CHILDHOOD STUNTING IN TAJIKISTAN: QUANTIFYING THE ASSOCIATION WITH WASH FOOD SECURITY, HEALTH AND CARE PRACTICES

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Childhood Stunting in Tajikistan:
Quantifying the Association with WASH, Food Security, Health, and Care Practices

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Abstract: More than 20 percent of children under the age of 5 in Tajikistan are stunted. A large literature finds that stunting and undernutrition in early childhood are commonly the result of several contributing environmental, food, hygiene, and health-related factors. However, quantifying these interactions is usually not possible due to the difficulty of collecting sufficient data on each dimension in a single survey. To address this issue, we integrated the samples of two separate nationally representative surveys conducted simultaneously in Tajikistan in late 2016. This design allows analysis of the determinants of undernutrition in a unified framework. The results show strong associations between undernutrition and the number of food calories consumed, food diversity, access to water, sanitation and hygiene (WASH) services, access to health services, and care practices. Consistent with previous studies, the results also show that overlapping adequacies are associated with much reduced stunting risk. The findings suggest that: i) nutrition interventions addressing multiple risk factors may promote better outcomes than focusing on any single deprivation, ii) there is need for programs addressing food inadequacy, both in the form of the number of calories consumed and the diversity of food consumed, iii) promoting food adequacy alone is likely not sufficient to generate large reductions in malnutrition, and iv) interventions should predominantly focus on rural areas where risks of malnutrition are substantially higher.

Keywords: Tajikistan, Nutrition, Stunting, WASH, Health

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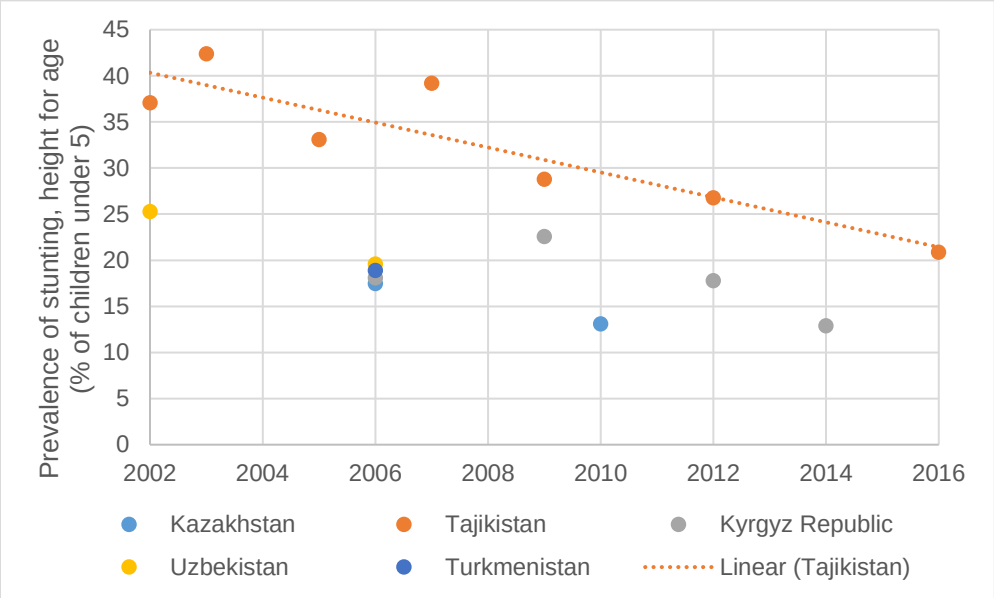
PART I – INTRODUCTION

Although the prevalence of childhood stunting in Tajikistan has declined over the past decade, in 2016 more than 20 percent of children under the age of five were stunted, the highest rate of any country in Europe and Central Asia (ECA) (Figure 1.1). The Government of Tajikistan has identified improving nutrition as one of the country's key goals in the current National Development Strategy,[1] and many development partners engage in efforts to reduce the prevalence of undernutrition.[2]

Figure 1.1 Prevalence of Stunting, 2002-2016



Source: World Bank staff calculations using World Development Indicators and UNICEF TNSS 2016

Stunting and undernutrition in childhood are commonly the result of many contributing environmental, food, hygiene, and health-related factors. The effects of inadequate nutrition during first few years of a child's life can be irreversible. Inadequate nutrition in childhood can lead to permanent cognitive impairment, and malnourished children are at much higher risk of death. Since independence, Tajikistan has enacted various laws and strategies relevant to improving nutrition.[3] The most recent systematic example is the Healthy Nutrition and Physical Activity Strategy 2015-2024, which focuses on curbing malnutrition and overnutrition.[4] Within the health sector, examples such as National Health Sector Strategy 2010-2020 and National Child and Adolescent Health Strategy 2010-2015

[1] Please see Appendix A for more details.

[2] While there are various programs to address nutrition, these are mostly pilots and has yet to be implemented at the national level. Among these programs are: (1) Micronutrient supplementation including multiple micronutrient powders (Sprinkles), Vitamin A and iron folic acid in 39 out of the 69 districts; (2) Management/Treatment of severe acute malnutrition primarily through the in-patient facility based approach but CMAM (community based management of acute malnutrition); (3) Management of moderate acute malnutrition in under-fives through targeted supplementary feeding programs; (4) Promotion of Breast Feeding and Optimal IYCF through the Baby Friendly Health Initiative; and (5) Salt iodization.

[3] Including: the Convention on the Rights of the Child (1993), "On health care" (1997), "On reproductive health and reproductive rights (2002), "On promotion of breastfeeding" (2006), "On salt iodization", and "On safety of food products (2012).

[4] http://extwprlegs1.fao.org/docs/pdf/taj170171.pdf

also include interventions related to nutrition. Outside of the health sector, high-level government planning documents such as National Development Strategy 2030 and Living Standards Improvement Strategy (as well as strategies under development such as Food Security Strategy and School Feeding Strategy) include nutrition components.

However, a review by Health Partners International and ICF International reveal that clear links between the strategies are not explicit and strategies appear to exist in isolation of each other.[5] With the establishment of Food Security Council of the Republic of Tajikistan in 2011, and the country's entry into the Scaling Up Nutrition (SUN) initiative in 2013, a more cohesive and multi-sectoral approach to nutrition has begun, but remains incomplete. In addition, limited empirical evidence is currently available regarding the potential drivers of undernutrition in Tajikistan. This study is intended to add to the knowledge available to practitioners and other actors involved in nutrition-related interventions in the country.

Due to the design of the survey instruments on which it is based, this study is also a modest improvement over existing approaches often used in the literature. Despite the crucial role of interactions among the contributing factors to malnutrition, it is uncommon for the data required for a full analysis of each of these dimensions to be collected in a single survey (Skoufias, 2016). While the most commonly used sources of data such as the Demographic and Health Surveys (DHS) or the Multiple Indicator Cluster Surveys (MICS) collect data for some key variables such as child care, environment, and health; these instruments usually lack detailed information on food security. In contrast, other specialized surveys collect information on dimensions of food security, but usually lack information on child nutrition and anthropometric measures (Skoufias, 2016).[6] Prior to this study, no such integrated data were available for Tajikistan.

This paper describes the results of an analysis of stunting and height-for-age z-scores for children under the age of 5 in Tajikistan. The analysis is based on nationally representative primary survey data collected in Tajikistan from October through December 2016.[7] The approach focuses on the association of undernutrition with indicators of food security, food diversity, environment, health, and care practices. Risks for undernutrition among children that are of specific relevance to the Tajikistan context are quantified and discussed in the following sections. The first statistical tests focus on height-for-age z-scores, finding particularly notable associations with adequate care practices and a safe WASH environment. However, having *simultaneous* access to adequate food, care practices, a safe environment, and adequate healthcare is much more strongly associated with higher height-for-age z-scores than individual adequacy indicators, suggesting strong synergies between them. In separate regression models focusing on stunting incidence (a binary variable), the results also show significant associations with food deprivations, care practices, and access to WASH facilities, both individually, and together. The findings are consistent with the Government of Tajikistan (GoT) stated key priorities in the National

[5] Support to Tajikistan Through a Review of the Alignment of Nutrition Policies and Plans and Development of Initial Stakeholder Mapping of Nutrition Activities

[6] The Living Standards Measurement Surveys (LSMS) surveys are exceptions in some specific cases. For instance, Brown et. al. (2017) make use the few cases in which LSMS surveys include anthropometric data to highlight the high frequency of stunting and undernutrition among households above the monetary poverty line, particularly in Sub-Saharan Africa. However, such data sources are rare.,

[7] A comprehensive report on the results of the National Nutrition Survey in Tajikistan 2016 is under review at the time of this writing. The final results will be made available by UNICF Tajikistan and the Swiss Centre for International Health providing greater detail on the trends and distribution of nutritional issues in Tajikistan.

Development Strategy 2030, and the intention to address environmental factors, food security, and addressing nutritional deficits related to essential vitamins.[8]

The remainder of this paper is organized as follows. Part (II) describes the expected relationship between the correlates of interest and malnutrition based on the international literature, and specific issues of importance in the context of Tajikistan. Part (III) describes the data and indicators used in the analysis, Part (IV) describes the statistical approaches used, and Part (V) provides the results and related discussion. Part (VI) concludes and provides recommendations for programming.

PART II – MALNUTRITION AND TAJIKISTAN

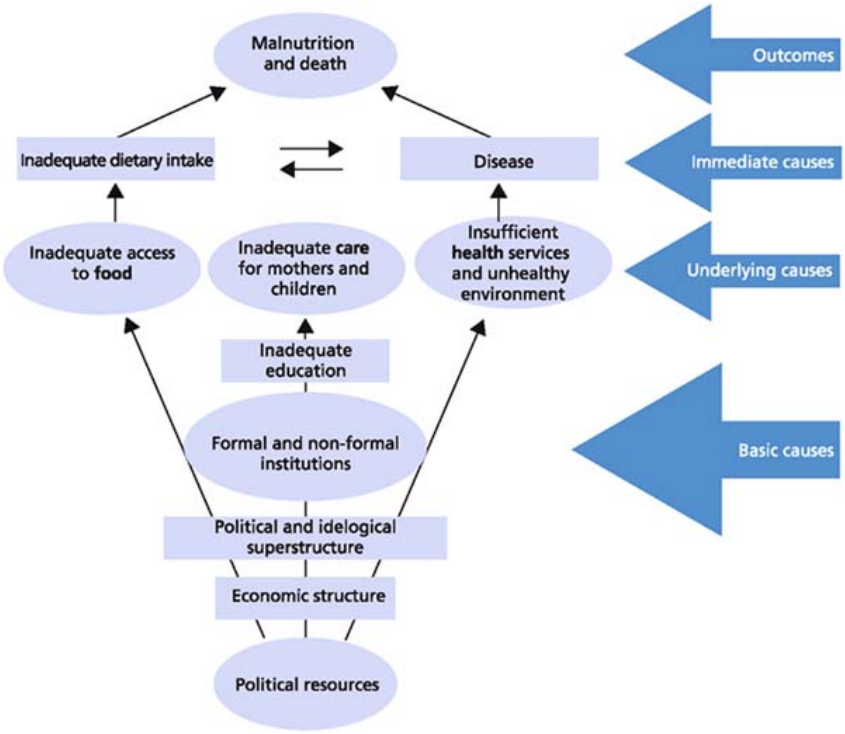
THE DRIVERS AND CONSEQUENCES OF MALNUTRITION

Development interventions to combat childhood malnutrition are often guided by the UNICEF Conceptual Framework on Nutrition. First set out in 1990, the framework identifies food security, environment, health, and child care practices as the main underlying determinants of child malnutrition (Figure 2..1). It also emphasizes the synergies and interactions among the different determinants, and the importance of jointly addressing the deprivations that together contribute to a greater risk of childhood malnutrition. Most international donor organizations, NGOs, and many governments have adopted and extended this framework, including the SUN initiative, which started in 2010 and has since been endorsed by 59 countries.

That the determinants of malnutrition are multi-sectoral is widely recognized in the literature. For instance, in an analysis of Demographic and Health Surveys (DHS) from many countries Fink *et al.*, (2010) find a strong correlation between access to improved water and sanitation and lower risks of diarrhea, child mortality, and stunting. The results suggest dire health consequences of lacking access to improved water and sanitation for children below 5 years of age in developing countries. In a recent study conducted in India, the provision of integrated water and sanitation was associated with both short-term and long-term reductions in diarrhea episodes (by 30-50 percent). Fink *et al.*, (2010) also find important complementarities between water and sanitation improvements. Another influential study from Galiani *et. al.* (2005) studies a water privatization scheme in Argentina and finds that improved access to clean water was associated with an 8 percent decline in child mortality (and a 26 percent decline in the poorest areas).

[8] See Appendix A for more detail

Figure 2.1. UNICEF Framework of Nutrition Determinants



Full eradication of open defecation at the village level in India, Indonesia, Mali, and Tanzania has been shown to lead to an increase in child height-for-age increases by about 0.44 standard deviations, if eradication is accompanied by health promotion campaigns inducing behavioral changes in sanitation. Health promotion campaigns were found to improve behavior by both convincing households to invest in in-home sanitation facilities and nudging increased use of those facilities (Gertler *et al.,* 2015).

The analysis undertaken in this paper builds on this existing work to assess the presence and magnitude of synergies among different suspected causes of malnutrition in Tajikistan. The analysis follows elements of the approach first adopted in Skoufias (2016), which examined the association between three main underlying determinants of nutrition (that is, food security, child care, health services and environment) with nutrition outcomes, both on their own and interactively. However, the survey integration design used here provides superior measures of several dimensions, especially those relating to food security. In the following analysis, more detailed information on the role and importance of food calories and diversity is leveraged beyond what has been possible based on standard MICS and DHS surveys.

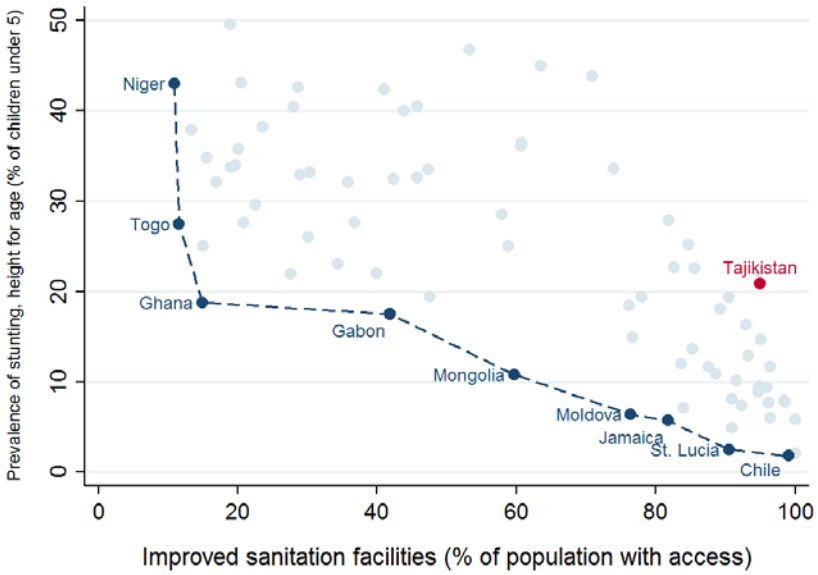
STUNTING AND MALNUTRITION IN TAJIKISTAN

Despite recent improvements, stunting rates remain exceedingly high in Tajikistan. The stunting prevalence was estimated at 29.3 percent in 2009[9], falling to 26.2 percent by 2012,[10] and as of 2016, more than 1 in 5 children (20.9 percent) under five years of age

[9] MSST (2009)
[10] DHS (2012)

still suffered from stunting. The prevalence of severe stunting stood at about 6.4 percent at the national level in 2016. The most recent data available suggests that Tajikistan suffers from the highest rate of stunting in ECA, and from a much higher rate than in other countries with similar levels of access to improved sanitation (Figure 2).

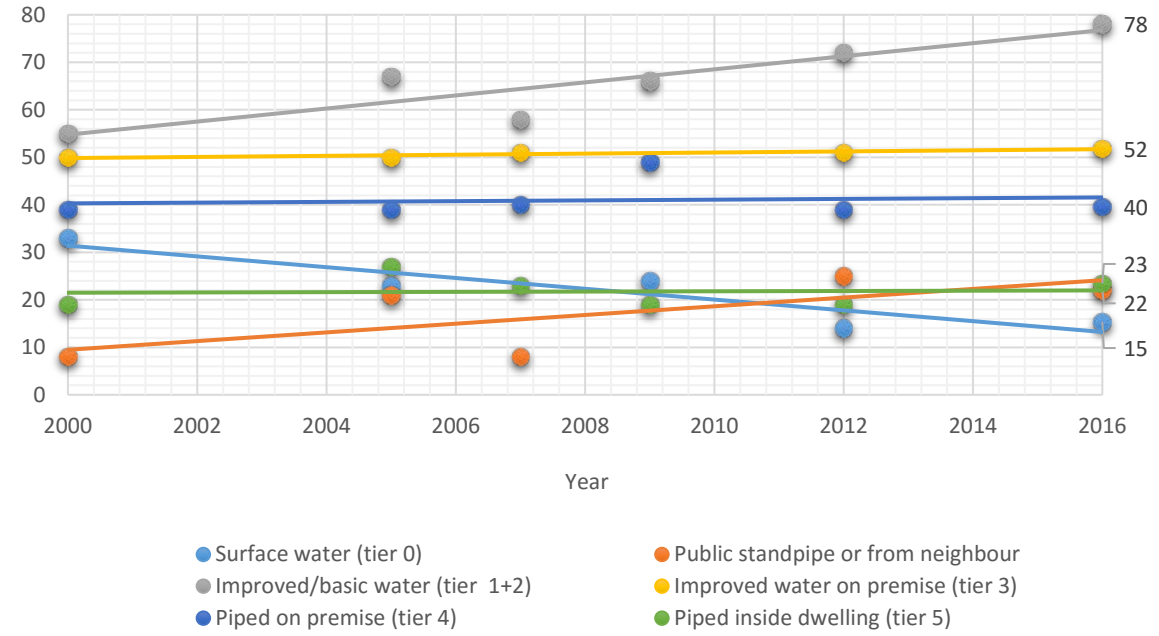
Figure 2.2. Access to Sanitation Facilities and Stunting Prevalence



Source: World Bank staff calculations using World Development Indicators and UNICEF TNSS 2016
Note: Data used is latest available between 2011 and 2016. Countries for which no data was available after 2010 not pictured.

Access to basic safe and reliable drinking water has been slowly improving in Tajikistan, from about 55 percent of households in 2000 to about 78 percent in 2016 (Figure 2.3). Because over 80 percent of the urban population already had piped water connections either on their premises or dwellings, most of the improvement seen since 2000 took place in rural areas. Improvements have been primarily driven by a decline in the share of households relying on surface water; most commonly, surface water is replaced with water from wells and pubic standpipes. The share of households with access to piped water on the premises of their dwelling has largely remained unchanged since 2000. Despite these recent improvements, access to high quality sources of water is unequally distributed, and rural areas remain far behind urban areas**.**

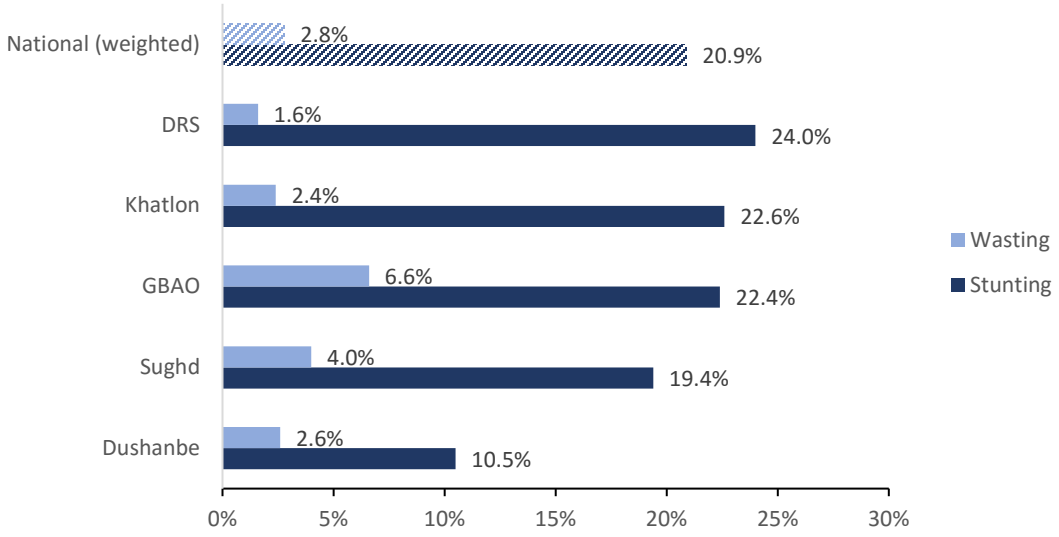
Figure 2.3. Trends in Multi-tier Levels for Household Access to Main Water Source, 2000-2016 (proportion of households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Tajikistan Living Standard Survey (TLSS) 2007, 2009; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016. Note: For the 2016 data point, tier 1+2 shows improved water.

The results of the Micronutrient Status Survey in Tajikistan (TMSS) of 2016, described in more detail in the following section, gathered information on the nutritional and micronutrient status of children and on the risk factors for deficiencies. Alongside stunting, other nutritional deficiencies such as wasting, anemia, and micronutrient deficiencies were found to be widespread among children in Tajikistan. Substantial spatial differences in deprivations across regions and between urban and rural areas were also identified. The highest prevalence of stunting was observed in the DRS region (24 percent), while the lowest was observed in Dushanbe (10.5 percent) (Figure **2.**2.4). Children living in rural areas were found to be significantly more likely to be stunted than children in urban areas. In 2016, no significant differences in wasting or stunting were observed when comparing genders.

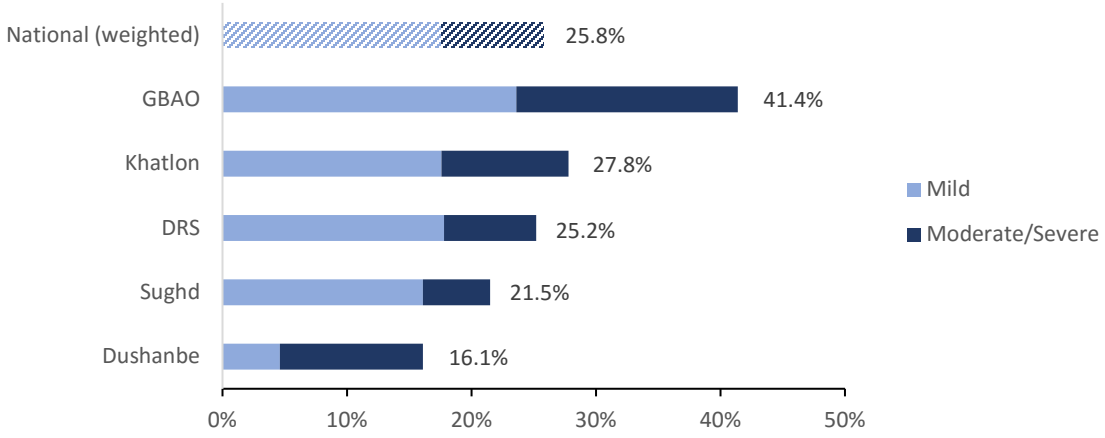
Figure 2.4. Wasting and Stunting by Region, 2016



Source: UNICEF TMSS 2016

Per the survey results, a large proportion of children in Tajikistan also suffered from anemia in 2016, most frequently found among children under 2 years of age. More than one quarter (26.4 percent) of children aged between 6 and 59 months had hemoglobin values below 11g/dl in 2016. Though a high prevalence in comparison to other countries, this represents a slight improvement over 2009, when the prevalence of anemia was estimated at 28.7 percent. As with stunting, there were strong regional disparities in the prevalence of anemia identified as well. Children located in GBAO were particularly likely to be anemic (41.4 percent) (Figure **2.5**). As is the case for wasting and stunting, no statistically significant differences in hemoglobin concentration were apparent between boys and girls in the 2016 survey.

Figure 2.5. Anemia by Region, 2016



Source: UNICEF TNSS 2016

A regional study in Central Asia published in 2005 found that micronutrient malnutrition cost around 1 percent of GDP (ADB, 2005). The TMSS 2016 suggests that many of these

deficiencies continue in Tajikistan. In particular, the survey identified critically high rates of iron deficiency, vitamin A deficiency, and vitamin D deficiency among children.

2016 survey estimates indicate that iron deficiency[11] affects most children (53.2 percent) in Tajikistan, and is particularly widespread in the Sughd region (66.4 percent). A UNICEF study on Integrated Young Child Feeding program found that iron deficiency is exacerbated by the practice of replacing breastmilk by black tea, which inhibits uptake of iron. Iron deficiency anemia impairs the cognitive development of young children and is irreversible (ADB, 2010).

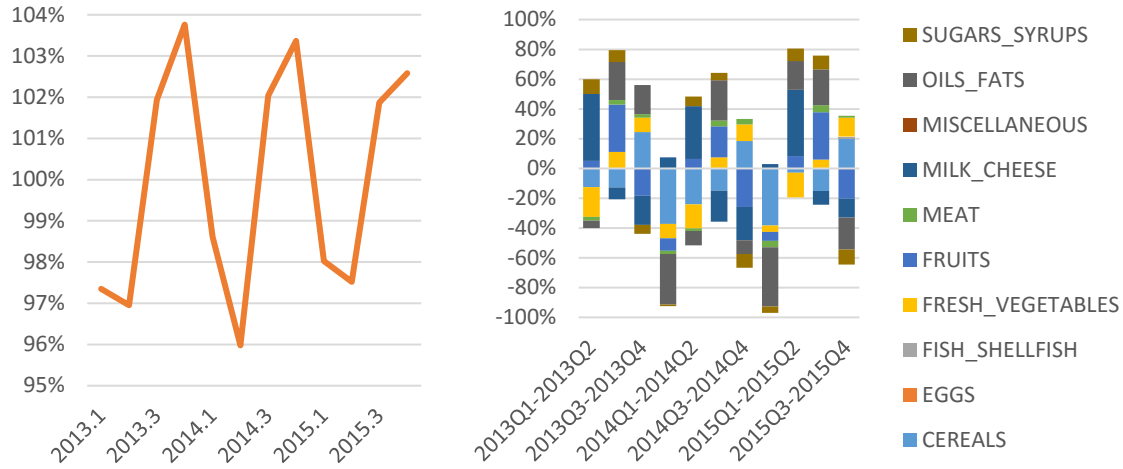
In 2016, 37 percent of children were found to have vitamin A deficiency (the deficiency is considered severe for 6.7 percent of children). This high rate of suggests that vitamin A deficiency among children is a severe public health problem in Tajikistan. Like iron deficiency, in 2016 severe vitamin A deficiency was most frequent identified in the Sughd region (42.9 percent). Vitamin D deficiency was also estimated to affect 12.4 percent of children (4.6 percent severely so).

Breastfeeding provides many health benefits for children and is a widespread practice in Tajikistan. The results of the 2016 survey suggest that more than 9 in 10 infants under 2 years of age (90.8 percent) were breastfed at that time. Regional differences in the survey were small (the highest proportion was in the DRS region at 94.6 percent, and the lowest in the Sughd region at 87.7 percent). Exclusive breastfeeding for the first 3 months was continued by more than three quarters (78.0 percent) of the mothers who breastfed or were breastfeeding at the time of interview. However, per the 2016 survey results, the share falls quickly after the fifth month to 23.9 percent by the six-month mark. A large share of mothers who stopped breastfeeding between month 5 and 6 cited lack of milk (41 percent) or new pregnancies (24 percent) as the main reasons for stopping.[12]

Food accounts for about 75 percent of consumption expenditure for poor households in Tajikistan, and the cost of acquiring enough food is often a concern for at risk households. Converting reported food consumption reported in the national Household Budget Survey (HBS) for Tajikistan into calorie equivalents highlights the seasonal component of risk for nutrition deprivation (Seitz, 2017). Seasonal food deprivation is a persistent trend in Tajikistan: the winter and spring months are associated with an increase in the share of the population with consumption below the 'extreme' poverty line that is almost 8 percentage points higher than the annual minimum (Figure 2.). The most extreme recent example occurred in the first quarter of 2014 when the food poverty rate was nearly 4 percentage points higher than the annual average, driven by declining consumption of cereals and oils/fats (Seitz, 2017).

[11] Defined as either a low serum ferritin or an elevated transferrin receptor value.
[12] A study by UNICEF (2016) found that early cessation of breastfeeding can be attributed to return of a young mother to her husband's family from her parents' home.

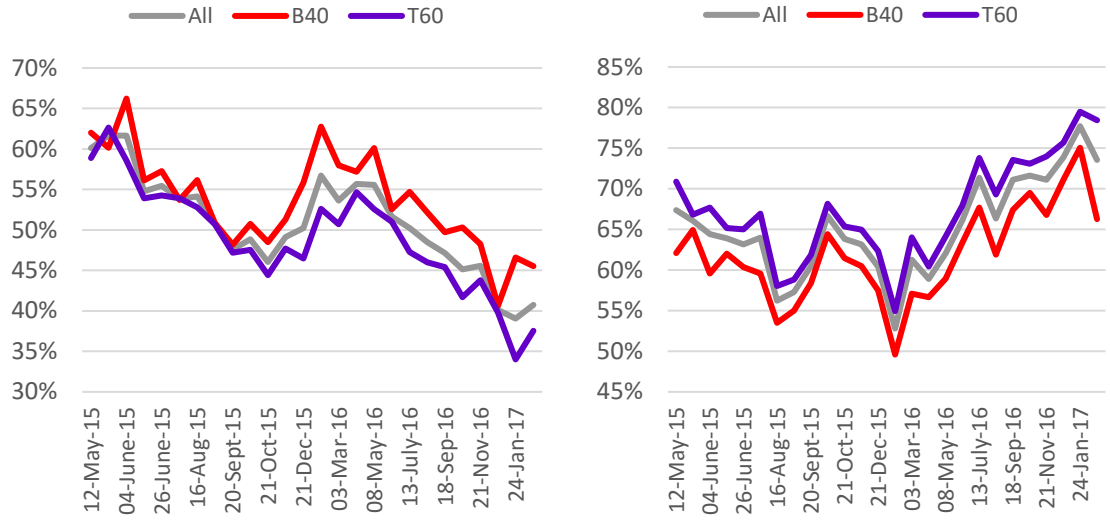
Figure 2.6. Seasonal Fluctuations Official Food Poverty (Annual Average=100) (left), Decomposition of Changes in Food Poverty (right)



Source: Authors' Calculations based on the Household Budget Survey of Tajikistan (2015)

Perceptions-based responses in the Listening-to-Tajikistan (L2TJK) survey also indicate that many households struggle to obtain sufficient food. Figure 2 reports substantial fluctuations in responses over time, often related to changes to the market price of staple foods. Further analyses of the L2TJK data indicate that the availability of food (and especially the availability of food for children) is one of the key determinants of life satisfaction in Tajikistan (Azevedo & Seitz, 2017). Research conducted by UNICEF in 2016 found children 6-24 months commonly consume an extremely non-diverse basket of food in Tajikistan, concentrated in starchy staples and dairy. Insufficient meal frequency is also common, particularly for 6-8 months-old infants.

Figure 2.7. Households "Reducing Expenditure on Food to Pay for Other Basic Needs" (Left), Households "Able to Pay for Enough Food" (Right)



Source: Authors' Calculations using Listening-to-Tajikistan (2017)

PART III – DATA AND INDICATORS

DATA

The data for this study come from two nationally representative surveys with integrated sample designs. Both surveys were conducted in the winter of 2016. The first, a comprehensive survey of water, sanitation, and hygiene (WASH), included a sample of 3052 households from a total of 150 PSUs. The sample was drawn to ensure representativeness in each of the five regions of Tajikistan. The survey was conducted on behalf of the World Bank by a private firm. The survey included detailed questions regarding access to, and quality of, water and sanitation facilities, as well as a full module on food consumption and expenditure.

The analysis also draws from the TMSS 2016, which was conducted at the same time as the WASH survey was in the field. To allow for the analysis conducted below, the sample for the two surveys were partially integrated, where possible. In such cases, households participated in both surveys. The TMSS 2016 assessed (i) the nutrition and micronutrient status of the women and children (aged 5 and younger), determine risk factors for deficiencies, and compare the findings with the last nutrition survey completed (in 2009).

Table 3.1: WASH/Nutrition Sample Integration Design

Region	WASH Clusters	Nutrition Clusters	Nutrition Clusters added/or Subtracted	Planned Integrated Clusters	Planned Maximum HHs	Achieved Integrated Clusters	Achieved Integrated HHs
DUSHANBE	14	36	22	14	112	13	53
SUGHD	44	36	-8	36	288	36	244
KHATLON	53	36	-17	36	288	35	241
RRP	34	36	2	34	272	33	179
GBAO	4	36	32	4	32	4	29
	150	**180**	**31**	**124**	**992**	**121**	**746**

For integrated households, anthropometric indicators on stunting and height for age z-scores are available for the analysis (approximately 530 children under the age of 2, and approximately 1178 children under the age of 5).

FOOD CONSUMPTION AND DIVERSITY

The WASH survey included a full module of food consumption at the household level using a recall approach over a one-week reference period. To create an indicator of calorie intake, food consumption was first converted into calorie equivalents using a standard FAO concordance (see appendix B). For the purposes of the analysis, household-level total calories consumed were adjusted to adult equivalents. The adjustment factor was calculated according the rules described in Table 3.2 using the household demographic information collected in the WASH survey.

Table 3.2: Adult Equivalence Factor

	Age	Calories (kcal)	Ad. Equiv. Factor
Newborns			
	0-1	750	0.29
Children			
	1-3	1300	0.51
	4-6	1800	0.71
	7-10	2000	0.78
Men			
	1-14	2500	0.98
	15-18	3000	1.18
	19-50	2900	1.14
	51+	2300	0.9
Women			
	11-14	2200	0.86
	15-18	2200	0.86
	19-50	2200	0.86
	51+	1900	0.75

Using these definitions allowed for the creation of binary indicator for whether a given household's aggregate food calorie consumption meet a minimum threshold, in adult equivalent terms. For the integrated sample of children that participated in this study, the adequacy prevalence was strongly associated with monetary welfare (defined as total per-capita consumption) and the estimated share of households suffering from this definition of food calorie deprivation decreased monotonically by welfare quintiles. Table 3.3 presents the weighted shares of children living in households that exceed this threshold by area (left) and by per-capita consumption quintile (right) for the participating sample.

Table 3.3: Share of Children Living in Households with "Adequate" Estimated Calorie Consumption

Area	All	Urban	Rural
All	53%	56%	52%
Dushanbe	56%	56%	.
DRS	58%	67%	57%
Khatlon	57%	65%	55%
Sughd	45%	40%	46%
GBAO	21%	.	.

Quintile	All	Urban	Rural
All	53%	56%	52%
1	22%	23%	22%
2	41%	27%	44%
3	66%	74%	64%
4	74%	78%	73%
5	82%	80%	83%

An additional measure of diversity was created based on an index of concentration in food types. This was estimated by grouping observed food consumption into categories (please see categories in appendix B), and assigning weights to a diversity measure by the share of household calorie consumption allocated to each of the different categories. The measure is of the type:

$$H = 1 - \left(\sum_{i=1}^{N} s_i^2 \right) \qquad \text{Eq. 1}$$

Where H is the index value, s_i is the calorie share of food group *i* in the consumption basket, and *N* is the number of food groups. In such an index (often referred to as a

Simpson index), higher values indicate greater diversity. The resulting average values are presented in Table 3.4.

Table 3.4: Average Index Values for Regions and Consumption Quintiles

Area	All	Urban	Rural	Quintile	All	Urban	Rural
All	0.906	0.912	0.904	All	0.906	0.912	0.904
Dushanbe	0.920	0.920	.	1	0.882	0.887	0.881
DRS	0.905	0.909	0.905	2	0.906	0.910	0.905
Khatlon	0.900	0.904	0.899	3	0.913	0.916	0.912
Sughd	0.909	0.911	0.909	4	0.914	0.915	0.914
GBAO	0.906	.	.	5	0.927	0.934	0.924

For the purposes of the analysis, children were considered to have "adequate" levels of wellbeing in the food security component if the following criteria were met: 1) their household ranked in the top 80 percent of the dietary diversity index distribution; and 2) each member of the household consumed, on average, at least 2250 calories in adult-equivalent terms. If these conditions are not met, the child was categorized as having an inadequacy in the food dimension. Such binary indicators simplify the interpretation of the variables in the regression analysis. However, for the analysis on stunting as opposed to a continuous measure of height for age, the food-related indicators are included directly in the regression rather than using a binary variable relating to the "adequacy" threshold.

WASH INDICATOR

Two separate indicators were used to measure the quality of water access and sanitation facilities. Both indicators were constructed to best reflect the WASH context of Tajikistan. For the first, a child's environment was categorized as "adequate" if the household had both a flush toilet and improved water, and if at least 50 percent of the households located in the same primary sampling unit also had a flush toilet. To test for robustness, an alternative composite measure of adequacy of sanitation facilities and safe drinking water was also constructed. The second measure was defined as simultaneous household access to improved sanitation, improved water, and living in a location where more than 90 percent of households in the community had access to improved sanitation. Both approaches were motivated by the multidimensional nature of infection risk.

Each of these thresholds are stricter than is standard in the literature. Because most households surveyed in Tajikistan report having access to both "adequate" sanitation and "improved" water (using standard adequacy definitions applied for the related Sustainable Development Goal indicators), an indicator based solely on these thresholds would not provide information regarding which households are at greater risk in Tajikistan.

HEALTH AND CARE INDICATORS

To account for the availability of health and care-related indicators in the surveys resulting from the questionnaire designs, both the *adequate care* component and the *adequate health* components were defined differently for children depending on their age.

Children under two years of age were considered adequate in the care dimension if the following criteria were met: 1) the child was breastfed within 30 minutes of birth; 2) the child was exclusively breastfed for 6 months, or was still being exclusively breastfed if under 6 months of age; 3) the child was still being complementarily breastfed (for up to two years). Children between two and five years of age were considered adequate in the care dimension if they were reported as having washed at least once in the previous 24 hours.

In terms of health services, children under the age of two were considered to have crossed the adequacy threshold if the child had received at least one visit from a health worker in the previous 6 months (and the health worker asked questions or gave advice on at least one aspect of their health and development). Children aged two or more were considered to have crossed the adequacy threshold in the health component if they received dietary supplements (such as vitamin A, vitamin B, or iron) in the previous 6 months.

SUMMARY OF INDICATORS

Using these definitions, about 45.6 percent of children were considered to have adequate conditions in the food component, 32.6 percent of children in the environment component, 29.0 percent in the care component, and 49.7 percent in the health component in 2016 (as illustrated in Figure 3.). A large share of children (37.3 percent) were adequate in only one out of four dimensions. About 34.2 percent were adequate in two dimensions (Table 3.5), 13.7 percent were adequate in three dimensions, and only 2.1 percent were adequate across all 4 dimensions. About 12.6 percent of children were not adequate in any dimension (shown in Figure 3.).

Figure 3.1. Proportion of Children by Adequacy Status

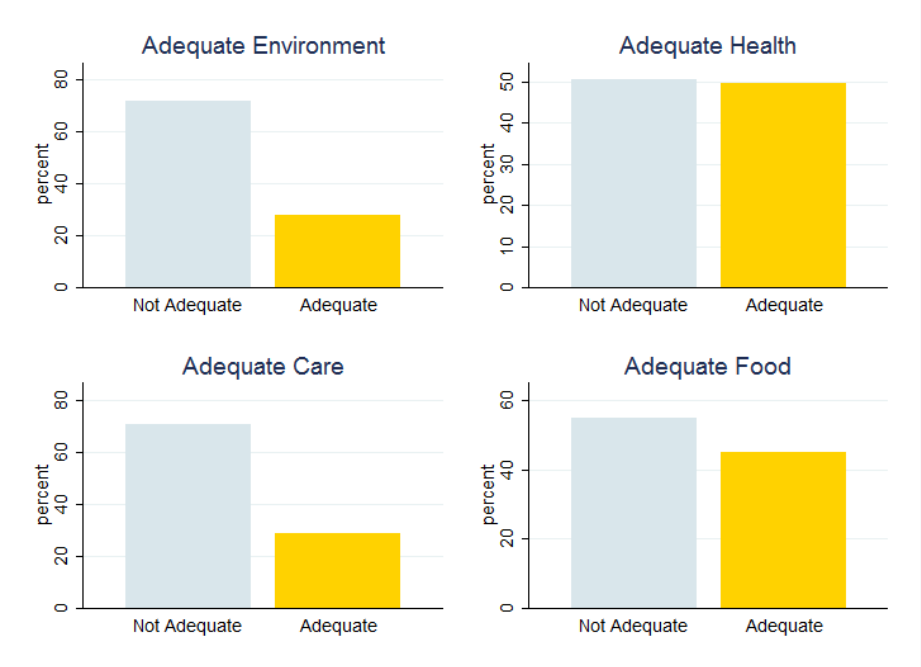


Figure 3.2: Proportion of Children by Number of Adequate Components

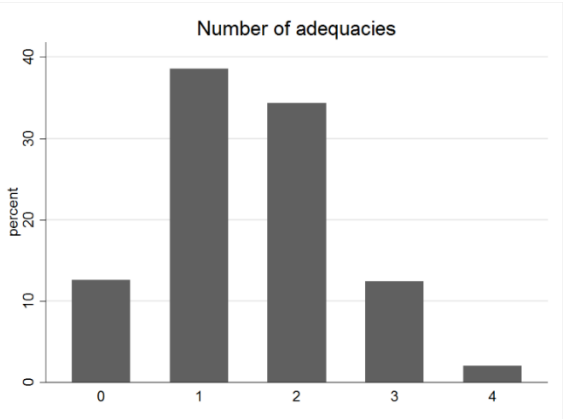


Table 3.5: Number and Proportion of Children by Adequacy Status

Adequate Environment	Adequate Health		
	Not Adequate	Adequate	Total
Not Adequate	469	470	939
	39.6%	39.7%	79.3%
Adequate	135	110	245
	11.4%	9.3%	20.7%
Total	604	580	1184
	51.0%	49.0%	100.0%

Adequate Health	Adequate Care		
	Not Adequate	Adequate	Total
Not Adequate	541	75	616
	44.8%	6.2%	51.1%
Adequate	457	133	590
	37.9%	11.0%	48.9%
Total	998	208	1206
	82.8%	17.3%	100.0%

Adequate Environment	Adequate Care		
	Not Adequate	Adequate	Total
Not Adequate	768	177	944
	64.6%	14.9%	79.4%
Adequate	213	32	245
	17.9%	2.7%	20.6%
Total	980	209	1189
	82.5%	17.5%	100.0%

Adequate Health	Adequate Food		
	Not Adequate	Adequate	Total
Not Adequate	354	254	608
	29.8%	21.4%	51.2%
Adequate	353	227	580
	29.7%	19.1%	48.8%
Total	707	481	1188
	59.5%	40.5%	100.0%

Adequate Environment	Adequate Food		
	Not Adequate	Adequate	Total
Not Adequate	592	352	944
	49.8%	29.6%	79.4%
Adequate	120	125	245
	10.1%	10.5%	20.6%
Total	712	477	1189
	59.9%	40.1%	100.0%

Adequate Care	Adequate Food		
	Not Adequate	Adequate	Total
Not Adequate	576	407	984
	48.3%	34.2%	82.5%
Adequate	136	73	209
	11.4%	6.2%	17.5%
Total	712	481	1193
	59.7%	40.3%	100.0%

PART IV – ESTIMATION STRATEGY

The analysis proceeds using two standard statistical approaches adapted for the analysis of height-for-age (a continuous variable) and stunting (a binary variable). The first was introduced by Skoufias (2016), and focuses on the interactions between factors that reduce the risk of stunting. As such, the model is estimated using OLS for a set of interacted binary explanatory variables. We proceed by estimating a model of the type (in the simplified case of only explanatory two-variables):

$$zscore_i = \beta_0 + \beta_{1i}x_{1i} + \beta_{2i}x_{2i} + \beta_3(x_{1i} * x_{2i}) + \varepsilon_i \qquad \text{Eq. 2}$$

Where $zscore_i$ is a continuous measure of individual i's height for age z-score, x_1 is the first adequacy indicator, x_2 the second. The terms β_1 and β_2 are the coefficients to be estimated when the associated explanatory variable is equal to one, and β_3 is the coefficient relating to the case when both explanatory variables are equal to one. As such, the comparison category is the case when all adequacy variables are equal to zero. In practice, the model is estimated with all available adequacy variables.

The second approach modifies the estimation strategy to use binary outcome (probit) model of the type:

$$\Pr(stunt_i = 1 \,|x_i) = \theta\,(x_i\beta) \qquad \text{Eq. 3}$$

Where $stunt_i$ is a binary measure of whether individual i's height for age z-score was less than two standard deviations from the median of the reference population, θ is a standard normal distribution function, x_i is a vector of explanatory variables, and β is a vector of coefficients to be estimated.

It is important to note that neither of these approaches provide a direct causal interpretation. Strong associations may suggest a relationship, but correlational analyses of these types are not on their own sufficient to establish causality.

PART V – RESULTS

The results for the first approach are included in Table , which highlights the synergies between adequacy in the various indicators of interest. Columns 1 contains indicators of "unique adequacies" (in which only a single adequacy is identified, and all other measures are coded as "inadequate"). Column 2 contains the same, while adding an indicator for "all 4 adequate". Columns 3 and 4 contain similar regressions, however, they include variables with higher order interactions.

In each case, the variable "all 4 adequate" is of key interest. Adequate food, care, and environment, absent other types of adequacy, do not explain the variation in z-scores at a significant level (indeed, having *only* adequate food is associated with significantly lower height-for-age scores). However, interaction terms between the various adequacy indicators are significant and in the expected direction. This relationship is consistent with the synergies view: single interventions to address stunting may be less effective that approaches that address the full breadth of factors that may lead to stunting incidence in concert.

Higher height-for-age z-scores are primarily associated with overlapping adequacies, which is aligned with the expectation that the adequacy factors measured here are associated with reduced risk of stunting and low height for age scores. Simultaneous adequacy in i) health and care, and ii) all four are significantly associated with higher height for age scores among children under the age of five in Tajikistan.

Table 5.1: OLS Results Using Variable Definitions A (columns 1-2) and Definitions B (columns 3-4)

	Height-for-age z-score			
	(1)	(2)	(3)	(4)
Adequate in: Food only	-0.297*	-0.287*	-0.203	-0.181
	(0.154)	(0.154)	(0.177)	(0.177)
Adequate in: Care only	-0.255	-0.246	-0.156	-0.134
	(0.227)	(0.227)	(0.245)	(0.245)
Adequate in: Environment only	-0.007	0.001	0.088	0.109
	(0.330)	(0.329)	(0.338)	(0.338)
Adequate in: Health only	0.017	0.028	0.116	0.138
	(0.143)	(0.144)	(0.159)	(0.160)
Adequate in: Food and Care only			0.566	0.590
			(0.472)	(0.472)
Adequate in: Food and Environment only			0.052	0.074
			(0.235)	(0.233)
Adequate in: Food and Health only			-0.174	-0.151
			(0.153)	(0.154)
Adequate in: Environment and Care only			0.730*	0.750*
			(0.414)	(0.412)
Adequate in: Health and Care only			1.034***	1.059***
			(0.255)	(0.256)
Adequate in: Health and Environment only			-0.026	-0.003
			(0.282)	(0.282)
Adequate in: All Four		1.040***		1.163***
		(0.391)		(0.394)
Constant	-1.115***	-1.121***	-1.171***	-1.188***
	(0.245)	(0.244)	(0.253)	(0.253)
Controls	Yes	Yes	Yes	Yes
Observations	1,168	1,168	1,168	1,168
R-squared	0.021	0.024	0.051	0.054

Robust standard errors in parentheses
note: .01 - ***; .05 - **; .1 - *;

Separate results for children in rural vs. urban areas are included in Table . The results indicate that synergies across different dimensions are larger and more significant in rural areas, where stunting rates are also the highest. The z-scores of rural children adequate in all four dimensions are on average 0.97 higher than the comparison group (children with more than one individual adequacy, but less than all four). Overall, the positive synergies across environment, health, food, and care seem to be stronger in rural areas, where child malnutrition is also a more pressing problem.

Table 5.2: OLS Results for Rural/Urban Sub-samples

	(1) Rural	(2) Rural	(3) Urban	(4) Urban
Adequate in: Food only	-0.293*	-0.160	0.179	0.198
	(0.169)	(0.193)	(0.331)	(0.392)
Adequate in: Care only	-0.237	-0.101	-0.285	-0.235
	(0.286)	(0.304)	(0.264)	(0.342)
Adequate in: Environment only	-0.695***	-0.543**	0.178	0.206
	(0.221)	(0.241)	(0.421)	(0.491)
Adequate in: Health only	0.090	0.230	-0.327	-0.301
	(0.164)	(0.177)	(0.269)	(0.316)
Adequate in: Food and Care only		0.349		2.122
		(0.461)		(1.288)
Adequate in: Food and Environment only		-0.139		0.015
		(0.377)		(0.297)
Adequate in: Food and Health only		-0.111		-0.026
		(0.165)		(0.468)
Adequate in: Environment and Care only		.		0.275
				(0.667)
Adequate in: Health and Care only		1.255***		0.416
		(0.283)		(0.421)
Adequate in: Health and Environment only		0.378		-0.184
		(0.551)		(0.389)
Adequate in: All Four	0.970**	1.120***	1.406	1.450
	(0.409)	(0.409)	(1.235)	(1.251)
Constant	-1.229***	-1.303***	-0.640	-0.674
	(0.280)	(0.285)	(0.439)	(0.516)
Controls	Yes	Yes	Yes	Yes
Observations	913	913	255	255
R-squared	0.029	0.067	0.063	0.087

Robust standard errors in parentheses
note: .01 - ***; .05 - **; .1 - *;

The results from the second statistical approach included in Table focus on the determinants of stunting, rather than overall z-scores (as in Table and Table). The results indicate a strong association between stunting and key indicators relating to environment, adequate care, and the sufficiency of the calories consumed. These relationships are robust to the addition of select spatial indicators in the model (column 5), and the coefficients are relatively stable in magnitude as additional covariates are added (Table - moving from left to right).

Table 5.3: Probit Regressions on Binary Variable Indicating Stunting

	(1)	(2)	(3)	(4)	(5)
Adequate Environment = 1	-0.273**	-0.281**	-0.261**	-0.266**	-0.223*
	(0.120)	(0.121)	(0.119)	(0.119)	(0.121)
Adequate Care =1		-0.230**	-0.244**	-0.225*	-0.224*
		(0.117)	(0.120)	(0.129)	(0.131)
calories > 2250 per adult equiv. = 1			-0.192*	-0.203*	-0.197*
			(0.112)	(0.113)	(0.111)
Diversity Index			-1.947***	-1.933***	-2.115**
			(0.740)	(0.739)	(0.835)
Adequate Health = 1				-0.056	-0.075
				(0.104)	(0.108)
Female = 1					0.006
					(0.008)
Dushanbe Region = 1					-0.079
					(0.310)
DRS Region = 1					0.137
					(0.146)
Sughd Region = 1					0.125
					(0.149)
Rural = 1					0.069
					(0.156)
Constant	-0.799***	-0.713***	1.132*	1.149*	1.047
	(0.094)	(0.103)	(0.658)	(0.657)	(0.680)
Number of observations	1,183	1,182	1,182	1,177	1,177
Adjusted R2	0.009	0.015	0.025	0.026	0.031

note: .01 - ***; .05 - **; .1 - *;

The coefficients can be more easily interpreted in terms of odds ratios. Adequate water and sanitation is associated with a reduction in the relative risk of stunting by about 32.8 percent. Adequate care by 33.4 percent, and sufficient daily calories with a reduction of about 29 percent. Simultaneous adequacy in calories consumed, and care is associated with reduced risk of stunting about 56 percent; while care, environment, and calorie consumption adequacy together is associated with a 68 percent lower risk. The direct index measure of dietary diversity is also strongly associated with stunting: more diverse diets are strongly associated with reduced risk.

As discussed above, it is important to note however that this analysis is highlighting associations, and is insufficient to measure any potential causal relationship between the adequacy indicators and stunting. Because these estimates should not be interpreted as

proving a causal relationship, it is useful to consider alternative interpretations of the relationships reported in the results tables.

One such interpretation is that there is an unobserved shock to child wellbeing that could cause the explanatory indicators to co-move with the undernutrition outcome. In such a case, our indicators of interest are more appropriately considered as proxies of deprivation, rather than causes of it.

A more general concern is the possibility of omitted variable bias in the analyses presented here. Although this is addressed in part with the inclusion of control variables, we cannot fully rule out omitted variables that may drive the relationships we observe. This is a serious concern with respect to deriving policy based on the findings we report. However, moderating this concern is the knowledge that the variables of interest in this case (including healthy environments, food adequacy, health access, and care practices) have each individually been shown to directly affect nutrition. We have more confidence in the "synergies" interpretation of our results given the consistent relationships we describe with respect to the large literature on the causal relationships between the adequacy indicators of interest and nutrition.

Yet another possibility is that the indicators themselves are endogenous. Poor health care could lead to poor labor market outcomes, which could lead to poor food consumption. This interpretation as well is somewhat related to the definition of "synergies" adopted elsewhere in the literature, and likely moderates the usefulness of the findings with respect to the relative magnitudes of the relationships described.

PART VI – CONCLUSION AND RECOMMENDATIONS

Despite substantial progress in reducing the prevalence of stunting, Tajikistan still suffers from high rates among at-risk groups of children. The analysis conducted in this report highlights the strong association between different dimensions of adequacy and a lower risk for malnutrition, as measured by height-for-age z-scores, and separately, for a binary indicator for childhood stunting. The associations are particularly strong and significant in rural areas, where stunting rates are also the highest.

A child living in a household with an adequate water and sanitation environment has a lower relative risk of stunting of about 32 percent, akin to the lower odds associated with a child living in a household with adequate care. Children in household consuming sufficient calories as measured in the WASH survey were by about 29 percent less likely to be stunted.

The analysis also finds evidence of strong synergies between adequacy along several measures of wellbeing, as found in many other contexts. Simultaneous adequacy on several of these indicators at the same time was associated with even lower risk: an adequate care environment, adequate calorie consumption, and an adequate WASH environment together was associated with a 68 percent lower risk. Greater adequacy is associated with higher height for age z-scores, and particularly low height for age z-scores are associated with lacking adequacy on multiple overlapping measures.

While the results of the analysis are quite consistent with experimental research into the causes of childhood stunting, it is important to note that this analysis is descriptive in nature, and is not sufficient to fully measure any potential causal relationship between the adequacy indicators and stunting. Nonetheless, the results are consistent with related findings in the literature on the importance of jointly addressing the risk factors for stunting, rather than each factor individually. The results find that greater stunting risks are associated with cases in which children suffer from multiple overlapping deprivations.

The results provide evidence that is consistent with several recommendations for nutrition interventions in Tajikistan:

1. **Multi-sectoral interventions**: Programs that simultaneously address overlapping risk factors may improve nutrition outcomes much more than an intervention that focuses on only one risk factor.
2. **Address food inadequacy**: There is clear support in the analysis to support programs addressing food inadequacy, both in the form of the number of calories consumed and the diversity of food consumed.
3. **Addressing food inadequacy in isolation may be less effective**: In the absence of adequacy in other dimensions (and particularly the health and child care environment), food adequacy alone is not associated with reduced stunting risk at a statistically significant level.
4. **Focus interventions in rural areas**: The potential drivers discussed in the paper are all strongly concentrated in rural areas.

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APPENDIX A – NATIONAL DEVELOPMENT STRATEGY

Improving access to quality nutrition by:

- Increasing public awareness of exclusive breastfeeding of infants;
- Legislative underpinning of the need for iodization of produced and imported salt, inclusion of iron supplements and vitamin A in the package of basic PHC services;
- Implementing the “Concept of school feeding" and “Scaling Up Nutrition (SUN) Strategy”;
- Implementing the Strategy of nutrition and physical activity, including measures to prevent malnutrition, monitoring of the food quality and safety, the availability of information systems for proper nutrition.
- Increasing access to safe drinking water, and improving hygiene and sanitation condition;

Strengthening the institutional capacity of drinking water supply, sanitation and hygiene through:

- Regulatory and legal consolidation of the institutional "areas of responsibility" and interactions related to the partnerships in the process of managing water supply, sanitation and hygiene infrastructure;
- Carrying out a range of measures to strengthen drinking water supply, sanitation and hygiene systems by supporting the processes of developing an information base, tariffs, training and attracting investment;
- Ensuring progress in construction dynamics, rehabilitation of water supply systems, sanitation and hygiene, including (those that are) project based;
- The adoption of a package of measures to support the development of international cooperation in the field of water supply and sanitation (including in the areas of rainwater harvesting technologies, water purification, water efficiency, the use of recycling and reuse technologies).

Improving the Social Protection system through

- The tools and mechanisms for monitoring of poverty, targeting of low-income people and evaluation of needs implemented, including at the local level;
- A Single Window for registration of beneficiaries and provision of social protection services to the population established and operational;
- Subject to budgetary constraints, the pension and benefit rates increased while maintaining fiscal sustainability, the pension to wage ratio is not below the minimum level of 40 percent;
- Targeting and access to social assistance and social services for socially vulnerable categories of citizens increased;

APPENDIX B – CALORIE CONCORDANCE FOR FOOD ITEMS

ID	Food Item	Calories per 100gm	ID	Food Item	Calories per 100gm
852	Non (bread)	367	872	Oranges (lemon)	32
870	Other vegetables	330	882	Lamb	241
857	Macaroni products (pasta)	367	885	Canned meat	233
859	Other grain products (e.g. maize, oats, barley)	348	886	Other meat products	181
869	Preserved vegetables	330	881	Chicken	122
854	Wheat	349	884	Sausages	181
853	Flour	349	880	Beef	216
851	Bread and bread products	367	891	Milk	59
856	Rice	360	892	Cheese	244
855	Cereals (e.g. barley, millet, wheat/semolina)	348	894	Other dairy products	201
890	Eggs	144	897	Ghee	879
887	Fresh fish	62	898	Animal Fat	838
888	Canned fish	314	896	Vegetable oil	884
889	Salted fish	230	895	Butter (margarine)	716
861	Garlic	36	858	Dried beans (beans, peas, lentils, etc.)	345
863	Tomatoes	19	879	Walnuts	610
860	Onion	37	862	Potatoes	70
867	Cucumber	10	906	Sweets, Eastern sweets/pastries	535
865	Cabbage	17	905	Sugar	387
875	Pumpkin	23	908	Ice-cream	535
864	Carrot	37	909	Chocolate	535
874	Watermelon, melon	13	899	Soft drinks (coke, etc.)	0
878	Preserved fruits	268	914	Meals consumed outside home	0
877	Dried fruits	268	900	Mineral water	0
871	Apple	49	915	Drinks consumed outside home	0
901	Fruit juice	49	903	Tea	0
873	Grapes	62	902	Coffee	0
907	Jam	46	904	Salt	0
876	Other fresh fruits	49			

APPENDIX C – ADEQUACY INDICATORS

Adequacy Indicators	Skoufias, 2016*	Lavado et al., 2017
Adequate Health	In terms of prenatal health services, a mother must have had at least four prenatal visits. For post-natal health services, it is required for the child to have their immunizations up to date and that the child has received a vitamin A supplementation (as drops or tablets) since birth.	Children under the age of two were considered to have crossed the adequacy threshold if the child had received at least one visit from a health worker in the previous 6 months (and the health worker asked questions or gave advice on at least one aspect of their health and development). Children aged two or more were considered to have crossed the adequacy threshold in the health component if they received dietary supplements (such as vitamin A, vitamin B, or iron) in the previous 6 months.
Adequate Environment	Access to safe water and improved sanitation is considered and it is required that more than 75 percent of a child's community have access to improved sanitation.	1) A child's environment was categorized as "adequate" if the household had both a flush toilet and improved water, and if at least 50 percent of the households located in the same primary sampling unit also had a flush toilet. 2) Simultaneous household access to improved sanitation, improved water, and living in a location where more than 90% households in community have access to improved sanitation
Adequate Care	For children under the age of 6 months, adequate care consists of exclusive breastfeeding. For children 6 to 8 months of age complementary feedings are required. All children under 24 months are required to be breast-fed.	Children under two years of age were considered adequate in the care dimension if the following criteria were met: 1) the child was breastfed within 30 minutes of birth; 2) the child was exclusively breastfed for 6 months, or was still being exclusively breastfed if under 6 months of age; 3) the child was still being complementarily breastfed (for up to two years). Children between two and five years of age were considered adequate in the care dimension if they were reported as having washed at least once in the previous 24 hours.
Adequate Food	Child's Dietary Diversity Score, Minimum Acceptable Diet (for children 6-24 months). Proxies if indicators not available: Household Dietary Diversity Score (for child/mom)	Children were considered to have "adequate" levels of wellbeing in the food security component if the following criteria were met: 1) their household ranked in the top 80 percent of the dietary diversity index distribution; and 2) each member of the household consumed, on average, at least 2250 calories in adult-equivalent terms.

*Indicators vary by country

More than 20 percent of children under the age of 5 in Tajikistan are stunted. A large literature finds that stunting and undernutrition in early childhood are commonly the result of several contributing environmental, food, hygiene, and health-related factors. However, quantifying these interactions is usually not possible due to the difficulty of collecting sufficient data on each dimension in a single survey. To address this issue, we integrated the samples of two separate nationally representative surveys conducted simultaneously in Tajikistan in late 2016. This design allows analysis of the determinants of undernutrition in a unified framework. The results show strong associations between undernutrition and the number of food calories consumed, food diversity, access to water, sanitation and hygiene (WASH) services, access to health services, and care practices. Consistent with previous studies, the results also show that overlapping adequacies are associated with much reduced stunting risk. The findings suggest that: i) nutrition interventions addressing multiple risk factors may promote better outcomes than focusing on any single deprivation, ii) there is need for programs addressing food inadequacy, both in the form of the number of calories consumed and the diversity of food consumed, iii) promoting food adequacy alone is likely not sufficient to generate large reductions in malnutrition, and iv) interventions should predominantly focus on rural areas where risks of malnutrition are substantially higher.

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