Overview

This Dataverse page provides access to three related datasets that describe the prevalence of inadequate nutrient intakes for subnational age-sex groups in 185 countries globally. These datasets originated from three related papers with similar underlying methodologies, building off of each other to add new layers of information, including the role of fortification and protein in inadequate nutrient intakes. The variable names, subnational groups, and methodologies across the three papers have been harmonized, allowing users to select and download the dataset(s) that best meet their needs.

Dataset 1: Diet

The first dataset is from Passarelli et al. (2022), which estimated the prevalence of inadequate intakes for 15 micronutrients for 34 age-sex groups in 185 countries. These estimates did not include fortification and therefore represent the prevalence of inadequate intakes based on intrinsic nutrients in foods alone. The estimates were generated using estimates of mean micronutrient intakes from the Global Dietary Database and estimates in the variability of micronutrient intakes from Passarelli et al. (2022). Overall, inadequate intakes were described for nine vitamins (vitamin E, riboflavin, folate, vitamin C, vitamin B6, vitamin A, vitamin B12, thiamin, niacin) and six minerals (iodine, calcium, iron, zinc, selenium, and magnesium).

Dataset 2: Fortification

The second dataset is from Friesen et al. (in press), which used the methodology developed by Passarelli et al. (2022) to estimate the prevalence of inadequate intakes for 13 micronutrients in the same 34 age-sex groups in 185 countries accounting for current fortification programs as well as potential expanded fortification programs. Vitamin C and magnesium were excluded because they are not commonly fortified. The levels of current fortification were described using data from the Global Fortification Data Exchange (GFDx), which describes the fortification of five food vehicles (salt, oil, wheat flour, maize flour, rice) in nearly every country. Friesen et al. (in press) also estimated the prevalence of inadequate intake under improved fortification scenarios. Thus, results are presented for the following:

- **Scenario 1-Current fortification:** Evaluates the prevalence of inadequate intakes under current fortification programs.
- **Scenario 2-Improved compliance:** Evaluates the prevalence of inadequate intakes in a scenario in which compliance with current fortification programs increases to 90%.
- **Scenario 3-Aligned standards:** Evaluates the prevalence of inadequate intakes in a scenario in which country-specific fortification standards are increased to match international standards.
- **Scenario 4-Aligned standards with improved compliance:** Evaluates the prevalence of inadequate intakes in a scenario in which country-specific fortification standards are increased to match international standards and compliance is increased to 90%.
- **Scenario 5-Aligned standards, improved compliance, and expanded coverage:** Evaluates the prevalence of inadequate intakes in a scenario in which country-specific

fortification standards are increased to match international standards, compliance is increased to 90%, and more countries adopt fortification programs at international standards.

Friesen et al. (in press) also estimated the prevalence of excessive intakes under the current and improved fortification programs.

Dataset 3: Protein

The third dataset is from De Nicola et al. (in preparation), which estimates the prevalence of inadequate dietary protein intake for 40 age–sex groups across 185 countries in 2018.

This dataset extends the distribution-based framework developed by Passarelli et al. (2024) by explicitly linking protein intake to modeled caloric intake distributions and physiological, body-weight–scaled protein requirements. Because protein intake is intrinsically coupled to energy intake, protein inadequacy is evaluated under both a counterfactual energy-adequate scenario and a set of realistic caloric intake scenarios.

Protein inadequacy is assessed relative to the Estimated Average Requirement (EAR), defined in grams per kilogram of body weight per day and converted to absolute daily requirements using country-, age-, and sex-specific body weight data. Intake distributions are reconstructed probabilistically using harmonized estimates of mean intake, variability, and distributional form.

The dataset includes results under three caloric intake scenarios (low, medium, and high), derived from FAO Food Balance Sheet data after adjusting for varying levels of downstream food waste. The medium scenario is calibrated such that global caloric inadequacy is approximately 10%, consistent with FAO benchmark estimates.

In addition, sensitivity analyses adjusting protein requirements for dietary protein quality are provided. Protein quality is proxied using the share of dietary protein derived from animal-source foods (ASFs). No adjustment is applied when ASF protein share is ≥40%; protein requirements are increased linearly by 0–15% when ASF share falls between 40% and 20%; and a full +15% increase is applied when ASF share is <20%.

Nutrient reference values

Across the first two datasets, inadequate and excessive intakes are assessed using the harmonized nutrient reference values from Allen et al. (2020). For the third dataset (protein), inadequacy is assessed relative to the Estimated Average Requirement (EAR) defined by the U.S. Institute of Medicine (2005).

Dataset versions and file types

We provide two versions of each dataset: (1) a “full” version that includes all columns used for intermediate calculation; and (2) a “reduced” version that provides only the most important columns needed to describe subnational inadequate intake levels.

We provide each version as a CSV file for all users.

We also provide the GitHub repositories for each analysis with corresponding code: (1) baseline inadequate intake estimates; (2) fortification scenario estimates; and (3) protein estimates.

References

Passarelli S, Free CM, Allen LH, Batis C, Beal T, Biltoft-Jensen AP, Bromage S, Cao L, Castellanos-Guitiérrez A, Christensen T, Crispim SP, Dekkers A, De Ridder K, Kronsteiner-Gicevic S, Lee C, Li Y, Moursi M, Moyersoen I, Schmidhuber J, Shepon A, Viana DF, Golden CD (2022) Estimating national and sub-national habitual nutrient intake distributions of global diets. *The American Journal of Clinical Nutrition* 116(2): 551-560.

Passarelli S, Free CM, Shepon A, Beal T, Batis C, Golden CD (2024) Global estimation of dietary micronutrient inadequacies: a modeling analysis. *The Lancet Global Health* 12(10): e1590-e1599.

Friesen VM, Free CM, Adams KP, Bai Y, Costlow L, Dewey K, Masters WA, Mbuya MNN, Nordhagen S, Vasta F, Beal T. Impact of large-scale food fortification programs on micronutrient inadequacies and their implementation costs: a modelling analysis. *In press* at *The Lancet Global Health.*

De Nicola G, Beal T, Nordhagen S, Phillips SM, Passarelli S, Golden CD (2026) Estimating Protein Intake Inadequacy Worldwide. *In preparation.*

Inadequate micronutrient intakes without fortification

Full data

Column	Description
nutrient_type	Nutrient type (mineral, vitamin)
nutrient	Nutrient
units	Units
continent	Continent
country	Country
iso3	ISO3 code for country
gdd_type	Availability of mean intake in the GDD (reported or borrowed from another country)
gdd_iso3	ISO3 of country contributing mean intake data from the GDD
gdd_country	Name of country contributing mean intake data from the GDD
sex	Sex (males, females)
age_range	Age group (0-4, 5-9, 10-14, etc.)
supply_med	Mean intake from GDD
age_range_water	Age range of daily water intake estimate
water_l_day	Daily water intake (liters)
npeople	Number of people
hdi	Human Development Index for country
hdi_catg	Human Development Index category (low, medium, high, very high) for country
zinc_iso3	ISO3 code for country providing zinc data
phytate_mg	Daily phytate intake (mg)
iron_abs	Iron absorption (%)
age_range_ar	Age range associated with average requirement
ar_units	Average requirement units
ar_source	Average requirement source (EFSA, IOM)
ar	Average requirement
ar_cv	Coefficient of variation of the average requirement
dist_id	Unique id for the intake distribution (Nutrient-ISO3-Sex-Age group)
dist_id_genus	Unique id when matching to the GENuS database
shape_status	Status of the distribution shape (known from Passerrel et al. 2022 or borrowed from most similar country)
shape_source	Source of the distribution shape when borrowed from most similar country (form opposite sex, from closest age group, from most similar country)
within_sex_yn	Is the distribution shape from the lending country known within this sex (T/F)?
within_iso_yn	Is the distribution shape from the lending country known within the opposite sex (T/F)?
dist_id_shape	The unique id of the distribution providing the shape information
dist_yn	Is distribution shape data available within this country/nutrient (yes/no)?
iso3_w_data	ISO3 of the most similar country with data?
dist_id_nutriR	The distribution id of the lending country-sex-age group
best_dist	The distribution of the intake distribution (gamma, lognormal)
g_shape	Gamma distribution shape parameter
g_rate	Gamma distribution rate parameter
g_mu	Mean of the gamma distribution
ln_meanlog	Log-normal distribution mean parameter

ln_sdlog	Log-normal distribution standard deviation parameter
ln_mu	Mean of the log-normal distribution
g_shape_shift	Shape parameter of the gamma distribution shifted to match the GDD mean
g_rate_shift	Rate parameter of the gamma distribution shifted to match the GDD mean
sev	Proportion of people with inadequate intakes
ndeficient	Number of people with inadequate intakes
ln_meanlog_shift	Mean parameter of the log-normal distribution shifted to match the GDD mean
ln_sdlog_shift	Standard deviation parameter of the log-normal distribution shifted to match the GDD mean
region	World Bank region

Reduced data

Column	Definition
continent	Continent
region	Region
iso3	ISO3
country	Country name
nutrient	Nutrient
units	Nutrient units
sex	Sex (male/female)
age_range	Age group (yrs)
intake	Usual intake
ar	Average requirement
ar_source	Average requirement source
sev	Percent inadequate intake (summary exposure value)
npeople	Number of people in age-sex group
ndeficient	Number of people w/ inadequate intake in the age-sex group

Inadequate micronutrient intakes with fortification

Full data

Column	Description
iso3nutr	ISO-nutrient name
nutrient_type	Nutrient type (mineral, vitamin)
nutrient	Nutrient
units	Intake units (mg, ug)
ar_source	Average requirement source (EFSA, IOM)
ar_units	Average requirement units (mg, ug)
ar	Average requirement
ar_cv	Coefficient of variation of the average requirement
ul_source	Upper limit source (EFSA, IOM)
ul_units	Upper limit units (mg, ug)
ul	Upper limit
country	Country name
iso3	ISO3 code of country
sex	Sex (males, females)
age_group	Age group (0-4, 5-9, 10-14, etc.)
npeople	Number of people
best_dist	Intake distribution shape (gamma, log-normal)
g_rate	Gamma distribution rate parameter of donor population
g_shape	Gamma distribution shape parameter of donor population
ln_meanlog	Log-normal distribution mean parameter of donor population
ln_sdlog	Log-normal distribution standard deviation parameter of donor population
g_rate0	Gamma distribution rate parameter without fortification
g_shape0	Gamma distribution shape parameter without fortification
ln_meanlog0	Log-normal distribution mean parameter without fortification
ln_sdlog0	Log-normal distribution standard deviation parameter without fortification
intake0	Mean intake without fortification
sev0	Proportion of people with inadequate intakes without fortification
ndeficient0	Number of people with inadequate intakes without fortification
subsidy_mg1	Fortification subsidy under scenario 1 (mg)
subsidy_mg2	Fortification subsidy under scenario 2 (mg)
subsidy_mg3	Fortification subsidy under scenario 3 (mg)
subsidy_mg4	Fortification subsidy under scenario 4 (mg)
subsidy_mg5	Fortification subsidy under scenario 5 (mg)
subsidy1	Fortification subsidy under scenario 1 (intake units)
subsidy2	Fortification subsidy under scenario 2 (intake units)
subsidy3	Fortification subsidy under scenario 3 (intake units)
subsidy4	Fortification subsidy under scenario 4 (intake units)
subsidy5	Fortification subsidy under scenario 5 (intake units)
intake1	Mean intake under scenario 1 in intake units
intake2	Mean intake under scenario 2 in intake units
intake3	Mean intake under scenario 3 in intake units
intake4	Mean intake under scenario 4 in intake units

intake5	Mean intake under scenario 5 in intake units
fortification_yn	Does fortification occur for this nutrient in this country in any scenario?
ul0	Proportion of people above upper limit without fortification
ul1	Proportion of people above upper limit under scenario 1
ul2	Proportion of people above upper limit under scenario 2
ul3	Proportion of people above upper limit under scenario 3
ul4	Proportion of people above upper limit under scenario 4
ul5	Proportion of people above upper limit under scenario 5
sev1	Proportion of people with inadequate intakes under scenario 1
sev2	Proportion of people with inadequate intakes under scenario 2
sev3	Proportion of people with inadequate intakes under scenario 3
sev4	Proportion of people with inadequate intakes under scenario 4
sev5	Proportion of people with inadequate intakes under scenario 5
ndeficient1	Number of people with inadequate intakes under scenario 1
ndeficient2	Number of people with inadequate intakes under scenario 2
ndeficient3	Number of people with inadequate intakes under scenario 3
ndeficient4	Number of people with inadequate intakes under scenario 4
ndeficient5	Number of people with inadequate intakes under scenario 5
g_shape1	Gamma distribution shape parameter under scenario 1
g_rate1	Gamma distribution rate parameter under scenario 1
g_shape2	Gamma distribution shape parameter under scenario 2
g_rate2	Gamma distribution rate parameter under scenario 2
g_shape3	Gamma distribution shape parameter under scenario 3
g_rate3	Gamma distribution rate parameter under scenario 3
g_shape4	Gamma distribution shape parameter under scenario 4
g_rate4	Gamma distribution rate parameter under scenario 4
g_shape5	Gamma distribution shape parameter under scenario 5
g_rate5	Gamma distribution rate parameter under scenario 5
ln_meanlog1	Log-normal distribution mean parameter under scenario 1
ln_sdlog1	Log-normal distribution standard deviation parameter under scenario 1
ln_meanlog2	Log-normal distribution mean parameter under scenario 2
ln_sdlog2	Log-normal distribution standard deviation parameter under scenario 2
ln_meanlog3	Log-normal distribution mean parameter under scenario 3
ln_sdlog3	Log-normal distribution standard deviation parameter under scenario 3
ln_meanlog4	Log-normal distribution mean parameter under scenario 4
ln_sdlog4	Log-normal distribution standard deviation parameter under scenario 4
ln_meanlog5	Log-normal distribution mean parameter under scenario 5
ln_sdlog5	Log-normal distribution standard deviation parameter under scenario 5
sev0_norm	Proportion of people with inadequate intakes without fortification when using a normal intake distribution

Reduced data

Column	Description
nutrient_type	Nutrient type (mineral, vitamin)
nutrient	Nutrient
units	Intake units (mg, ug)
ar_source	Average requirement source (EFSA, IOM)
ar	Average requirement
ar_cv	Coefficient of variation of the average requirement
ul_source	Upper limit source (EFSA, IOM)
ul	Upper limit
country	Country name
iso3	ISO3 code of country
sex	Sex (males, females)
age_group	Age group (0-4, 5-9, 10-14, etc.)
npeople	Number of people
subsidy1	Fortification subsidy under scenario 1 (intake units)
subsidy2	Fortification subsidy under scenario 2 (intake units)
subsidy3	Fortification subsidy under scenario 3 (intake units)
subsidy4	Fortification subsidy under scenario 4 (intake units)
subsidy5	Fortification subsidy under scenario 5 (intake units)
intake0	Mean intake without fortification
intake1	Mean intake under scenario 1 in intake units
intake2	Mean intake under scenario 2 in intake units
intake3	Mean intake under scenario 3 in intake units
intake4	Mean intake under scenario 4 in intake units
intake5	Mean intake under scenario 5 in intake units
sev0	Proportion of people with inadequate intakes without fortification
sev1	Proportion of people with inadequate intakes under scenario 1
sev2	Proportion of people with inadequate intakes under scenario 2
sev3	Proportion of people with inadequate intakes under scenario 3
sev4	Proportion of people with inadequate intakes under scenario 4
sev5	Proportion of people with inadequate intakes under scenario 5
ndeficient0	Number of people with inadequate intakes without fortification
ndeficient1	Number of people with inadequate intakes under scenario 1
ndeficient2	Number of people with inadequate intakes under scenario 2
ndeficient3	Number of people with inadequate intakes under scenario 3
ndeficient4	Number of people with inadequate intakes under scenario 4
ndeficient5	Number of people with inadequate intakes under scenario 5
ul0	Proportion of people above upper limit without fortification
ul1	Proportion of people above upper limit under scenario 1
ul2	Proportion of people above upper limit under scenario 2
ul3	Proportion of people above upper limit under scenario 3
ul4	Proportion of people above upper limit under scenario 4
ul5	Proportion of people above upper limit under scenario 5

Inadequate protein intakes

Full data

Column	Description
units	Intake units (g/day)
iso3	ISO3 code of country
country	Country name
sex	Sex (males, females)
age_group	Age group (1–4, 5–9, 10–14, …, 95–99 years)
population	Number of people in the age–sex group (2018)
region	World Bank region
calorie_scenario	Caloric intake scenario (low, medium, high)
mean_calorie_intake	Mean daily caloric intake (kcal/day)
calorie_requirement	Minimum Dietary Energy Requirement (MDER, kcal/day)
sev_calorie	Proportion of people with inadequate caloric intake
mean_protein_intake	Mean daily protein intake (g/day)
protein_share	Share of total dietary energy derived from protein
protein_requirement	Estimated Average Requirement (EAR) for protein (g/day)
protein_requirement_opt	Alternative “optimal” protein requirement (g/day)
protein_requirement_adj	Quality-adjusted protein requirement (g/day), where applicable
best_dist_protein	Distributional form assumed for protein intake (gamma or log-normal)
cv_protein	Coefficient of variation of protein intake
best_dist_calorie	Distributional form assumed for caloric intake (gamma or log-normal)
cv_calorie	Coefficient of variation of caloric intake
sev	Proportion with inadequate protein intake (EAR-based)
sev_opt	Proportion with inadequate protein intake (optimal threshold)
sev_adj	Proportion with inadequate protein intake (quality-adjusted EAR)
ndeficient	Number of people with inadequate protein intake (EAR-based)
ndeficient_opt	Number of people with inadequate protein intake (optimal threshold)
ndeficient_adj	Number of people with inadequate protein intake (quality-adjusted EAR)
prop_asf	Share of total dietary protein derived from animal-source foods
quality_factor	Protein quality adjustment factor applied to requirements

Reduced data

Column	Description
iso3	ISO3 code of country
country	Country name
sex	Sex
age_group	Age group
population	Number of people in the age–sex group (2018)
mean_protein_intake	Mean daily protein intake (g/day)
protein_requirement	Estimated Average Requirement (EAR) for protein (g/day)
sev	Proportion of people with inadequate protein intake (EAR-based)
ndeficient	Number of people with inadequate protein intake in the age–sex group

All estimates refer to dietary protein intake and are expressed in grams per day (g/day). Results correspond to the central (medium) caloric intake scenario only. Protein inadequacy is defined as intake below the Estimated Average Requirement (EAR) and is reported as both a proportion (sev) and absolute number (ndeficient) within each country–age–sex group. This reduced dataset excludes alternative caloric scenarios, protein quality adjustments, and distributional parameters, which are provided in the full dataset.