Under Nourishment in Children:
Causes of Inter country variation

By

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1 INTRODUCTION

According to the National sample survey of 2004-5, 1.9% of Indian households defined themselves as hungry for some part of the year. Based on the same survey, the Planning Commission determined the proportion of poor according to the then prevailing national poverty line was between 21.8% and 27.5 per cent. However, according to the National Family Health Survey 2005-6, 45.9 per cent of children under 3 were malnourished (in terms of the weight for age measure of undernourishment).[1]

As argued in Das Gupta et al (2009), half of India's children are stunted (height for age measure of malnourishment)[2], and the fact that 25% of those in the highest wealth quintile are stunted reflects the burden of morbidity even among the affluent. The WHO estimates that half of malnutrition is attributable not to lack of food but to infections arising from poor sanitation.[3]

The polio eradication program has faltered in Uttar Pradesh and Bihar because poor sanitation causes such a high burden of gastro-enteric illness that some children's digestive tracts are unable to absorb the vaccine.[4] They therefore contract polio despite repeated vaccination, and the disease spreads to other parts of India and the world, necessitating re-vaccination programs where the disease had been controlled.

Virmani (2007) argued that mixing up issues of Hunger, average availability of food/cereals (or Calorie deficiency), poverty and malnutrition, can lead to serious diagnostic errors and ineffective policies that make little dent on these problems. The same paper also concluded that the most important determinant of the variation of malnutrition across India States was public health deficiencies as proxied by access to improved sources of sanitation and drinking water. That is, the weakening of the absorptive capacity of the stomach due to gastrointestinal diseases and germs played a much more significant role in malnutrition than the availability of cereals which are the focus of the PDS system and many 'right to food' advocates. The paper also suggested that basic public health information, nutritional knowledge and availability about nutritional foods may also play a role.[5]

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[1] Virmani (2007)
[2] IIPS (2007)
[3] Pruss-Ustin et al (2008)
[4] WHO 2009:11-12
[5] Though the improvement in public health has often been linked in the literature to declines in mortality, there are few if any academic articles linking public health to child malnutrition. For instance Bozoli et al

The current paper investigates the determinants of cross-country variation in mal-nutrition.

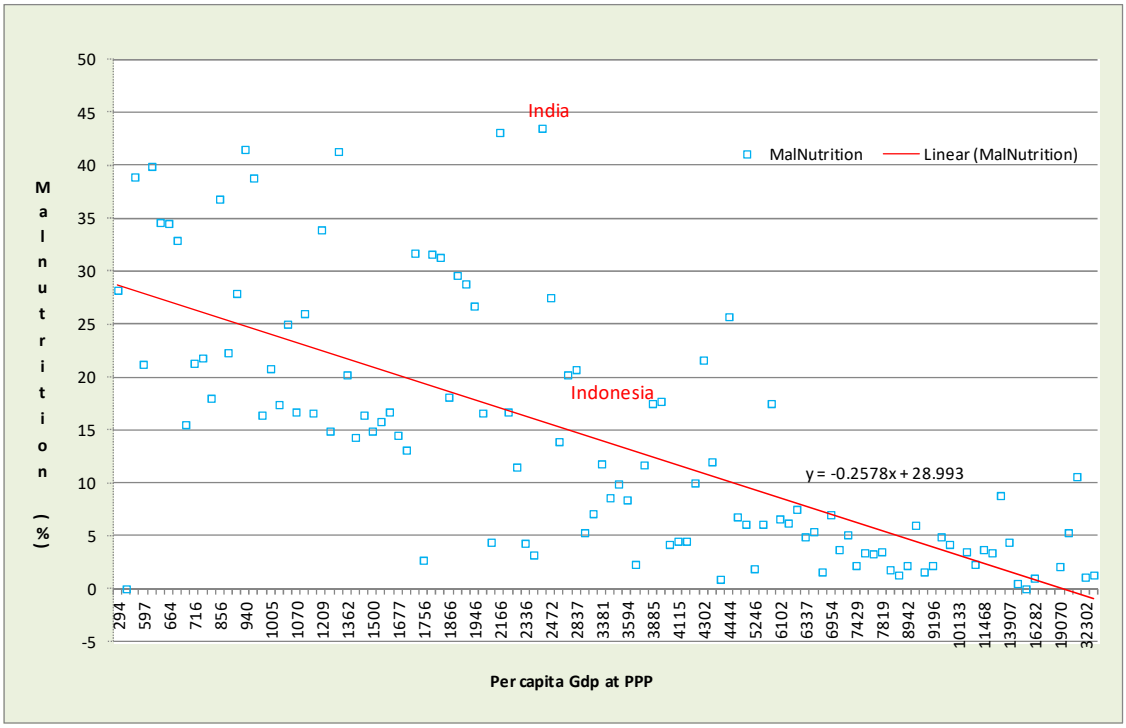
2 GLOBAL PERSPECTIVE

A cross country comparison of malnutrition, defined in terms of weight for age, shows that India is a clear negative outlier relative to its level of per capita income (Figure 1). India is, however, also somewhat of an outlier in terms of the World Bank's estimates of poverty using the standard $1.25 (in PPP) per day poverty line for all countries (Figure 2). This suggests that cross-country variations in malnutrition could be related to variations in poverty levels.

Virmani (2007) postulated three elements (sets of potential variables) to explain inter-state variations in malnutrition. Do these play any role in inter country variation? Figures 3 and 4 depict two of the elements in a cross-country perspective. India appears to have very poor sanitation for its per capita income level, but reasonably good access to improved water for its income level.

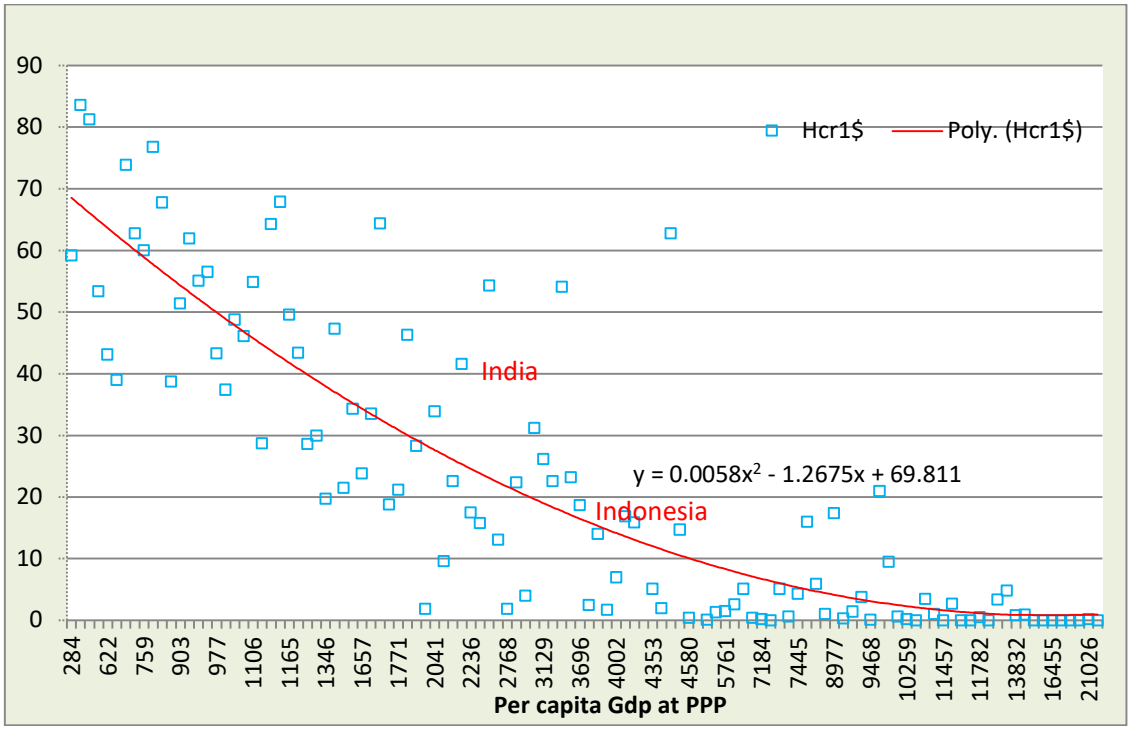
mention "net nutrition' and diarrheal disease as a negative factor in the introduction of their paper but there is no discussion of sanitation or clean drinking water in the rest of the paper

Figure 1: Malnutrition-Weight for age (% of children under 5 years)



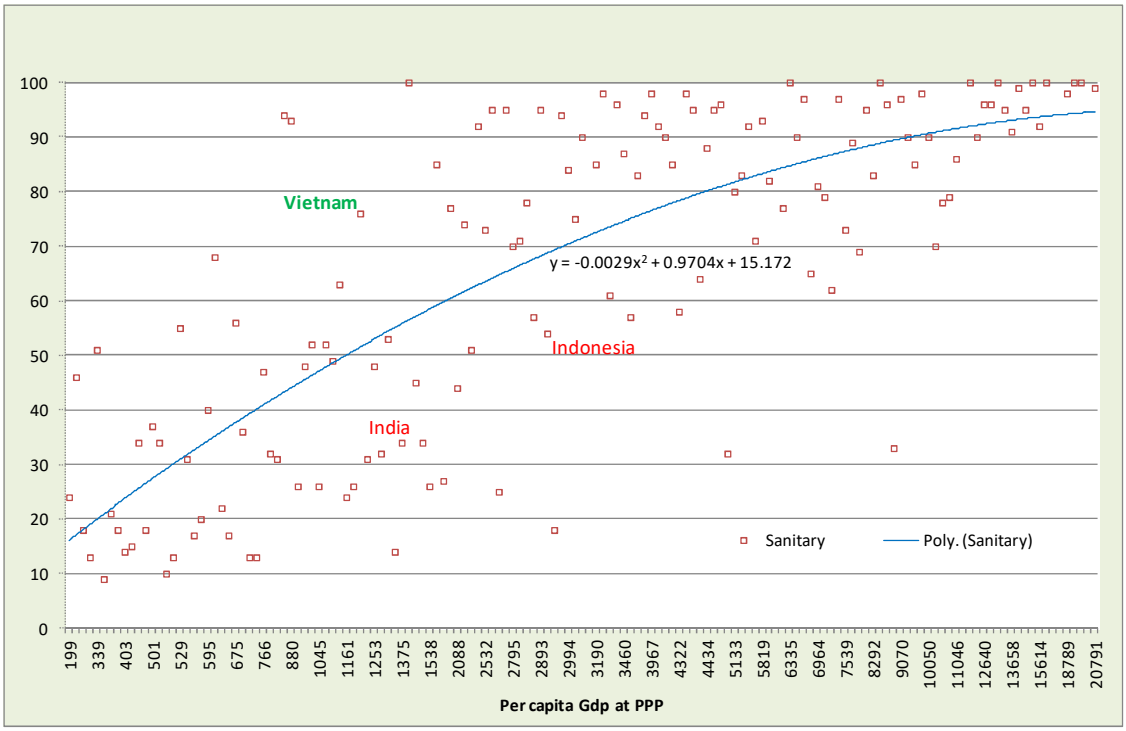
Source: Authors calculation based on World Bank, WDI 2012 data

Figure 2: Poverty headcount ratio at $1.25 a day PPP (% of pop)



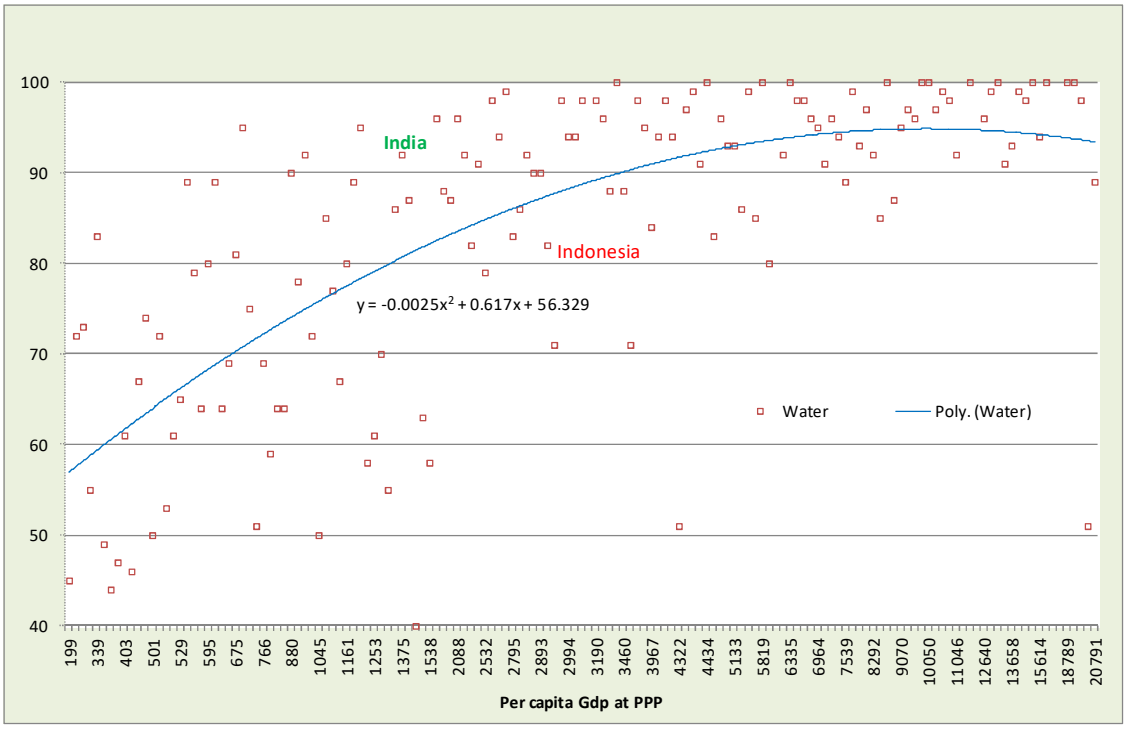
Source: Authors calculation based on World Bank, WDI 2012 data

Figure 3: Improved sanitation facilities (% of pop with access)



Source: Authors calculation based on World Bank, WDI 2012 data

Figure 4: Improved water source (% of population with access)



Source: Authors calculation based on World Bank, WDI 2012 data

3 HYPOTHESIS and EMPERICAL TESTING

Following Virmani (2007), we posit three different models for explaining cross-country variation in child malnutrition. The first, the base model (M1), represents conventional reasoning about lack of calories due to lack of income and ability to purchase adequate food (with particular focus on cereals). A more elaborate version of this model (M1b) would include more elements of nutrition such as major food groups (proteins) and micro-nutrients.

The second model (M2) is based on inadequacy of public health measures, resulting in prevalence of gastro-intestinal infections (even if they do not manifest themselves in a visible disease or ill health), that inhibit the absorption and use of food in the body. Even if enough food is available, the child may not be able to ingest or absorb it properly, resulting in under-nutrition.[6] A more elaborate version of this model (M2b) would include other diseases such as infectious diseases amenable to public health policy such as environmental sanitation, vector control and vaccination.

The third model (M3) relates public education and knowledge.[7] Information about personal hygiene and nutrition and appreciation of its importance could enable parents to take greater care against gastro-intestinal and other infections and to use more nutritious foods. Some of the relevant factors are the spread of education, the teaching of these issues in school and public health education campaigns through the media.

M 1: Malnutrition = F (Poverty, Calorie deficiency)

Malnutrition is measured here by the percentage of children under who are more than two standard deviations from the international norm for weight for age.[8] Poverty is measured in terms of the head count ratio and the poverty gap. There are two global poverty lines: $1.25 and $ 2 per person per day measured at purchasing power parity. The best available cross-country measure of Hunger or Food deficiency is in terms of average calorie deficiency relative to a norm.

M2: Malnutrition = F (Improved Sanitation, Clean Drinking Water)

[6] Bozzoli et al (2007) refer to food intake as 'gross nutrition' and 'net nutrition' as 'determined not only by food availability, but by losses to diseases, most obviously diarrheal diseases.' (Introduction, page 4).
[7] Behrman et al (1988) conclude that mothers schooling has a "substantial and robust" effect on household nutrition.
[8] Height for age (stunting) and weight for height are other ways of measuring malnutrition.

Sanitation is measured by the proportion of a country's population with access to improved means of sanitation. Water is correspondingly the per cent of population with access to improved sources of drinking water.

M3: Malnutrition = F (Primary Education, Public education/information)

Primary education is the completion rate or per cent of children completing primary education. A similar measure for the completion rate for females is also obtained and used.

All cross country data is obtained from the World Bank, World Development Indicators data set accessible to the public on the World Bank website. Models 1 and 2 are tested individually as well as separately to see which is more valid in a cross-country context. Model 3 is not tested separately as the cross-country data is not available on the information variables.

The results are presented in Table 1. Both model M1 and M2 are found to fit the data well, though the adjusted R^2 for the latter (0.52) is higher than for the former (0.44). However, when the variables from the two models are included in a single equation, the variables from M1 (the poverty rate and the average calorie deficiency) are not significant.[9] Both variables from M2, access to improved sanitation and water remain significant at the 5% and 10% level respectively. We therefore select M2 as the base model and include the knowledge variable primary education from model M3. This variable is found to be significant at the 1% level. The primary completion rates for females are however, more significant than for both male and female together.

These results are consistent with the results found in Virmani (2007) for inter-State variation in malnutrition rates within India.

[9] Preliminary analysis/estimation of stunting of children under age 5 confirms the non significance of calorie deficiency variable. However, the poverty rate remains significant in the combined model.

Table 1: Regression Coefficients

Dependent Variable	Malnutrition(weight for age) in children under 5				
Independent Variables	M1	M2	M1-2	M2-3a	M2-3b
Poverty: HCR $1.25 a day (%)	0.245***		0.06		
	(0.057;4.3)		(0.07;0.9)		
Hunger: Calorie defficiency (K cal)	0.044**		0.03		
	(0.022;2.0)		(0.02;1.3)		
Access to Improved Sanitation (%)		-0.16***	-0.13**	-0.15***	-0.14***
		(0.04; -3.7)	(0.05; -2.4)	(0.04; -3.7)	(0.04; -3.6)
Acess to improved Water sources(%)		-0.25***	-0.16*	-0.17**	-0.15**
		(0.08; -3.1)	(0.10; -1.7)	(0.07; -2.4)	(0.07; -2.1)
Primary completion rate(%)				-0.1**	
				(0.05; -2.2)	
Primary completion rate Female(%)					-0.12***
					(0.04; -2.7)
Constant	-1.8	44***	26.7***	44.8***	43.5***
	(4.2;-0.4)	(4.8;9.3)	(9.9; 2.7)	(3.9; 11.5)	(3.8; 11.5)
R^2	0.45	0.53	0.53	0.62	0.63
R^2 (adjusted)	0.44	0.52	0.51	0.61	0.62
	(9.1)	(8.4)	(8.5)	(7.2)	(7.1)
F statistic	37	53	56	56	58
	0.0000	0.0000	0.0000	0.0000	0.0000
No of observations	93	98	93	106	106

Note: Standard deviation and t statistics in bracket (SD; t stat). Significance at the 1% (***), 5%(**) and 10% (*) level is indicated by the number of stars.

4 CONCLUSION

Our results show that the quality of public health, as measured by variables such as access to better sanitation and improved water sources, is an important factor in explaining cross-country variations in the prevalence of malnutrition. It indicates that improvements in environmental sanitation could have a significant impact in reducing malnutrition in India. It also confirms the importance of primary education, particularly of females, in helping spread information and knowledge about personal hygiene, sanitation and nutrition. Much more could however be done through

appropriate school curricula and media campaigns to promote public health education.

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6 APPENDIX: Problem Mongering or Problem Solving

The hunger index conflates child mortality, Child malnutrition and Average Calorie deficiency (population) and calls it an Index of hunger. Using the per capita income as a benchmark, we see that India's under-five child mortality rate is exactly what we would expect for its level of per capita GDP (figure A1). This is also true of life expectancy at birth (figure A2) and maternal mortality (figure A3). The proportion of households that are hungry (as perceived by survey respondents were in 2004-5, 1.9% to 2.5% of households. The hungry are likely be dispersed and isolated (aged, disabled, mentally ill, living in inhospitable or remote areas) where even the Public Distribution system does not reach. For instance West Bengal State that is one of the highest and most effective users of the Central PDS system, also had the highest proportion of hungry household among all the States in India (Virmani (2007)). Thus malnutrition in India does not appear to have much to do with either food availability in terms of cereals (Deaton and Dreze(2009)), or with hunger as perceived by people (NSS Consumption Surveys - question on hunger).

Figure A1: Child mortality rate, under-5 (per 1,000 live births)

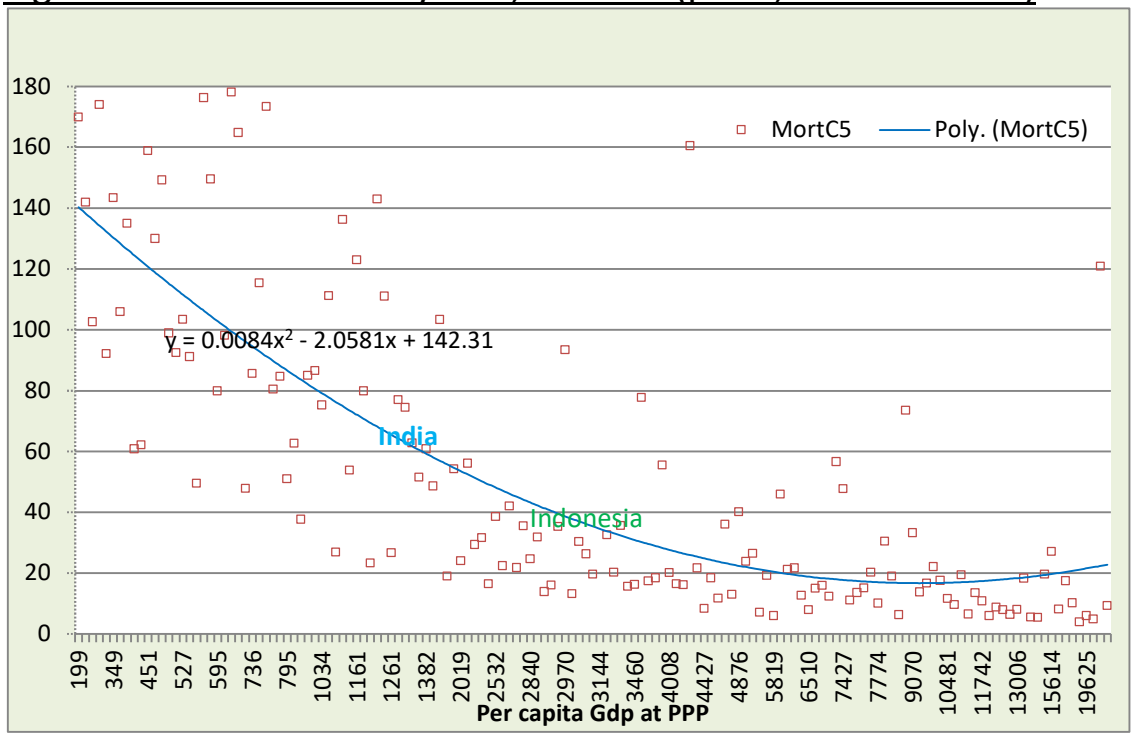


Figure A2: Life Expectancy at Birth

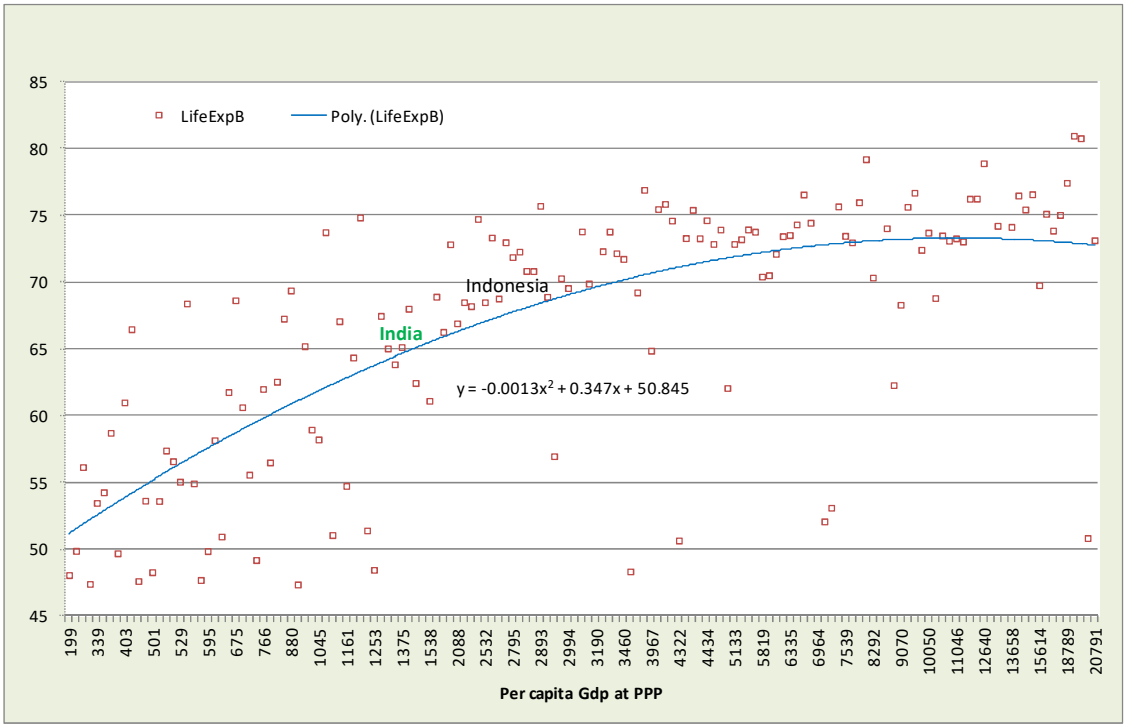
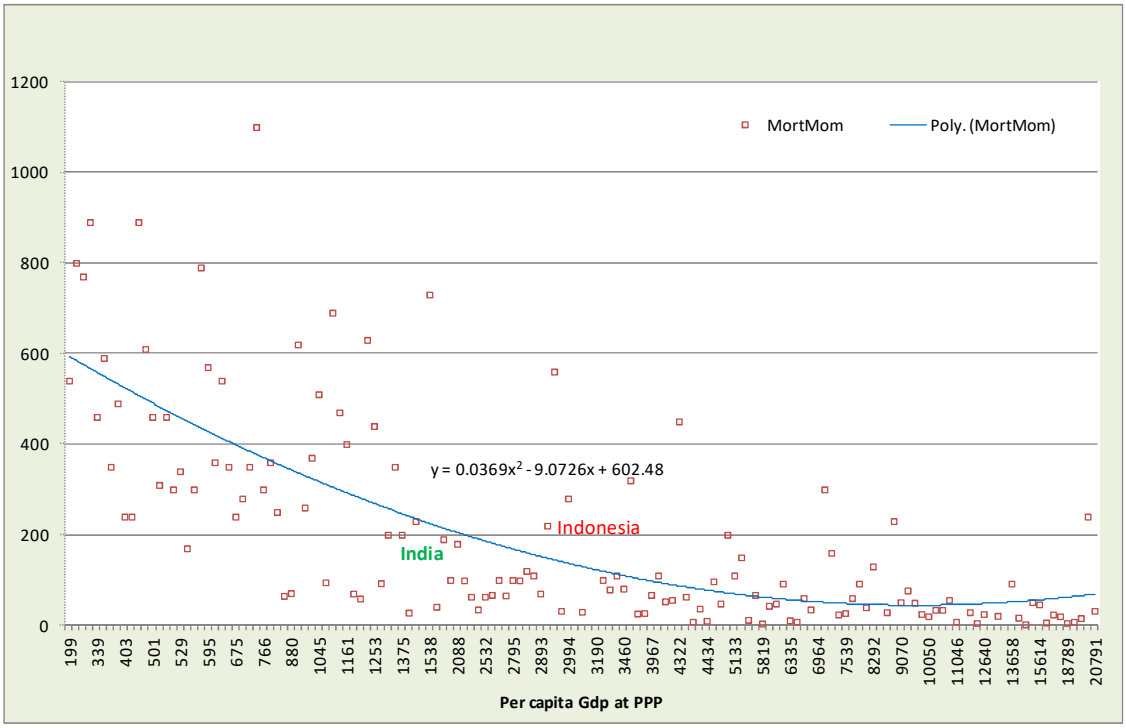
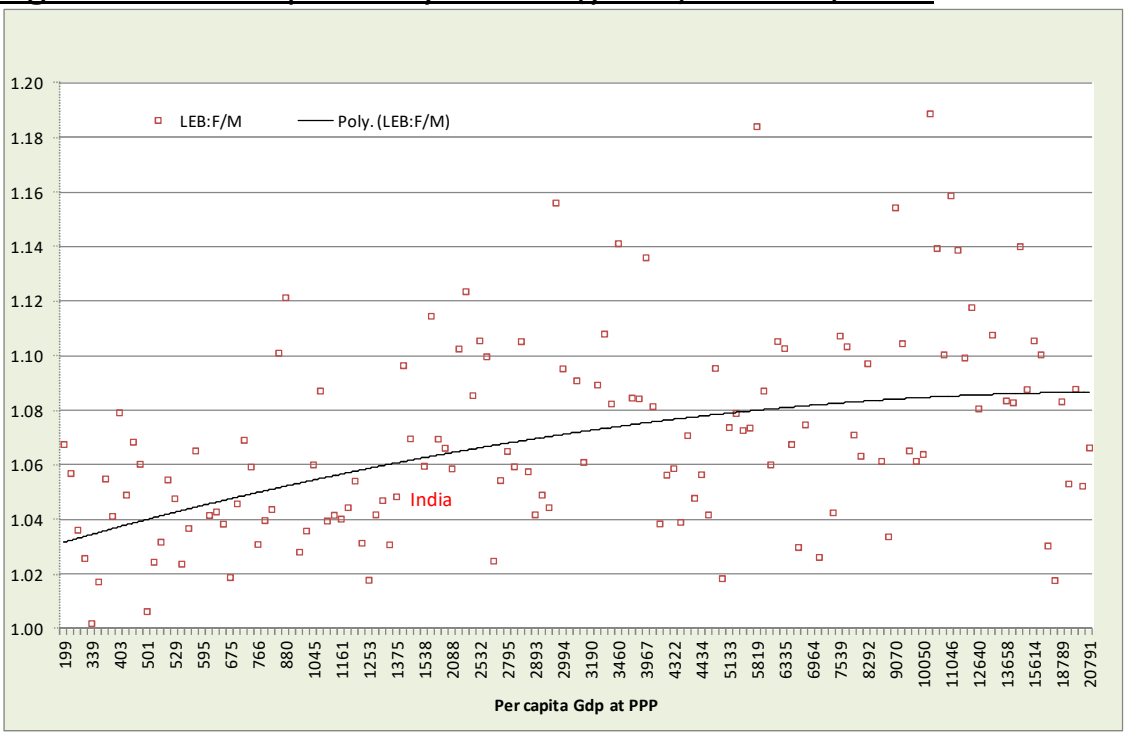


Figure A3: Maternal Mortality Ratio (per 100,000; modeled)



There does, however, appear to be a problem of female (gender) discrimination, reflected in the imbalance between female to male life expectancy at birth (figure A4) that could be caused by actions (e.g. less effort in treating disease/ill health in female children) that also affect malnutrition in female children.

Figure A4: Life Expectancy at Birth(years): Female/Male



Similar comparative graphs show that India's primary education completion rate (fig A5) and the ratio of female to male completion rates (fig A6) is better than expected for its level of per capita GDP. Consequently traditional comments about India's abysmal record in primary education and the bias against girl children in schooling are somewhat outdated. However, it also shows that comparative graphs, even those with good benchmarking are helpful in drawing attention to real problems, but are not adequate for determining potential solutions.

Figure A5: Primary Completion Rate (% of relevant age group)

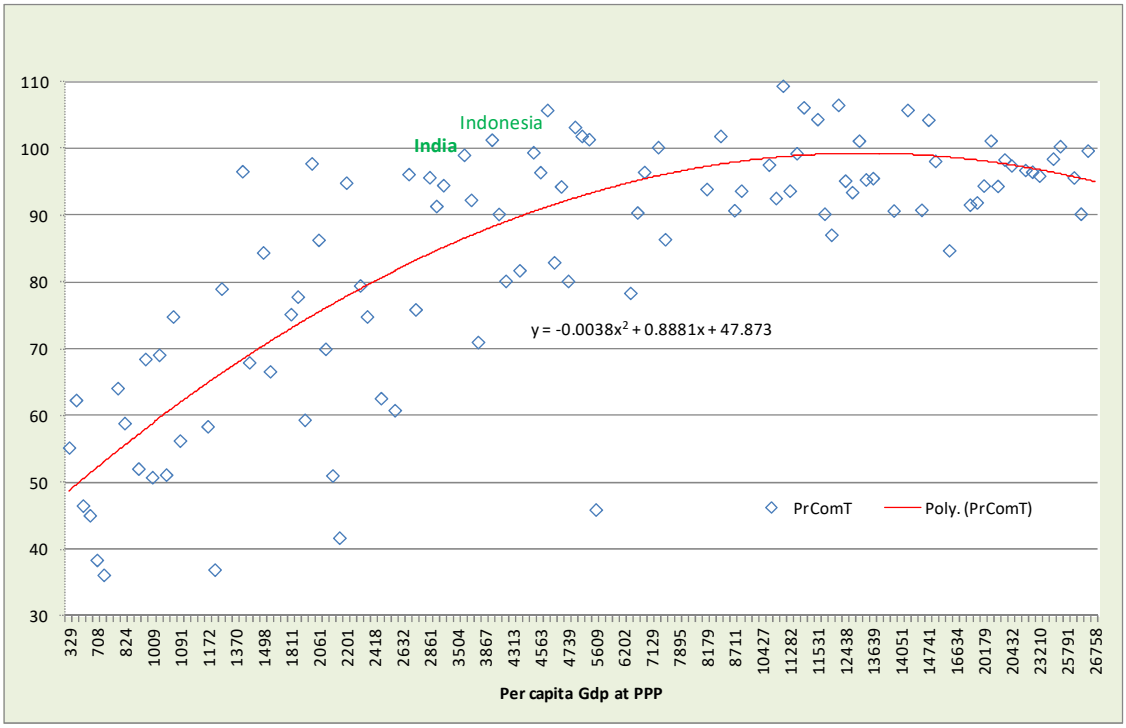
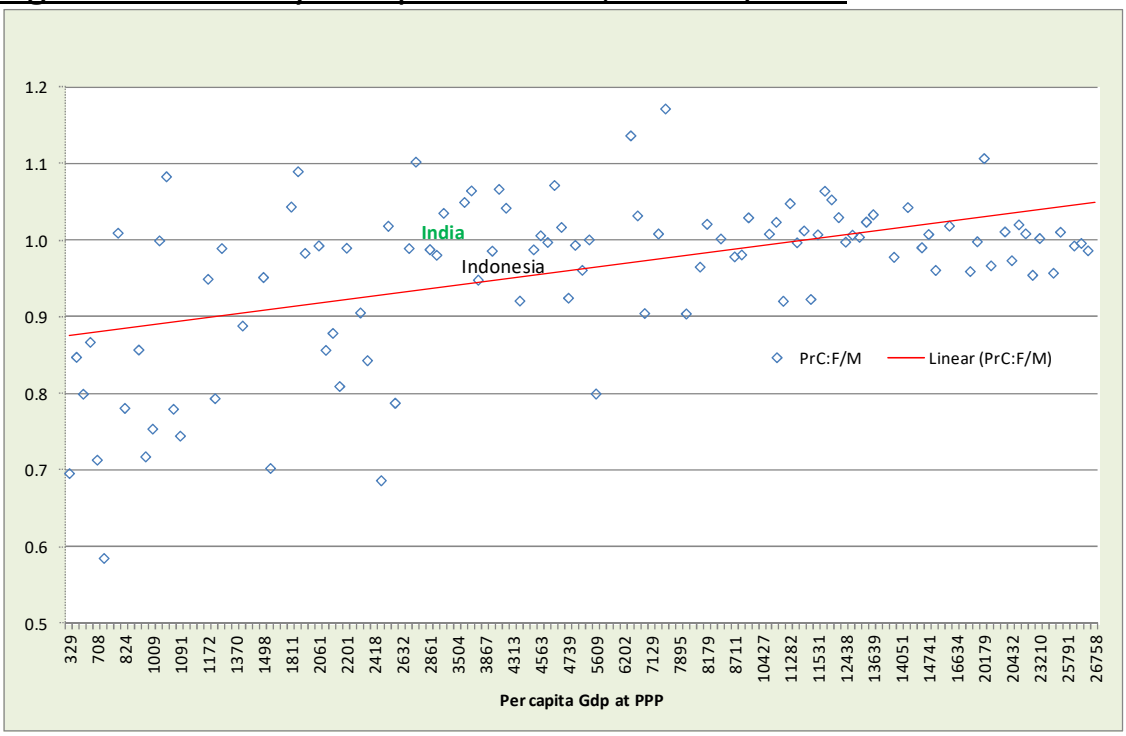


Figure A6: Primary Completion Rate, Female/Male



One of the interesting implications of bench marking social indicators against per capita GDP is to change the way we think about global policy on poverty and social services (health, education etc). From this perspective, there are two separate but perhaps interlinked dimensions of poverty (social development etc.):

(1) One is to determine the optimal trajectory for evolution of social services and social policy as countries move up the per capita GDP scale, and

(2) The dispersion of poverty, education, health etc around the per capita GDP benchmark. This requires an identification of the most important problem(s) for each country. Identifying potential solutions that have worked and ideas that have not worked and preparing a menu of policy options for addressing these issues.

In my view this would be a good direction for global development institutions to re-direct their thinking and approaches.