

Spatial Patterns of Multiple Malnutrition Types in West Africa: Four Country Case Studies



PHOTO: MILO MITCHELL / IFPRI

Why is this analysis needed?

Low- and middle-income countries (LMICs), including in Africa south of the Sahara, face a “new nutrition reality” (Popkin, Corvalan, and Grummer-Strawn 2020) referred to as the double burden of malnutrition, where children under five years of age (U5s) and women of reproductive age (WRA) continue to experience high rates of undernutrition while, at the same time, the rates of overweight and obesity in these populations are on the rise (Development initiatives 2020).

Transform Nutrition West Africa is funded by the Bill & Melinda Gates Foundation and led by IFPRI.

Addressing this new reality requires double and even multiple duty interventions (Hawkes et al. 2020). To design and deliver such interventions effectively, it is critical for decisionmakers to understand factors driving this double burden. They need to know where different malnutrition types (co-)occur within communities and households and even within a single individual, as well as what factors contribute to this (co-)occurrence. To address this knowledge gap,

Transform Nutrition West Africa, as part of its aim to improve effective policy and programmatic action on nutrition in the West Africa region, carried out a study in its four focal countries, Burkina Faso, Ghana, Nigeria, and Senegal. The findings can support policymakers in setting more informed priorities for addressing all types of malnutrition in their country. They also inform researchers and implementers on contextual factors that play a role in these (co-)occurrences.

Multiple malnutrition burdens in case countries

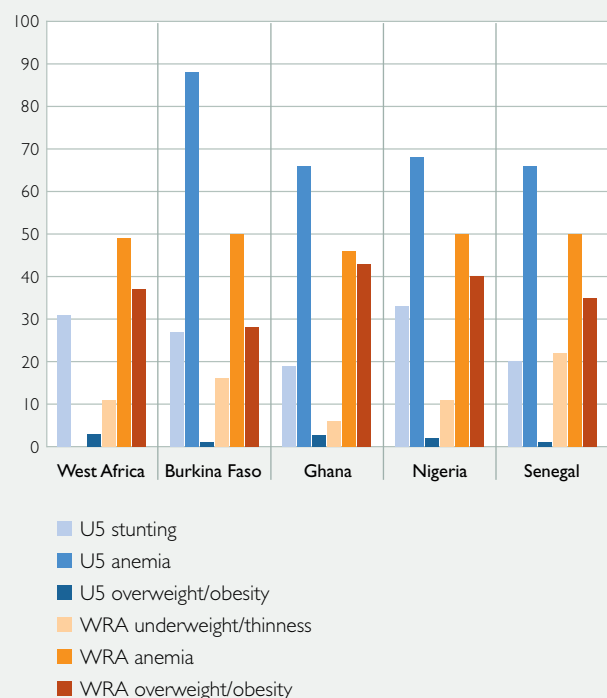
Burkina Faso, Ghana, Nigeria, and Senegal are characterized by a high prevalence of undernutrition among U5s and WRA (**Figure 1**), while overweight/obesity is rising steadily in all four countries, particularly among WRA (Development initiatives 2020). All now face the intersecting crises of undernutrition (U5 stunting, WRA underweight/thinness, U5/WRA anemia), overweight and obesity, and related non-communicable diseases (NCDs), alongside the compounding challenges posed by climate change (Swinburn et al. 2019) and COVID–19.

Earlier work focusing on Africa south of the Sahara has mapped existing and predicted prevalence of several types of malnutrition (Osgood-Zimmerman et al. 2018), examined the spatial correlation between them (Gayawan, Adebayo, and Waldmann 2019; Adeyemi, Zewotir, and Ramroop 2019), and identified their underlying contextual factors (Chuang et al. 2020). Very few studies, however, have looked at the spatial patterns of the co-occurrence of multiple malnutrition burdens (MMBs) within the same individuals or within mother–child pairs (Jones, Acharya, and Galway 2016). To allow for better decision-making on how to address these MMBs, we sought to understand where these MMB (co-)occur within communities and mother-child pairs (households) and within single individuals, and identify which contextual factors play a role in these co-occurrences.

Key messages

- Multiple malnutrition types among children under five years of age (U5s) and women of reproductive age (WRA) are increasingly found within a single community or household, and even within a single individual.
- Stunting and anemia among U5s is the most common co-occurrence of malnutrition types in Burkina Faso, Ghana, and Nigeria.
- The most frequent co-occurrence of malnutrition in mother–child pairs is anemic mothers with anemic children, and overweight/obese mothers with anemic children.
- Contextual factors of multiple malnutrition burdens (MMBs) vary between countries, with some similarities. When both mother and child suffer from anemia it is found to most likely be associated with malaria, whereas when an overweight/obese woman's child is anemic, it is more likely associated with poor hygiene and feeding practices.
- The MMB of overweight/obese mothers with anemic children is also more likely to be found in rural areas, wealthier households, and in families with more educated women.

Figure 1. Prevalence levels of different malnutrition types among children under five and women of reproductive age

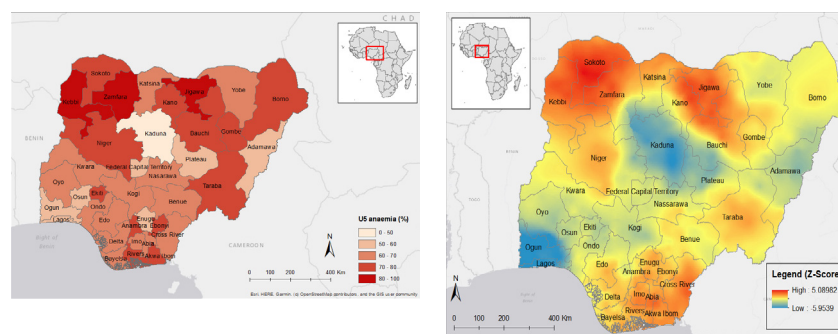
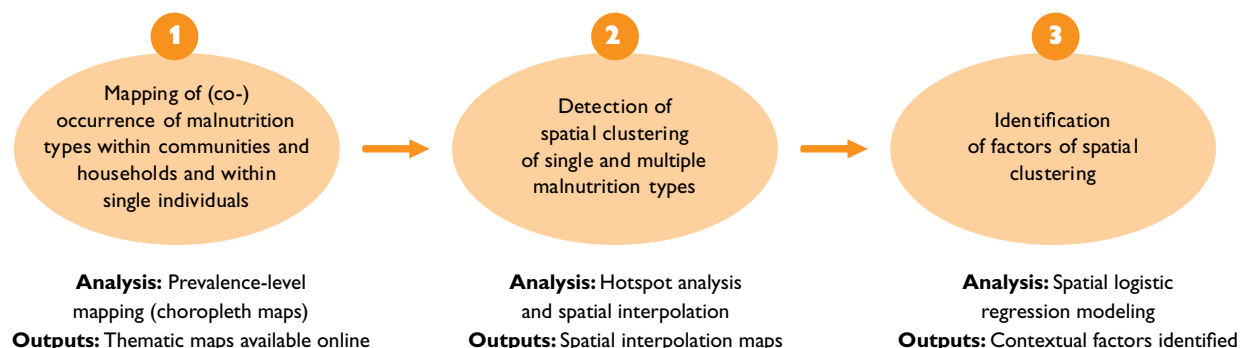


SOURCE: Transform Nutrition West Africa's Inception Report, 2018, using Joint Malnutrition Estimates 2017 data (IFPRI 2018).
NOTE: U5 = children under five years of age;
WRA = women of reproductive age.

Approach to mapping multiple malnutrition burdens

To map malnutrition burdens, we used the latest Demographic and Health Survey (DHS) data from Burkina Faso (2010), Ghana (2014), Nigeria (2018), and Senegal (2019). Data from these health surveys was used to: (1) analyze the occurrence and the co-occurrence of multiple types of malnutrition within the same communities and the same households (mother–child pairs), and among single individuals; (2) detect spatial clustering of these single and multiple types of malnutrition; and (3) identify contextual factors of this spatial clustering (**Figure 2**).

Figure 2. Analysis steps



SOURCE: Transform Nutrition West Africa; further details are available online (IFPRI 2021).

First, we examined the prevalence of single occurrences of malnutrition types among U5s and WRA at the subnational level (**Table 1**); the co-occurrence of more than one malnutrition burden in the same location (region or state); the proportion of mother–child pairs experiencing more than one malnutrition type; and the proportion of individuals experiencing more than one malnutrition type (U5s or WRA).

Second, hotspot analyses¹ were carried out on DHS clusters to determine where clusters of high (hotspots) or low (coldspots) MMBs occurred (**Box 1**). Spatial interpolation was carried out to predict if areas not covered by the DHS were hotspots or coldspots.

Finally, for malnutrition types for which a spatial clustering was detected, we used spatial regression modelling at the cluster level to better understand which factors were associated with the hotspots. The complete set of results and maps for each country can be found online (IFPRI 2021). **Table 2** provides the full list of the maps that were produced for each country; those that are included in this evidence note are starred.

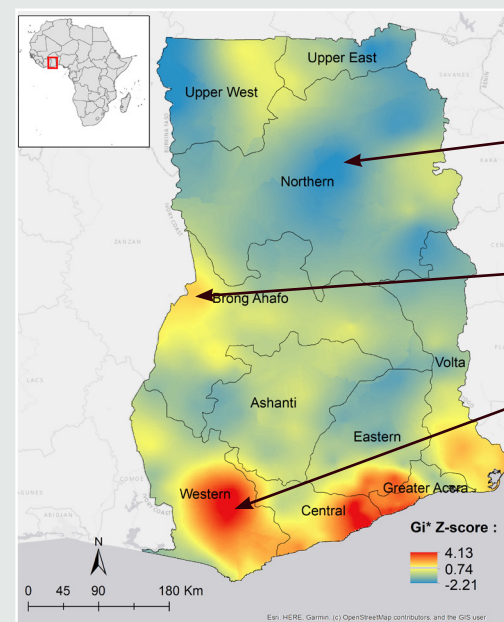
¹ The hotspot analysis allows to calculate the Getis-ord G_i^* statistic, a z-score, for each cluster. Hotspots are clusters with positive and statistically significant G_i^* meaning these clusters have high prevalence of a given MMB and are surrounded by clusters with high prevalence (clustering of high values). Cold spots have negative and statistically significant G_i^* indicating a clustering of low prevalence clusters.

Table 1. Types of malnutrition considered and their definitions

Type of malnutrition	Definition
U5 stunting ¹	Height-for-age z-score under -2 standard deviations (SDs)
U5 anemia ^{1,2}	Hemoglobin (Hb) under 11.0 g/dL (110 g/l)
U5 overweight/obesity ¹	Weight-for-height z-score over 2 SDs
WRA thinness/underweight ²	Body mass index (BMI) under 18.5 kg/m ²
WRA anemia ^{1,2}	Hb under 12.0 g/dL (120g/L)
WRA overweight/obesity ²	BMI equal to or over 25 kg/m ²

NOTE: ¹ Malnutrition type is part of World Health Assembly 2025 targets; ² Data on anemia among U5s and malnutrition among WRA was not collected in Senegal's 2019 Demographic and Health Survey; U5 = under five years of age; WRA = women of reproductive age.

Box 1. How to interpret the maps presented in this evidence note



These maps result from the spatial interpolation of the hotspot analysis results.

Blue areas represent coldspots: areas with a spatial clustering of low prevalence of two types of malnutrition.

Yellow to **orange** areas represent areas in which no spatial clustering was found.

Red areas represent hotspots: areas with a spatial clustering of high prevalence of two types of malnutrition.

Table 2. List of the maps generated, by country

	Burkina Faso	Ghana	Nigeria	Senegal+
SINGLE MALNUTRITION TYPES				
U5 stunting				*
U5 anemia				
U5 overweight and obesity		No spatial clustering	No spatial clustering	*
WRA underweight/thinness				
WRA anemia				
WRA overweight and obesity				
CO-OCCURRENCE OF MULTIPLE MALNUTRITION TYPES				
Within location (subnational level)				
U5 malnutrition burden by location				
WRA malnutrition burden by location				
Within the same household (mother–child pairs)				
U5 stunting + WRA thinness				
U5 anemia + WRA overweight	*	*	*	
U5 stunting + WRA anemia				
U5 stunting + WRA overweight			No spatial clustering	
U5 anemia + WRA anemia	*		No spatial clustering	
Within a single individual				
WRA overweight + WRA anemia			*	
U5 stunting + U5 anemia	*	*		

SOURCE: Authors

NOTE: All maps are available online; + because the 2019 DHS in Senegal did not collect data on U5 anemia nor on several WRA malnutrition types (underweight/thinness, anemia, or overweight/obesity), it was not possible to carry out the full analysis for this country; * indicates inclusion in this evidence note; WRA = women of reproductive age; U5 = children under five years of age.

LEGEND

	Maps of prevalence levels or burdens
	Spatial interpolation maps of hotspot analysis
	Full analysis: choropleth map, spatial interpolation of hotspot and spatial regression analysis
	Hotspot analysis impossible, grouping analysis conducted
	Prevalence level below 10 percent
	No data available in most recent survey

Findings

This evidence note focuses on the co-occurrence of several types of malnutrition in mother–child pairs within households (U5s and WRA), and within single individuals. It reports on each of the four TNWA focal countries for which the hotspot analysis and spatial interpolation were carried out and present the most interesting results (see **Table 2**).

BURKINA FASO (BASED ON DHS 2010)

OCCURRENCE OF SINGLE MALNUTRITION TYPES

In 2010, both U5 anemia and stunting prevalence rates remained high in most of Burkina Faso, representing a severe public health problem (De Benoist and Mclean 2008). Anemia prevalence for U5s was over 90 percent in 9 out of 13 administrative regions and above 80 percent in 3 regions (Boucle de Mouhoun, Hauts-Bassins, and Sud-Ouest); only Centre Region (where the capital city Ouagadougou is located) had a slightly lower U5 anemia prevalence level of 75 percent. U5 stunting prevalence levels were similarly high in most of the country: between 30 and 40 percent in 9 out of 13 regions and over 40 percent in Sahel and Est regions. Two regions had lower stunting prevalence rates than this: Centre (20 percent) and Centre-Nord (29 percent).

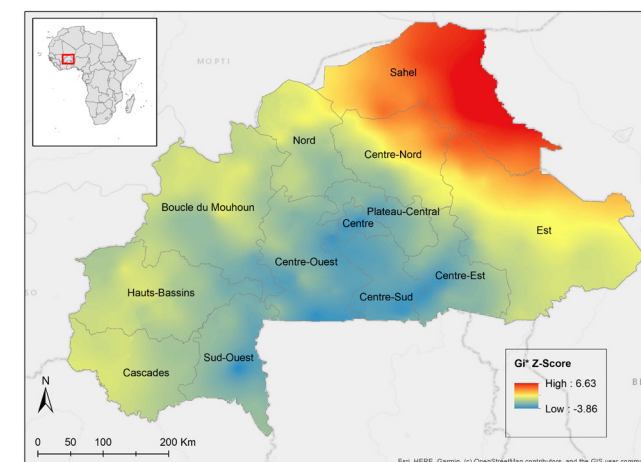
WRA underweight/thinness reflected a similar pattern, with Sahel and Est regions experiencing underweight/thinness prevalence rates of 21 percent and 28 percent respectively, while prevalence rates were below 20 percent in the rest of the country and below 10

percent in Centre and Cascades. While overweight/obesity rates remained below 10 percent for U5s and WRA in most of the country, this was higher for WRA in Centre (13 percent) and for U5s in Est (3 percent) (maps available online (IFPRI 2021)).

CO-OCCURRENCE OF MULTIPLE MALNUTRITION TYPES AND THEIR ASSOCIATED FACTORS

Prevalence of mother–child pairs in which both the mother and child were anemic was highest in Cascades and Sahel regions (above 30 percent of mother–child pairs), with Sahel being a particular hotspot (**Figure 3a**). The spatial regression analysis showed that the anemia from which this area's mother–child pairs suffered was strongly associated with the incidence of malaria. Hotspots were more likely to be found in areas with high levels of livestock in which mother–child pairs were composed of older children. It was also found that the risk of this MMB hotspot decreased in areas where mothers were educated, had an income-generating activity, delivered in health facilities, and had their child vaccinated for measles.

Figure 3a. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of mother–child pairs where both mother and child are anemic in Burkina Faso



NOTE: U5 = children under five years; WRA = women of reproductive age; G_i^* = Getis-Ord G_i^* .
SOURCE: Demographic and Health survey for Burkina Faso (2010)

Figure 3b. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of mother–child pairs with an anemic child and an overweight/obese mother in Burkina Faso

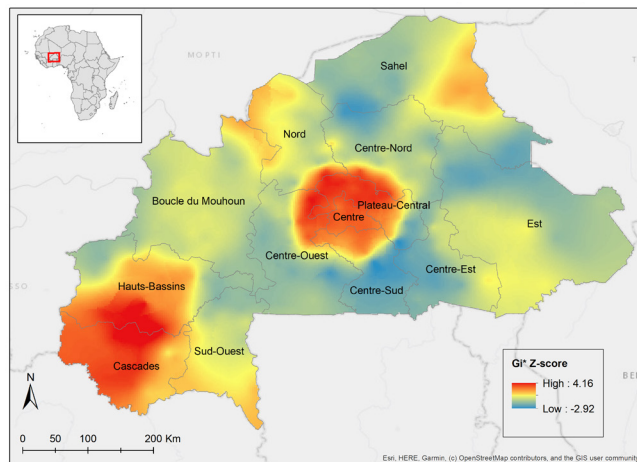
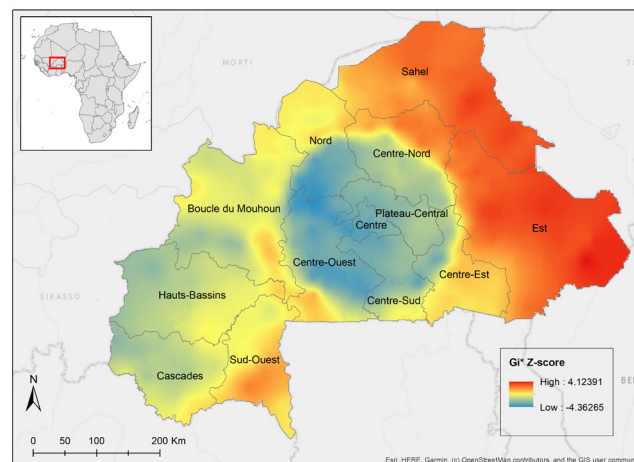


Figure 3c. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of simultaneous stunting and anemia among U5s in Burkina Faso



NOTE: U5 = children under five years; WRA = women of reproductive age; G_i^* = Getis-Ord G_i^* .
SOURCE: Demographic and Health survey for Burkina Faso (2010)

While the proportion of mother–child pairs with an anemic child and an overweight/obese mother remained under 10 percent in most of the country, there were two MMBs hotspots in and around Centre and in Cascades and Hauts-Bassins regions (**Figure 3b**). The spatial regression analysis showed that this type of anemia was less strongly associated with malaria and that such hotspots were more likely to happen in areas with wealthier households, higher prevalence of open defecation, and challenges faced by mothers in accessing medical facilities. Factors that coincided with a reduced risk of this kind of hotspot included higher prevalence of appropriate breastfeeding, better coverage by full vaccinations, and antenatal visits during pregnancy.

Prevalence rates of U5 children who were both stunted and anemic were high, with at least 20 percent of individuals experiencing this MMB throughout the country. Hotspots were noted in Sahel and Est regions, with coldspots in the central part of the country (**Figure 3c**). The spatial regression analysis showed a higher risk of a U5 combined anemia and stunting hotspot where there were more children per mother; more adults in a household, and where a higher proportion of mothers smoked, were educated, or had an income-generating activity. Factors that reduced the risk of such an MMB hotspot included being a rural area with a higher coverage of full polio vaccination and older mothers.

GHANA (BASED ON DHS 2014)

OCCURRENCE OF SINGLE MALNUTRITION TYPES

In 2014, most of the regions in Ghana had a single burden of anemia among U5s; the overall prevalence level was above 40 percent, indicating a severe public health problem (De Benoist and Mclean 2008). The Central, Upper-West, and Northern regions were facing burdens of both U5 stunting (with a prevalence level above the trigger level of 20 percent (De Onis et al. 2019)) and U5 anemia. The Greater Accra Region, where the capital city of Accra is located, was facing a double burden of anemia and overweight among U5s (with a prevalence level above the WHA target of 3 percent (IFPRI 2018)). Among WRA in all regions of Ghana, the prevalence of underweight/thinness, anemia, and overweight/obesity were below the threshold levels that indicate severe public health problems. At least one woman out of four in the Greater Accra Region, however, was experiencing overweight/obesity, and the prevalence of anemia was the highest in the country (28 percent), indicating a similar pattern to that among U5s (maps available online (IFPRI 2021)).

CO-OCCURRENCE OF MULTIPLE MALNUTRITION TYPES AND THEIR ASSOCIATED FACTORS

A focus on individuals who are facing different types of malnutrition simultaneously shows a clustering of areas in the Northern region where high proportions of children were both stunted and anemic (27 percent); this was the case to a lesser extent in the Central region (16 percent) (**Figure 4a**).

Figure 4a. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of simultaneous stunting and anemia among U5s in Ghana

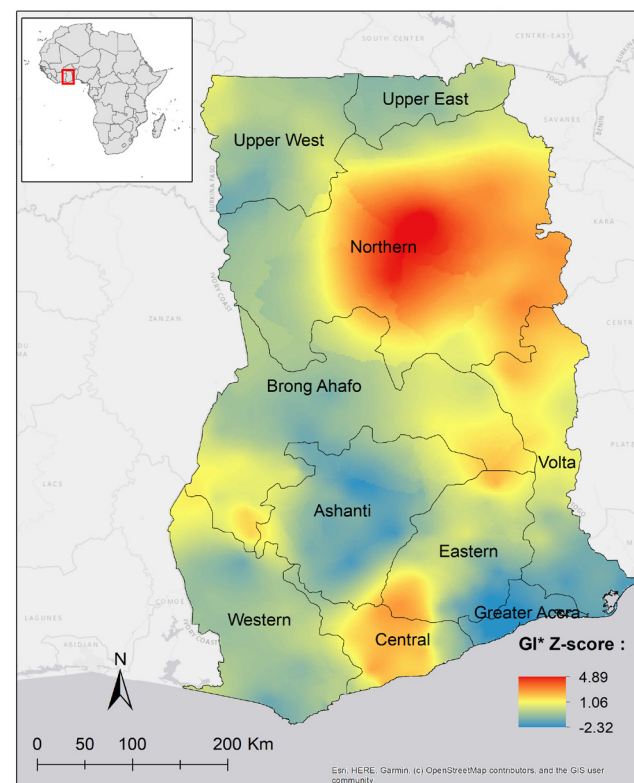
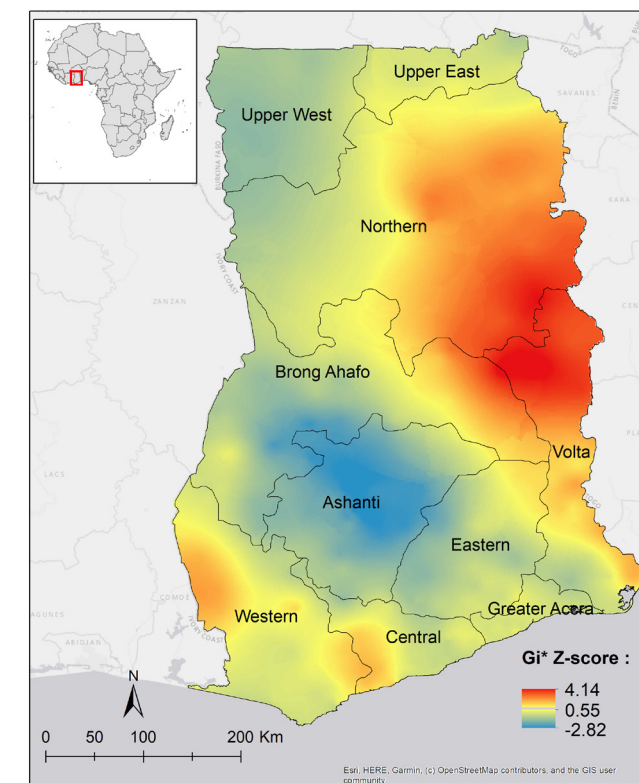


Figure 4b. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of mother-child pairs where both mother and child are anemic in Ghana



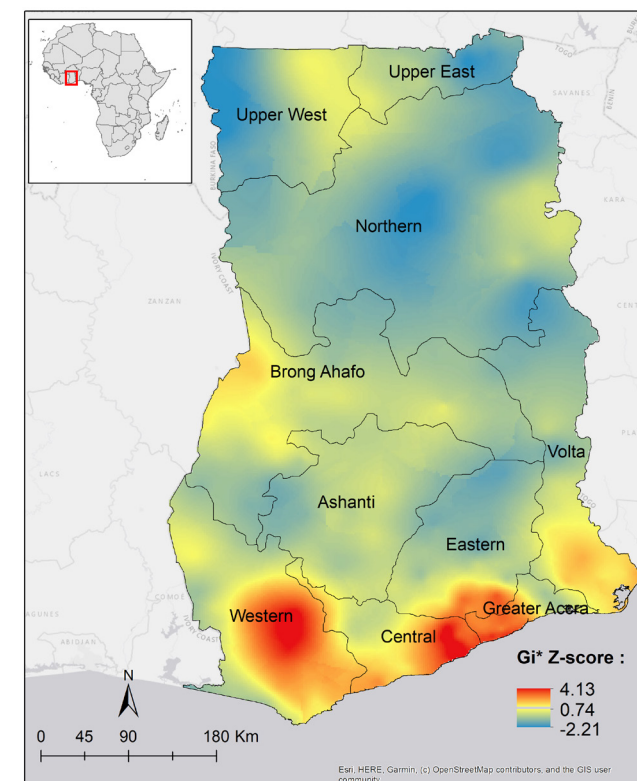
NOTE: U5 = children under five years; WRA = women of reproductive age; Gi* = Getis-Ord Gi*.
SOURCE: Demographic and Health survey for Ghana (2014)

Mother–child pairs in Ghana experienced undernutrition or a double burden of malnutrition in some regions. In the Northern, Central, and Volta regions, at least one in five mother–child pairs included a mother and a child who were both anemic. The hotspot analysis detected a clustering of areas in the Eastern region with high proportions of mother–child pairs with anemia (**Figure 4b**). The Ashanti region, which was found to have lower prevalence levels of U5 and WRA anemia, was also the region with a coldspot of mother–child pairs with anemia.

The spatial regression analysis on hotspots of anemic mother–child pairs showed that the anemia was strongly associated with malaria, and that other risk factors included the child being a girl, mothers having poor access to medical facilities, and a higher average size of household.

The double burden of malnutrition is a problem among mother–child pairs in Ghana, with higher proportions of mother–child pairs in the Volta, Greater Accra, Central, and Western regions where the child was anemic and the mother was overweight/obese (**Figure 4c**). Coldspots of this MMB were found in the Northern part of Ghana, where underweight/thinness was more prevalent among WRA (IFPRI 2021). The risk factors of hotspots of this MMB included a higher proportion of wealthy households living in a rural area in which the children had achieved minimum dietary diversity. It was also found that the anemia from which the children in these mother–child pairs suffered was not associated with malaria.

Figure 4c. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of mother–child pairs with an anemic child and an overweight/obese mother in Ghana



NOTE: U5 = children under five years; WRA = women of reproductive age; Gi* = Getis-Ord Gi*.
SOURCE: Demographic and Health survey for Ghana (2014)

NIGERIA (BASED ON DHS 2018)

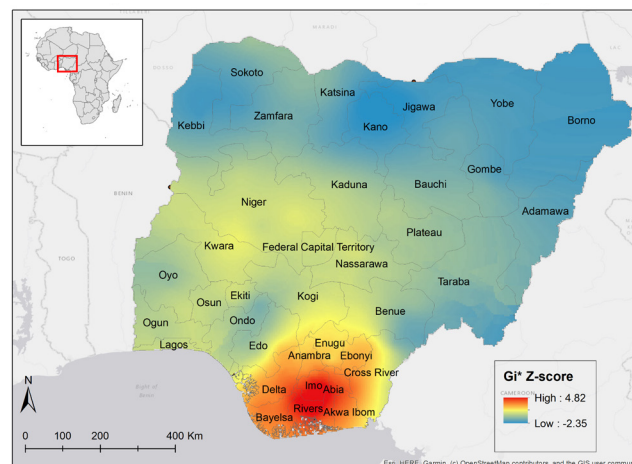
OCCURRENCE OF SINGLE MALNUTRITION TYPES

In 2018, prevalence of undernutrition in U5s (stunting, anemia) and WRA (underweight/thinness, anemia) was generally much higher in the northern part of the country than in the south, with northern states seeing U5 stunting rates of over 40 percent, U5 anemia rates of over 70 percent, and WRA underweight/thinness and anemia rates of over 10 percent and 50 percent, respectively. Anemia rates for both U5s and WRA tended also to be high in other parts of the country, such as the northwestern and southeastern states. Overweight/obesity, particularly for WRA, however, represented the opposite pattern, with southern states experiencing 10 to 20 percent WRA overweight/obesity and northern states seeing rates below 10 percent (maps available online (IFPRI 2021)).

CO-OCCURRENCE OF MULTIPLE MALNUTRITION TYPES AND THEIR ASSOCIATED FACTORS

The MMB in mother–child pairs in which the child was anemic and the mother was overweight/obese was particularly high in the southeastern states; in Rivers and Anambra, for example, this MMB was experienced by at least 3 out of 10 mother–child pairs. This is reflected by the hotspot analysis, which showed a clustering of this MMB in, and surrounding, these states (**Figure 5a**). The spatial regression analysis of this MMB showed that there were more hotspots in rural areas and that they coincided with a higher proportion of older, educated mothers. Hotspots were much less likely where there were appropriate breastfeeding practices, where

Figure 5a. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of mother–child pairs with an anemic child and an overweight/obese mother in Nigeria

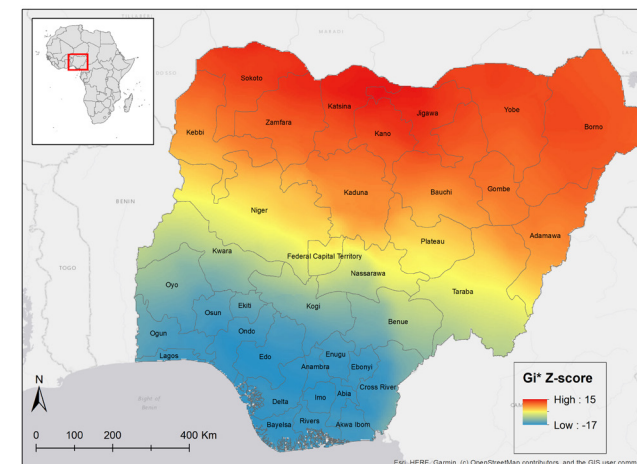


NOTE: WRA = women of reproductive age; U5 = children under five years; Gi* = Getis-Ord Gi*.
SOURCE: Demographic and Health survey for Nigeria (2018)

households had handwashing stations, and where the child of the mother–child pair was younger.

With regard to MMBs within a single individual, the proportion of U5s experiencing stunting and anaemia simultaneously was particularly high in northern states (over 30 percent), declining to rates between 10 and 20 percent in southern states. Only in Anambra and Lagos states was the proportion of U5 with this double burden lower than 10 percent. The hotspot analysis reflects these trends (**Figure 5b**). The spatial

Figure 5b. Spatial interpolation map showing hotspots (in red) and coldspots (in blue) of simultaneous stunting and anemia among U5 in Nigeria



regression analysis of this MMB showed that factors increasing the risk of such a hotspot included bigger average household size and high diarrhea prevalence levels. Higher coverage of vitamin A supplementation and antenatal visits during pregnancy, a higher proportion of children with minimum dietary diversity, and older educated mothers with an income generating activity were factors that reduced existence of such hotspots, as well as being a rural area.

SENEGAL (BASED ON DHS 2019)

Findings on Senegal are limited as the 2019 DHS did not include collection of data on U5 anemia or on several WRA malnutrition types (underweight/thinness, anemia, and overweight/obesity). We could therefore not perform the spatial regression analysis.

OCCURRENCE OF SINGLE MALNUTRITION TYPES

With regard to U5 stunting in 2019, however, a clustering of high prevalence areas was detected in the southern part of the country, particularly in Kédougou where almost one out of four children were stunted (a prevalence level of 24 percent) (maps available online (IFPRI 2021)).

The lowest prevalence of U5 stunting was found in and surrounding Dakar; which is the capital city and the most developed region. Despite the low prevalence of overweight/obesity in U5 children—which was below the WHA target of 3 percent in all regions—a hotspot was detected in Dakar and in its closest neighbour, Thiès (maps available online (IFPRI 2021)).

Using 2017 DHS data for Senegal, U5 anemia was found to be a burden in all regions in Senegal with a prevalence level higher than 50 percent, and at least one out of five children in the country's four southeast regions suffered from both stunting and anemia.

Monitoring of the situation through data collection is therefore important.

Comparison across countries and implications

In all four countries, the MMB of stunting and anemia was most prevalent in U5s. Only U5s in the Greater Accra Region of Ghana experienced, in addition to this MMB, a high burden of anemia and overweight. Among WRA, some regions/states of Burkina Faso and Nigeria stood out as having the highest prevalence of underweight/thinness and anemia. In terms of MMBs within households, anemia affecting both mother and child pairs was found in all three countries (in at least one out of five mother-child pairs in some regions/states). Ghana and Nigeria also had high prevalence of a U5 anemia and WRA overweight/obesity MMB in mother-child pairs (at least one pair out of five in the southern regions/states). With regard to MMBs within the same individual, U5s who were suffering from both stunting and anemia were found in (eastern) Burkina Faso, (northern) Nigeria, and (northern) Ghana.

Contextual factors for these MMBs varied between countries, but when both a mother and her child suffered from anemia it was more likely to be malaria related. Findings suggest that, in Burkina Faso, hotspots of children with an MMB of stunting and anemia were related to mothers having higher levels of education (and having an income-generating activity) or having larger households. In Nigeria, however, the complete opposite was found as the high proportion of educated mothers or those who had an income generating activity decreased the risk of having hotspots of this MMB. Rather, this MMB was associated with poor feeding and water, sanitation, and hygiene (WASH) practices. When an overweight/

obese woman had an anemic child, rather than being malaria related, in Burkina Faso, Ghana, and Nigeria it was linked with poor WASH practices; in Burkina Faso, it was also associated with poor feeding practices. In Ghana, the MMB of overweight/obese mothers with anemic children was also more common in rural areas, wealthier households, and households with more highly educated women.

The contextual factors associated with MMBs identified fall into three categories: modifiable factors (e.g., feeding and WASH practices), modifiable factors—that we do not want to modify (e.g., high levels of education of mothers or households' wealth being risk factors for overweight/obese mothers with anemic children), and non-modifiable factors (e.g., age of mothers, sex of children). While all categories contribute to a better understanding of which factors may drive the occurrence of these MMBs, the modifiable factors are those that can inform future intervention development. Non-modifiable factors may help identify key target groups. A limitation of this study is the use of the DHS datasets as these do not include data on potentially important factors such as food consumption, the food environment, or lifestyle behaviours (e.g., physical activity). Primary data collection on these factors, for identified MMBs hotspots, is needed to inform double duty actions.

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To cite this publication:

Diop, L., van den Bold, M., Guo, Z. and Verstraeten, R. 2021.
Spatial Patterns of Multiple Malnutrition Types in West Africa: Four Country Case Studies.
 Transform Nutrition West Africa Evidence Note No. 22 (August).
 Dakar, Senegal: International Food Policy Research Institute.

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Transform Nutrition West Africa is a regional platform to enable effective policy and programmatic action on nutrition. It is funded by the Bill & Melinda Gates Foundation from 2017–2021 and is led by the International Food Policy Research Institute.

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