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Affordability of nutrient-adequate diets as an indicator for food and nutrition security. Evidence from fill the nutrient gap analyses☆

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ABSTRACT

We conducted an ecological study using data from 373 subnational units in 32 countries collected from 2011 to 2020, to explore the associations of non-affordability of nutrient-adequate diets and of food insecurity (percentage of people with poor or borderline Food Consumption Score) with indicators measuring dietary quality and nutritional status. We found a strong negative monotonic correlation between non-affordability of nutrient-adequate diets and minimum dietary diversity in children 6–23 months ($r_s = -0.65, p < 0.01$), and a weaker correlation between poor or borderline Food Consumption Score with the same dietary diversity indicator ($r_s = -0.39, p < 0.01$). The relations between non-affordability and nutrition outcomes (prevalence of stunting and the composite indicator of 'people deprived in nutrition') were also highly significant at the subnational level, and had larger coefficients than indicators focusing on caloric adequacy. Examining these relations subnationally could provide relevant information for policies and programs aiming to address the risk of nutrition insecurity due to economic inaccessibility. Compared to dietary quality indicators, non-affordability is a relatively easy indicator to calculate and has the potential to use secondary data already captured through existing government systems.

1. Introduction

Diets are recognized as an immediate determinant of nutrition outcomes, and the consumption of diets for adequate food and nutrition security requires the ability to physically and economically access the required nutritious foods, as well as having adequate feeding and dietary practices (UNICEF, 2021). With poverty as one of the root causes for undernutrition (Bailey et al., 2015), analyses have shown that socioeconomic factors are a determinant of dietary quality, as households will likely only consume the foods they can afford and have the willingness to pay for (Ali et al., 2019; FAO, WHO, 2019; Morseth et al., 2017; Harris-Fry et al., 2015; Mayén et al., 2014). The global discussion on malnutrition prevention has increasingly focused on improving the understanding of the economic access dimension of food and nutrition security through the use of metrics measuring affordability of least-cost modelled diets (Bai et al., 2021, 2022; Masters et al., 2018). Studies have shown the correlation between non-affordability of least-cost diets that meet nutrient requirements, such as the nutrient-adequate diet, or that meet food-based dietary guidelines, such as the healthy diet basket, and nutrition and health outcomes, comparing national level estimates across countries and regions (Bai et al., 2021, 2022; FAO et al., 2020, 2021; Herforth et al., 2020).

Other metrics may be reflective of economic access to food, but they tend to jointly reflect other dimensions of food and nutrition security, or only reflect a basic measure of the quantity of food consumed. Indicators measuring dietary diversity and quality reflect the combined effect of access and consumption choices. These indicators have proven to be reliable estimates of nutrient adequacy of diets and are used in contexts to understand dietary risks (Diop et al., 2021; Arimond et al., 2010; Moursi et al., 2008). Food security indicators measuring dietary quantity, on the other hand, are largely focused on the adequacy of energy intake (Leroy et al., 2015), providing evidence on whether basic requirements of dietary adequacy are being met.

Indicators of cost and non-affordability of least-cost nutrient-adequate diets could reveal if and where households face economic constraints in accessing diets for adequate food and nutrition security.

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They speak directly to issues of economic access, as they are an estimate of a context-specific lower bound threshold to meet nutrient needs using locally available foods, and of the percentage of households that would not be able to meet this threshold based on their food expenditure. Their calculation requires data on retail food prices and household-level food expenditure, which could be sourced from data collection systems already in place, or could become available through adaptations of these systems.

The relationship between non-affordability of least-cost nutrient-adequate diets and food and nutrition security at the subnational level has been primarily explored within a country or for a specific subnational region. The World Food Programme's (WFP) Fill the Nutrient Gap (FNG) analyses have helped national stakeholders gain insight into economic and other barriers that households face to access diets that meet their nutrient needs in their specific context (Bose et al., 2019). From its conceptualization in 2015–16 and until 2021, there had been 40 FNG analyses in 37 countries. The subnational results on cost and non-affordability of nutrient-adequate diets of these analyses were standardized and compiled in the dataset published in Turowska et al. (*this issue*). We used this subnational dataset to explore the relationship between affordability of nutrient-adequate diets and indicators of dietary quality and nutritional status across countries and regions. Similarly, we analysed the relationship between the percentage of people with insufficient Food Consumption Score (FCS) and the same indicators of dietary quality and nutritional status. We sought to further the understanding on whether indicators of cost and non-affordability of nutrient-adequate diets could allow a more complete and continuous monitoring of the nutrition situation and the economic determinants of diets at the subnational level.

Using Spearman's rank correlation and two-way scatterplots, we first examine the associations between non-affordability and indicators of dietary quality (minimum dietary diversity, consumption of Vitamin A- and iron-rich foods by children 6–23 months), and between insufficient FCS with the same indicators of dietary quality. We then examine the associations between cost and non-affordability of nutrient-adequate diets. Finally, through regression analyses, we examine how non-affordability, insufficient FCS and dietary diversity relate to the prevalence of stunting in children under 5 and to the percentage of people deprived in nutrition. This paper builds on previous work (Bai et al., 2021; FAO et al., 2020, 2021) by increasing the granularity at which non-affordability of least-cost diets and nutrition indicators are compared.

2. Data and Methods

This ecological study used data on the cost and non-affordability of the nutrient-adequate diet from the dataset published in Turowska et al. (*this issue*), together with data on indicators of food security, dietary quality and nutrition and health outcomes from other sources. The cost of the nutrient-adequate diet represents the least-cost combination of foods that meets the required nutrient intake of a standard modelled 5-person household and includes approximately 50 percent of energy from locally preferred staple food (Bose et al., 2019; Turowska et al.). It was calculated using the linear optimization software Cost of the Diet, developed by Save the Children (UK) (Deptford et al., 2017), and requires market prices of 60–200 foods available in the assessment area (Cost of Nutritious Diets Consortium, 2018). Average cost was estimated in areas where multiple observations existed over time (e.g., if the FNG had included a seasonal analysis, we used only the unweighted average between seasons) or contexts (e.g., if the FNG included urban-rural provincial stratification, we used a population-weighted provincial average).

Non-affordability is the percentage of households whose per capita expenditure on food falls below the per capita average cost of the nutrient-adequate diet. for this, the average per capita cost of the nutrient-adequate diet for the modelled household was compared to the percentiles of per capita household expenditure on food. Household expenditure on food was obtained from household consumption and expenditure surveys (HCES) (Turowska et al.). These surveys capture households' different food sources, including purchases, and monetize the value of food produced by households for their consumption and of gifts (FAO et al., 2018). At the time we performed the analysis, the dataset included non-affordability datapoints for a total of 504 subnational regions in 37 countries, from a total of 40 FNG analyses. Where multiple observations existed per subnational unit, these were averaged following the same methodology used for cost estimates.

Data on percentage of people with insufficient Food Consumption Score (WFP, 2009) came from the WFP's HungerMap Live (WFP, 2022). The FCS captures household-level data on frequency of consumption of eight different food groups through a 7-day recall survey (WFP, 2008). Consumption frequencies for each food group are multiplied by a standard food group weight based on macro and micronutrient density (i.e., weights are higher for nutrient-dense groups) and the sum of the weighted food group scores results in the FCS expressed as a continuous variable (WFP, 2008). Recommended cut-offs for "poor", "borderline" or "acceptable" FCS are used to redefine the FCS into these three categories, established based on estimated calorie consumption *vis-a-vis* an established energy-intake target. Though cut-offs are standard for all regions, in populations where there is a high consumption of oil and sugar these may be slightly higher (WFP, 2008). The FCS is then dichotomized into sufficient FCS (those with "acceptable" FCS) and insufficient FCS (the sum of those with "poor" or "borderline" FCS).

Data on minimum dietary diversity, consumption of Vitamin A- and iron-rich foods by children 6–23 months were mostly obtained from the Demographic and Health Survey's (DHS) Program Application Programming Interface (DHS Program, ICF International). These data were used as, until recently, they were part of the suite of indicators for assessing Infant and Young Child Feeding (IYCF) practices (WHO, 2008). Though iron-rich food consumption has been excluded from the IYCF indicators in the most recent guidelines (WHO, 2008), for the period covered by our analysis, all three indicators were routinely collected and widely available. Although these indicators do not reflect all household members, evidence suggests that children are unlikely to be the first to suffer reduced access to food in the household, as caretakers tend to prioritize children's food consumption over their own (Brinkman et al., 2010; de Pee et al., 2000). Thus, we make the assumption of shared effects within the household, where other household members have similar or worse dietary quality than children under two.

With some exceptions, we obtained subnational stunting prevalence for children under 5 years from the Joint Child Malnutrition Estimates Expanded Database (JME) (UNICEF, WHO, World Bank, 2021). Data on the percentage of people deprived in nutrition (Deprived in Nutrition) were obtained from the Multidimensional Poverty Index (MPI) (Alkire et al., 2021). The MPI builds a deprivation profile for each household member for whom there is data in the subnational region. The nutrition sub-dimension of the MPI builds upon data from DHS, Multiple Indicator Cluster Surveys and World Health Surveys. It is a household-level measure assuming shared effects between members, as everyone in the household is considered deprived in nutrition if one or more members suffers from undernutrition (Alkire et al., 2020). Finally, subnational population size, used as a weight and control variable, was obtained from the MPI or from each country's national statistics agency. Appendix Table A1 contains the year DHS, JME and MPI data were collected. Appendix Table A2 contains a detailed description of the indicators used, and Appendix Table A3 contains the sources per country.

To bring these datasets together, we matched subnational regions for the different sources. Given discrepancies in the level of aggregation, we used population estimates to aggregate cost and non-affordability from territories to provinces for Democratic Republic of Congo, and insufficient FCS from district to sub-region for Uganda. We arranged the complete dataset as panel, nesting all subnational observations under each country, and nesting each country under its region.

The final list of countries and regions is in Table 1. Data on cost and non-affordability were available for all countries. Insufficient FCS, dietary quality and nutrition indicators were only available for a subset of countries and thus the number of observations and countries included in each analysis depends on the variables used, as specified in Appendix Table A4. Six FNG analyses were excluded because of (a) methodological differences in the analysis; (b) they were only a refugee analysis; or (c) the analysis had not been fully standardized in the dataset due to the lack of relevant data (Turowska et al.).

We used two-way scatterplots weighted by the log of subnational population size and Spearman's rank correlation coefficents (as the data were not normally distributed) to explore associations between non-affordability and minimum dietary diversity, consumption of Vitamin A- and iron-rich foods by children 6–23 months indicators, and between insufficient FCS and the same dietary quality indicators. We then explore the associations between cost and non-affordability of nutrient-adequate diets.

To explore the associations of insufficient FCS, dietary diversity and non-affordability indicators with nutrition outcomes, we used a 3-level mixed-effects linear regression model with clustered standard errors, with level one for each subnational unit, level two for each country, and level three for the geographic region. We used the mixed command in Stata, which uses maximum likelihood estimation to fit the model (StataCorp, 2021a, 2021b).

The mixed effects linear regression model consecutively introduced the three independent variables to the model. The first variable, non-affordability of nutrient-adequate diets, represented the economic access dimension of food security. The second one, insufficient FCS, represented the quantity component of food security (WFP, 2009). The third, the percentage of children 6–23 months consuming diets with minimum dietary diversity (MDD), representing dietary quality.

The regression analyses were conducted for two dependent variables, prevalence of stunting in children under 5 (UNICEF, WHO, World Bank, 2021), and percentage of people deprived in nutrition (Alkire et al., 2021). We controlled for subnational population size and region and country fixed effects.

We performed sensitivity analyses to identify any potential problems with our data and model (Chen et al., 2003). All statistical analyses were performed using the software Stata version 17 (StataCorp, 2021a).

3. Results and discussion

3.1. Correlations between insufficient FCS and non-affordability of nutrient-adequate diets, and indicators of dietary quality

Spearman correlations revealed strong negative monotonic correlations between non-affordability and (a) MDD ($r_s = -0.65, p < 0.01$), (b) consumption of iron-rich foods by children 6–23 months (Fe consumption) ($r_s = -0.66, p < 0.01$), and (c) consumption of vitamin A rich foods by children 6–23 months (VitA consumption) ($r_s = -0.57$, $p < 0.01$). Scatterplots (Figs. 1, 3 and 5) also revealed these relationships, as they show a clear decline in dietary quality with increasing non-affordability.

The percentage of people with insufficient FCS revealed a weaker correlation with the same indicators of dietary quality ($r_s = -0.39, p < 0.01$ for MDD, $r_s = -0.37, p < 0.01$ for Fe consumption, and $r_s = -0.44, p < 0.01$ for VitA consumption). The scatter plots (Figs. 2, 4 and 6) revealed a slight decline of dietary quality as insufficient FCS becomes more prevalent. Yet, this pattern is less clear and shows clustering of data points on the lower end of the x-axis.

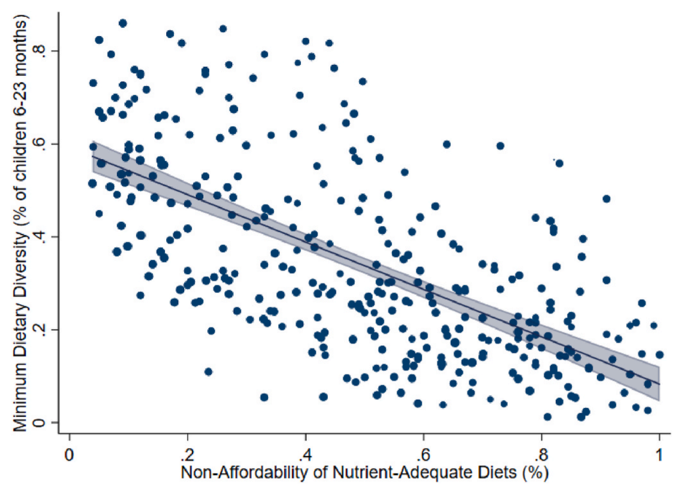

Fig. 1. Scatterplot between the percentage of children 6–23 months old with minimum dietary diversity and non-affordability of nutrient-adequate diets, weighted by the log of subnational population size (n = 345, $r_s = -0.65$, p < 0.01).

Table 1
List of countries by geographic region included in the analysis.

Latin America and the Caribbean	African Sahel	Sub-Saharan Africa	Central Asia	South Asia	East Asia and the Pacific
• Dominican Republic[1] • Ecuador • El Salvador • Guatemala[2]	• Burkina Faso • Mali • Mauritania • Niger[3]	• Burundi • Cameroon • Democratic Republic of Congo • Ethiopia • Guinea Bissau • Lesotho • Mozambique • Rwanda[4] • Tanzania • Uganda • Zambia	• Kyrgyzstan • Tajikistan	• Afghanistan • Bangladesh • Nepal • Pakistan • Sri Lanka	• Cambodia • Indonesia[5] • Laos • Myanmar • Philippines • Timor-Leste

(1) The Dominican Republic is not included in most correlation analyses and the regression analysis, as we were unable to match the FNG results (which use macro-region disaggregation) to other dietary and nutrition indicators (which use health region disaggregation).
(2) Guatemala is only partially included in most correlation analyses and the regression analysis, as we were only able to partially match the FNG results (which use a multi-department disaggregation) to other dietary and nutrition indicators (which use region or department disaggregation).
(3) The FNGSTAT database includes results for two separate analyses for Niger. For this paper, we used the 2016 Niger analysis.
(4) The FNGSTAT database includes results for two separate analyses for Rwanda, one of which is a refugee analysis, which was excluded as described in the Data and Methods section.
(5) The FNGSTAT database includes results for two separate analyses for Indonesia. The first one, a 2017 Cost of the Diet analysis performed in certain provinces and the second one, a 2021 FNG analysis (using 2019 data) performed in all provinces of the country. For this paper, we used the 2021 FNG analysis for Indonesia.

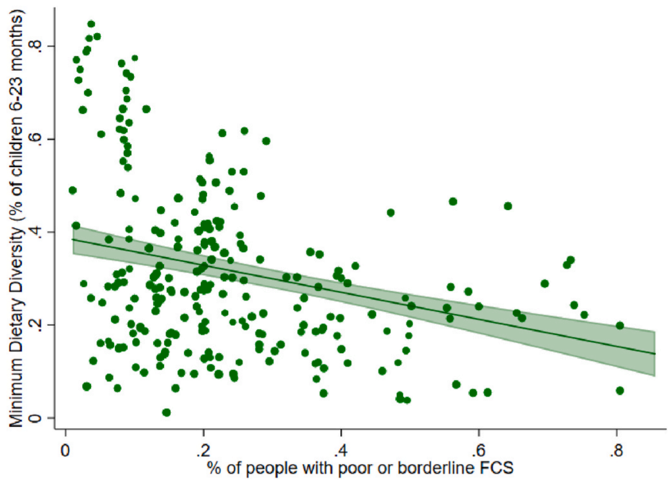

Fig. 2. Scatterplot between the percentage of children 6–23 months old with minimum dietary diversity and the percentage of people with insufficient food consumption score, weighted by the log of subnational population size ($n = 281$, $r_s = -0.39$, $p < 0.01$).

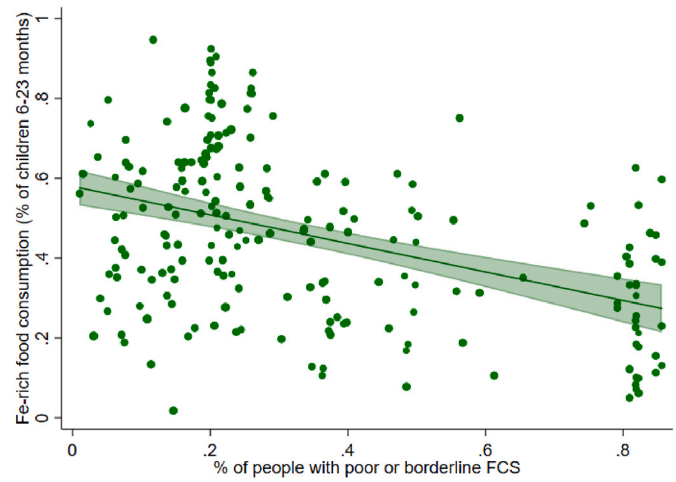

Fig. 4. Scatterplot between the percentage of children 6–23 months old consuming iron-rich foods and the percentage of people with insufficient food consumption score, weighted by the log of subnational population size ($n = 204$, $r_s = -0.37$, $p < 0.01$).

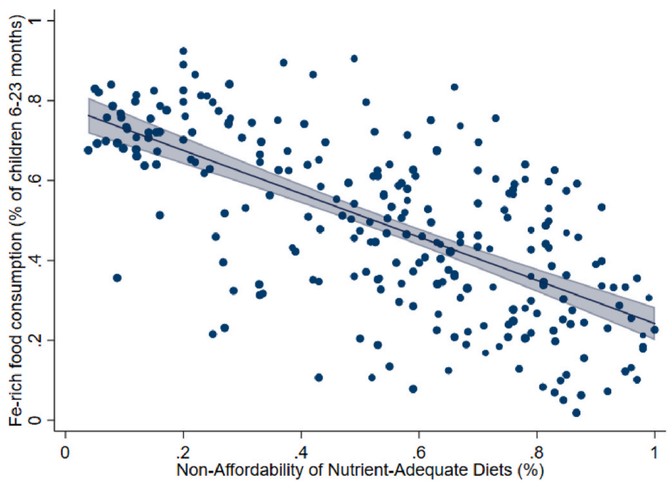

Fig. 3. Scatterplot between the percentage of children 6–23 months old consuming iron-rich foods and non-affordability of nutrient-adequate diets, weighted by the log of subnational population size ($n = 245$, $r_s = -0.66$, $p < 0.01$).

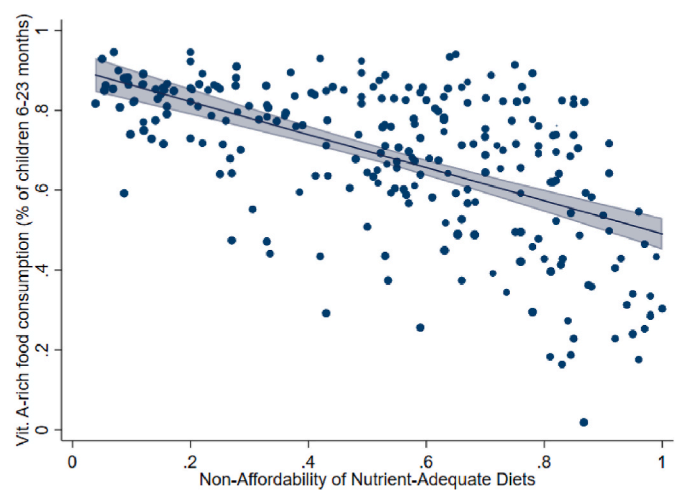

Fig. 5. Scatterplot between the percentage of children 6–23 months old consuming vitamin A-rich foods and non-affordability of nutrient-adequate diets, weighted by the log of subnational population size ($n = 245$, $r_s = -0.57$, $p < 0.01$).

Indicators of dietary diversity have been proven to be reliable estimates of micronutrient adequacy of diets (Diop et al., 2021; Arimond et al., 2010; Moursi et al., 2008). They also provide insights into the relationship between key dietary quality problems (e.g., monotonous diets or scarce consumption of nutritious food groups) and other evidence has shown their associations with socioeconomic status (Ali et al., 2019; Hatløy et al., 2000). Yet, these indicators reflect a combination of dietary practices and choices, as they measure not only household access, but what is actually being consumed or provided, in the case of MDD, to children between 6 and 23 months. Examining dietary diversity alone may not provide an understanding of the specific constraints households face (e.g., should households be enabled or motivated?). For example, in a region with low MDD, where households face financial constraints or poor food environments, social and behavior change strategies will likely be insufficient for improving nutrition (Headey et al., 2018). This differentiation between the effect of economic access and choices is necessary to address underlying barriers to adeaquate diets (and thus important for policy and programming purposes).

Challenges related to the collection and availability of data have hindered the use of dietary quality indicators for nutrition-based policymaking (Fiedler et al., 2013). Dietary diversity and consumption of micronutrient-rich foods are calculated through the use of 24-hr recall or food frequency questionnaires, which are technically complex and burdensome to collect, process and analyze (Coates et al., 2017; Wiesmann et al., 2009). In low income contexts these data remain widely unavailable (Coates et al., 2017), discouraging the development of nutrition programmes (Fiedler et al., 2013).

Food security indicators focused on the quantity component reflect energy-adequacy of diets based on food intake (Leroy et al., 2015; Wiesmann et al., 2009). These indicators aim to provide early warnings of when and where households are under distress and at risk of energy-undernutrition. Insufficient FCS is mainly used to report food insecurity as the percentage of households with a shortfall in energy intake (Leroy et al., 2015; Wiesmann et al., 2009). The weaker correlation between indicators of dietary quality and insufficient FCS and the clustering of data points at the lower end of insufficient FCS in Figs. 2, 4 and 6, suggest that this indicator fails to adequately capture micronutrient adequacy of diets, though this relationship could differ if the

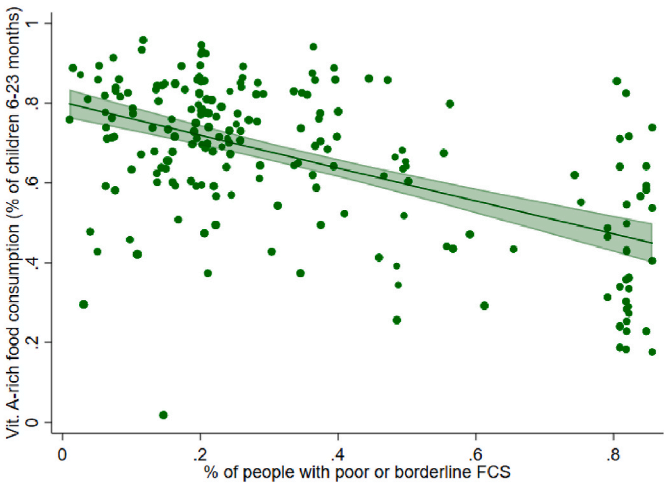

Fig. 6. Scatterplot between the percentage of children 6–23 months old consuming vitamin A-rich foods and the percentage of people with insufficient food consumption score, weighted by the log of subnational population size (n = 204, r_s = -0.44, p < 0.01).

continuous score, rather than the categorized version, was reported and used.

Non-affordability of diets, such as nutrient-adequate diets or the healthy diet basket (Herforth et al., 2020), provides direct insight into the proportion of households that face economic constraints to adequate nutrition in a subnational region. It does not speak to dietary patterns, but reflects the minimum threshold that food expenditure would need to surpass in order to permit adequate dietary intake. Non-affordability reflects the percentage of households that are unable to surpass this threshold (Turowska et al., *this issue*).

In most countries, non-affordability can be calculated using available secondary data (Turowska et al., *this issue*). This tends to make its estimation less time intensive than dietary adequacy indicators, which often require time consuming primary data (e.g. 24-hour recall or food frequency questionnaires). The calculation of cost of nutrient-adequate diets requires data on retail food prices, which are often collected by countries through government mechanisms (e.g., for inflation monitoring purposes). Non-affordability requires data on household food expenditure, which are periodically captured through household consumption and expenditure surveys, including in low and lower-middle income countries. Thus, the monitoring of the cost of nutrient-adequate diets and the periodical calculation of non-affordability may only require secondary data from data collection systems already in place or could become possible through small adaptations of these systems.

3.2. The relationship between cost and non-affordability of nutrient-adequate diets

The cost of nutrient-adequate diets depends on which foods are available and at what price, and varies by area of analysis. Household food expenditure primarily depends on the disposable income of each individual household, determined by individual capacity and by the general economic environment and degree of social welfare within a given context (Varlamova and Larionova, 2015). Cost and expenditure individually have the potential to lead to high non-affordability, and a shift in either would likely change non-affordability rates.

The costs of nutrient-adequate diets and non-affordability rates clustered within countries and geographic regions, though both also exhibited large variations. In Indonesia, for example, non-affordability ranged from 4 to 53% across provinces but had a weighted national mean of 12%. For South Asia, Afghanistan clusters at a very high non-affordability (with a weighted national mean of 87% non-affordability) while the weighted national mean non-affordability for other countries ranged between 11% (Sri Lanka) and 66% (Pakistan). As a result, the standard deviation of South Asia's non-affordability was the highest among all regions (Table 2).

Fig. 7 shows a significant but weak correlation ($r_s = 0.19, p < 0.01$) between the cost of nutrient-adequate diets and non-affordability. Though correlation was stronger within regions (data not shown), this generally indicates that low diet costs did not necessarily translate into low non-affordability, and vice versa. East Asia and the Pacific countries had the lowest mean non-affordability, while the region's mean cost of nutrient-adequate diets remained relatively close to the sample mean. Countries in African Sahel and Sub-Saharan Africa had the lowest regional mean cost of the nutrient-adequate diet but had the two highest mean non-affordabilities. This highlights the need to focus efforts on creating economic opportunities to increase disposable income alongside food and nutrition-specific interventions.

The relationship between cost and non-affordability and broader applications to economic development require further research (FAO et al., 2020; Shapiro et al., 2019). Analysis of country-level estimates suggests that cost and GDP per capita may have a non-linear relationship, as cost of nutrient-adequate diets was found to be lowest in low- and high-income countries and highest in middle-income countries, while there is a mostly linear negative relationship between GDP per capita and non-affordability (FAO et al., 2020, World Bank Group, 2022). This non-linearity could be an effect of multiple factors. For example, a higher level of integration into the global economy could drive down prices of highly tradeable foods (e.g., grains) but not necessarily of perishable fresh foods (e.g., fresh fruits and vegetables).

In the long-term, in countries that experience GDP growth, non-affordability would be expected to decrease even if nominal prices of nutritious foods (and the nominal cost of the nutrient-adequate diet) also increase. This is known as the Penn-Balassa-Samuelson effect, whereby per capita income levels and the price of goods and services are positively correlated (Hassan, 2016). Yet, as the price-income relation has also been shown to be non-monotonic due to the different stages of a country's development (Hassan, 2016) and GDP growth does not directly translate into growth in household disposable income (Ribarsky et al., 2016), further exploration of the long-term relationship between cost and non-affordability of nutrient-adequate diets as countries develop is required.

The dynamics of the relationship between cost and non-affordability are different in the short-term. Sudden changes in food prices and food expenditure are likely to affect economic access to nutrient-adequate diets, revealing the immediate relationship between cost and non-affordability. Sudden increases in the price of nutritious foods stemming, e.g., from extreme weather events, trade disruptions or other shocks, could have immediate consequences on their affordability and consumption (Bai et al., 2022; World Bank Group, 2019). Seasonality has also been shown to be associated with food security and nutrition outcomes in children and adults (Belayneh et al., 2020; Bonuedi et al., 2021; Van Liere et al., 2018). As such, the regular monitoring of the cost of nutrient-adequate diets, in conjunction with baseline non-affordability estimates, could provide early warning of higher risks of economic inaccessibility of nutritious foods, even in the case where food expenditure data has not been updated (WFP, 2021a, 2020). In these cases, to overcome the lack of frequent food expenditure data, Headey et al. (2023) have suggested adding wage data of low-skilled workers to high frequency food price data collection systems. These wage quotations would serve as a proxy for income and expenditure, and could be combined with least-cost diet metrics to monitor trends in food affordability (Headey et al., 2023). For households for whom the nutrient-adequate diet may have already been out of reach, additional metrics such as the affordability gap could help inform interventions, ensuring that they adequately respond to nutrition needs (Balagamwala et al., 2024).

Table 2
Population-weighted mean and standard deviation of the cost of nutrient-adequate diets for a five-person modelled household and non-affordability, by geographic region.

Geographic region	Countries	Cost of nutrient-adequate diets (2020 PPP USD)				Non-affordability (%)			
	N	N	Mean	Median	Standard Deviation	N	Mean	Median	Standard Deviation
All subnational areas (Total)	32	376	9.9	9.5	3.5	375[1]	42.6	46.8	27.0
Latin America and the Caribbean	4	39	17.9	18.4	2.3	39	39.7	41.0	12.5
African Sahel	4	36	5.5	4.5	2.8	36	58.0	54.6	15.9
Sub-Saharan Africa	11	114	8.2	8.4	2.7	114	64.1	67.0	15.6
Central Asia	2	13	17.7	17.1	4.7	13	49.2	53.5	16.3
South Asia	5	78	10.5	12.9	3.3	78	43.6	63.1	29.1
East Asia and the Pacific	6	96	10.2	9.7	2.5	95[1]	23.7	17.8	19.2

(1) Non-affordability was not calculated for Phnom Penh, Cambodia, given data limitations at the time the FNG analysis was performed.

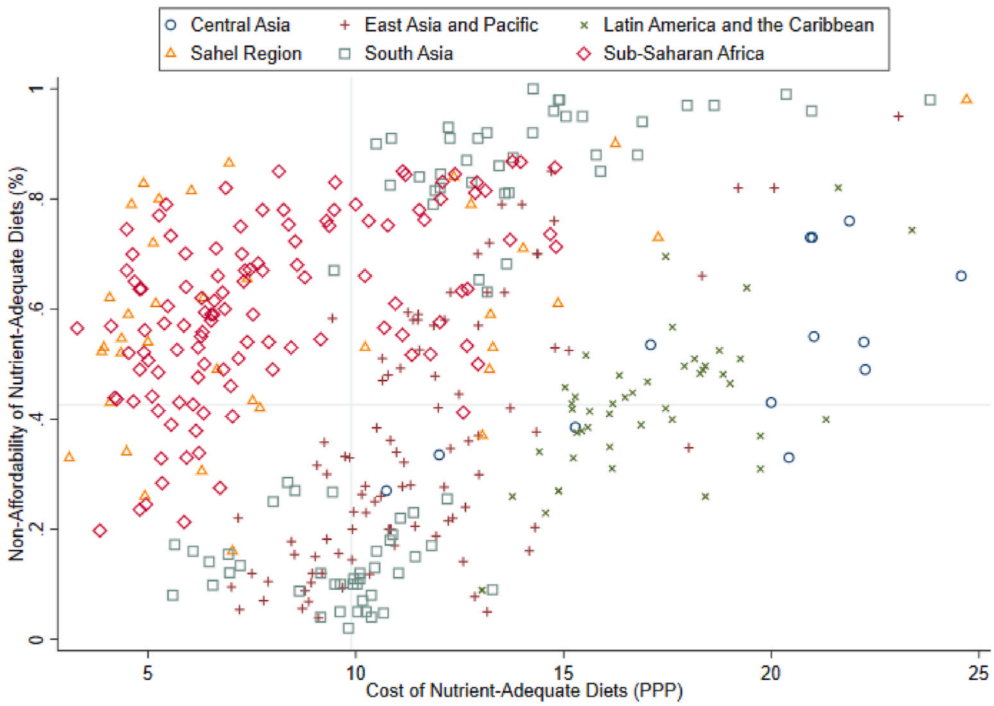

Fig. 7. Scatterplot between non-affordability prevalence and cost of nutrient-adequate diets for a five-person modelled household (2020 PPP USD), differentiating observations by geographic region, with gridlines indicating the mean non-affordability and the mean cost of nutrient-adequate diets ($n = 388$, $r_s = 0.19$, $p < 0.01$).

3.3. The relationship between non-affordability, insufficient FCS, minimum dietary diversity, and nutrition and health outcomes

Building on our analysis in section 3.1, we explored the relationship between non-affordability and nutrition outcomes among the low- and middle-income countries represented in the dataset. To explore the additive effect of the three regressors, we show the consecutive introduction of non-affordability, insufficient FCS and MDD to the model.

We found that all three regressors have a statistically significant association with stunting (Table 3). Non-affordability and MDD were highly significant ($p < 0.01$) and showed the largest coefficients in absolute values. Therefore, in areas with high levels of non-affordability or low levels of MDD, there may be a higher prevalence of stunting. Insufficient FCS showed a comparatively smaller, also significant ($p < 0.05$), coefficient, suggesting that this variable did not reflect the varying prevalence of chronic malnutrition as well, as it is not able to capture consumption adequacy beyond caloric adequacy.

Using the percentage of people deprived in nutrition as dependent variable showed consistent results as those found for stunting (Table 4). MDD showed the largest coefficient in absolute terms, followed by non-affordability ($p < 0.01$). Insufficient FCS showed the smallest coefficient ($p < 0.05$).

The indicator of percentage of people deprived in nutrition that feeds into the health poverty dimension of the MPI, "does not reveal intra-household disparities, but […] assumes shared positive (or negative) effects of achieving (or not achieving) certain outcomes" (Alkire et al., 2020). In turn, non-affordability of nutrient-adequate diets does not take into account how food expenditure is distributed within the household. Instead, it measures whether or not all individuals within that household would be able to access the nutrient-adequate diet. Both are household-level measures; the first of the effects and the other of the risks.

The lack of multicollinearity in our model suggested that non-affordability, MDD and insufficient FCS capture different aspects of nutritional vulnerability. Insufficient FCS reflects the risk of caloric inadequacy, providing early warning for places where the situation is most dire, but failing to provide the necessary nuance to understand risks beyond low energy intake. Low dietary diversity can be a reflection of overlapping challenges, including challenging food environments, gaps in knowledge of dietary needs, dietary practices and customs, or others. Non-affordability specifically reflects the economic challenges and limitations to affording nutrient-adequate diets in a subnational area, enabling an understanding of whether low household income and/or high prices of nutritious foods are impacting food security and nutrition.

Table 3
Regression analyses consecutively introducing the independent variables of Non-affordability, Insufficient FCS and MDD, and using stunting prevalence for children under 5 years of age as dependent variable.

Dependent variable: stunting prevalence for children under 5 years of age (%)			
	(1)	(2)	(3)
Non-affordability (%)	0.151*** (0.0326)	0.161*** (0.0243)	0.114*** (0.0186)
Insufficient FCS (%)		0.0396*** (0.0137)	0.0435** (0.0204)
Minimum Dietary Diversity (% of children 6–23 months)			−0.149*** (0.0418)
Constant	0.242*** (0.0151)	0.227*** (0.0186)	0.298*** (0.0206)
Observations	366	288	275
Number of groups	6	6	6

All regressions include region and country fixed effects, and controls for population size.
Robust standard errors in parentheses.
*p < 0.1.
*** p < 0.01.
** p < 0.05.

Table 4
Regression analyses consecutively introducing the independent variables of Non-affordability, Insufficient FCS and MDD as independent variables, and using percentage of people deprived in nutrition as dependent variable.

Dependent variable: people deprived in nutrition (%)			
	(1)	(2)	(3)
Non-affordability (%)	0.206*** (0.0595)	0.198*** (0.0683)	0.147** (0.0598)
Insufficient FCS (%)		0.0669 (0.0541)	0.0947* (0.0529)
Minimum Dietary Diversity (% of children 6–23 months)			−0.226*** (0.0712)
Constant	0.209*** (0.0528)	0.183*** (0.0505)	0.286*** (0.0492)
Observations	227	208	196
Number of groups	6	6	6

All regressions include region and country fixed effects, and controls for population size.
Robust standard errors in parentheses.
*** p < 0.01.
** p < 0.05.
* p < 0.1.

4. Limitations of this study

As an ecological study, the associations found should be interpreted with care and not as causal inference. These are only applicable at the subnational unit of analysis, and should not be drawn for individuals or households (Sedgwick, 2014; Morgenstern, 1995).

The dataset released in Turowska et al. (*this issue*) was limited to the low- and middle-income countries where an FNG analysis had been conducted, with a greater representation of Sub-Saharan Africa and Asia, and of low and lower-middle income countries. This analysis should not be considered globally representative, and the associations found may only be applicable for the included regions.

The analysis assumes that FNG estimates for cost and non-affordability were comparable across countries. For more information on the methodological approach for compiling FNG analyses for the dataset, please refer to Turowska et al. (*this issue*).

The indicators used in this analysis have different dates of collection, which could be a source of noise. Non-affordability depends on when the corresponding FNG analysis was performed. The date for dietary quality and nutrition and health outcome indicators varied by country, depending on the source used. These data could come from the same survey or from different ones, ranging from 2012 to 2019. We could not standardize the date for all variables used, and conditions in the country may have changed, though we do not expect large variations over this period. Stunting, for example, is a reflection of inadequate conditions over a long period of time and changes in prevalence rates are unlikely to be reflected over a short term (USAID Advancing Nutrition, 2020). The dietary diversity indicators used are measured at the food group level, and increases in the average number of food groups consumed are typically limited in magnitude. For further detail, please refer to Appendix Table A1 and Table A3.

Due to disparities in the subnational disaggregation or to limitations in data availability, we could not obtain a data point for certain variables and regions, and data points included in each analysis may vary. For further detail, please refer to Appendix Table A4.

Due to the lack of consolidated and comparable nutrition outcomes and dietary quality indicators for the household as a whole or for other household members at the subnational level, our comparison focuses on dietary quality of children 6–23 months, and stunting prevalence of children under 5. Other dietary quality or nutrition indicators, such as MDD-W or overweight and obesity, could show a different relationship.

Data from WFP's HungerMap were obtained from real-time monitoring surveys conducted using computer-assisted telephone interviewing (CATI). As not all households have access to phones or mobile networks, CATI methodology introduces a sampling bias, potentially skewed towards a wealthier more urban sample than the actual population. WFP uses a pre- and post-stratification weighting scheme to mitigate this bias, specific to the sampled households for each survey period (WFP, 2021b). Yet, biases may not be fully mitigated and could have an effect on the ability of the data to reflect the reality.

In the regression analyses we did not control for aspects pertaining to the way indicators were calculated (e.g., recall periods) or to the date in which these were collected. These may have an effect on the associations found and may limit the validity of our findings.

Finally, while we reviewed affordability of nutrient-adequate diets as a proxy to economic access of diets of adequate quality and quantity, we did not carry out in-depth comparisons with socioeconomic measures such as poverty, wealth, income or expenditure. The relationship between dietary intake and household economic indicators needs to be investigated further.

5. Conclusion

Economic downturns have been recognized globally as a major driver of food security and nutrition outcomes, with more than 1.5 billion people around the world already unable to afford a nutrient-adequate diet in 2017 (FAO et al., 2020), before the COVID-19 pandemic. Households with constrained purchasing power focus on meeting food needs through cheaper staple and highly processed, non-nutritious foods, sacrificing consumption of more expensive fresh nutritious foods and limiting diversity in their diets (Brinkman et al., 2010; Lo et al., 2009). Systematic reviews and evidence have shown that food insecurity and poor dietary quality increase the likelihood of stunting and other forms of malnutrition (Molani Gol et al., 2022; Gassara and Chen, 2021; Krasevec et al., 2017). Covariate shocks, such as the COVID-19 pandemic, can reduce people's ability to access nutritious foods, increasing even further vulnerable household's risk of malnutrition (Bai et al., 2022; Laborde et al., 2021).

Evidence at the subnational level is required for policy and programming to monitor vulnerabilities and risks of malnutrition and identify where interventions are needed. Quality biological or anthropometric data to assess malnutrition prevalence can be challenging to collect (Perumal et al., 2020; USAID, 2016), and outcomes such as stunting are high-level measures of long-term impact of different factors that are not easily attributable to a specific intervention (USAID Advancing Nutrition, 2020). On the other hand, dietary quality indicators such as minimum dietary diversity, rely on time consuming 24-h recall or food frequency questionnaire primary data that is not widely available, especially in low-income settings (Coates et al., 2017). This lack of data has been an obstacle for evidence-based nutrition policy and programmes (Coates et al., 2017; Fiedler et al., 2012), though availability of national-level data is likely to improve with the Global Diet Quality Project (Global Diet Quality Project). Finally, food security indicators which may be more widely and frequently monitored, such as insufficient FCS, focus on caloric adequacy and can fail to appropriately reflect nutritional risks. Though the FCS itself may also aim to capture considerations of nutrient density beyond energy content, dichotomizing the indicator by reporting only insufficient and sufficient FCS, shifts the focus to caloric insufficiency rather than inadequate diversity and quantity.

Non-affordability of nutrient-adequate diets and of other modelled diets such as the healthy diet basket (Herforth et al., 2020), in most cases can be calculated using secondary data (Turowska et al., *this issue*), making it an indicator relatively easy to calculate. It reflects the risk of inadequate nutrition due to economic constraints, providing evidence for policies and programmes to adequately address them. Global analyses have already shown the association between economic access and nutrition and health outcomes at the national level (Bai et al., 2020, 2021). Using the dataset published in Turowska et al. (*this issue*), we found this association holds at the subnational level. Non-affordability was strongly correlated with dietary quality indicators of minimum dietary diversity, consumption of vitamin A- and of iron-rich foods by children 6–23 months. In addition, regression analysis of prevalence of stunting and the percentage deprived in nutrition on non-affordability of nutrient-adequate diets returned highly significant results, indicating that non-affordability can help signal areas with greater risks and vulnerabilities to nutrition insecurity.

The calculation of non-affordability requires data on food prices and availability, and on household's expenditure on food. In many countries, these data are already being collected by governments or central banks for the calculation of Consumer Price Indices and can be representative at the subnational level. Household consumption and expenditure surveys also capture the availability of foods and the prices paid by consumers in a specific region (depending on the level of representativeness of the survey). The use of HCES as reliable source to understand food intake is increasingly being validated (Knight et al., 2021; Fiedler et al., 2012; Murphy et al., 2012). Other secondary sources can also potentially collect information on food prices and availability at the local level. For example, market price data collection systems in Mali, Niger and Burkina Faso have expanded their food lists to include fresh, nutritious foods (personal communication). This will allow the regular monitoring of the cost of nutrient-adequate diets in such countries.

Expenditure data is mostly obtained through HCES and could be periodically calculated depending on data availability in a specific country or region. In contexts where expenditure data is collected less frequently and therefore non-affordability can only be calculated every few years, monitoring the cost of the nutrient-adequate diet in between the calculation of non-affordability estimates, and used in conjunction with these periodical estimates, can help anticipate trends in the likelihood of consumption of nutritious and diverse foods. Proxies for income or expenditure, such as wages of the poor as proposed by Headey et al. (2023), could be used in conjunction with cost of nutrient-adequate diets to closely monitor affordability trends.

As food expenditure decisions are constrained by disposable income (FAO et al., 2020), the economic drivers of diets need to be measured and understood to be addressed. Periodical estimates of non-affordability of nutrient-adequate diets, in conjunction with constant monitoring of the cost of the nutrient-adequate diet, can provide valuable information for policy makers and programme design and monitoring by identifying risks to different forms of malnutrition, with the potential to reflect short, medium and long term effects of programmes and policies.

CRediT authorship contribution statement

Sabrina Kuri: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Zuzanna Turowska:** Writing – review & editing, Methodology, Data curation, Conceptualization. **Claudia Damu:** Writing – review & editing, Conceptualization. **Janosch Klemm:** Data curation. **Saskia de Pee:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix

Table A1
Survey year per country of the data extracted through the Demographic and Health Survey Program Application Interface (DHS API), the UNICEF/WHO/WB Joint Malnutrition Estimates (JME) data and the Multidimensional Poverty Index (MPI) data included in the analysis.

Country name	DHS API	JME	MPI
Afghanistan	2015	2018	2015–2016
Bangladesh	2017	2019	2019
Burkina Faso	2017	–	2010
Burundi	2016	2018–19	2016–2017
Cambodia	2014	2014	2014
Cameroon	2018	2018–19	2018
Democratic Republic of Congo	2013	2017–18	2017–2018
Dominican Republic	–	–	2014
Ecuador	–	2018–19	2013–2014
El Salvador	–	–	2014
Ethiopia	2019	2019	2019
Guatemala	2015	2014–15	2014–2015
Guinea Bissau	–	2019	2018–2019
Indonesia	2017	2018	2017
Kyrgyz Republic	2012	2018	2018
Laos	–	2017	2017
Lesotho	2014	–	–
Mali	2018	2019	2018
Mauritania	–	2018	2015
Mozambique	2018	2014–15	2011
Myanmar	2016	2017–18	2015–2016
Nepal	2016	2019	2019
Niger	2012	2019	2012
Pakistan	2017	2017–18	2017–2018
Philippines	2017	–	2017
Rwanda	2017	2019–20	2014–2015
Sri Lanka	–	–	–
Tajikistan	2017	2017	2017
Tanzania	2015	2018	–
Timor Leste	2016	2013	2016–2017
Uganda	2016	2016	2016–2017
Zambia	2018	2018–19	2018

Table A2
Detailed description of indicators used in the analysis

Indicator	Units	Source	Description
Cost of the nutrient-adequate diet	PPP USD	FNGSTAT	Least-cost staple-adjusted combination of foods that meets the required nutrient intake for energy, protein, fat, 9 vitamins and 4 minerals, of a standard 5-person modelled household including: • Child under 2 years, breastfed (either sex) • School-aged child (either sex) • Adolescent girl • Adult woman, pregnant or lactating • Adult man Staple adjustment is performed by adding two servings per day of a local staple per person, or only one serving per day for a child under 2 years old, which approximately cover half of energy requirements. (Bose et al., 2019; Turowska et al.) For this analysis, the per capita average of the modelled household cost is used. For specific data sources used to calculate this indicator in each country, please refer to Turowska et al..
Non-affordability of the nutrient-adequate diet	%	FNGSTAT	Percentage of people who are deemed not able to afford the calculated nutrient-adequate diet, based per capita expenditure on food. Non-affordability is calculated by comparing the per-capita cost of the nutrient adequate diet to per capita expenditure. This comparison is made by estimating expenditure percentiles in a given assessment area. Those percentiles falling below the cost of the nutrient-adequate diet are deemed as unable to afford it. Expenditure is obtained from surveys with standardized methodology, such as household consumption and expenditure surveys or living standards measurement surveys, when available. (Bose et al., 2019; Turowska et al.) For specific data sources used to calculate this indicator in each country, please refer to Turowska et al..
Insufficient FCS	%	WFP HungerMap	Percentage of people with poor or borderline Food Consumption Score (FCS). FCS is a composite score based on how often households consume items from eight different food groups, during a 7-day recall period. A food group score is calculated by multiplying consumption frequency by a standardized weight assigned to each food group. The resulting food groups scores are summed to obtain the overall Food Consumption Score. Households are classified into three group based on their scores: poor (0–21), borderline (21.5–35) and acceptable (>35). Those with poor or borderline FCS are grouped, and used in this analysis under the

(continued on next page)

Table A2 (*continued*)

Indicator	Units	Source	Description
			Insufficient FCS indicator. (INDDEX Project, 2018; WFP, 2022, 2009; Wiesmann et al., 2009)
Children 6–23 months old with minimum dietary diversity (MDD)	%	See Table A 3	Percentage of children 6–23 months of age who received foods from 5 or more food groups in the 24 h preceding the survey. MDD is one of the eight indicators used to asses Infant and Young Child Feeding practices, developed by the WHO. Data is collected through a questionnaire, where the child's caregiver is asked to indicate whether the child has consumed any food item belonging to 8 food groups in the preceding 24-h. The total number of food groups consumed is summed, and the indicator is calculated by dividing the number of children 6–23 months who received foods from 5 or more food groups by the total number of children 6–23 months in that area. (INDDEX Project, 2018; WHO, 2008)
Children 6–23 months old consuming iron-rich foods	%	DHS API	Percentage of children age 6–23 months who received foods rich in iron in the 24 h preceding the survey. This indicator is one of the eight indicators used to assess IYCF practices, developed by the WHO. Data is collected through a questionnaire, where the child's caregiver is asked to indicate whether the child has consumed any iron-rish or iron fortified food in the preceding 24-h. Iron-rich or iron fortified foods include flesh foods, commercially fortified foods designed for infants and young children, or foods fortified at home with a supplement containing iron. The number of children who received foods that are iron-rich or iron fortified is divided by the total number of children 6–23 months in that area. (INDDEX Project, 2018; WHO, 2008)
Children 6–23 months old consuming vitamin A-rich foods	%	DHS API	Percentage of children age 6–23 months who consumed foods rich in vitamin A in the 24 h preceding the survey. This indicator is calculated through a similar methodology as MDD, and often the same questionnaire is used to calculate both indicators. The number of children who received foods from the "vitamin-A rich fruits and vegetables" food group is divided by the total number of children 6–23 months in that area. (INDDEX Project, 2018; WHO, 2008)
Stunting prevalence for children under 5 years of age	%	See Table A 3	Percentage of children under 5 years of age falling below minus 2 standard deviations from the median height-for-age of the median from the WHO Child Growth Standards. (UNICEF, 2021)
People deprived in nutrition	%	MPI	Percentage of people living in a household where any person under 70 years of age for whom there is nutritional information, is undernourished. A household member is considered undernourished if: • For children under 5, if their z-score of either height-for-age or weight-for-age is below minus 2 standard deviations from the corresponding median of the reference population. • For children between 5 and 19 years of age, their body mass index (BMI) is below minus two standard deviations age-specific cutoff. • For adults above 19 years and under 70 years of age, their BMI is below 18.5 m/kg (Alkire et al., 2020, 2021)
Subnational population size	1000	See Table A 3	Thousands of people living in a specific subnational area.

Table A3
Data sources by indicator used for the analysis, per country

Country	Indicator Source		
	Children 6–23 months with MDD (%)	Stunting prevalence for children under 5 (%)	Population Size
Afghanistan	DHS API	JME	MPI
Bangladesh	DHS API	JME	MPI
Burkina Faso	Ministère de la Santé, 2020	Ministère de la Santé, 2020	MPI
Burundi	DHS API	JME	MPI
Cambodia	DHS API	JME	MPI
Cameroon	DHS API	JME	MPI
Democratic Republic of Congo	INS, 2019	JME	MPI
Dominican Republic	–	–	Oficina Nacional de Estadística, 2016
Ecuador	Instituto Nacional de Estadística y Censos, 2018	JME	MPI
El Salvador	Ministerio de Salud and Instituto Nacional de Salud, 2014	Ministerio de Salud and Instituto Nacional de Salud, 2014	MPI
Ethiopia	DHS API	JME	MPI
Guatemala	DHS API	DHS API	MPI
Guinea Bissau	–	JME	MPI
Indonesia	DHS API	JME	MPI
Kyrgyz Republic	DHS API	JME	MPI
Laos	Lao Statistics Bureau, 2018	JME	MPI
Lesotho	DHS API	DHS API	Lesotho Bureau of Statistics, 2016
Mali	DHS API	JME	MPI
Mauritania	–	JME	MPI
Mozambique	–	JME	MPI
Myanmar	DHS API	JME	MPI
Nepal	DHS API	JME	MPI
Niger	DHS API	JME	MPI
Pakistan	DHS API	JME	MPI
Philippines	Food and Nutrition Research Institute, 2016	Food and Nutrition Research Institute, 2016	MPI
Rwanda	National Institute of Statistics of Rwanda, 2021	JME	MPI
Sri Lanka	Department of Census and Statistics and Ministry of Health, 2017	Department of Census and Statistics and Ministry of Health, 2017	Department of Census and Statistics, 2021

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Table A3 (*continued*)

Country	Indicator Source		
	Children 6–23 months with MDD (%)	Stunting prevalence for children under 5 (%)	Population Size
Tajikistan	DHS API	JME	MPI
Tanzania	DHS API	JME	National Bureau of Statistics, 2013
Timor Leste	DHS API	DHS API	MPI
Uganda	DHS API	JME	MPI
Zambia	DHS API	JME	MPI

Table A4
Matrix of countries included in each analysis.

Analysis	Scatterplot & Spearman rank correlation						
Variables	- Children 6–23 months with MDD (%) - Non-affordability of nutrient-adequate diets (%)	- Children 6–23 months with MDD (%) - People with insufficient FCS (%)	- Children 6–23 months consuming iron-rich foods (%) - Non-affordability of nutrient-adequate diets (%)	- Children 6–23 months consuming iron rich foods (%) - People with insufficient FCS (%)	- Children 6–23 months consuming Vitamin A-rich foods (%) - Non-affordability of nutrient-adequate diets (%)	- Children 6–23 months consuming Vitamin A-rich foods (%) - People with insufficient FCS (%)	- Cost of the Nutrient-Adequate Diet (PPP USD) - Non-affordability of nutrient-adequate diets (%)
Figure	Fig. 1	Fig. 2	Fig. 3	Fig. 4	Fig. 5	Fig. 6	Fig. 7
n	345	281	245	204	245	204	388
Countries included	Afghanistan Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Indonesia Kyrgyz Republic Laos Lesotho Mali Myanmar Nepal Niger Pakistan Philippines Rwanda Sri Lanka Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Kyrgyz Republic Laos Lesotho Mali Myanmar Nepal Niger Philippines Rwanda Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burundi Cambodia Cameroon Democratic Republic of Congo Ethiopia Guatemala Indonesia Kyrgyz Republic Lesotho Mali Myanmar Nepal Niger Pakistan Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burundi Cambodia Cameroon Democratic Republic of Congo Ethiopia Guatemala Kyrgyz Republic Lesotho Mali Myanmar Nepal Niger Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burundi Cambodia Cameroon Democratic Republic of Congo Ethiopia Guatemala Indonesia Kyrgyz Republic Lesotho Mali Myanmar Nepal Niger Pakistan Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burundi Cambodia Cameroon Democratic Republic of Congo Ethiopia Guatemala Kyrgyz Republic Lesotho Mali Myanmar Nepal Niger Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Dominican Republic Ecuador El Salvador Ethiopia Guatemala Guinea bissau Indonesia Kyrgyz Republic Laos Lesotho Mali Mauritania Mozambique Myanmar Nepal Niger Pakistan Philippines Rwanda Sri Lanka Tajikistan Tanzania Timor Leste Uganda Zambia

Analysis	Mixed-effects regression analysis			Mixed-effects regression analysis		
Variables	Dependent: - Stunting prevalence for children under 5 (%) Independent: - Non-affordability of nutrient-adequate diets (%)	Dependent: - Stunting prevalence for children under 5 (%) Independent: - Non-affordability of nutrient-adequate diets - People with insufficient FCS (%)	Dependent: - Stunting prevalence for children under 5 (%) Independent: - Non-affordability of nutrient-adequate diets - People with insufficient FCS (%) - Children 6–23 months with MDD (%)	Dependent: - People deprived in nutrition (%) Independent: - Non-affordability of nutrient-adequate diets (%)	Dependent: - People deprived in nutrition (%) Independent: - Non-affordability of nutrient-adequate diets - People with insufficient FCS (%)	Dependent: - People deprived in nutrition (%) Independent: - Non-affordability of nutrient-adequate diets - People with insufficient FCS (%) - Children 6–23 months with MDD (%)

(*continued on next page*)

Table A4 (*continued*)

Analysis	Mixed-effects regression analysis			Mixed-effects regression analysis		
Table	Table 3	Table 3	Table 3	Table 4	Table 4	Table 4
n	367	289	276	227	208	196
Countries included	Afghanistan[1] Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Guinea bissau Indonesia Kyrgyz Republic Laos Lesotho Mali Mauritania Mozambique Myanmar Nepal Niger Pakistan Philippines Rwanda Sri Lanka Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan[1] Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Guinea bissau Kyrgyz Republic Laos Lesotho Mali Mozambique Myanmar Nepal Niger Philippines Rwanda Tajikistan Tanzania Timor Leste Uganda Zambia	Afghanistan Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Kyrgyz Republic Laos Lesotho Mali Myanmar Nepal Niger Philippines Rwanda Tajikistan Tanzania Timor Leste Uganda Zambia	Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Guinea Bissau Kyrgyz Republic Laos Mali Mauritania Mozambique Myanmar Nepal Niger Pakistan Rwanda Tajikistan Timor Leste Uganda Zambia	Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Guinea Bissau Kyrgyz Republic Laos Mali Mozambique Myanmar Nepal Niger Rwanda Tajikistan Timor Leste Uganda Zambia	Bangladesh Burkina Faso Burundi Cambodia Cameroon Democratic Republic of Congo Ecuador El Salvador Ethiopia Guatemala Kyrgyz Republic Laos Mali Myanmar Nepal Niger Rwanda Tajikistan Timor Leste Uganda Zambia

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