out in 2005-06 reveals that 55.3% of women in the age group of 15-49 years in India are anaemic in terms of iron deficiency. Also, 35.6% of women suffer from chronic energy deficiency (CED) indicated by the body mass index (BMI) below 18.5. This is much higher than the incidence in most countries of sub-Saharan Africa. For instance, of the 23 countries of sub-Saharan Africa for which comparable data exists, with a singular exception of Eritrea, all other countries have much lower incidence than that of India (Deaton and Dreze 2009: 54). With closer to 40% of women suffering from CED, “the situation can be considered critical in India” (Black et al 2008: 244). Therefore, it is important to identify the primary

causes and more so the factors that would potentially reduce women’s undernutrition in India.

Causes and Cures

What makes a large proportion, and indeed, number of women in India undernourished? The answer for this simple question is not so simple. Nonetheless, there is a fair measure of consent that

...undernutrition is associated with a cluster of related, often coexistent, factors which together constitute what may be termed the ‘poverty syndrome’, the major attributes of which are (1) income levels that are inadequate to meet basic needs of food, clothing and shelter; (2) diets that are quantitatively and often qualitatively deficient; (3) poor environment, poor access to safe water and poor sanitation; (4) poor access to healthcare; and (5) large family size and high levels of illiteracy – especially female illiteracy (Gopalan 1992: 18).

Thus, poverty emerges as the primary cause of undernutrition, and this would be true for women as well.

Additionally, analyses also suggest that there is something regressive in the culture of the south Asian region that leads to the excessive neglect of women’s nutrition, in addition to the usual determinants (Ramalingaswami et al 1996; Osmani and Bhargava 1998; Osmani and Sen 2003). These regressive aspects include, but by no means are limited to, the discriminatory practices against women in the allocation of healthcare and food and the excessive demands made on the time and energies of women (Ramalingaswami et al 1996; Osmani and Bhargava 1998).

Arguably, public policy can play a progressive role in attenuating the above poverty syndrome, though actual results leave a lot to be desired. “Poor sanitation” is one of the elements of the above poverty syndrome, which not only blights the nutrition of women and men significantly through infections and ill-health (Hunt 2001), but also public policy would have a strong influence on it. The question that becomes relevant here is: how does lack of access to toilet facilities, which make both women and men equally vulnerable to numerous infections, affect the nutrition of women more than that of men in India?

An additional number of factors make women in India far more vulnerable to the adverse health effects ensuing from lack of access to proper sanitation. For instance, in many regions of rural India, where households use open spaces or fields for defecation, women have to wait till late evening, if they were not able to manage to go before dawn. This not only makes them especially vulnerable to numerous health problems, but also often forces them to eat less well. What is more, together with cultural constraints and biological reasons, lack of access to sanitation becomes sometimes a source for reduced physical safety and dignity for women.

Unlike sanitation, the potential role of public policy in enfeebling the efficacy of regressive social norms against women remains far from sure. Nonetheless, one of the regressive aspects which public policy can possibly influence is “the excessive demands made on the time and energies of women”. That fetching firewood and drinking water is primarily the task of women in India goes without saying. For instance, in 81% of households in India which do not have a source of drinking water on the premises, it is the primary responsibility of women to fetch drinking water (IIPS and Macro International 2007: 36).

How does fetching drinking water and biofuels (straws, shrub or grass, agricultural crop residues and animal dung, and so on) impair the nutrition of women in India? Estimates suggest that fetching biofuels and water drains a sizeable amount of women's physical energy (Batliwala 1982; Rao et al 2008). Also, biofuels, which remain at the low end of the energy ladder in terms of combustion efficiency and cleanliness (Smith and Lim 2004 cited in Mishra and Retherford 2007: 118), not only consume long hours for cooking, but also make the physical presence of women almost a necessity. This leads to a close and unequally long exposure of women to the toxic gases and pollutants, including carbon monoxide, and particulate matter, emitted during the combustion of biofuels, while cooking (Parikh et al 1999; Duflo et al 2008). An analysis suggests that exposure to the smoke from the biofuels is associated significantly with the incidence of asthma among elderly women and men (60 years and above) in India, and the influence is much higher among women than men (Mishra 2003).

What is more, besides blighting women's nutrition severely and unequally, lack of access to drinking water on the premises and clean cooking fuels helps to sustain the gender-based hierarchy at the household. That is, since these aspects belong to the realm of activities considered typically as women's domain in India, collection of biofuels and drinking water becomes primarily the responsibility of women. Viewed in this way, lack of access to these aspects of social infrastructure also serves to sustaining the gender-based regressive roles and responsibilities (Desai and Jain 1994), which undermine women's well-being, including nutrition, in substantive ways.

These multiple implications, together with higher incidence of women's undernutrition in India, make it important and relevant to assess whether access to these aspects of social infrastructure reduces women's undernutrition in India. Specifically, we examine whether, and to what extent, access to toilet facilities, drinking water on premises and clean cooking fuels goes along with a significant decline in undernutrition among women in India. By doing so, we intend to assess the role of public policy in reducing women's undernutrition in India.

Estimation and Data

The BMI, one of the very commonly used measures of nutrition, presumes that the weight of a well-grown adult should be equivalent to the square of her height. A BMI, the ratio of weight to squared height (W/H^2), below 18.5 is considered as an indication of undernutrition or CED, though more rigorous measurement on undernutrition would also require detailed information on physical activity levels (Shetty and James 1994). Following this, we consider a BMI below 18.5 (CED, hereafter) as a measure of undernutrition.

Women's access to social infrastructure is assessed in the following way: Women who (1) use open spaces, fields or bushes for defecation are considered as lacking access to toilet facilities and others as having access to toilet facilities; (2) have access to drinking water on premises or not. Women who do not have access to drinking water on premises are classified further based on the time spent, up to 15 minutes (median time) and above 15 minutes,

on fetching drinking water; and (3) women who use wood, straws/shrub/grass, agricultural crop residues or animal dung, coal/charcoal and lignite (biofuels, hereafter) as main source of cooking fuels or not. Note that more than access to drinking water on the premises, studies emphasise the importance of access to safe drinking water, as poor quality of water is a known cause for numerous health problems (Kulshrestha and Mittal 2003). However, we have considered drinking water on the premises primarily because of the gender dimension associated with fetching drinking water, if there is no access to it on the premises.

The analysis makes use of the unit-level data from the third round of the NFHS-3, carried out in all the Indian states during 2005-06, data which contain information on aspects of undernutrition and access to social infrastructure (for more details on the survey including the methodology, see IPS and Macro International 2007). It merits a mention here that since the nutritional status relates to women (15-49 years), access to each of these aspects of social infrastructure is also assessed for women, rather than at the household level. Hence, women for whom the information on social infrastructure is unavailable (mainly visitors) are excluded from the analysis.

Role of Social Infrastructure

Table 1 presents the descriptive statistics on women's access to social infrastructure in India. For about 53% of women (15-49 years) in India, who lack access to toilet facilities, the inherent biological process of defecation is in itself a potential source of embarrassment and infections. The fact that over 55% of households in India do not have access to toilet facilities, and thereby, defecate in the open spaces or fields (IPS and Macro International 2007: 37) indicates the extent of generalised deprivation which is an inherent part of, though stands far away from, the contemporary (shining!) India. That the rural households (74%) and women (72%) in India bear the brunt of this deprivation more than urban households and urban women is a reality that speaks for itself.

Table 1: Women's Access to Social Infrastructure in India

	Total		Rural		Urban	
	%	N	%	N	%	N
Access to toilet facilities		1,17,467		78,475		38,992
No	53.1	62,374	71.6	56,224	15.8	6,150
Yes	46.9	55,093	28.4	22,251	84.2	32,842
Time to fetch drinking water		1,17,346		78,410		38,936
Drinking water on premises	54.0	63,325	45.0	35,317	71.9	28,008
Up to 15 minutes	29.9	35,111	35.3	27,716	19.0	7,395
Above 15 minutes	16.1	18,910	19.6	15,377	9.1	3,533
Major type of cooking fuels		1,17,536		78,543		38,993
Biofuels	71.0	83,414	90.5	71,097	31.6	12,317
Clean fuels	29.0	34,122	9.5	7,446	68.4	26,676

N refers to number of women.
Source: Computed from NFHS-3 data.

Over 70% of women (and an equal percentage of households) in India depend on biofuels, which are not only time and energy consuming, but also have adverse health consequences. Yet again, the rural-urban divide is large here – the rural figure being three times higher than the urban, though the percentage of women depending on these sources in urban India is not so low

either. Only on access to drinking water on the premises, does the situation improve marginally. Here too, around 46% of women have to spend, almost every day, some time and of course, energy in fetching drinking water. Of them, 16% of women spend more than 15 minutes. Unlike in the other two aspects of social infrastructure, the rural-urban gap is relatively lower here.

The access to toilet facilities goes along with an impressive difference, nearly 20% points, in the incidence of CED among women in India (Table 2). What is more, the gap in the incidence of undernutrition tends to get almost halved, if women have access to clean cooking fuels. Though access to drinking water on premises goes along with a noticeable difference in CED among women in India, the extent of gap (hovers around 12% points) is relatively smaller. However, an increase in the time spent by women in fetching drinking water tends to go with only a marginal increase in the incidence of CED.

Both rural and urban parts of India allude to the above broad pattern: that access to these aspects of social infrastructure tends to go with a significant difference in the incidence of CED among women. While in rural India, the access to clean cooking fuels tends to register the largest difference (around 20% points), it is replaced by access to toilet facilities in urban India (around 16% points). An access to drinking water on the premises turns out to be the aspect that goes with the lowest gap in both rural and urban India: varies from 8 to 11% points. Note here that the difference in CED coexisting with access to toilet facilities and drinking water on the premises is relatively lower, though marginally, in rural India. Yet, the sheer magnitude of the incidence of CED in rural India (last column, Table 2) makes such a difference quite important.

Table 2: Women's Undernutrition and Social Infrastructure in India

India	Percentage of Women with CED*							CED
	Access to Toilet Facilities		Time to Fetch Drinking Water			Major Cooking Fuel		
	No	Yes	On Premises	15 Min	Above 15 Min	Biofuels	Clean Fuels	
Overall	44.8	25.3	30.2	41.7	42.4	41.9	20.4	35.6
Rural	45.4	29.8	36.5	44.5	44.4	43.0	21.8	40.6
Urban	38.6	22.2	22.0	31.1	33.8	35.4	19.9	25.0

* Excludes pregnant women and those who gave birth within two months preceding the survey. Source: Computed from NFHS-3 data.

Major States of India

It is clear that going by the incidence of CED across the major states in India, with much higher incidence the eastern states, such as Bihar (45.1%), Jharkhand (43.4%), Orissa (41.7%) and West Bengal (39.1%), remain as the repository of women's undernutrition in India (Table 3, last column). As opposed to this, the southern states with lower incidence remain at the other end of the spectrum, though it is worth a mention here that Punjab outperforms most of the southern states barring Kerala.

Table 3 also suggests that the states that remain at the bottom on the incidence of CED are also the ones that have the lowest levels of access to toilet facilities. In these states, more than 70% of women use open spaces or fields for defecation. The notable exception here is West Bengal, where nearly 60% of women have access to toilet facilities. Also, proportions of women having access to drinking water on the premises are quite low in these states. The exception here is Bihar, where nearly 70% of women

Table 3: Women's Access to Social Infrastructure: Major States of India (%)

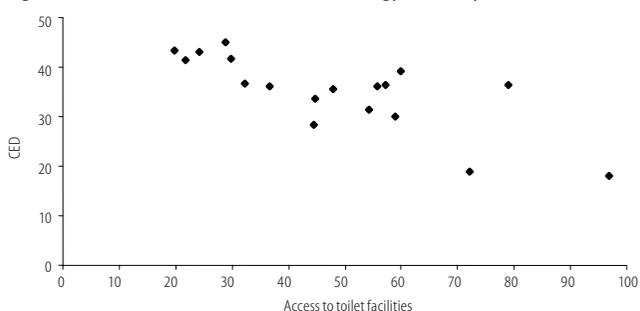
States	Toilet Facilities		Time to Fetch Drinking Water			Major Cooking Fuel		CED
	No	Yes	On Premises	15 Min	Above 15 Min	Biofuels	Clean Fuels	
Kerala	3.2	96.8	77.6	18.9	3.5	73.8	26.2	18.0
Punjab	27.9	72.1	89.0	7.5	3.5	58.0	42.0	18.9
Tamil Nadu	55.6	44.4	36.0	43.5	20.5	58.9	41.1	28.4
Uttarakhand	41.1	58.9	61.7	17.3	21.0	61.7	38.3	30.0
Haryana	45.8	54.2	63.0	17.0	20.0	70.7	29.3	31.3
Andhra Pradesh	55.2	44.8	39.2	43.3	17.5	65.2	34.8	33.5
Karnataka	52.0	48.0	48.4	32.7	18.9	64.8	35.2	35.5
Uttar Pradesh	63.3	36.7	67.6	24.9	7.5	81.0	19.0	36.0
Maharashtra	44.3	55.7	68.5	20.2	11.3	46.1	53.9	36.2
Gujarat	42.8	57.2	69.8	19.9	10.3	51.0	49.0	36.3
Assam	21.0	79.0	69.7	24.3	6.0	76.7	23.3	36.5
Rajasthan	67.7	32.3	47.1	20.8	32.1	77.3	22.7	36.7
West Bengal	40.1	59.9	36.3	49.2	14.5	81.6	18.4	39.1
Orissa	78.2	21.8	26.4	51.4	22.2	88.0	12.0	41.4
Madhya Pradesh	70.2	29.8	31.8	26.2	42.0	80.1	19.9	41.7
Jharkhand	75.9	24.1	29.7	39.6	30.7	88.8	11.2	43.0
Chhattisgarh	80.1	19.9	21.7	52.1	26.2	86.2	13.8	43.4
Bihar	71.2	28.8	69.0	23.5	7.5	89.5	10.5	45.1
India	53.1	46.9	54.0	29.9	16.1	71.0	29.0	35.6

Source: Computed from NFHS-3 data.

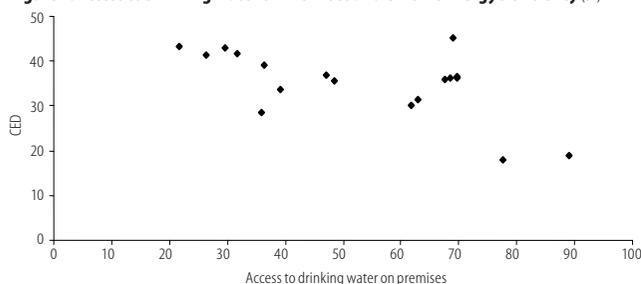
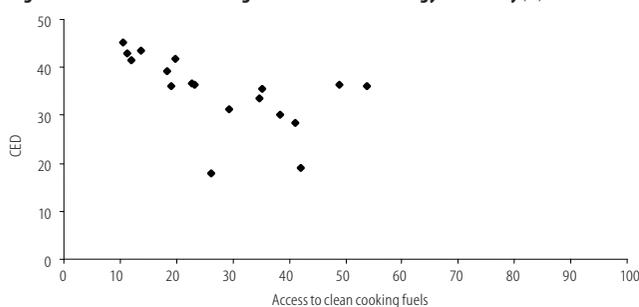
have access to drinking water on the premises. Again, with little access to clean cooking fuels these states remain at the bottom.

Scatter plot showing the relationship between social infrastructure and CED in major states of India is given in Figure 1.

Figure 1: Access to Toilet Facilities and Chronic Energy Deficiency (%)



The graphical presentation of these figures seems to suggest a clear negative association between access to social infrastructure and incidence of CED (see Figures 1-3). For a start, look at the five states, such as Orissa, Madhya Pradesh, Jharkhand, Chhattisgarh and Bihar, where incidence of CED is higher. These states also suffer with low access to these three aspects of social infrastructure. By contrast, states with greater access to three aspects of social infrastructure, mainly Kerala, Punjab, Uttarakhand and Haryana, also seem to have relatively lower incidence of CED. The states which are exceptions are Assam, West Bengal, Gujarat and Maharashtra. Though the Assam has greater access to toilet facility, the incidence of CED is also higher. Similarly, Bihar with higher access to drinking water on the premises has higher incidence of CED (Figure 2, p 87). Gujarat and Maharashtra rank top with respect to access to clean cooking fuels but have lower achievement with regard to maternal nutrition (Figure 3, p 87). In Kerala, only one-fourth of the women have access to clean fuels but the incidence of the CED is the lowest in the state. This seems to underline the influence of a number of other factors, in addition to these three aspects of social infrastructure, on women's nutrition.

Figure 2: Access to Drinking Water on Premises and Chronic Energy Deficiency (%)**Figure 3: Access to Clean Cooking Fuels and Chronic Energy Deficiency (%)**

Do all the major Indian states exhibit the broad patterns observed from Table 2? Here too, the above patterns appear unchanging in all the 18 major states of India considered here (Table 4). Barring Assam, Rajasthan and Punjab, the difference in CED associated with access to toilet facilities is quite high. In these three states, the extent of difference is less than 10% points. By contrast, the difference is the highest in Orissa (around 25% points), wherein the incidence of CED is also quite high (41.7%). More so, the difference is around 20% points or more in the five states which, with much higher incidence of CED, remain at the bottom. Only in Bihar, the state with the highest incidence of CED (45.1%) in India, the difference is a bit lower than these states: around 17% points.

An equally impressive degree of difference registers in almost all the major states of India along with an access to clean cooking fuels. The difference is the highest in Orissa (around 25% points) and the lowest in Punjab (around 8% points). As noted above, the bottom five states register a difference of more than 20% points here as well. The exception here is Jharkhand rather than Bihar. As far as the time spent on fetching drinking water is concerned, a uniform decline in CED along with a decline in the time spent appears in 11 out of 18 states. Nonetheless, the difference in CED associated with the access to drinking water on premises, though lower when compared to other two aspects, is more than 10% points in most of the states.

Do these patterns emerge in both rural and urban parts of these states? An access to these aspects of social infrastructure goes well along with a sharp difference in CED among women in both rural and urban parts of all the above states (results are not shown here). Indeed, the extent of difference varies considerably across the states and between rural and urban parts among them. In rural parts of these states, for instance, the difference in CED coexisting with the access to toilet facilities and clean cooking fuels is the largest in Orissa and the smallest in Assam and Rajasthan in these two aspects, respectively. In the urban parts

of the states, on the contrary, Assam and Bihar are the states with the largest and smallest difference, respectively, in access to toilet facilities. They are replaced by Tamil Nadu and Rajasthan in access to clean cooking fuels.

Multivariate Analysis

A binary logistic regression analysis has been carried out for India and also for the major states separately to assess the nature and extent of influence of these three aspects of social infrastructure controlling other potential factors on women's nutrition. Two models were constructed. While the first model excludes household wealth index, the second model includes it as a covariate. This is because the household wealth index, available at the NFHS-3 data, is constructed out of 33 variables comprising various aspects of household assets, which also include the three variables we have analysed (IIPS and Macro International 2007: 43). Hence, it is useful to find whether the influence of these three aspects on women's nutrition undergoes any variation once the household wealth index is included.

The estimated effects (odd ratios) of some of the factors that would potentially influence women's nutrition are given in Table 5 (p 88). Most of the factors considered for the analysis seem to have a significant positive influence on women's nutrition in Model 1. The probability to be free from undernutrition among women goes up if they reside in urban areas, belong to castes other than scheduled tribes (STs), scheduled castes (SCs) and Other Backward Classes (OBC), and Christian religion. Women's age seems to have a significant influence, which goes up along with an increase in age. The younger women (15-19 years) are three times more likely to suffer from undernutrition than older women (40-49 years). While the positive and significant influence of women's education on their nutrition is on expected lines, the adverse influence of their employment seems to suggest that

Table 4: Women's Undernutrition and Social Infrastructure: Major States of India

States	Percentage of Women with CED*							CED
	Access to Toilet Facilities		Time to Fetch Drinking Water			Major Cooking Fuel		
	No	Yes	On Premises	15 Min	Above 15 Min	Biofuels	Clean Fuels	
Kerala	34.7	17.4	16.4	24.1	23.9	21.0	10.1	18.0
Punjab	26.1	16.2	17.8	29.2	26.0	22.1	14.5	18.9
Tamil Nadu	36.7	18.0	18.6	33.9	33.6	37.0	15.9	28.4
Uttarakhand	38.4	24.5	26.5	37.9	34.8	37.7	18.3	30.0
Haryana	38.8	25.4	26.7	38.5	40.4	37.3	17.1	31.3
Andhra Pradesh	42.3	22.7	27.8	38.6	34.1	41.8	18.1	33.5
Karnataka	44.9	25.3	28.7	41.7	42.9	43.3	21.0	35.5
Uttar Pradesh	41.4	27.3	33.3	42.4	43.4	39.6	21.7	36.0
Maharashtra	47.7	26.5	30.8	46.6	49.1	48.6	25.0	36.2
Gujarat	50.3	25.7	31.7	45.6	48.9	48.5	23.6	36.3
Assam	42.1	35.3	33.3	45.5	40.5	41.5	20.9	36.5
Rajasthan	39.6	30.5	34.0	36.9	40.4	39.0	28.6	36.7
West Bengal	54.2	29.7	32.7	43.2	43.4	45.1	14.2	39.1
Orissa	47.0	21.4	27.6	45.3	49.6	44.9	16.4	41.4
Madhya Pradesh	47.8	27.9	33.0	46.0	45.9	46.0	25.5	41.7
Jharkhand	49.2	25.9	33.8	47.1	48.3	47.0	16.5	43.0
Chhattisgarh	48.4	24.2	28.4	47.8	47.9	47.0	21.8	43.4
Bihar	51.0	33.7	43.2	50.2	55.6	48.4	24.1	45.1
India	44.8	25.3	30.2	41.7	42.4	41.9	20.4	35.6

Same as in Table 2.

Source: Computed from NFHS-3 data.

the association between women's employment and nutrition is likely to be more complex. More than mere gainful employment, under what conditions women take up paid employment and what kind of jobs they carry out are also likely to impinge on women's nutrition.

The access to toilet facilities and clean cooking fuels tends to influence women's nutrition positively and significantly, independent of the factors included in the regression analysis. Women having access to toilet facilities or clean cooking fuels are 53% more likely to be nourished compared to women not having access to these facilities. As far as access to drinking water is concerned, rather than a decline in the time spent only access to drinking water on the premises seems to have a positive influence on their nutrition. These clearly reinforce the results emerging from the bivariate analysis. However, since these three aspects are also part of the social environment characterising poverty, it is important to see whether their influence persists, if other aspects of poverty (household wealth) are taken into consideration.

Model 2, which includes wealth quintiles along with other covariates, shows that the positive and significant influence of access to toilet facilities and clean cooking fuels remains independent of other but related aspects of household wealth. However, the influence of access to drinking water on the premises becomes insignificant, but still positive. As stated already, the influence of access to drinking water on women's nutrition would also depend on, in addition to the time spent, whether water available is safe or not and whether water is treated before drinking or not. Nonetheless, the multivariate analysis clearly suggests that access to aspects of social infrastructure, especially toilet facilities and clean cooking fuels, would make a significant impact on the undernutrition of women in India.

Given the varying incidence of women's undernutrition and access to aspects of social infrastructure across the states, we have also attempted to assess whether the influence of social infrastructure on women's undernutrition is pervasive across the major states in India (results not shown here). In Model 1, access to toilet facilities tends to have a positive influence on women's nutrition in all the states except Assam. But, the influence is significant in only 12 states. Equally, access to clean cooking fuels tends to have a positive influence on women's nutrition, and the influence

is significant in most of the states barring Rajasthan and Chhattisgarh. Access to drinking water on the premises seems to have a positive influence on all the states except Andhra Pradesh, Gujarat and West Bengal. However, the influence is significant only in nine states.

When wealth index is included in the model (Model 2), not only the influences of access to toilet facilities and drinking water on the premises get lowered, but also become insignificant in most of the states. This is expected due to high correlation between wealth index and social infrastructure variables. Moreover, the effect of these variables has also been captured in the wealth index. However, the singular exception here is access to clean cooking fuels. Though its influence also gets reduced in all the states, it remains significant in about 10 states. Notwithstanding the lowered influence of these three aspects, what needs to be noted here is that they seem to exert a positive influence in most of the states over and above the combined influence of 33 variables of household assets, including these three variables. This

seems to indicate the potential role of social infrastructure, especially access to toilet facilities and clean cooking fuels, in enhancing women's nutrition in India.

Concluding Remarks

The paper examines whether access to aspects of social infrastructure, such as toilet facilities, drinking water on premises and clean cooking fuels, leads to a decline in the incidence of undernutrition among women, which remains quite high, in India. This is attempted by analysing the NFHS-3 data. The analysis brings out the following broad findings:

Incidence of undernutrition is substantially larger among women who lack access than women who have access to these three aspects of social infrastructure at the all-India level and major states. Multivariate analysis suggests that access to toilet facilities and clean cooking fuels is likely to enhance women's nutrition significantly in India. The influence of access to drinking water on premises appears to be relatively low when compared to these two aspects.

The above findings go well along with the finding of a recent empirical study which suggests that access to water and toilet facilities tends to significantly reduce women's vulnerability to, and the incidence of, CED in Uttar Pradesh (Kumar et al 2009). Also, the finding that the improvements in

Table 5: Estimated Effects of Proximate Factors on Women's Nutrition in India

(Dependent variable: Women's nutrition = 1, if BMI >18.5; 0, if otherwise)

Explanatory Factors	Odds Ratios	
	Model 1	Model 2
Place of Residence (Ref: Rural)		
Urban	1.071***	1.024
Caste (Ref: Scheduled Tribes)		
Scheduled Castes	0.866***	0.827***
Other Backward Classes	0.998	0.921**
Others	1.077**	0.970
Religion (Ref: Hindus)		
Muslims	0.963	1.002
Christians	2.098***	2.055***
Others	1.644***	1.546***
Women's Age (Ref: 15-19 years)		
20 – 29 years	1.588***	1.565***
30 – 39 years	2.568***	2.485***
40 – 49 years	3.340***	3.113***
Women's Education (Ref: Illiteracy)		
Primary	1.292***	1.213***
Secondary	1.306***	1.118***
Higher	1.606***	1.267***
Women's Employment (Ref: Unemployed)		
Employed, not for cash	0.946**	0.974
Employed for cash, seasonal	0.842***	0.901***
Employed for cash, regular	0.903***	0.946**
Wealth Quintiles (Ref: Poorest)		
Poorer	NI	1.227***
Non-poor	NI	1.585***
Richer	NI	1.915***
Richest	NI	2.778***
Access to toilet facilities (Ref: No)		
Yes	1.525***	1.280***
Access to clean cooking fuels (Ref: No)		
Yes	1.524***	1.200***
Time to get drinking water (Ref: Above 15 minutes)		
1 – 15 minutes	0.996	0.990
On premises	1.138***	1.018
-2 Log Likelihood	114447	113689
Model chi-square	9864	10622
Number of women	1,02,107	1,02,107

*** p<.001, ** p<.05 and * p<.10. NI refers to Not Included.

environment and personal hygiene as one of the possible reasons for the gains in nutritional outcomes of children and adults, despite the decline in the consumption of calories and other nutrients over the years in India (Deaton and Dreze 2009), lends support to the findings emerging from our analysis.

That the finding access to toilet facilities, clean cooking fuels and drinking water on the premises would reduce the incidence of undernutrition among women in India appears rather obvious, though interesting. Obvious, because the lack of access to these aspects of social infrastructure, being an essential part of the poverty syndrome, alludes to the fact that poverty can blight women's well-being, and by extension affect the human development. Interesting, because it implies that simple enough measures, such as the provision of toilet facilities, clean cooking fuels and drinking water, can possibly bring a significant improvement in women's nutrition in India.

Of these three aspects, the significant influence of access to clean cooking fuels on women's nutrition merits here a mention. It tends to reinforce the potential numerous health risks, brought out by a large number of studies, associated with women's unequally long and close exposure to toxic gases

and pollutants emitted during the combustion of biofuels while cooking. This underlines the importance of policy measures that would progressively reduce the indoor air pollution in general, and women's exposure to toxic gases from biofuels in particular.

The findings assume importance from multiple angles. Women's undernutrition, which implies their deprivation in one of the basic but central aspects of well-being, is in itself a pressing issue of, in addition to its adverse and lasting influence on crucial aspects of, human development. Equally, these three aspects of social infrastructure, which are closely associated with numerous communicable and non-communicable diseases besides women's undernutrition, also relate to aspects of public health. Finally, the failure to provide access to drinking water within or closer to the premises and clean cooking fuels also serves to sustaining the gender biased regressive roles and tasks that undermine women's freedom and well-being. These multiple, interrelated dimensions increase the importance of public policy that ensures access to aspects of social infrastructure to the poor in general, and poor women, in particular.

REFERENCES

- Barker, D J P (1995): "Fetal Origins of Coronary Heart Disease", *British Medical Journal*, 311(6998), pp 171-74.
- Batliwala, Srilatha (1982): "Rural Energy Scarcity and Nutrition: A New Perspective", *Economic & Political Weekly*, 17(9), pp 329-33.
- Black, Robert E, Saul S Morris and Jennifer Bryce (2003): "Where and Why Are 100 Million Children Dying Every Year?", *Lancet*, 361(9376), pp 2226-34.
- Black, Robert E, Lindsay H Allen, Zulfiqar A Bhutta, Laura E Caulfield, Mercedes de Onis, Majid Ezzati, Colin Mathers and Juan Rivera for the Maternal and Child Undernutrition Study Group (2008): "Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences", *Lancet*, 371(9608), pp 243-60.
- Caulfield, Laura E, Mercedes de Onis, Monica Blossner and Robert E Black (2004): "Undernutrition as an Underlying Cause of Child Deaths Associated with Diarrhoea, Pneumonia, Malaria and Measles", *American Journal of Clinical Nutrition*, 80(1), pp 193-98.
- Deaton, Angus and Jean Dreze (2009): "Food and Nutrition in India: Facts and Interpretations", *Economic & Political Weekly*, 44(7), pp 42-65.
- Desai, Sonalde and Devaki Jain (1994): "Maternal Employment and Changes in Family Dynamics: The Social Context of Women's Work in Rural South India", *Population and Development Review*, 20(1), pp 115-36.
- Duflo, Esther, Michael Greenstone and Rema Hanna (2008): "Cooking Stoves, Indoor Air Pollution and Respiratory Health in Rural Orissa", *Economic & Political Weekly*, 43(32), pp 71-76.
- Gopalan, C (1992): "Undernutrition: Measurement and Implications" in S R Osmani (ed.), *Nutrition and Poverty* (New Delhi: Oxford University Press), pp 17-47.
- Hunt, Caroline (2001): *How Safe Is Safe: A Concise Review of the Health Impacts of Water Supply, Sanitation and Hygiene*, A WELL (Water and Environmental Health at London and Loughborough) Study by Task 509, London School of Hygiene and Tropical Medicine, London.
- IIPS and Macro International (2007): *National Family Health Survey-3, 2005-06, India: Volume-I*, International Institute for Population Sciences, Mumbai.
- Jose, Sunny and K Navaneetham (2008): "A Factsheet on Women's Malnutrition in India", *Economic & Political Weekly*, 44(33), pp 61-67.
- Khan, Khalid S, Daniel Wojdyla, Lale Say, A Metin Gulmezoglu and Paul F A Van Look (2006): "WHO Analysis of Causes of Maternal Death: A Systematic Review", *Lancet*, 367(9516), pp 1066-74.
- Kulshrestha, Mukul and Atul K Mittal (2003): "Diseases Associated with Poor Water and Sanitation: Hazards, Prevention, and Solutions", *Reviews on Environmental Health*, 18(1), pp 15-32.
- Kumar, K S Kavi, Maithili Ramchandran and Brinda Viswanathan (2009): "What Characterises Women Vulnerable to Chronic Energy Deficiency?", *Social Indicators Research*, 90(3), pp 365-80.
- Mishra, Vinod (2003): "Effect of Indoor Air Pollution from Biomass Combustion on Prevalence of Asthma in the Elderly", *Environmental Health Perspectives*, 111(1), pp 71-77.
- Mishra, Vinod and Robert D Retherford (2007): "Does Biofuel Smoke Contribute to Anaemia and Stunting in Early Childhood?", *International Journal of Epidemiology*, 36(1), pp 117-29.
- Navaneetham, K, A Dharmalingam and G Caselli (2008): *Poverty, Nutrition and Mortality: A Comparative Perspective* (Paris: CIRCED).
- Osmani, Siddiq and Alok Bhargava (1998): "Health and Nutrition in Emerging Asia", *Asian Development Review*, 16(1), pp 31-71.
- Osmani, Siddiq and Amartya Sen (2003): "The Hidden Penalties of Gender Inequality: Fetal Origins of Ill-health", *Economics and Human Biology*, 1(1), pp 105-21.
- Parikh, Jyoti, Kirk Smith and Vijay Laxmi (1999): "Indoor Air Pollution: A Reflection on Gender Bias", *Economic & Political Weekly*, 34(9), pp 539-44.
- Rao, Shobha, Medha Gokhale and Asawari Kanade (2008): "Energy Costs for Daily Activities for Women in Rural India", *Public Health Nutrition*, 11(2), pp 142-50.
- Ramalingaswami, Vulimiri, Jonsson, Urban and Jon Rohde (1996): "The Asian Enigma" in UNICEF (ed.), *The Progress of Nations*, UNICEF, New York, pp 11-17.
- Reddy, K Srinath, Bela Shah, Cherian Varghese and Anbumani Ramadoss (2005): "Responding to the Threat of Chronic Diseases in India", *Lancet*, 366(9498), pp 1744-49.
- Sen, Amartya (1992): *Inequality Re-examined* (New Delhi: Oxford University Press).
- Shetty, P S and W P T James (1994): *Body Mass Index: A Measure of Chronic Energy Deficiency in Adults*, FAO Food and Nutrition Paper Series No 56, Food and Agriculture Organisation of the United Nations, Rome.
- Smith, K R and Y Lim (2004): "Indoor Air Pollution in Developing Countries" in J M Samet (ed.), *Epidemiology of Lung Cancer* (New York: Marcel Dekker, Inc) pp 154-63.
- UNICEF and World Health Organisation (WHO) (2004): *Low Birth Weights: Country, Regional and Global Estimates*, United Nations Children's Fund New York.
- Victora, Cesar G, Linda Adair, Caroline Fall, Pedro C Hallal, Reynaldo Martorell, Linda Richter and Harshpal Singh Sachdev for the Maternal and Child Undernutrition Study Group (2008): "Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital", *Lancet*, 371(9608), pp 340-57.
- WHO (2004): *Maternal Mortality in 2000: Estimates Developed by World Health Organisation, UNICEF and UNFPA*, Department of Reproductive Health and Research, WHO, Geneva.

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