Research Paper

Multisectoral approach to nutrition in Pakistan

Muhammad Ali

ABSTRACT

The under-five stunting rate in Pakistan is one of the highest in the world despite rapid decline in poverty and open defecation over the years. To identify the determinants of childhood stunting in Pakistan, this study used a parsimonious regression model to quantitatively apply the UNICEF multisectoral nutrition framework to Pakistan using Demographic and Health Survey 2012–13 data. The econometric analysis shows that simultaneous improvements in determinants of nutrition are more likely to reduce malnutrition in Pakistan compared to improvements in individual components. Adequacies in 'food only' and 'health only' are the strongest determinants of height-for-age while adequacy in Water, Sanitation and Hygiene (Environment) alone does not have a robust relationship with height-for-age. Food has a much stronger and more robust correlation with height-for-age when it is combined with Environment. Under Adequacy Definition 1, children with access to all four dimensions are significantly taller than others. The results show that multisectoral interventions are more likely to be successful in reducing malnutrition as compared to isolated interventions targeting one of the determinants of malnutrition; this is especially true for interventions in Water, Sanitation and Hygiene.

Key words | malnutrition, sanitation and hygiene, stunting, WASH, water

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INTRODUCTION

Pakistan did not meet the Millennium Development Goal target to 'reduce malnutrition by half during 1990–2015'. WHO Child Growth Standards define moderate and severe wasting as 'Percentage of children aged 0–59 months that are below 2 SD from median weight-for-height' and moderate and severe stunting as 'Percentage of children aged 0–59 months that are below 2 SD from median height-for-age'. According to these standards, during 1990–2013 the percentage of underweight children aged 0–59 months decreased from 39% to 31% and the percentage of stunted children in the same age group decreased from 54.5% to 45%. However, currently Pakistan has one of the highest percentages of stunted children aged 0–59 months in the world (UNICEF 2015; Mansuri *et al.* 2018). The slow progress in reducing stunting in over 25 years calls for a deeper analysis into the determinants of malnutrition that should be the policy focus in stunting reduction programmes both at national and provincial levels.

Stunting is known to have long-term consequences for human welfare. In addition to its cognitive and economic productivity effects, stunting also has long-term effects on schooling and maternal reproduction (Dewey & Begum 2011). Since most of these effects are strongly related to the capacity and capabilities of the individuals in adulthood, the adverse effects of stunting are likely to transfer over generations. The commonly known primary cause of malnutrition among children is inadequate dietary intake; however, recent research has shown that targeting food security alone to reduce malnutrition might not be sufficient and that a multi-sectoral approach is needed where health and

doi: 10.2166/washdev.2018.122

environment are also targeted to reduce stunting. UNICEF (1990) proposed a multisectoral framework which identified three underlying determinants of nutrition: food security, environment and health, and child care practices. The framework goes beyond a unidirectional nutrition model which concentrates on food security and highlights the importance of synergies among different sectors that should be considered to improve nutrition outcomes. Skoufias (2016) quantified the UNICEF (1990) framework by analysing the correlation between stunting and the three underlying determinants, as well as their synergies, across different countries. His methodology proposes a parsimonious model to identify the potential 'binding constraints' in reducing malnutrition as well as the potential interactions and synergies among proposed determinants. This paper extends the work of Skoufias (2016) to analyse the determinants of nutrition status in Pakistan where, instead of three categories, the nutrition components are divided into four: food, child care, environment, and health. Previous studies on determinants of malnutrition in Pakistan lacked a systematic approach to understanding cross-linkages among determinants of nutrition that should be addressed together to reduce stunting. This study aims to fill this gap in the literature for Pakistan. In addition to the national outcomes, synergies are also explored for rural and urban settings, as well as for the children in the bottom 40 percentage and top 60 percentage of the household wealth distribution separately.

The rest of the report is structured as follows. The next section presents the state of stunting in Pakistan. Further sections cover the following: key components of multisectoral nutrition framework proposed by UNICEF (1990); the econometric methodology; exploration of the determinants of nutrition by population subgroups; the sectoral adequacies and their relationship with nutrition outcomes; and final conclusions.

THE STATUS QUO OF PREVALENCE OF STUNTING IN PAKISTAN

Stunting by geographical and population groups within Pakistan

To delve deeper into the prevalence of stunting in Pakistan, Figure 1 presents a set of charts to compare the distribution of prevalence of stunting across urban rural segments, regions and income groups. Figure 1 shows that stunting is more prevalent in rural areas of Pakistan than in urban areas (48% vs 37%). Despite the prevalence of stunting in rural and urban areas being noticeably different, the urban rate of stunting is still quite high in absolute terms and has reduced only by about four percentage points since 1990–91. Stunting in urban areas was 40.7% (DHS-Pakistan 1992). Distinguishing among regions, Khyber Pakhtunkhwa and Punjab have lower stunting rate than national average (41% and 40% respectively) while Sindh has a significantly higher percentage of stunting than the national average (57%). Islamabad had the lowest rate of stunting among regions due to its unique population composition. The estimate for Baluchistan needs to be interpreted with caution as only 41% of the measurements were valid in the Demographic and Health Survey for Baluchistan. With respect

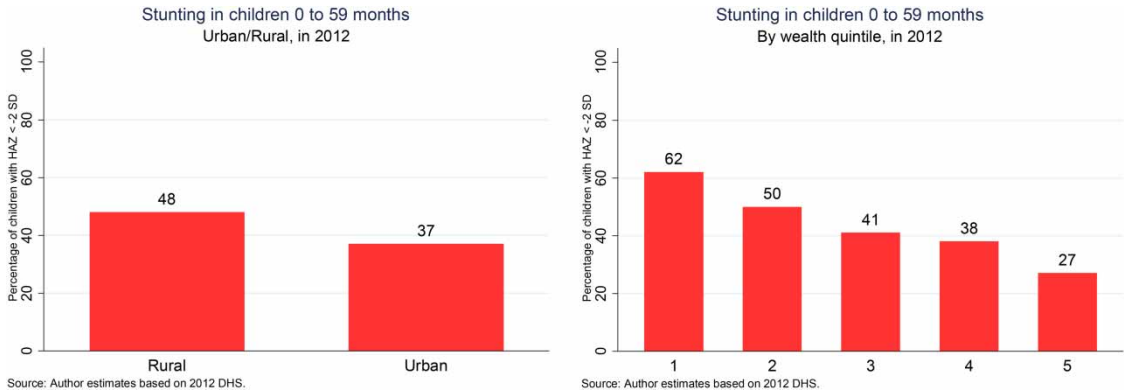

Figure 1 | Prevalence of stunting in Pakistan by geographical and population groups.

to the income groups, the rate of stunting appears to have negative correlation with the wealth quintiles. In particular, 56% of the children in the Bottom 40% and 36% in the Top 60% were stunted, showing that children of the poor segment of the society are more likely to be stunted.

MULTISECTORAL NUTRITION FRAMEWORK

The UNICEF (1990) multisectoral nutrition framework classifies the causes of malnutrition into three hierarchical categories: the immediate causes, the underlying causes and the basic causes. The main objective of the framework is to draw attention to the multitude of factors other than dietary intake that could be related to malnutrition. For this purpose, underlying causes of malnutrition are grouped into the three categories: (1) inadequate household food security, (2) inadequate care and feeding practices and (3) unhealthy household environment and inadequate health services. For the present analysis, the framework has been extended by separating health- and environment-related causes, where Water, Sanitation and Hygiene (WASH) is used as a proxy for a healthy environment. This extension allows for a comprehensive evaluation of WASH-related indicators and their relationship with malnutrition. Figure 2 shows the multisectoral nutrition framework used in the rest of this analysis. The hierarchy of causes follows a bottom-up structure where basic causes lead to underlying causes followed by immediate causes that eventually result in both short-run and long-run consequences for human abilities. This analysis focuses on underlying causes and the first component within underlying causes is access to adequate food security. However, due to lack of data availability on food security, the immediate cause of food 'inadequate dietary intake' is used in the analysis instead. The second component of underlying causes of malnutrition is access to adequate care which measures the ability of the primary caregiver to provide a safe and appropriate environment for the child to grow and develop. An ideal measure of access to adequate care would include children's caregivers' (1) knowledge, practices and beliefs regarding childcare, (2) health and nutritional status, (3) mental health, stress level

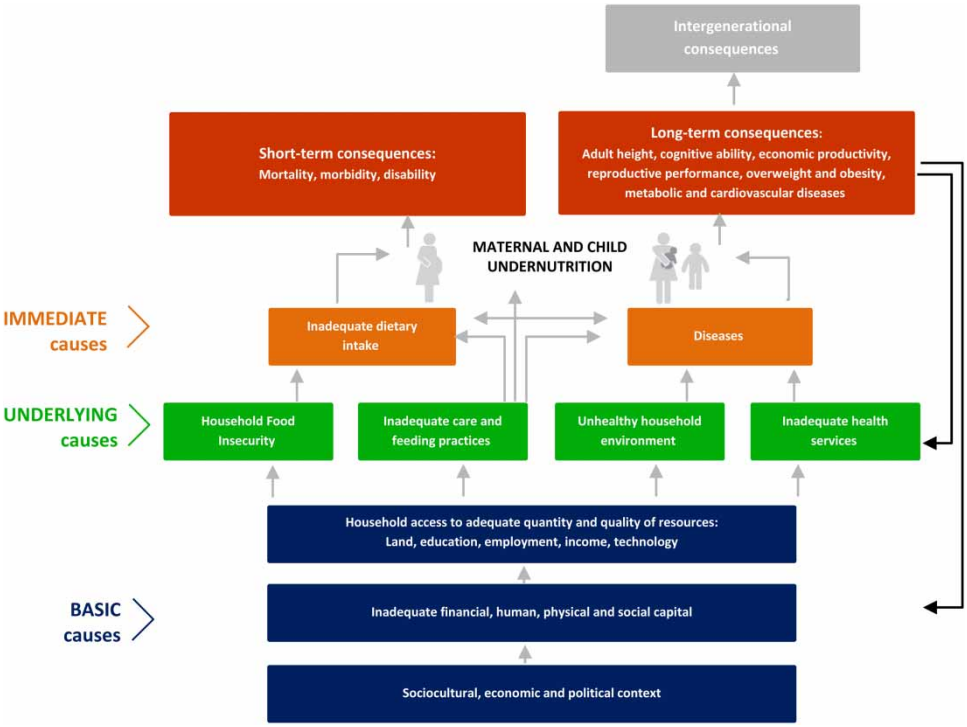

Figure 2 | Determinants of malnutrition. Source: Adapted from UNICEF's *Approach to Scaling-up Nutrition for Mothers and their Children*. June 2015. p. 09. which is based on UNICEF (1990).

and self-confidence, (4) autonomy and control of resources, (5) workload and time constraints, (6) social support received from family and community.

The third component is access to adequate environment (in our case, WASH access). This dimension measures children's exposure to pathogens in the physical environment where they live. The measure is based on adjusted definitions adopted by WHO/UNICEF Joint Monitoring Programme (JMP) as part of monitoring the Sustainable Development Goals that include components on: (1) access to improved drinking water; (2) access to improved sanitation; (3) adequate hand washing practices; (4) access to adequate healthcare. The fourth dimension measures the child's access to skilled medical care to minimize the effects of illness and preventively address health issues, especially those linked with malnutrition, such as diarrhoeal diseases. The measure encompasses the availability and use of healthcare services for pre-natal, birth and post-delivery care including vaccinations.

ECONOMETRIC METHODOLOGY

Following Skoufias (2016), a parsimonious regression model was used to analyse the relative importance of four broad determinants of nutrition, as identified in the previous section, as well as synergies among them if any. In principle, the model determines the differences in mean height-for-age among children with access to only one or more of the four nutritional dimensions. The key difference between the approach used by Skoufias (2016) and the one used in this study is that environment and health adequacies are considered separately here instead of as a joint measure of adequacy in environment and health.

The following econometric specification is estimated:

$$\begin{aligned} HAZ_i = {} & \alpha + \beta_1 F + \beta_2 C + \beta_3 E + \beta_4 H \\ & + \gamma_1 F \times C + \gamma_2 F \times E + \gamma_3 F \times H + \gamma_4 C \times E \\ & + \gamma_5 C \times H + \gamma_6 E \times H + \gamma_7 F \times C \times E + \gamma_8 F \times C \times H \\ & + \gamma_9 C \times E \times H + \gamma_{10} F \times E \times H + \gamma_{11} F \times C \times E \times H + \epsilon_i \end{aligned} \quad (1)$$

where HAZ_i is the Height-for-Age Z-scores for the child i, and F, C, E and H denote access to the four adequacies, for each child i. Namely, F is 1 when the household is adequate in food and is 0 otherwise; C is 1 when the household is adequate in care and is 0 otherwise; E is 1 when the household is adequate in environment and is 0 otherwise; and H is 1 when the household is adequate in health and is 0 otherwise. The fundamental difference between Equation (1) and Skoufias (2016) is that instead of grouping E and H together, Equation (1) separates them. It is also important to keep in mind that there are no additional control variables used in the regression because the objective here is simply to compare mean values in HAZ among children in different sub-groups defined by the extent to which they have access to one or more of the components.

COMPONENTS OF NUTRITION

The data used for the estimation of the above-mentioned econometric model is taken from the Demographic and Health Survey of Pakistan 2012–13 (DHS-Pakistan 2013). The Demographic and Health Survey is the only nationally representative survey with information on aspects of the four nutrition dimensions as well as anthropometric measures for 2012–13.

Adequacy in food

> '*Food adequacy is a concept that includes three distinct components: (1) that all nutritional needs should be satisfied, both in terms of energy and all other essential nutrients; (2) that foods consumed should be both safe and palatable, and; (3) that the types of foodstuffs commonly available should be acceptable within the prevailing food culture*' (Oshaug (1994) as cited by Ruel *et al.* (1998)).

The above definition of food adequacies is quite comprehensive but it is difficult to quantify all aspects of this definition. Given the data at hand, it is possible to construct a *minimum acceptable diet* indicator for children. For children under the age of 6 months, the only acceptable diet is exclusive breastfeeding. For children 6 to 23 months it depends on their *Dietary Diversity Score* (*DDS*) and meal

frequency. The DDS is a measure of the nutritional quality of the food consumed. The WHO (2008) definition of DDS (for children under 24 months) is based on the consumption of seven food groups consumed during the past 24 hours. The seven food groups considered are: (1) grains, roots and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods including organ meats; (5) eggs; (6) vitamin A rich fruits and vegetables including orange and yellow vegetables; and (7) other fruits. In order to have a minimum acceptable diet, a child needs to have consumed from at least four of the seven food categories. Furthermore, breastfed children, between 6 and 8 months of age, need to have been fed solid food at least twice in the past 24 hours, and for children between 9 and 23 months, at least three times. For non-breastfed children from 6 to 23 months of age, the child needs to have been fed four times in the past 24 hours. The second component is *age appropriate breast feeding* for the first 24 months. According to WHO (2008) guidelines, children under 6 months of age should be exclusively breastfed and all children 6 to 24 months of age should be breastfed. The WHO also recommends that complementary feeding should commence at 6 months of age and all children between 6 and 8 months of age should be introduced to solid/semi-soft/soft foods (WHO 2008). A child fulfilling all the age-appropriate conditions is deemed to be adequate in food.

Food adequacy in Pakistan at the national level is presented in Figure 3. Only 37% of the children aged 0–5 months are exclusively breastfed. For children aged 6–23 months, only 13% consume a diverse diet while 45% receive the minimum number of feedings. A mere 17% of children aged 0–5 months consume a vitamin A rich fruit or vegetable while one-third of the children were reported to consume other types of fruit. About three-fourths of the children in the same age group consumed starch during the 24 hour recall period. About 18% of the children consumed flesh food while 26% consumed eggs. In the same age group, 13% consumed dairy products and 6% consumed legumes.

Adequacy in care

The care components are classified into two groups: (1) child specific and (2) mother specific. Among child-related components, the first component is early *initiation of breastfeeding*. That is, breastfeeding should have been initiated within 1 hour of birth (WHO 2008). Among mother's characteristics, firstly, mother's *literacy status* is considered which signals the mother's ability to read text to measure her ability to read instructions regarding child rearing and health care. Second, we include mother's *empowerment* to make decisions as measured by her ability to make decisions about her own health (either alone or jointly with someone else).

The percentage of children adequate in components of care at national level are presented in Figure 4. About one-third of the children received early breastfeeding while about 60% of the children aged 6–8 months received complementary feedings. About one-half of the women were empowered and about 39% were literate in the sample.

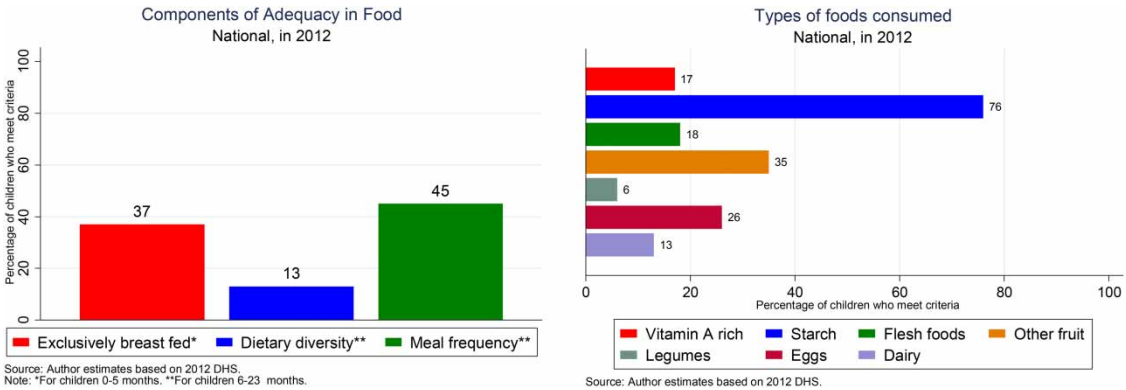

Figure 3 | Food adequacy: national.

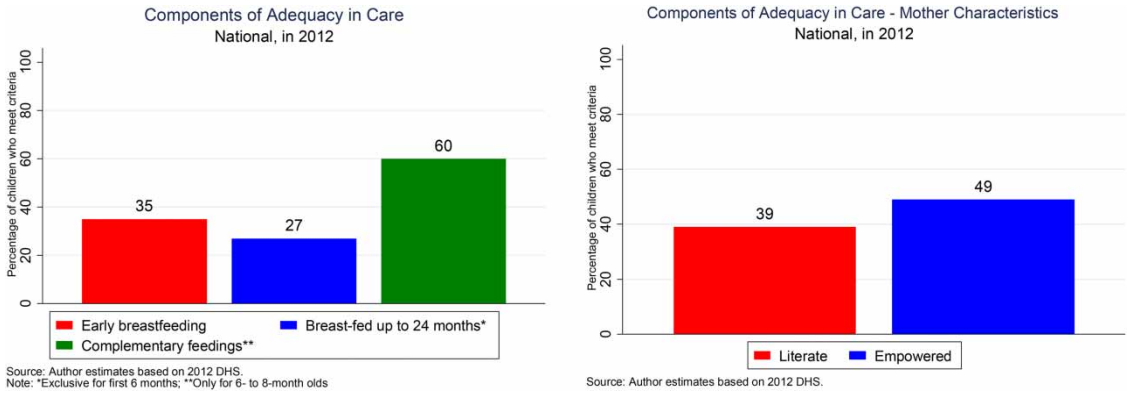

Figure 4 | Adequacy in care: national.

Adequacy in environment (WASH)

The environmental indicators measure the sanitary and hygienic conditions in the dwelling as well as the surroundings of the dwelling where the child lives. Components of adequate environment include access to drinking water and access to sanitation in the dwelling. As per the JMP classification, an improved drinking water source is considered to be one that 'protects drinking water from outside contamination, especially from fecal matter' (WHO/UNICEF Joint Monitoring Program for Water Supply & Sanitation 2015, p. 21). According to the JMP definition, *improved sanitation* effectively separates excreta from human contact, and ensures that excreta do not re-enter the immediate household environment (WHO/UNICEF Joint Monitoring Program for Water Supply & Sanitation 2015, p. 20).

About 56% of the population in Pakistan have basic sanitation (improved and non-shared) and handwashing facilities (Figure 5). The percentage is much lower for improved community sanitation (75% of households having basic sanitation in the neighbourhood) at 36% which shows that even when children have basic sanitation and handwashing facilities at home, they are still exposed to the unimproved sanitation facilities in the neighbourhood. About 87% have access to improved water source but only 26% apply any kind of purification treatment to the water before drinking.

Adequacy in health

The health indicators measure the use of health services or medical products to monitor the development of the child

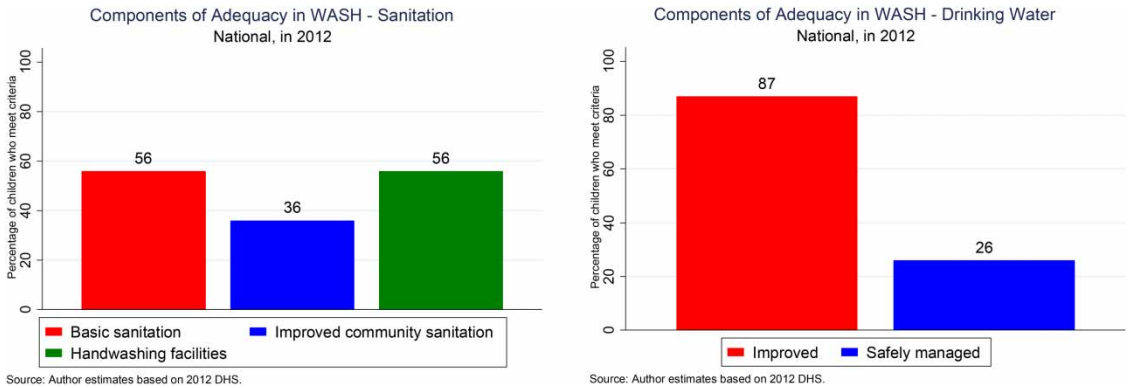

Figure 5 | Components of adequacy in WASH: national.

and to prevent and cure illness. These services cover prenatal, birth and postnatal care.

The first measure considered is the use of prenatal services. The WHO (2007) recommends at least four *prenatal visits* by a pregnant woman, therefore the adequacy in health uses four visits as the threshold. The second measure considered is *immunization status* following WHO's recommended immunization schedules for Pakistan (taken from WHO (2015)). The immunizations considered here are: BCG (at birth), DPT/pentavalent (at 2, 4 and 5 months), measles (at 9 and 15 months) and oral polio (at 2, 4 and 5 months). We allow for a 3-month leeway in immunization compliance. For example, all infants 0–2 months are considered in compliance with BCG regardless of actual immunization status. Only at 3 months will a child be considered to be non-compliant with the BCG immunization. Similarly, we apply the same 3-month window to all immunizations considered. Furthermore, the use of oral rehydration solutions for diarrhoea and antibiotics for pneumonia are measures often associated with adequate access to health services. However, given that information on such behaviours is only available for the subset of children who had the disease incidence in the previous 2 weeks, it significantly reduces the number of observations available hence these indicators are not included in the analysis.

Nationally, about 98% children had assisted birth while 51% mothers seek post-natal check-ups and the same percentage of children received recommended vaccinations (Figure 6). The percentage of women seeking prenatal check-ups is 38%.

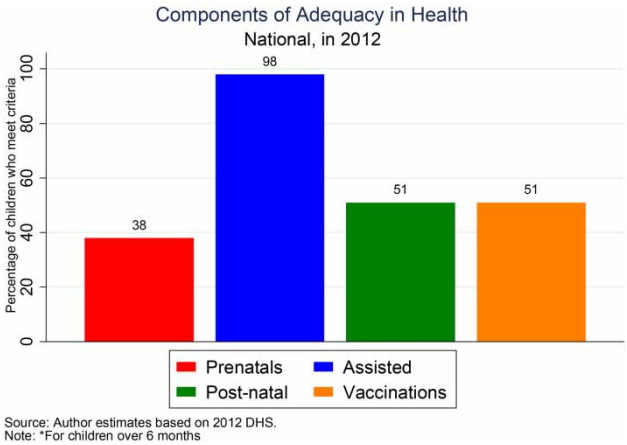

Figure 6 | Components of adequacy in health: national.

SECTORAL ADEQUACIES AND NUTRITIONAL OUTCOMES

A crucial step in the multisectoral nutrition framework is to define the adequacies. The summary of definitions is presented in Table 1. The definitions of Adequate Food and Health are straightforward and therefore they are kept constant in both overall definitions of adequacies. Definitions of Adequate Care and Environment vary under the broad definitions 1 and 2 to assess how definitions might affect our results.

Table 1 | Definitions of adequacies used in synergy models

	Definition 1	Definition 2
Adequate food		
Exclusive breastfeeding (0 to 5 months old) = 1	●	●
Dietary diversity = 4 out of 7 food groups for 6 to 23 months old = 1	●	●
Food frequency (6 to 23 months old) = dairy and min 4 times solid food = 1	●	●
Complementary feedings (6 to 8 months old) = had dairy and solids = 1	●	●
Adequate care		
Skin-to-skin = Contact with mother's breast within 1 h after birth = 1		●
Empowerment = Mother makes own health decisions (jointly or alone) = 1	●	●
Literacy = Mother can read whole or parts of a sentence = 1	●	●
Adequate environment (WASH)		
Improved sanitation = access to a flush toilet, a ventilated improved pit latrine, a pit latrine with slab or a composing toilet = 1	●	●
Improved water = piped into the dwelling, yard or plot, comes from a public tap or standpipe, comes from a tubewell or a borewell, comes from a protected well or spring, or is rainwater = 1	●	●
Hand washing facility = handwashing facility is available with water and soap = 1		●
Adequate health		
Vaccines = WHO recommended vaccination are up-to-date = 1	●	●
Four pre-natal visits = mother had at least 4 prenatal doctor visits = 1	●	●

For each adequacy measure, all the corresponding components need to be met in order for the child to be considered adequate in that dimension. That is, for both definition sets, only children who have a diverse diet and the minimum acceptable number of meals, are considered adequate in food, and the indicator variable is set to 1. Those with a diverse diet, exclusive breastfeeding, complementary feeding and minimum number of meals are considered adequate in food and the variable for Adequate Food is set to 1 and zero otherwise. The variables for the other Adequacies are constructed in the similar manner as per the definitions given in Table 1.

An extended elaboration of the adequacies is presented in Table 2 that shows the percentage of children in each exclusive adequacy category for the two sets of definitions at national level. Exclusive category means that, say, if a child is adequate in both Food and Health, the same child will not show up in 'Food only' or 'Health only', i.e. each category has an 'exclusive' set of children that do not overlap with other categories. Also, it presents the distribution of the adequacy categories for the urban and rural subsamples. The distribution of children in each of the adequacy combinations shows that apart from 'Adequacy in Environment only' and 'Adequacy in None', most components have representation in single-digits. The majority of the groupings with two or more dimensions represent between 1 and 10% of the sample. When interpreting the coefficient estimates below, it is important to keep in mind that some of the estimates are based on a very small number of children who meet all the required conditions. At national level, about 70% and 61% of the population is adequate in at least one dimension using Definition 1 and Definition 2, respectively. As far as the rural–urban differences are concerned, children in urban areas are more likely to be adequate in multiple dimensions. Due to exclusive grouping, children in rural areas are more likely to be adequate in Food only and Environment only (and inadequate in the other three).

RESULTS OF THE ECONOMETRIC ANALYSIS

This subsection presents the results of the econometric analysis. Table 3 presents the results for the national sample from estimating Equation (1), i.e. using exclusive

Table 2 | Distribution of children in adequacy groupings

	National (%)					
Adequate in	**Definition 1**	**Definition 2**	**Rural (%) Definition 1**	**Urban (%)**	**Rural (%) Definition 2**	**Urban (%)**
None	30	39	38	11	48	17
Food only	7	9	8	4	10	6
Care only	4	5	3	5	5	6
Environment only	19	11	20	16	12	11
Health only	4	5	4	5	4	7
Food and Care only	1	1	1	1	1	2
Food and Environment only	5	3	6	5	3	4
Food and Health only	2	2	2	1	2	1
Care and Environment only	6	4	4	8	3	7
Care and Health only	4	4	3	5	3	6
Environment and Health only	7	6	6	12	4	10
Food, Care and Environment only	1	1	1	2	1	2
Food, Care and Health only	1	1	1	1	1	1
Care, Environment and Health only	4	3	1	11	1	9
Food, Environment and Health only	4	4	2	9	2	10
All four	2	2	1	4	1	3
Total (%)	100	100	100	100	100	100

Table 3 | Correlation of HAZ with access to adequacies Equation (1) (exclusive): national

	Definition 1	Definition 2
Adequate in: Food only	0.588** (0.297)	0.622** (0.268)
Adequate in: Care only	0.26 (0.357)	0.102 (0.313)
Adequate in: Environment only	0.318 (0.225)	0.452* (0.267)
Adequate in: Health only	1.396*** (0.486)	1.503*** (0.436)
Adequate in: Food and Care only	0.876* (0.45)	0.846* (0.446)
Adequate in: Food and Environment only	1.310*** (0.35)	1.664*** (0.443)
Adequate in: Food and Health only	0.228 (0.444)	0.275 (0.419)
Adequate in: Care and Environment only	0.630* (0.356)	0.723* (0.426)
Adequate in: Care and Health only	1.410*** (0.365)	1.218*** (0.404)
Adequate in: Environment and Health only	0.973*** (0.25)	0.933*** (0.258)
Adequate in: Food, Care and Environment only	0.223 (0.247)	0.130 (0.237)
Adequate in: Food, Care and Health only	0.094 (0.813)	0.203 (0.781)
Adequate in: Care, Environment and Health only	1.299*** (0.397)	1.739*** (0.379)
Adequate in: Food, Environment and Health only	1.124*** (0.336)	1.078*** (0.349)
Adequate in: All four	1.434*** (0.465)	1.294** (0.538)
Constant	−1.902*** (0.157)	−1.858*** (0.144)
Observations	963	906
R-squared	0.077	0.093

Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

definitions. Here each estimate is the average difference in the average height-for-age for that particular set of adequacies in comparison to the average height-for-age for those without access to any of the dimensions of nutrition. The use of two definitions of adequacies allows for a sort of robustness check for the results. For this purpose, adequacies with significant coefficients over all definitions should be given highest importance in interpretation followed by the ones that are significant for one of the definitions.

The intercept of each model represent the average height of the children with access to none of the components. The size of the coefficient decreases as the definitions become less stringent showing that less stringent definitions accommodate more children in at least one of the adequacy groups.

In terms of access to only one of the components, access to adequate health and adequate food are the significant determinants of height-for-age regardless of the definitions used. The coefficient of Health is about twice has high as Food. More specifically, at national level, a child is on average between 1.4 and 1.5 standard deviations taller if they have access to adequate health, depending on the definition used, as compared to the ones with access to none of the four dimensions. Similarly, at national level, on average a child with access to adequate food is about 0.6 standard deviations taller than a child without access to any adequacies. Adequacy in Care only does not have a significant relationship with height-for-age and Adequacy in Environment only is weakly significant under Definition 2.

Among children adequate in more than one component, a child adequate in both 'Food and Environment' is 1.3 standard deviations taller (about double the difference compared to a child with access to adequate 'Food only'). A child with access to adequate 'Environment and Care' is 0.63 standard deviations taller under Definition 1 (under Definition 1, access to 'Food only' and 'Environment only' were insignificant). These results clearly show that combination of food interventions with environment and care interventions with environment are likely to have a stronger impact on child's height-for-age compared to the isolated interventions in these sections. Moreover, a child adequate in 'Environment and Health' is 0.97 standard deviations taller but the magnitude of the joint access is about two-thirds of the size of access to 'Health Care' only which is against the prediction of multisectoral nutrition framework and it shows weak complementarity between health and environment in Pakistan.

Among children who are adequate in three or more components, joint access to 'Care, Environment and Health' and 'Food, Environment and Health' clearly have a strong impact on height-for-age. Under Definition 2, environment includes handwashing in addition to water and sanitation which is why the coefficient for 'Environment only' is weakly significant under Definition 2 and magnitude of the coefficient

for 'Care, Environment and Health' under Definition 2 is even higher than the magnitude of 'Health only' which shows that handwashing plays a strong role in nutrition improvement. Under Definition 1, children with access to all four adequate nutrition dimensions are significantly taller than everyone else; however, under Definition 2, while the coefficient of four adequacies is significant and positive, its magnitude is smaller than some of the other adequacies. The results show that magnitude of the coefficients strongly depends on the definitions of the variables.

Table 4 presents the results by Bottom 40% (B40) and Top 60% (T60) groups as well as urban rural subpopulations.

Table 4 | Correlation of HAZ with access to adequacies **Equation (1)** (exclusive): B40/T60 and urban/rural groups

	By wealth		By urban/rural classification			
Adequate in:	**B40 Definition 1**	**T60**	**Urban Definition 1**	**Rural**	**Urban Definition 2**	**Rural**
Food only	0.656*	0.482	0.696	0.564*	1.100**	0.531*
	(0.378)	(0.421)	(0.571)	(0.332)	(0.506)	(0.303)
Care only	−0.252	0.321	0.993	−0.147	1.114**	−0.240
	(0.443)	(0.474)	(0.610)	(0.361)	(0.543)	(0.316)
Environment only	0.574	−0.174	−0.503	0.568**	0.182	0.571*
	(0.407)	(0.343)	(0.498)	(0.262)	(0.477)	(0.320)
Health only	1.116	1.236**	1.585**	1.163*	2.069***	1.124*
	(0.782)	(0.548)	(0.658)	(0.697)	(0.520)	(0.642)
Food and Care only	−0.090	0.831*	0.900	0.632	1.125**	0.553
	(0.188)	(0.445)	(0.557)	(0.811)	(0.489)	(0.809)
Food and Environment only	1.384**	0.929**	1.755**	1.071***	2.761***	1.139**
	(0.642)	(0.417)	(0.805)	(0.386)	(0.714)	(0.508)
Food and Health only	0.624	−0.430	−0.701	0.436	−0.499	0.457
	(0.429)	(0.833)	(1.169)	(0.458)	(1.135)	(0.429)
Care and Environment only	−0.704	0.362	0.439	0.664	0.582	0.899
	(0.912)	(0.434)	(0.522)	(0.535)	(0.477)	(0.717)
Care and Health only	2.008***	0.879*	1.393**	1.314***	2.016***	0.761
	(0.734)	(0.488)	(0.700)	(0.427)	(0.551)	(0.516)
Environment and Health only	0.816*	0.533	0.912*	0.884***	1.077**	0.842**
	(0.466)	(0.368)	(0.531)	(0.311)	(0.459)	(0.348)
Food, Care and Environment only	2.961	−0.259	−0.198	0.533	−0.100	0.455
	(2.220)	(0.335)	(0.467)	(0.354)	(0.382)	(0.350)
Food, Care and Health only	1.333***	0.166	−0.807	0.260	−0.480	0.341
	(0.204)	(0.786)	(0.510)	(0.932)	(0.484)	(0.898)
Care, Environment and Health only	0.752	0.859*	1.537***	−0.028	2.004***	0.920
	(0.815)	(0.475)	(0.559)	(0.922)	(0.515)	(0.932)
Food, Environment and Health only	1.313**	0.655	0.986	1.073***	1.188**	0.974***
	(0.583)	(0.424)	(0.619)	(0.263)	(0.591)	(0.273)
All four	3.718***	0.944*	0.379	2.514***	0.349	2.396***
	(0.685)	(0.527)	(0.576)	(0.536)	(0.690)	(0.552)
Constant	−2.100***	−1.432***	−1.723***	−1.927***	−1.925***	−1.848***
	(0.188)	(0.289)	(0.446)	(0.168)	(0.355)	(0.157)
Observations	379	584	407	556	372	534
R-squared	0.069	0.069	0.171	0.068	0.213	0.064

Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

For B40, apart from access to Health only, most of the components have stronger relationship with height-for-age as compared to T60. The combinations of 'Food and Environment', 'Care and Health', 'Environment and Health', 'Food, Care and Health' and 'Food, Environment and Health' have positive and significant correlation with height-for-age of children in the B40 category and their significance and signs are significantly higher than the ones for T60. The coefficient for the access to all four categories in B40 children is four times higher than their counterparts in the T60 population which shows that the B40 population has much more potential to gain from access to all four dimensions as compared to T60.

For urban/rural subgroups, regardless or the definition or urban/rural classification, adequacy in 'Health only' is a significant correlate of the height-for-age with higher coefficients for rural as compared to urban. Adequacy in 'Food only' and 'Environment only' are significant for rural household in both definitions. With respect to adequacies in more than one component, children adequate in 'Food and Environment only' and 'Environment and Health only' are taller regardless of the definition and urban rural classification. Finally, children who are adequate in 'Food, Environment and Health only' and adequate in all four components are taller if they belong to a rural household. The coefficient for adequacy in all four dimensions in rural areas is about three times as high as that of urban areas.

CONCLUSIONS

The under-five stunting rate in Pakistan is among the highest in the world. While countries such as Bangladesh and Afghanistan have been successful in reducing stunting rates in their countries, Pakistan does not seem to make any progress in this regard despite significant reduction in poverty over the years. This alarming situation calls for a comprehensive analysis on the determinants of stunting in Pakistan. The current paper aims to address this gap by identifying multisectoral determinants of nutrition in Pakistan and by testing whether improvements in multiple indicators are more rewarding than improving, say, food only. The multisectoral nutrition framework analysis for Pakistan shows that improvements in multiple determinants of nutrition are likely to bring greater improvement in nutrition status as compared to improvements in individual determinants. Among the four adequacy measures, adequacy in health care is the strongest determinant of nutrition in Pakistan at national level as well as rural–urban and B40–T60 subpopulation. In other words, improvements in health care of children (recommended vaccinations) as well as mothers (prenatal care) are likely to reduce stunting. At national level, adequacy in 'Environment only' did not have a robust positive effect across definitions, although it certainly has a strong positive and significant effect on height-for-age when combined with 'Health', 'Health and Care' and 'Food and Health'. However, 'Environment only' has a significant relationship with height-for-age in rural areas. Moreover, access to all four determinants of nutrition at the same time is much more rewarding for B40 and rural populations showing that poor and rural households have much more to gain as compared to their counterparts with improvements in underlying causes of malnutrition. The results of this study call for multisectoral interventions to achieve reduction in malnutrition in Pakistan especially for populations in the B40 and rural segments. The findings are especially important for interventions in WASH sector that do not address food and health deficiencies of the target population because isolated WASH interventions are less likely to have a significant impact on nutrition improvement.

While this analysis provides strong implications for policy, some limitations are apparent. The regression analysis was carried out using cross-sectional household data which provides coefficients of correlation and these coefficients do not necessary imply causation. Moreover, sample size of the estimations is relatively small for household level analysis. Replication on larger datasets could improve reliability of results. Lastly, definitions of adequacies in this analysis were restricted by data availability. A dataset that can better fit the theoretical definitions of adequacies, as explained in detail in this paper, could improve the results.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the feedback and technical support of Katja Vinha, Consultant at the World Bank Headquarters, Washington DC, USA.

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First received 13 August 2018; accepted in revised form 31 October 2018. Available online 23 November 2018