Data DENT

Data for Decisions in Nutrition

TECHNICAL NOTE

Measuring who is being reached with multisector nutrition interventions:

a methodological framework for co-coverage and composite coverage analysis



Project Note

DataDENT (Data for Decisions in Nutrition, www.datadent.org) aims to transform the availability and use of nutrition data by addressing gaps in nutrition measurement and advocating for stronger nutrition data systems. This work was carried out by the following DataDENT: Johns Hopkins Bloomberg School of Public Health (JHBSPH) [N. Akseer, A. Maiga, R. Heidkamp, H. Tasic, T. Morrison, K. Siekmans],and International Food Policy Research Institute (IFPRI) [S. Kim, P, Nguyen, S. Manohar], Collaborating institutions include Ethiopian Public Health Institute (EPHI), International Centre for Diarrhoeal Disease Research, Bangladesh (Iccdr,B), Bangladesh National Nutrition Council, Nigeria Agriculture and Health Initiative (NAHI).

This work was primarily funded by the Gates Foundation. The Nigeria application was funded by Big Win Philanthropy. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Gates Foundation or Big Win Philanthropy.

Suggested citation: DataDENT 2026. Technical Note: Measuring who is being reached with multisector nutrition interventions: a framework for co-coverage & composite coverage analysis. Johns Hopkins Bloomberg School of Public Health.

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Abbreviations

ANC: Antenatal care
ANC 4+: Four or more antenatal care visits
ANC 4 months: Antenatal care in the first trimester
DataDENT: Data for Decisions in Nutrition
DHS: Demographic and Health Survey
DHIS2: District health information software 2
DW: Deworming
EPHI: Ethiopian Public Health Institute
FNBS: Food and nutrition baseline survey
GMP: Growth monitoring and promotion
HH: Household
Iccdr,B: International Centre for Diarrhoeal Disease Research, Bangladesh
IFA: Iron folic acid
IFPRI: International Food Policy Research Institute
IPTp: Intermittent preventive treatment for malaria during pregnancy
IYCF: Infant and young child feeding
JHBSPH: Johns Hopkins Bloomberg School of Public Health
MAM: Moderate acute malnutrition
MAR: Missing at random
MCAR: Missing completely at random
MDD: Minium dietary diversity
MICYN: Maternal, infant, young child and adolescent nutrition
MICS: Multiple Indicator Cluster Survey
MNCHW: Maternal newborn and child health week
NMAR: Not missing at random
NNS: National nutrition survey
ONCS: One Nutrition Coverage Survey
PCA: Principal component analysis
PNC: Post-natal care
SAM: Severe acute malnutrition
SQ-LNS: Small quantity lipid-based nutrient supplements
VAS: Vitamin A supplementation
WASH: Water, sanitation and hygiene

Introduction

Most national nutrition strategies include a range of interventions implemented by different sectors to address nutrition problems in women, children and other priority populations. For example, at least three sectors are commonly engaged to prevent vitamin A deficiency in young children:

- Health delivers high-dose vitamin A supplements and counseling about feeding vitamin A-rich foods
- Industry fortifies of cooking oil with vitamin A
- Agriculture promotes household or commercial production and consumption of orange-fleshed sweet potatoes and other vitamin A-rich produce

National information systems include household surveys and administrative information systems that collect data on who is being reached with individual interventions. DataDENT has developed co-coverage and composite coverage analysis methods that use these data to quantify the integration of nutrition interventions at individual, household or group level. They fundamentally answer, “who is being reached with multisectoral nutrition interventions?” Co-coverage and composite coverage complement, but do not replace, the need to examine coverage of individual interventions.

Figure 1 presents co-coverage of interventions to address vitamin A deficiency across four districts in Bangladesh. Data were collected in the One Nutrition Coverage Survey (ONCS)[1].

Figure 1: Co-coverage of vitamin A deficiency control interventions in Bangladesh (n=478 households with children < 2 years, 8 eligible interventions)

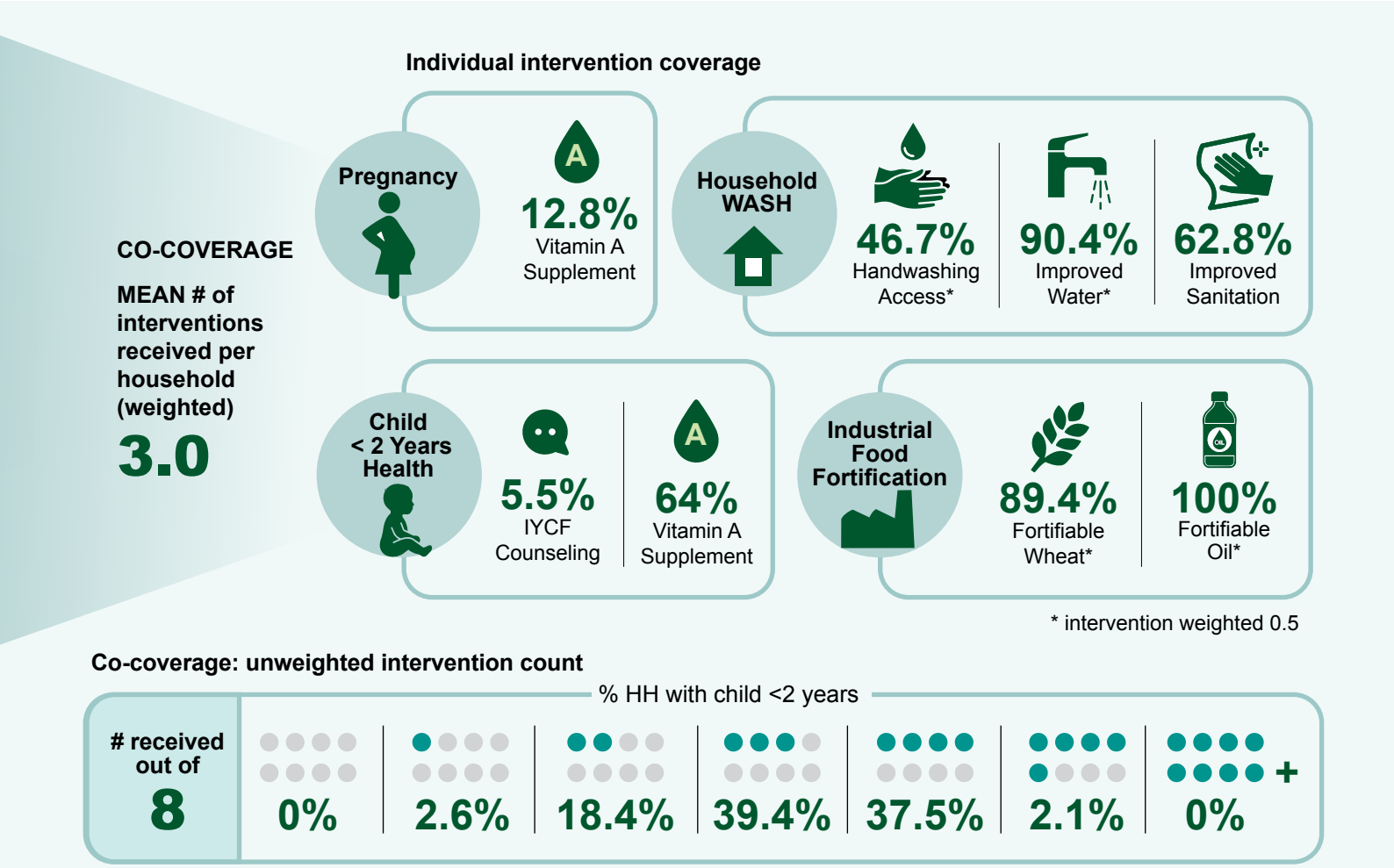
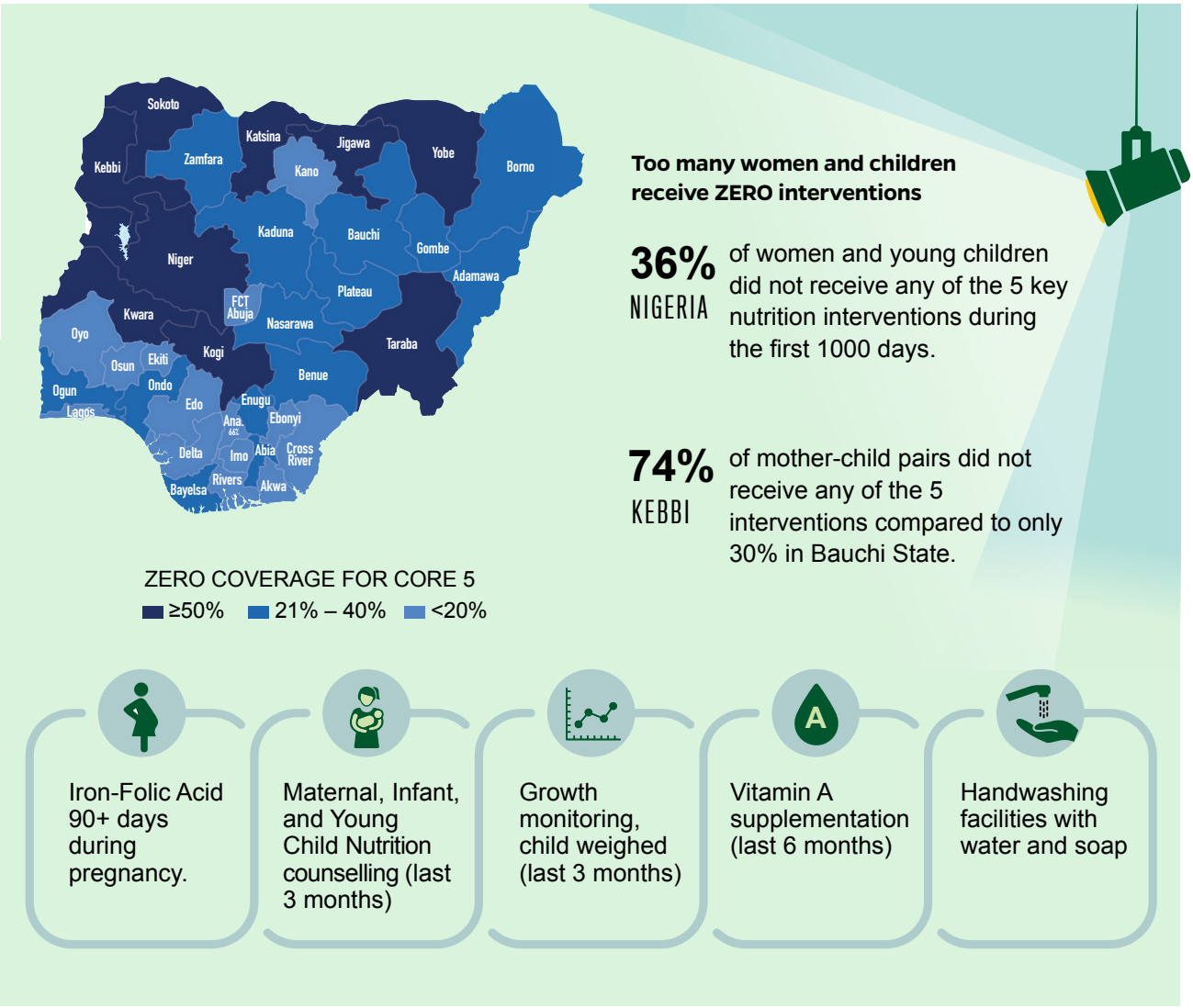


Figure 2 presents the co-coverage of five key mother-child interventions measured in the most recent Nigeria DHS; more than one-third of mother-child pairs had “zero coverage” across all five interventions.

Figure 2 : Zero-coverage of five key nutrition interventions in Nigeria (NDHS 2024-2025)



This technical note presents a flexible analytical framework for co-coverage and composite coverage analysis that can be adapted to different contexts. It includes examples from multi-sector nutrition policies and programs in three countries where DataDENT has engaged - Ethiopia, Bangladesh, and Nigeria. The framework can be applied beyond nutrition.

The primary audience for this technical note is people with core knowledge of statistics and data analysis. However, the background sections are intended for a wider audience including policymakers, health and nutrition program implementers, and donors. These actors play a critical role in defining information needs, informing analytical priorities, and using the findings to guide policy and programs.

What is co-coverage and composite coverage?

We define intervention coverage as the proportion of people who receive an intervention among those who are eligible for that intervention. [2]. Co-coverage and composite coverage reflect whether two or more interventions are received by eligible individuals, households or sub-groups [3]. In the literature, co-coverage and composite coverage measures are described using a variety of terms, including “summary, aggregate, composite” and “indicators, measures, scores, index”. For consistency, this technical note uses the term *summary measure*.

There are two key differences between co-coverage and composite coverage: level of aggregation and data source. Co-coverage requires individual-level data from a single household survey. Composite coverage uses group-level data and can combine data from multiple survey and administrative data sources as long as intervention coverage is estimated at the same unit across all data sources and the data sources were collected maximum 3-5 years apart.

How is co-coverage calculated?

Co-coverage **(Figure 3)** is the more common approach to estimate summary measures because household surveys directly measure the joint receipt of interventions by individuals and households. It is usually more straightforward to interpret. However, in practice, it can be challenging to identify a single survey dataset that contains all interventions of interest.

Figure 3: Simplified illustration of co-coverage calculation and interpretation

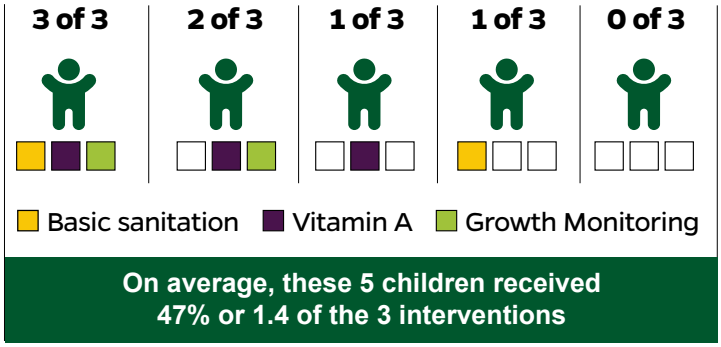
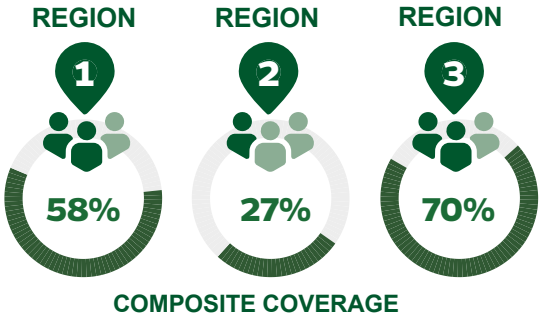


Figure 4: Simplified illustration of composite coverage calculation and interpretation



Basic sanitation	65%	15%	90%
Vitamin A	80%	86%	95%
Growth Monitoring	30%	95%	25%

On average children across the three regions receive 44% or 1.3 of the three interventions

How is composite coverage calculated?

Composite coverage **(Figure 4)** is more flexible because data can come from multiple sources. Composite coverage may be more complex to interpret than co-coverage. However, in some applications, composite coverage measures have demonstrated stronger associations with nutrition outcomes than co-coverage measures, confirming their validity [3].

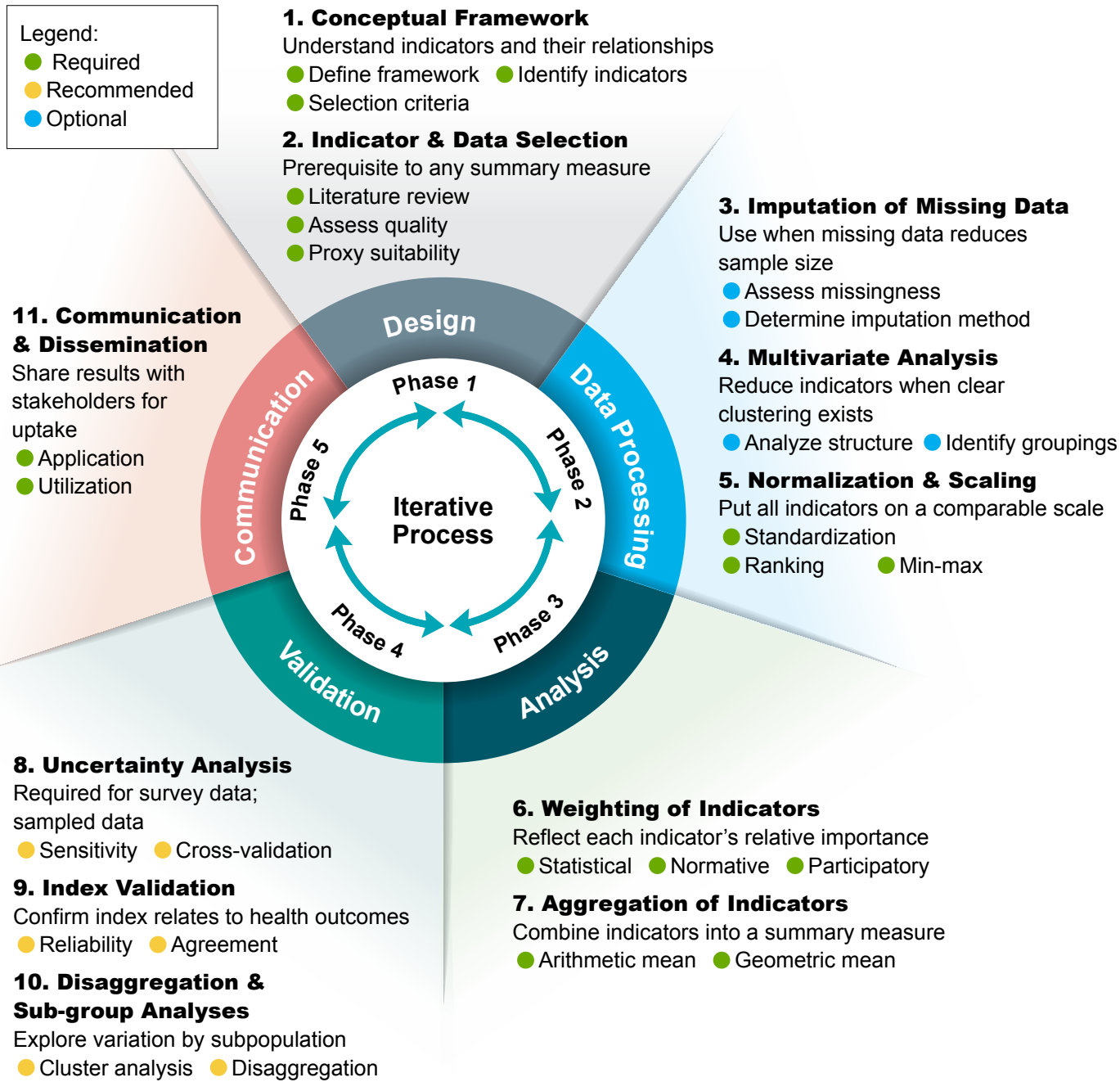
- Basic sanitation
- Vitamin A (coverage estimates are from the same household survey)
- Growth Monitoring (coverage estimates are from a HMIS report)

Overview of the analytical framework

This framework organizes the process of designing, analyzing and communicating co-coverage and composite coverage indicators into five phases. Steps within each phase are summarized in **Figure 5** and detailed in subsequent sections.

The framework is designed to be both rigorous and flexible. It describes the aims and desired outcome of each step, but assumes users will decide on specific methods.

Figure 5: Overview of framework for co-coverage & composite coverage analysis



Phase 1: Design requires actively engaging policymakers, program implementers, nutrition experts, and analysts to co-design the summary measures. Together these stakeholders define the analytical objective and select the appropriate lens. Policy and program stakeholders should also be involved in selecting interventions, identifying data sources, determining the aggregation and weighting approaches, and suggesting useful disaggregations.

Phase 2: Data Processing is carried out by analysts. During this phase analysts harmonize indicator definitions across data sources, produce comparable estimates for individual interventions and apply weights, normalization, and scaling methods prior to aggregation. Modelling approaches may be used to fill data gaps. Some phase 1 design decisions may need to be revisited.

Phase 3: Analysis is when the analyst calculates the summary measure and produces disaggregated estimates that can identify inequity in coverage.

Phase 4: Validation will vary depending on the purpose and design of the analysis. Analysts can evaluate the validity, reliability, and robustness of summary measures using different methods. Previous phases may need to be revisited to address validity issues.

Phase 5: Communication re-engages policy and program data users and nutrition experts to interpret the summary measures alongside individual intervention coverage estimates. Together they identify key messages and recommendations for policy and program decision makers. They can also identify the preferred output format for the intended audience including how to effectively visualize the summary measures.

DataDENT's co-coverage and composite coverage analysis framework is rooted in the work of the Countdown to 2030 and the International Center for Equity in Health, Pelotas [4], which first developed methods for co-coverage and composite coverage analysis to monitor Universal Health Coverage [5,6]. Prior to DataDENT, IFPRI carried out a co-coverage analysis of maternal and child nutrition interventions in seven South Asian countries [7,8] and Johns Hopkins Bloomberg School of Public Health team members developed composite coverage methods for the Exemplars in Global Health initiative [9].

During DataDENT, IFPRI and Johns Hopkins Bloomberg School of Public Health coordinated efforts to carry out co-coverage and composite coverage methodological scoping reviews [10, 11] and drafted the unified framework to reflect the diverse methods identified in the reviews. Research partners in Bangladesh and Ethiopia helped to refine the methods. The refined framework was used by government and partners in Nigeria.

Use cases & design principles

Summary measures can be used throughout the policy and program cycle to support planning, implementation and monitoring. Potential applications include:

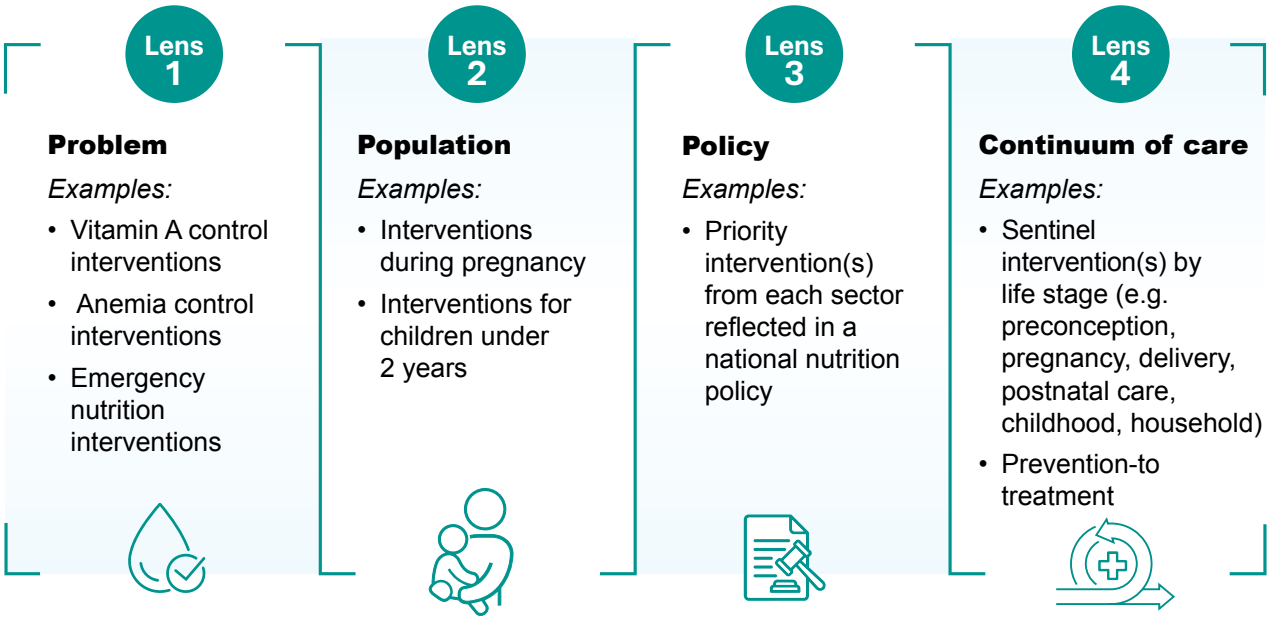
- Landscape assessment and priority setting: Identify and quantify gaps in intervention coverage across sectors, population groups, or life stages; identify missed opportunities for service integration; and inform priority-setting and program design.
- Monitoring multisectoral nutrition plans: Track the implementation of multisectoral nutrition strategies and assess whether cross-sector coordination is reflected in multisector interventions reaching the same target populations.
- Monitoring health system and program performance: Monitor changes in aggregated coverage over time. Improvements in co-coverage or composite coverage may reflect stronger service integration, multisectoral coordination, and overall health systems strengthening.
- Identifying inequities and missed opportunities: Examine how different combinations of interventions reach specific population sub-groups or geographic areas including whether populations are being left behind.
- Informing program improvement: Identify service delivery bottlenecks and opportunities to strengthen integration across sectors, programs, and life stages, enabling more targeted program adjustments.
- Monitoring progress toward nutrition goals: Provide a holistic indicator of progress toward nutrition targets (e.g. stunting, wasting, etc.).

Summary measures are also used as exposure variables or covariates for epidemiological and impact evaluation research.

Design lens

Four complementary “lenses” that can guide design of actionable summary measures include population-specific, problem-specific, policy-specific and continuum-of-care. These four lenses are reflected in the examples shared throughout this technical note **(Figure 6)**.

Figure 6: Four lenses for designing actionable summary measures of intervention coverage



Box 1. Guiding principles for applying co-coverage & composite coverage framework

Adopt a participatory approach. Engage policymakers, program implementers and nutrition technical experts alongside the analysts to ensure the summary measures address priority questions, reflect the local context, and are useful for decision-making.

Prioritize simplicity and interpretability. Select the smallest set of indicators and simplest weighting and aggregation methods that adequately address the analytical objective, making the resulting measures easier to interpret, communicate, and apply.

Use direct measures of intervention coverage. Select indicators that directly measure receipt of interventions rather than using behaviours, determinants, or health or nutrition outcomes as proxies of intervention coverage.

Maximize data comparability. When feasible, derive all indicators from a single primary data source. For composite coverage, use additional data sources only as required to fill essential data gaps. Carefully review whether the contributing data sources are comparable in terms of indicator definitions, populations, and timing.

Present coverage of individual interventions alongside summary measures. Examining the individual intervention coverage estimates is essential for accurately interpreting summary measures.

Document the analytical process. Document the assumptions and methodological decisions made as the framework is applied in a specific use case; this will help ensure transparency and replicability of the results.

Box 2: Application of the framework in Ethiopia

Background. The co-coverage and composite coverage methodological framework was piloted in collaboration with the Ethiopian Public Health Institute (EPHI). We used co-coverage and composite coverage approaches to generate and compare common summary measures at national level.

Conceptual framework. Three scenarios were identified using problem and population lens 1) anemia reduction in pregnant women, 2) stunting in children under five, 3) vitamin A deficiency control in children under five. The National Food and Nutrition Strategy, National Nutrition Program II and the Seqota Declaration Roadmap for Expansion and Scale-up were used to define target populations and identify relevant interventions.

Indicator and data selection. The nationally representative Ethiopia Food and Nutrition Baseline Survey 2022 (FNBS) was used for co-coverage. For composite coverage multiple data sources including Ethiopia Demographic and Health Surveys (DHS), World Bank surveys, and administrative data from the DHIS2 were used.

Data quality and imputation. No significant missing data issues were identified during the quantitative and qualitative data quality assessments.

Box 2: Application of the framework in Ethiopia, continued

Weighting and aggregation of indicators. Multiple approaches to weighting individual interventions were tested including consensus by global experts and national program stakeholders; in the final analysis intervention domains were considered of equal relevance and given the same weight. Data were aggregated using the arithmetic mean formula for both co-coverage and composite coverage. Confidence intervals were calculated using complex survey design to assess the precision of the summary measures.

Index validation. Sensitivity analyses compared estimates using different weighting options. A data agreement validation exercise compared co-coverage and composite coverage estimates and a cross-validation exercise assessed the correlation between each summary measure and the relevant nutrition outcomes (e.g. anemia, stunting).

Dissemination. Multiple stakeholders reviewed outputs including global and national nutrition experts, EPHI and the national Nutrition Monitoring and Evaluation Research Steering Committee. Results were presented at international scientific conferences and published as blogs, journal articles and in social media posts.

To learn more, visit the DataDENT website (https://datadent.org/tools-resources/) Select topic "co-coverage & composite coverage" and location "Ethiopia" from the menu.

Box 3: Application of the framework in Bangladesh

Background. The aim of the Bangladesh analysis was to compare co-coverage and composite methods using subnational data.

Conceptual framework. Three scenarios were identified using problem and population lens 1) anemia reduction in pregnant women, 2) stunting in children under five, 3) vitamin A deficiency control in children under five. Key policy documents used to inform population, intervention and indicator selection included Bangladesh's Second Plan of Action for Nutrition (2016-2025), the National Strategy on Prevention and Control of Micronutrient Deficiencies (2015-2025), the National Nutrition Service Operational Plan, and the National Nutrition and Food Security Policy Plan of Action 2021-2030.

Indicator and data selection. The Bangladesh One Nutrition Coverage Survey (ONCS), a DataDENT led multisector coverage survey across four districts, was used for co-coverage analysis. The ONCS did not collect data on nutrition outcomes. Composite coverage estimates were generated from multiple Bangladesh Demographic and Health Surveys (DHS), and one Multiple Indicator Cluster Survey (MICS).

Imputation of missing data. We used small area estimation to model district-level estimates from the DHS which is representative at division level. The ONCS and MICS are representative at district level.

Box 3: Application of the framework in Bangladesh, continued

Weighting and aggregation of indicators. Intervention domains were considered of equal relevance to the policies and given the same weight; if there was more than one indicator for a domain, we split the weight. Arithmetic means was used to aggregate estimates for both co-coverage and composite coverage. Confidence intervals accounted for complex survey design.

Index validation. Data agreement was validated by comparing alignment between co-coverage and composite coverage estimates for reach district and across all four districts.

Dissemination. Findings will be presented at a dissemination event for policy makers and implementers in Bangladesh as well as in international conferences, and journal publications.

To learn more, visit the DataDENT website (https://datadent.org/tools-resources/) Select topic "co-coverage & composite coverage" and location "Bangladesh" from the menu.

Box 4: Application of the framework in Nigeria

Background. The Nigeria analysis was requested by a donor to support planning with government for a multisector nutrition investment across five states in northern Nigeria.

Conceptual framework. The analysis team consulted with federal and state data users and nutrition experts to select the target populations and priority indicators for nutrition. Four scenarios were identified using a life stage continuum lens: 1) mother-child pairs, 2) pregnant women, 3) children 6-23 months and 4) children 24-59 months.

Indicator and data selection. Based on the lists of multisectoral interventions developed through consultations, corresponding indicators were mapped across two rounds of a national household surveys: NDHS 2024 and 2018.

Imputation of missing data. No imputation was needed.

Weighting and aggregation of indicators. Global and local experts discussed how to weight individual interventions and agreed to give all intervention domains equal weight. If multiple relevant indicators were available for a single intervention, they were given partial weight (e.g. ANC).

Index validation. No formal efforts were made to validate the summary measures.

Dissemination. Findings were presented at a working group meeting for investment planning. Data were communicated as "zero-coverage" to emphasize populations that are completely missed by interventions and as "opportunity gaps" where coverage of a nutrition intervention (e.g. IFA) was much lower than coverage of the delivery platform (e.g. ANC).

To learn more, visit the DataDENT website (https://datadent.org/tools-resources/) Select topic "co-coverage & composite coverage" and location "Nigeria" from the menu.

Steps in the analytical framework

This section provides more detailed guidance on each step of the framework **(Figure 5).** Most steps are required or recommended; some steps are optional and will depend on the use case.

PHASE 1: DESIGN OF THE ANALYSIS

STEP 1: CONCEPTUAL FRAMEWORK AND IDENTIFICATION OF KEY INTERVENTIONS

The aims of step 1 are to identify how the summary measure will be used, to select the analytical lens that will guide its design – a nutrition problem, population group, policy and/or continuum of care **(Figure 6)** – and to identify the interventions that will ideally be included.

First, consult policy documents and engage key stakeholders to identify relevant interventions. A summary measure that aggregates many interventions can be difficult to interpret; consider how to reduce to a meaningful parsimonious set. For example, rather than including every intervention in a policy, have stakeholders identify one key intervention per delivery platform (e.g. one facility-based, one community-based, one campaign-based, one market-based). In Nigeria stakeholders identified five "core" nutrition interventions for mothers and children **(Figure 2)**. Statistical methods can also be used to help streamline the indicator design (see Step 4 multivariate analysis).

Weighting – giving some interventions or indicators more influence in the summary measure - is another important topic to discuss in Step 1. Weights can dramatically change the interpretation of the summary measure. For example, to monitor a policy focused on stunting, consider giving more weight to interventions with larger effect on stunting. See Step 6 for further discussion of how to approach weighting.

Guiding questions for defining the conceptual framework

What nutrition problem, population, policy and/ or continuum are we trying to measure?	Which policies or strategies and stakeholders should guide selection of interventions?	Which interventions are most important to include in the summary measure given the purpose and lens?	How might weighting be used to give certain interventions more or less influence in the summary measure?

STEP 2: INDICATOR AND DATA SELECTION

The next step is to select data source(s) and indicators. This requires identifying available data sources, mapping indicators in those sources, and assessing data quality. Data should be recent relative to the timeline of the use case, reliable in terms of data quality, and representative of the populations of interest.

Common data sources include DHS, MICS, and HMIS / DHIS2. Population-based surveys are usually preferred for coverage data; however, for some interventions such as wasting treatment, administrative data may be the only available source. Important data quality dimensions to consider include timeliness for the use case, completeness, and reliability. Data quality assessment guidance and tools are available for survey and administrative data. In some cases, missing data can be imputed [13-15] (See Step 3).

Indicator selection may require reviewing literature and/or consulting with experts to evaluate the relevance of available indicators for a summary measure. Proxy indicators can be considered when coverage data on specific interventions is not available. However, it is not recommended to use coverage of behaviors or practices to proxy receipt of interventions (e.g. using minimum dietary diversity as proxy for coverage of infant and young child feeding counseling); they are not consistently related [16].

As an example, **Table 1** presents individual interventions and indicators selected in Nigeria for co-coverage across multiple sectors, population groups and delivery platforms.

Table 1: Individual indicators selected for population-specific multisector co-coverage indicators in Nigeria

	Mother & Child Pairs	Pregnant Women	Children 0-23 months	Children 24-59 months
Total #	'Core 5' interventions	9 interventions	12 interventions	7 interventions
HEALTH	1. IFA in pregnancy	1. ANC visits timing, number	1-3. Newborn care and breastfeeding support	1. GMP
	2. MIYCN counselling	ANC Services 2. MIYCN counseling 3. IFA 4. IPTp 5. Blood test	Well Child Clinic 4. Vaccination 5. GMP 6. MIYCN counseling	MNCH Week 2. VAS 3. Deworming
	3. GMP	MIYCN counseling, IFA, IPTp, blood taken	MNCH Week 7. VAS 8. Deworming	4. MAM/SAM Screening
	4. VAS	6. Skilled birth attendant	9. MAM/SAM Screening	
FOOD SYSTEMS		7. Iodised salt	10. Iodised salt	5. Iodised salt
WASH	5. HH handwashing facility +soap +water	8. Basic water & sanitation	11. Basic water & sanitation	6. Basic water & sanitation
		9. Handwashing facility +soap + water	12. Handwashing facility	7. Handwashing facility

ANC: Antenatal care; DW: Deworming; GMP: Growth monitoring and promotion; HH: Household; IFA: Iron folic acid; IPTp: Intermittent preventive treatment for malaria during pregnancy; MAM: Moderate acute malnutrition; MICYN: Maternal, infant, young child and adolescent nutrition; MNCHW: Maternal Newborn and Child Health Week; SAM: Severe acute malnutrition; VAS: Vitamin A supplementation

Guiding questions for indicator and data selection

What data sources are available including surveys (e.g., DHS, MICS, NNS, special surveys) and administrative data (e.g., DHIS2)?

Are the available indicators aligned with how interventions are designed and implemented in practice?

Are data recent, reliable, and representative for the target population?

Do all indicators have adequate measurement quality and sample sizes?

Are there data gaps that need to be filled with proxy indicators and/or imputed data?

PHASE 2: DATA PROCESSING

STEP 3: IMPUTATION OF MISSING DATA (OPTIONAL)

The aim of this step is to address data quality issues identified in the previous step and generate an analytical dataset with no missing values that maintains reliability and interpretability of the underlying data. Missingness may occur in survey or administrative datasets for several reasons, including non-response, data quality issues, or lack of measurement in specific modules. Missingness is generally not a problem in datasets from DHS or MICS surveys, but the quality of these datasets should still be reviewed.

Imputation is a statistical approach for addressing missing data. Methods will vary depending on the extent and pattern of missing data (e.g. Missing Completely at Random (MCAR), Missing at Random (MAR), or Not Missing at Random (NMAR)). Imputation options include case deletion, single imputation, or more robust methods such as multiple imputation. The plausibility of imputed values should be assessed and other data outliers should be identified and possibly addressed.

Guiding questions for imputation of missing data

Is imputation necessary to avoid substantial sample loss? Which indicators have issues with missing data? What is the proportion and pattern (MCAR, MAR. NMAR)?

Which imputation method is most appropriate (single, multiple, or omission)?

Are imputed values plausible and consistent with the distribution of observed data?

STEP 4: MULTIVARIATE ANALYSIS TO SUPPORT DESIGN OF SUMMARY MEASURE (OPTIONAL)

The aim of this step is to use statistical methods to determine how indicators cluster together conceptually or empirically and use that information to refine design of the summary measure. Multivariate analysis can be used to explore patterns, relationships, and internal structure within the selected indicators. Principal component analysis (PCA), factor analysis, cluster analysis, and reliability testing (e.g., Cronbach's alpha) are tools to examine correlations, identify latent domains, and detect redundancies or inconsistencies across indicators. Visualizing indicator distributions through correlation matrices, scree plots, or component loadings supports decisions on indicator grouping and potential exclusion. Ultimately, this step helps ensure that the summary measure reflects meaningful relationships within the data and is consistent with aim and lens identified in Step 1 rather than arbitrary combinations of indicators.

Guiding questions for multivariate analysis

Do indicators cluster empirically in ways that align with the Step 1 purpose and lens?

Are there highly correlated or redundant indicators that should be removed?

Do PCA or factor loadings support grouping or exclusion decisions?

Are indicator distributions reasonable, or do transformations appear necessary?

STEP 5: INDICATOR NORMALIZATION AND SCALING

The aim of this step is to prepare dataset for weighting and aggregation by placing all indicators onto a common and interpretable scale. Normalization and scaling are critical for harmonizing indicators that are measured in different units, ranges, or directions. Without adjustment, indicators with larger numerical ranges could disproportionately influence the summary measure.

Recoding or directional adjustment may be needed to ensure that all indicators have the same values for same categories and/or move in the same direction relative to the construct being measured (e.g., reversing indicators where higher values reflect poorer performance (see **Table2**). Other normalization techniques may include min-max scaling, z-score standardization, ranking, or distance-to-reference approaches. Adjust for cyclical indicators, population or income scaling, or categorical rescaling where appropriate.

Table 2: Examples of indicator scaling to facilitate aggregation

Indicator in dataset	Response Options		Comment
	Unscaled	Scaled	
Vitamin A supplementation	Yes: 1 No: 0	Yes: 1 No: 0	Keep as is. Beneficial outcome given value of "1"; less beneficial given value of "0"
Improved sanitation	Yes: 2 No: 1	Yes: 1 No: 0	Change. Scale to 1/0 instead of 2/1
Appropriate IYCF counseling	Yes: 0 No: 1	Yes: 1 No: 0	Change. Give beneficial option the value of "1" and less beneficial “0”

Guiding questions for indicator normalization and scaling

Are indicators measured on different scales requiring harmonization?

Which normalization technique is appropriate (z-score, min-max, ranking)?

Do all indicators move in the same direction (e.g., higher = better)?

Should any indicators be reversed to ensure consistency?

PHASE 3: DATA ANALYSIS

STEP 6: ASSIGN WEIGHTS

Discussions about whether and how to weight interventions should happen during Step 1 of the design phase; but weights are applied at this stage of data analysis. The purpose of assigning weights is to define how much influence each individual indicator contributes to the aggregated summary measure. It is one of the most consequential methodological decisions in construction of the summary measure. The choice of weighting method should be based on interpretability, data availability, compatibility with aggregation methods, and the intended use of the summary measure.

Three broad weighting approaches may be used: statistical, normative, and participatory. Statistical approaches (e.g., PCA, factor analysis, reliability analysis) derive weights empirically from the underlying data and can reveal latent structures (see Step 4). These statistical approaches may not be intuitive to data users and can be difficult to generalize across multiple contexts. Normative approaches anchor weighting in programmatic logic, intervention importance, life-stage relevance, or policy priorities, allowing for more transparent and context-specific justification. Participatory methods, such as the Delphi technique, incorporate expert judgment and stakeholder consensus in a systematic way.

In Table 3, multiple approaches to weighting that considered for the Ethiopia analysis. The final decision was Option 1 to weight intervention **domains** equally. The underlying assumption was that for sector-level accountability purposes, all interventions included in a policy or program are equally important. When datasets include multiple indicators for the same intervention, weights can be used to combine them. For example, DHS datasets include at least two indicators that reflect different dimensions of ANC coverage: "ANC in the first trimester" and "4+ ANC visits". Both are important and so by giving each indicator a weight of 0.5, ANC has a total weight of 1 - equal to the other interventions included in the summary measure. A similar approach was used for food fortification coverage in Ethiopia (Table 3, Option 1).

Table 3: Comparing weighting options for summary measure of anemia control in pregnant women in Ethiopia

Sector	Interventions	Weighting options		
		Option 1	Option 2	Option 3
Health	Attended 4+ ANC visits	0.5	0.5	1
Health	Attended ANC during 1st trimester	0.5	0.5	1
Health	Deworming	1	1	2
Health	Nutrition counseling from any health worker	1	2	3
Health	Iron-containing supplement (90+)	1	2	3
Social Protection	Received cash or food assistance	1	1	1
Industry	Fortifiable foods in HH: Oil	0.5	1	1
Industry	Fortifiable foods in HH: Wheat	0.5	1	1

OPTION 1

Policy-based approach give equal weight to all intervention domains in policy; included country stakeholder in decision.

OPTION 2

Impact on outcomes: Global experts ranked effectiveness on a 1-4 scale, took average, and applied as weight.

OPTION 3

Global Framework:
Used framework from literature Keats et al 2021 Lancet Global Health

- health sector direct = 3
- health sector indirect = 2
- other sector direct = 2
- other sector indirect = 1

Guiding questions for indicator weighting

Should all indicators contribute equally, or should some carry greater influence?	Should weights reflect policy priorities, empirical data, or stakeholder consensus?	Are weighting decisions transparent and defensible?	Are weights compatible with the chosen aggregation method? (See Step 7)

STEP 7: AGGREGATION OF SUMMARY MEASURES

This step uses a mathematical formula to combine individual intervention coverage estimates and produce the summary measure. Depending on the use case, summary measures can be expressed as a count and/or as a proportion of eligible interventions. (See Step 8)

Commonly used mathematical formulas for aggregation of weighted individual indicators are arithmetic mean, geometric mean, and multicriteria analysis. Arithmetic means are based on the addition and multiplication of individual indicators while geometric means bring together indicators using the product and the nth root of the values. The multicriteria analysis uses the aggregation option with the highest score from the analysis and comparison of different alternatives under different criteria or indicators. The aggregated score of each alternative is obtained from the sum of each indicator's weight multiplied by the normalized score of the alternative.

Guiding questions for aggregation of indicators

Should aggregation use arithmetic mean, geometric mean, or multicriteria analysis?	Should co-coverage be expressed as a count or proportion of interventions received?	Does the summary measure estimate mask wide variation in coverage of individual interventions?	Are summary measures easy to interpret for key audiences?

PHASE 4: VALIDATION OF CO-COVERAGE AND COMPOSITE COVERAGE ESTIMATES

STEP 8: UNCERTAINTY ANALYSIS AND MEASUREMENT (RECOMMENDED)

This recommended step applies to summary measures derived from sample-based data. The aim of calculating the uncertainties around the estimates is to assess how precise and reliable the summary measure estimates are. The confidence interval and standard errors are useful to understand the range of values the estimate is likely to take. Like the estimates, the uncertainties must be calculated according to the survey sampling design accounting for weighting, clustering and stratification.

Guiding questions for uncertainty analysis and measurement

Does the dataset require accounting for complex survey design?

Have standard errors and confidence intervals been calculated correctly?

Are uncertainties clearly communicated alongside point estimates?

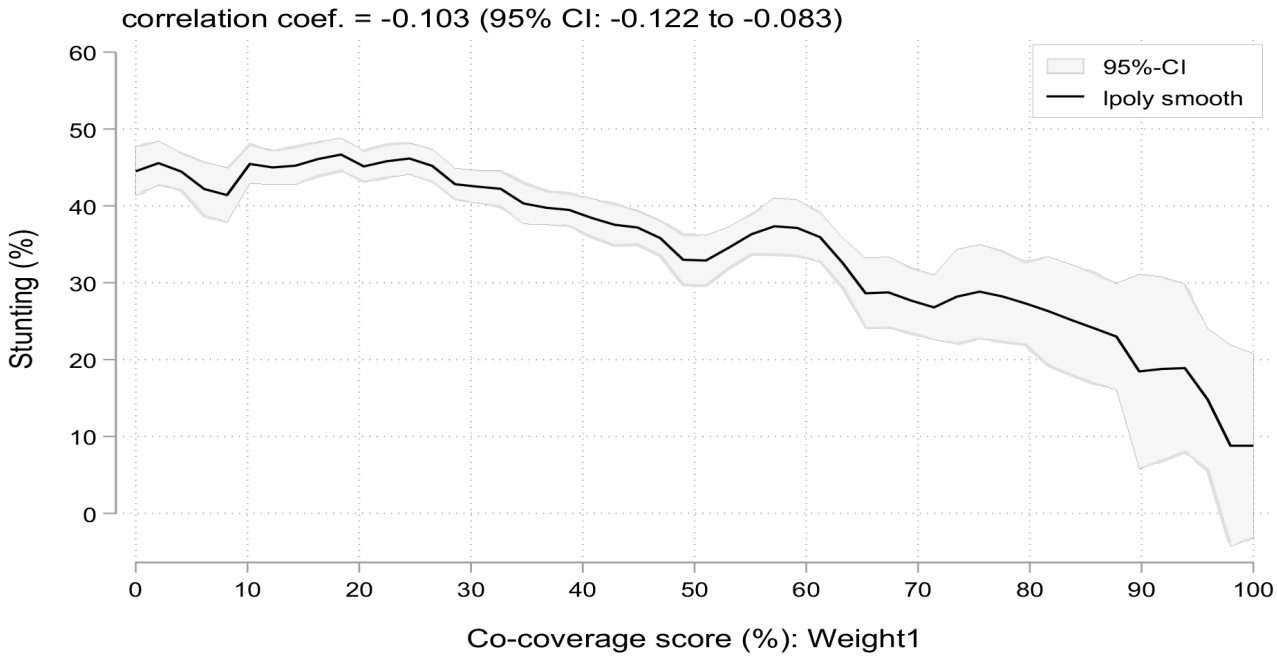
STEP 9: SUMMARY MEASURE VALIDATION (OPTIONAL)

Index validation is a useful step to assess the validity, accuracy and reliability of the summary measures. Validation methods can be simple or complex; approaches include sensitivity analysis, data agreement, reliability analysis, cross-validation, convergent validation. The choice of methods depends on the purpose and intent of analysis, type of data, weighting approach, and construction methodology.

Sensitivity analysis is useful to assess the reliability of estimates calculated from different sets of indicators or that use different weighting and aggregation methods. Data agreement is a benchmarking method, useful to test the degree of concordance between two or multiple sets of summary measures. Data agreement methods include comparison of confidence intervals, or the calculation of Cohen Kappa's or Kendall's coefficient or intraclass correlation coefficients. Cross-validation is a method consisting of producing different summary measures from subsets of individual indicators and assessing their ability to produce similar results.

Convergent validation assesses the correlation between the summary measure and a relevant nutrition outcome. For example, in **Figure 7**, co-coverage of interventions for stunting prevention in Ethiopia is plotted against stunting as an outcome.

Figure 7: Convergent validation comparing co-coverage of interventions to address stunting and stunting as a outcome (Ethiopia FNBS 2022)



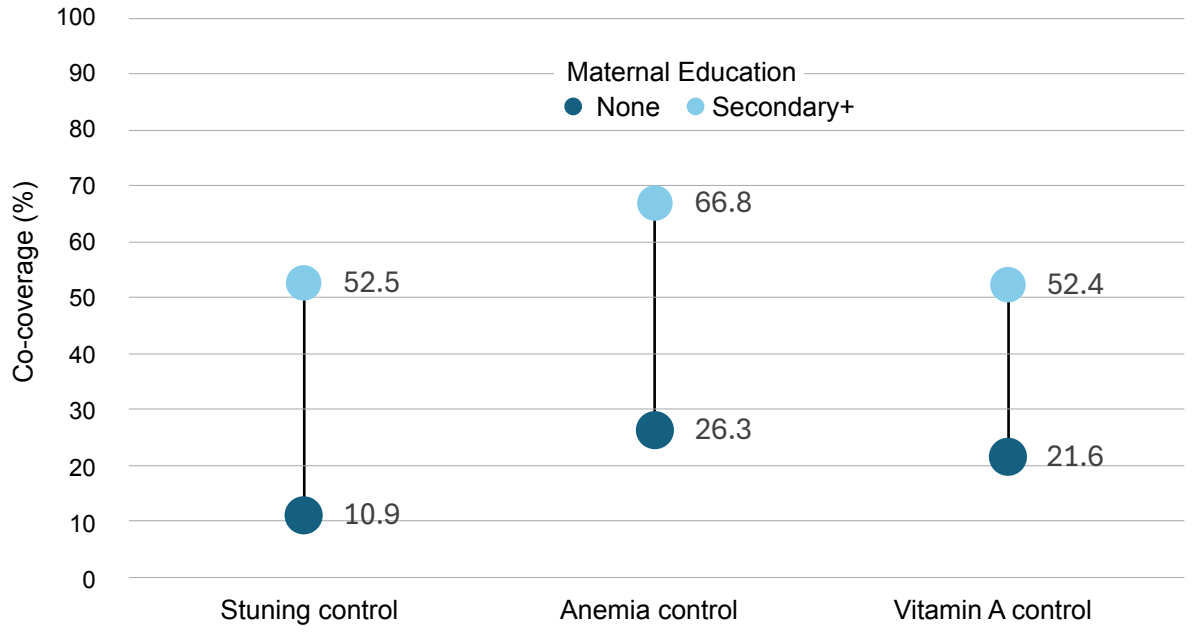
Guiding questions for index validation

Do sensitivity analyses show that results are stable across indicator or weighting choices?	Do co-coverage and composite measures agree, if both approaches are used?	Are validation results sufficient to support policy use?	Does the summary measure correlate logically with nutrition outcomes?

STEP 10: DISAGGREGATION, SUBGROUP AND TREND ANALYSIS

This step identifies inequities in coverage by disaggregating the summary measure estimates using dimensions such as region, age, wealth quintile, urban/rural residence, etc. See the example from Bangladesh in **Figure 8**. Cluster analyses can also be used to identify underlying patterns that are meaningful to data users. Finally, the summary measure can be compared across time, between countries, or other groupings of interest.

Figure 8: Inequities in co-coverage of interventions for a) stunting, b) anemia and c) vitamin A deficiency by maternal education across four districts in Bangladesh [17]



Guiding questions for disaggregation, subgroup and trend analysis

Which subgroups should be examined (e.g. wealth, region, age, urban/rural)?	Do coverage patterns reveal inequalities or clusters of low performance?

PHASE 5: Communication & dissemination

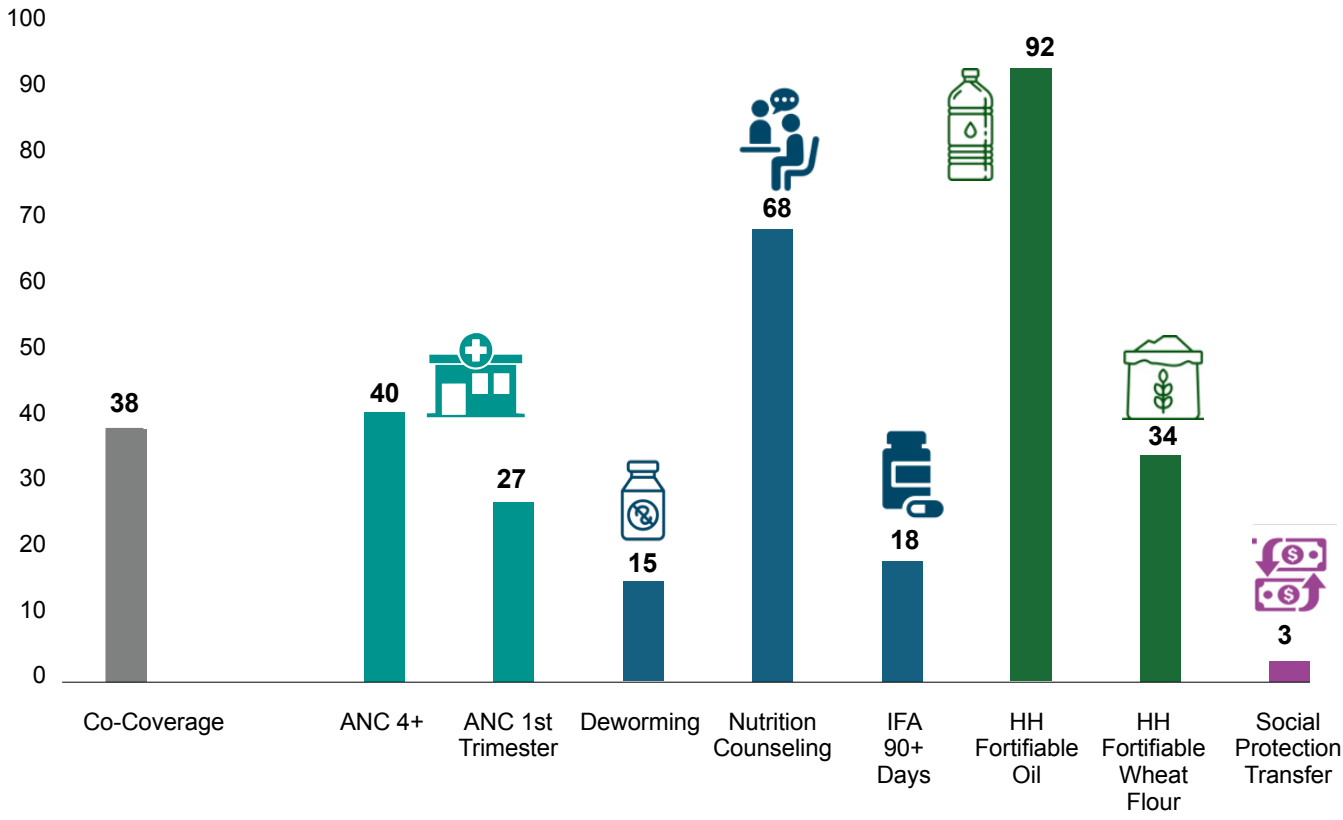
STEP 11: COMMUNICATION & DISSEMINATION OF RESULTS

Interpretation and communication of summary measures should reflect the aggregation methods and be tailored to difference audiences and use cases. Summary measures should be presented alongside individual intervention coverage estimates. This step also includes documenting all methodological decisions to ensure transparency and reproducibility (e.g. indicator selection, imputation methods).

in some cases, summary measures can be calculated and interpreted as the total count of interventions received [10,11]. For example, pregnant women received, on average, 2.7 out of 7 interventions. This aggregated count is understood by most audiences. However, it requires that all individuals or population units are eligible for the same number of interventions. To express a summary measure as a simple count may be necessary to further disaggregate age groups (e.g. children 6-23 months vs. children 24-59 months).

Another way to present the summary measure is as the percentage of eligible interventions received; using the previous example 2.7 out of 7 is 38%. **(Figure 9)** Expressing the summary measure as a percentage allows grouping of populations that are eligible for different interventions (e.g. children 0-5 months and children 6-59 months) The percentage approach also allows comparison between different packages of services; for example, women received 63% of anemia control interventions and children 0-59 months received 41% of stunting reduction interventions.

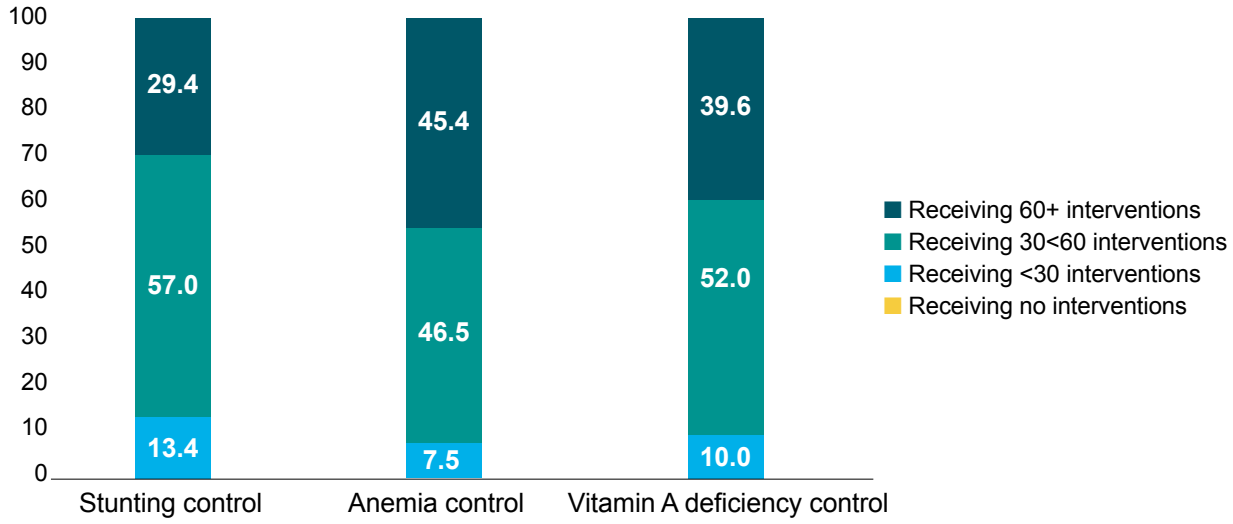
Figure 9: Anemia prevention during pregnancy: co-coverage and individual intervention coverage by sector (2022 Ethiopia National Food & Nutrition Baseline Survey, n=4,698)



Note: Out of 7 interventions total; ANC indicators are each weighted 0.5

The percentage of eligible intervention received can also be presented using a categorical approach **(Figure 10)**.

Figure 10: Co-coverage of interventions to address stunting, anemia, and vitamin A deficiency: percent of households by category (Bangladesh ONCS 2022)



Summary measures should be presented in formats that effectively reach data users. (e.g. dashboards, scorecards, maps, technical reports, and peer-reviewed publications) and clearly explain how results should be interpreted, including their limitations.

Guiding questions for communication and dissemination

How will results be shared back to government and other stakeholders for action?	What formats are most useful (technical report, dashboard, policy brief, scorecards)?	Are key messages framed appropriately for technical vs. non-technical audiences?	Have all methodological decisions been clearly documented?

Conclusion

This framework for co-coverage & composite coverage analysis provides a structured yet flexible methodology for measuring convergence of multisectoral nutrition interventions at individual, household or group level. The step-wise approach guides users to design robust summary measures that reflect their context and information needs. It is intentionally adaptable across contexts with different policy environments and data availability. While the framework has strong advantages, it also requires thoughtful decisions regarding indicator quality, weighting, and interpretation. Nonetheless, when applied systematically and transparently, it expands approaches for multisectoral nutrition monitoring and ultimately, can help to accelerate nutrition progress.

Annex 1– Summary of guiding questions in framework

Step 1 – Conceptual framework and identification of key interventions

- What nutrition problem, population, policy and/ or continuum are we trying to measure?
- Which policies or strategies and stakeholders should guide selection of interventions?
- Which interventions are most important to include in the summary indicator given the lens and purpose?
- How might weighting be used to give certain interventions more influence in the summary measure?

Step 2 – Indicator and data selection

- What data sources are available including surveys (e.g., DHS, MICS, NNS, special surveys) and administrative data (e.g., DHIS2)?
- Are the available indicators aligned with how interventions are designed and implemented in practice?
- Are data recent, reliable, and representative for the target population?
- Do all indicators have adequate measurement quality and sample sizes?
- Are there data gaps that need to be filled with proxy indicators and/or imputed data?

Step 3 – Imputation of missing data

- Is imputation necessary to avoid substantial sample loss? Which indicators have issues with missing data? What is the proportion and pattern (MCAR, MAR. NMAR)?
- Which imputation method is most appropriate (single, multiple, or omission)?
- Are imputed values plausible and consistent with the distribution of observed data?

Step 4 – Multivariate analysis to support design of summary measure

- Do indicators cluster empirically in ways that align with Step 1 purpose and lens?
- Are there highly correlated or redundant indicators that should be removed?
- Do PCA or factor loadings support grouping or exclusion decisions?
- Are indicator distributions reasonable, or do transformations appear necessary?

Step 5 – Indicator normalization and scaling

- Are indicators measured on different scales requiring harmonization?
- Which normalization technique is appropriate (z-score, min-max, ranking)?
- Do all indicators move in the same direction (e.g., higher = better)?
- Should any indicators be reversed to ensure consistency?

Step 6 – Assign weights

- Should all indicators contribute equally, or should some carry greater influence?
- Should weights reflect policy priorities, empirical data, or stakeholder consensus?
- Are weighting decisions transparent and defensible?

Step 7 – Aggregation of summary measures

- Should aggregation use arithmetic mean, geometric mean, or multicriteria analysis?
- Should co-coverage be expressed as a count or proportion of interventions received?
- Does the summary measure estimate mask wide variation in coverage of individual interventions?
- Are summary measures easy to interpret for key audiences?

Step 8 – Uncertainty analysis and measurement

- Does the dataset require accounting for complex survey design?
- Have standard errors and confidence intervals been calculated correctly?
- Are uncertainties clearly communicated alongside point estimates?

Step 9 – Summary measure validation

- Does the summary measure correlate logically with nutrition outcomes?
- Do sensitivity analyses show that results are stable across indicator or weighting choices?
- Do co-coverage and composite measures agree, if both approaches are used?
- Are validation results sufficient to support policy use?

Step 10 – Disaggregation, subgroup and trend analysis

- Which subgroups should be examined (wealth, region, age, urban/rural)?
- Do coverage patterns reveal inequalities or clusters of low performance?

Step 11 – Communication & dissemination

- How will results be shared back to government and other stakeholders for action?
- What formats are most useful (technical report, dashboard, policy brief, scorecards)?
- Are key messages framed appropriately for technical vs. non-technical audiences?
- Have all methodological decisions been clearly documented?

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