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# Child food poverty and severe dietary deprivation among children aged 6–23 months in Somalia: evidence from the 2020 Somali Health and Demographic Survey

**Abdifatah Jama Noor**

noor.abdifatah@outlook.com

Amoud University

**Mohamed Ismail Ibrahim**

Amoud University

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## Abstract

# Background

Child food poverty (CFP) describes the consumption of foods from too few food groups and anchors UNICEF's framework for monitoring early-childhood nutritional deprivation. Somalia faces recurrent drought, conflict and food-system disruption, yet nationally representative evidence on the diets of children aged 6–23 months is scarce. We measured the prevalence of CFP, severe dietary deprivation (SDD) and minimum dietary diversity (MDD) and how each varied by settlement type and community.

# Methods

We analysed the Kids Record file of the 2020 Somali Health and Demographic Survey, a nationally representative two-stage cluster survey. The sample comprised 3,786 children aged 6–23 months in 309 clusters. From consumption of the eight WHO/UNICEF food groups on the preceding day we defined MDD (≥ 5 groups), CFP (≤ 4) and SDD (≤ 2). Survey-weighted prevalences and multivariable logistic regression adjusted for settlement type, child and maternal characteristics, household wealth and region. Multilevel models with community random intercepts gave the intraclass correlation coefficient (ICC). Sensitivity analyses used E-values and adjustment for an animal-source food (ASF) score and interview timing.

# Results

CFP affected 88.2% of children and SDD 72.9%; only 11.8% achieved MDD. Relative to rural children, nomadic (pastoralist) children had lower adjusted odds of CFP (adjusted odds ratio [AOR] 0.33, 95% CI 0.23–0.48) and SDD (AOR 0.45, 95% CI 0.33–0.60), whereas urban and rural children were similar. Lower odds of both outcomes accompanied higher household wealth, maternal education, child age and maternal age. Between-community variation was large (null-model ICC 41.4% for CFP, 27.7% for SDD). Regional CFP ranged from 73.5% in Sanaag to 96.6% in Bakool. The nomadic association persisted after adjustment for the ASF score and interview timing, and E-values (2.88 for CFP and 2.36 for SDD) indicated moderate robustness to unmeasured confounding.

# Conclusions

Dietary deprivation in early childhood is near-universal in Somalia, and is patterned more strongly by community and region than by individual characteristics alone. The favourable diets of nomadic children, linked to greater animal-source food consumption, and the substantial between-community variance point to geographically targeted, context-specific programming rather than strategies aimed only at household-level risk factors.

# Background

Adequate nutrition in the first two years of life underpins child survival, growth and cognitive development. The months from 6 to 23 are a narrow but decisive window. Breast milk can no longer cover a child's expanding nutrient needs, complementary foods must take over, and the deficits incurred here carry forward to stunting, weakened immune function, poorer cognitive development and higher mortality, much of it only partly reversible in later life.[1, 2] What fills the bowl matters as much as how full it is. Diets built on starchy staples, with little meat, dairy, egg, fruit or vegetable, are a proximate driver of these deficits throughout low- and middle-income countries (LMICs).[3, 4]

Adequacy is difficult to measure directly at population scale, so the World Health Organization (WHO) and UNICEF rely on standardised, food-group-based indicators of infant and young child feeding.[4] The central one is minimum dietary diversity (MDD): a child meets it by consuming at least five of eight defined food groups in the previous day, and low diversity tracks poorer anthropometric outcomes in cohort and cross-sectional studies alike.[1, 4] The 2023 WHO complementary-feeding guideline placed dietary diversity, and animal-source foods in particular, at the centre of its recommendations for children aged 6–23 months.[2]

UNICEF's 2024 Child Food Poverty report recast dietary deprivation as a form of poverty in its own right.[3] The framework grades the same food-group count into tiers: a child eating from four or fewer of the eight groups is living in child food poverty (CFP), and a child eating from two or fewer is in severe child food poverty, referred to throughout as severe dietary deprivation (SDD), a diet of extreme monotony. UNICEF placed 181 million children, roughly 27% of those under five, in severe child food poverty worldwide, concentrated in fragile and conflict-affected settings.[3] CFP and MDD are not mirror images. MDD marks the threshold of an adequate diet; CFP and SDD measure how far children fall below it, and recent work has stressed how far apart the two can sit.[5]

Across sub-Saharan Africa the picture is remarkably consistent. Pooled analyses of Demographic and Health Survey (DHS) data put MDD at roughly 10–23% and a minimum acceptable diet near 10%, with the same gradients surfacing study after study: maternal education, household wealth, media exposure, breastfeeding and place of residence.[6–9] Multilevel and decomposition analyses trace much of the gap between poor and non-poor children to maternal and household socioeconomic resources.[10, 11] Regional work in the Middle East and North Africa and in Ghana adds the weight of context and market access, and shows household wealth modifying the effect of other factors.[12, 13]

Why diets stay narrow is only partly a household story. In rural, remote and fragile settings, drought, insecurity, weak roads and disrupted supply chains can put dietary diversity structurally out of reach, whatever a caregiver knows or intends.[3] Dietary deprivation tends to cluster geographically and socially rather than scatter at random across households, which places community-level structure, not household characteristics alone, at the centre of both analysis and response.

Few countries bring these forces together as starkly as Somalia, which makes it a setting of global importance for child food poverty. More than three decades of armed conflict, recurrent and intensifying drought, repeated mass displacement and persistent state fragility have hollowed out the food systems and health infrastructure on which child feeding depends.[14] Layered onto this is a large pastoralist population whose livestock-based livelihoods shape both the food that is available and the way young children are fed. This particular combination, chronic insecurity, climatic shock, displacement, weak institutions and a pastoral economy, is precisely the profile under which UNICEF projected some of the highest severe child food poverty in the world.[3] Yet the evidence base for Somalia and the wider Horn of Africa remains thin and fragmented, and most of what exists predates the framework now used for global monitoring.

What evidence exists is largely subnational or indirect. A machine-learning analysis of the same 2020 SHDS examined inadequate meal frequency but did not apply the food-group framework.[15] Earlier work in Somalia's northwestern (Somaliland) regions found that 58% of children under five did not meet minimum dietary diversity, with marked spatial clustering and the highest burden in Sool (79.7%) and Sanaag (74.4%) against a far lower burden in Maroodi Jeex (32.8%),[16] alongside a heavy burden of child malnutrition.[17] That evidence was limited to a subset of regions, covered children under five rather than the complementary-feeding window, and was not framed within the UNICEF CFP indicators that allow direct global comparison. Across the border, studies in the Somali Region of Ethiopia and among pastoralist communities in Kenya report similar vulnerability among children in arid and pastoral settings,[18, 19] and broader Ethiopian and southern-African work links inappropriate complementary feeding to undernutrition and maps its spatial determinants.[20–22]

This leaves three gaps. No nationally representative study has applied the UNICEF Child Food Poverty framework to Somalia, so national CFP and SDD remain undocumented within the framework now used for global monitoring. The diets of nomadic children, a large and policy-relevant group, have not been set directly against those of rural and urban children using consistent, survey-weighted methods. And no analysis has partitioned how much of the variation in dietary deprivation lies between communities rather than between households, a distinction that decides whether programmes should target places or families.

We use the 2020 SHDS, the most comprehensive nationally representative nutrition dataset available for Somalia, to place the country within the UNICEF Child Food Poverty framework. To our knowledge this is the first nationally representative application of that framework in Somalia, one of the first in any highly fragile, conflict-affected setting, the first to compare rural, urban and nomadic children within it, and the first to quantify how much of the variation in child food poverty and severe dietary deprivation in Somalia lies between communities. Drawing on 3,786 children aged 6–23 months nested within 309 communities, the study estimates the survey-weighted national prevalence of MDD, CFP and SDD; describes food-group consumption and the dietary-diversity spectrum across urban, rural and nomadic settlements; identifies individual-, household- and community-level determinants of CFP and SDD using survey-weighted and multilevel models; quantifies community-level variation through intraclass

correlation coefficients and median odds ratios; and characterises regional inequalities across all accessible administrative regions. A prespecified set of sensitivity analyses, including adjustment for interview seasonality and scenario-based bounding of the national estimates, tests how far the principal findings hold.

## Methods

# Study design and data source

We performed a secondary analysis of the 2020 Somali Health and Demographic Survey (SHDS)[23], a nationally representative, cross-sectional household survey conducted with standard DHS methodology. The design was stratified and two-stage: 44 sampling strata were defined by the intersection of region and residence type, clusters were drawn at the first stage and households at the second. Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidance for cross-sectional studies. The analysis used the Kids Record (KR) recode file, which holds one record per living child of interviewed women, with the child's feeding, anthropometric and background information.

## Study population and sample derivation

The analysis was restricted to children in the complementary feeding window. From all KR records (n = 21,218) we kept living children (n = 18,542), then those aged 6–23 months (n = 4,196). Complete information on all eight WHO food groups (n = 3,799) and complete survey-design variables (cluster, sampling weight, region and residence) were then required, leaving 3,786 children. The final analytical sample of 3,786 children aged 6–23 months was distributed across 309 sampling clusters and underpinned every survey-weighted and multilevel analysis. Figure S1 (Additional file 1) sets out the derivation and the reason for each exclusion.

## Outcome construction

Outcome construction

Three outcomes were derived from the count of WHO food groups consumed in the day or night before the interview. A child met minimum dietary diversity (MDD) by consuming at least five of the eight groups. Following the UNICEF framework, child food poverty (CFP) was four or fewer groups and severe dietary deprivation (SDD), corresponding to severe child food poverty, was two or fewer. Children consuming three or four groups were additionally labelled as experiencing moderate child food poverty. CFP and SDD entered the regression models as binary outcomes, and the three indicators kept these definitions throughout.

## Food-group operationalisation

The eight WHO/UNICEF food groups were breast milk; grains, roots and tubers; legumes and nuts; dairy products; flesh foods (meat, organ meat, fish and other flesh); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables. A group was coded as consumed (1) when any corresponding SHDS KR source variable indicated intake in the previous 24 hours, and not consumed (0) otherwise. Breastfeeding status came from the DHS variable M4. Table S1 (Additional file 1) gives the full mapping of WHO food groups to SHDS variables and the coding rules.

## Covariates

Covariates were chosen a priori from the complementary feeding literature and what the DHS data allowed. Settlement type was the principal exposure, coded rural, urban or nomadic with rural as the reference. Child-level covariates were age in months and sex. Maternal covariates were age in years and educational attainment (no education, primary, secondary, higher, entered as an ordered level). The DHS wealth index captured household socioeconomic position, and region of residence was also included. Region comprised the 16 sampled regions, with Awdal as the reference; two regional strata (codes 23 and 27, Lower Shabelle and Middle Juba) lay outside the SHDS sampling frame and could not be estimated (Additional file 1: Table S7).

# Statistical analysis

All descriptive and regression estimates carried the complex survey design. Sampling weights were the DHS weight variable divided by 1,000,000, and the stratified two-stage cluster structure was specified so that standard errors and 95% confidence intervals came from Taylor-series linearisation. Continuous characteristics are reported as survey-weighted means with standard errors and categorical characteristics as weighted percentages. We estimated survey-weighted prevalences of each food group and of MDD, CFP and SDD, overall and by settlement type. Survey-weighted multivariable logistic regression related the covariates to CFP and to SDD, with results given as adjusted odds ratios (AOR) and 95% confidence intervals; a two-sided p-value below 0.05 was treated as significant. Regional prevalences were estimated separately for each outcome, and the Benjamini-Hochberg false-discovery-rate procedure handled multiplicity across regional comparisons. Analyses used standard statistical software with established procedures for complex survey data and mixed-effects models.

## Multilevel analysis

To gauge how far dietary deprivation clusters within communities, we fitted two-level logistic models with a random intercept for the sampling cluster (primary sampling unit), separately for CFP and SDD. Each outcome had a null model with the random intercept alone and a full model adding the covariates above. From the cluster-level variance on the logit scale we derived the intraclass correlation coefficient ($ICC = \sigma^2 / [\sigma^2 + \pi^2/3]$), the median odds ratio (MOR), which expresses residual between-cluster heterogeneity on the odds-ratio scale, and the proportional change in variance (PCV) between null and

full models, which indexes the share of community-level variance explained by the measured covariates. Model fit was compared with the Akaike Information Criterion (AIC). Table S2 (Additional file 1) reports the full diagnostics.

## Sensitivity analyses

Several sensitivity analyses probed the robustness of the principal settlement finding. We computed E-values for the protective nomadic-versus-rural association, that is the minimum strength of association on the odds-ratio scale that an unmeasured confounder would need with both exposure and outcome, beyond the measured covariates, to explain the adjusted association away; E-values were also computed for the confidence-interval limit nearer the null (Additional file 1: Table S5). Because pastoralist diets are rich in milk and other animal-source foods, we refitted the CFP and SDD models with additional adjustment for an animal-source food (ASF) consumption score (range 0–3, summing dairy, flesh foods and eggs); these models are exploratory, since the ASF score shares constituent food groups with the outcomes and so risks over-adjustment (Additional file 1: Table S6). To address the possibility that pastoralist children's favourable diets reflect transient, season-dependent milk availability, we refitted the models with adjustment for the month and year of interview; this seasonality-adjusted analysis is summarised qualitatively, as the coefficients are not separately tabulated here. Finally, we considered what the regions excluded from the SHDS sampling frame (Additional file 1: Table S7) imply for the national estimates.

# Ethics

This study used fully de-identified, publicly available secondary data and involved no new contact with participants. The SHDS 2020 was carried out under the ethical standards governing DHS surveys, including informed consent from respondents at the time of data collection and approval by the relevant national authorities. No additional ethical approval was needed for this secondary analysis; access to the dataset was obtained through the Somali National Data Archive data-access procedure.

## Results

# Participant characteristics

The final analytical sample comprised 3,786 children aged 6–23 months: 998 rural, 1,596 urban and 1,192 nomadic (Table 1). Weighted mean age was similar across settlements (about 13–14 months), as was the proportion of boys (51–54%). Maternal education was very low everywhere, with more than four in five mothers reporting no formal schooling in every stratum (83.3% rural, 80.5% urban, 84.1% nomadic) and secondary or higher education rare. Household wealth was spread across all five quintiles in every settlement type, and mean wealth scores were broadly comparable (2.83–2.92).

Table 1
Characteristics of children aged 6–23 months by settlement type

| Characteristic | Rural (n = 998) | Urban (n = 1596) | Nomadic (n = 1192) |
|---|---|---|---|
| Child age, months, mean | 13.72 | 13.25 | 13.96 |
| Maternal age, years, mean | 27.38 | 27.71 | 27.00 |
| Household wealth index, mean score | 2.87 | 2.83 | 2.92 |
| Male child, % | 54.3 | 53.9 | 51.1 |
| **Maternal education, %** | | | |
| No education | 83.3 | 80.5 | 84.1 |
| Primary | 11.8 | 15.5 | 9.5 |
| Secondary | 3.1 | 3.1 | 4.5 |
| Higher | 1.7 | 0.9 | 2.0 |
| **Household wealth quintile, %** | | | |
| Lowest | 24.7 | 24.1 | 17.4 |
| Second | 22.1 | 20.1 | 24.7 |
| Middle | 13.5 | 19.6 | 22.4 |
| Fourth | 21.5 | 21.2 | 19.3 |
| Highest | 18.3 | 14.9 | 16.2 |

Survey-weighted estimates for children aged 6–23 months, Somalia SHDS 2020. Continuous variables are weighted means; categorical variables are weighted percentages. Wealth index mean score is on the five-level quintile scale (1 = lowest to 5 = highest).

# Food-group consumption patterns

Consumption of individual food groups was low and dominated by staples (Table 2, Fig. 1). Apart from breast milk, reported for roughly three-quarters of children in every settlement, only grains, roots and tubers reached a substantial minority (37.6–43.2%). Nutrient-dense groups were eaten infrequently, but the settlement gradient was pronounced and consistent, with nomadic children reporting the highest consumption of every animal-source and micronutrient-rich group. Dairy reached 16.3% of nomadic children against 9.9% of rural and 8.8% of urban children; flesh foods 28.1% of nomadic against 15.1% of rural and 18.9% of urban; and eggs 19.3% of nomadic against 8.2% of rural and 8.3% of urban. Vitamin A-rich and other fruits and vegetables followed the same pattern, with nomadic consumption roughly double that of rural and urban children.

Table 2
Consumption of the eight WHO/UNICEF food groups by settlement type

| Food group (previous 24 hours) | Rural | Urban | Nomadic |
|---|---|---|---|
| Breast milk | 73.5 (69.1–77.9) | 77.1 (74.3–79.9) | 77.4 (74.0–80.8) |
| Grains, roots and tubers | 41.7 (37.5–46.0) | 37.6 (33.3–42.0) | 43.2 (40.0–46.4) |
| Legumes and nuts | 7.1 (4.8–9.4) | 9.2 (7.2–11.3) | 16.8 (13.8–19.9) |
| Dairy products | 9.9 (6.2–13.6) | 8.8 (6.8–10.9) | 16.3 (13.0–19.5) |
| Flesh foods | 15.1 (11.1–19.1) | 18.9 (15.5–22.3) | 28.1 (22.7–33.4) |
| Eggs | 8.2 (5.7–10.7) | 8.3 (6.4–10.3) | 19.3 (15.6–23.0) |
| Vitamin A-rich fruits and vegetables | 21.6 (16.7–26.5) | 24.5 (19.9–29.1) | 39.1 (33.5–44.8) |
| Other fruits and vegetables | 12.6 (8.5–16.7) | 12.1 (9.1–15.1) | 29.5 (24.2–34.8) |

Survey-weighted prevalence (%, with 95% confidence interval) of consumption in the preceding 24 hours among children aged 6–23 months, Somalia SHDS 2020.

# Prevalence of minimum dietary diversity, child food poverty and severe dietary deprivation

Dietary deprivation was near-universal (Table 3, Fig. 2). Overall, 88.2% of children aged 6–23 months were in child food poverty (≤ 4 food groups) and 72.9% in severe dietary deprivation (≤ 2 groups), while only 11.8% reached minimum dietary diversity (≥ 5 groups). The settlement gradient seen for individual food groups carried through to the summary indicators. Nomadic children were the least deprived: 23.2% met MDD against 9.3% of rural and 10.8% of urban children, and CFP affected 76.8% of nomadic children against 90.7% of rural and 89.2% of urban children. Severe dietary deprivation followed the same order, at 59.7% of nomadic children against 75.3% of rural and 74.3% of urban children. Rural and urban children were broadly alike on all three indicators, so the principal contrast lay between nomadic children and the rest.

Table 3
Dietary diversity and deprivation indicators by settlement type

| Indicator | Rural | Urban | Nomadic | Overall |
|---|---|---|---|---|
| MDD met (≥ 5 groups) | 9.3 (6.8–11.8) | 10.8 (8.0–13.6) | 23.2 (19.0–27.5) | 11.8 |
| Moderate CFP (3–4 groups) | 15.4 (11.5–19.4) | 14.8 (12.4–17.3) | 17.1 (14.5–19.7) | 15.3 |
| Severe dietary deprivation (≤ 2 groups) | 75.3 (70.0–80.6) | 74.3 (70.2–78.5) | 59.7 (54.2–65.1) | 72.9 |
| Child food poverty (≤ 4 groups) | 90.7 (88.2–93.2) | 89.2 (86.4–92.0) | 76.8 (72.5–81.0) | 88.2 |

Survey-weighted prevalence (%, with 95% confidence interval where estimated) among children aged 6–23 months, overall and by settlement type, Somalia SHDS 2020. MDD, minimum dietary diversity; CFP, child food poverty. Child food poverty comprises the moderate and severe categories combined.

# Correlates of child food poverty and severe dietary deprivation

In survey-weighted multivariable logistic regression, the settlement contrast held after adjustment for child, maternal, household and regional characteristics (Tables 4 and 5, Fig. 3). Relative to rural children, nomadic children had substantially lower adjusted odds of both child food poverty (AOR 0.33, 95% CI 0.23–0.48, $p < 0.001$) and severe dietary deprivation (AOR 0.45, 95% CI 0.33–0.60, $p < 0.001$), while urban children differed little from rural children for either outcome (CFP AOR 1.01, $p = 0.952$; SDD AOR 1.10, $p = 0.525$). Of the characteristics shown in Fig. 3, the nomadic contrast lay furthest from an odds ratio of 1, and only some regional contrasts were larger. Model-adjusted predicted probabilities by settlement type are shown in Additional file 1: Figure S2.

The socioeconomic and demographic gradients ran in the expected directions and were consistent across the two outcomes. Each additional month of child age was associated with lower odds of deprivation (CFP AOR 0.93 per month; SDD AOR 0.93 per month, both $p < 0.001$), in line with progressive dietary diversification as complementary feeding becomes established. Higher maternal education (CFP AOR 0.74 per level, $p = 0.002$; SDD AOR 0.70 per level, $p = 0.006$) and higher household wealth (CFP AOR 0.56 per quintile; SDD AOR 0.67 per quintile, both $p < 0.001$) were each independently associated with lower odds, and older maternal age was modestly protective. Child sex was associated with neither outcome.

Region of residence was strongly associated with deprivation even after individual and household adjustment. With Awdal as the reference, the odds of child food poverty were several-fold higher across a band of north-eastern and south-central regions, most strikingly Bakool (AOR 8.29, 95% CI 3.72–18.50), Nugaal (AOR 4.03), Bari (AOR 3.52) and Mudug (AOR 3.50), all $p < 0.01$. The pattern for severe dietary

deprivation was similar but less extreme, with the highest adjusted odds in Bari (AOR 3.25), Mudug (AOR 3.09), Nugaal (AOR 2.26), Galgaduud (AOR 2.21) and Hiraan (AOR 2.25), and further significant elevations in Woqooyi Galbeed, Sool and Bakool. These adjusted contrasts show that the geography of deprivation is not explained by the measured composition of households alone.

Table 4
Factors associated with child food poverty: adjusted odds ratios

| Variable | AOR (95% CI) | p-value |
|---|---|---|
| **Settlement type** | | |
| Rural | 1.00 (reference) | |
| Urban | 1.01 (0.69–1.48) | 0.952 |
| Nomadic | 0.33 (0.23–0.48) | < 0.001 |
| Child age (per month) | 0.93 (0.91–0.96) | < 0.001 |
| Female (vs male) | 1.01 (0.72–1.42) | 0.944 |
| Maternal education (per level) | 0.74 (0.61–0.89) | 0.002 |
| Household wealth (per quintile) | 0.56 (0.49–0.65) | < 0.001 |
| Maternal age (per year) | 0.97 (0.95–0.99) | 0.003 |
| **Region (reference: Awdal)** | | |
| Woqooyi Galbeed | 1.48 (0.73–3.03) | 0.279 |
| Togdheer | 1.13 (0.65–1.95) | 0.670 |
| Sool | 1.60 (0.89–2.87) | 0.118 |
| Sanaag | 1.32 (0.76–2.30) | 0.319 |
| Bari | 3.52 (1.54–8.01) | 0.003 |
| Nugaal | 4.03 (1.85–8.79) | < 0.001 |
| Mudug | 3.50 (1.79–6.83) | < 0.001 |
| Galgaduud | 1.70 (0.83–3.47) | 0.145 |
| Hiraan | 1.95 (0.88–4.28) | 0.098 |
| Middle Shabelle | 2.04 (0.97–4.30) | 0.061 |
| Banadir | 1.29 (0.66–2.50) | 0.457 |
| Bay | 2.60 (0.99–6.84) | 0.053 |
| Bakool | 8.29 (3.72–18.50) | < 0.001 |
| Gedo | 2.32 (0.88–6.12) | 0.089 |
| Lower Juba | 0.87 (0.44–1.70) | 0.674 |

Survey-weighted (design-based) multivariable logistic regression for child food poverty (≤ 4 food groups) among children aged 6–23 months, Somalia SHDS 2020. AOR, adjusted odds ratio; CI, confidence

interval. Maternal education and household wealth were modelled as ordered levels (per-level odds ratios).

Table 5
Factors associated with severe dietary deprivation: adjusted odds ratios

| Variable | AOR (95% CI) | p-value |
|---|---|---|
| **Settlement type** | | |
| Rural | 1.00 (reference) | |
| Urban | 1.10 (0.82–1.47) | 0.525 |
| Nomadic | 0.45 (0.33–0.60) | < 0.001 |
| Child age (per month) | 0.93 (0.91–0.95) | < 0.001 |
| Female (vs male) | 1.01 (0.82–1.24) | 0.917 |
| Maternal education (per level) | 0.70 (0.55–0.91) | 0.006 |
| Household wealth (per quintile) | 0.67 (0.61–0.73) | < 0.001 |
| Maternal age (per year) | 0.98 (0.96–0.99) | 0.010 |
| **Region (reference: Awdal)** | | |
| Woqooyi Galbeed | 2.02 (1.10–3.73) | 0.024 |
| Togdheer | 0.99 (0.61–1.61) | 0.976 |
| Sool | 1.84 (1.10–3.09) | 0.021 |
| Sanaag | 1.32 (0.84–2.09) | 0.234 |
| Bari | 3.25 (1.90–5.57) | < 0.001 |
| Nugaal | 2.26 (1.38–3.69) | 0.001 |
| Mudug | 3.09 (1.69–5.63) | < 0.001 |
| Galgaduud | 2.21 (1.17–4.20) | 0.015 |
| Hiraan | 2.25 (1.30–3.90) | 0.004 |
| Middle Shabelle | 1.61 (0.82–3.16) | 0.165 |
| Banadir | 1.33 (0.77–2.29) | 0.308 |
| Bay | 1.33 (0.74–2.39) | 0.339 |
| Bakool | 1.73 (1.01–2.96) | 0.046 |
| Gedo | 1.86 (0.94–3.71) | 0.076 |
| Lower Juba | 0.99 (0.59–1.65) | 0.973 |

Survey-weighted (design-based) multivariable logistic regression for severe dietary deprivation (≤ 2 food groups) among children aged 6–23 months, Somalia SHDS 2020. AOR, adjusted odds ratio; CI, confidence interval. Maternal education and household wealth were modelled as ordered levels (per-level odds ratios).

# Regional variation

Survey-weighted regional estimates confirmed a burden that was pervasive but geographically uneven (Fig. 4; Additional file 1: Tables S3 and S4). Child food poverty affected roughly three-quarters of children or more in every region, ranging from 73.5% in Sanaag to 96.6% in Bakool, with Nugaal (95.7%), Bari (94.5%), Gedo (94.2%) and Bay (93.3%) also among the most affected. Severe dietary deprivation ranged from 54.7% in Awdal to 85.1% in Bari. The regions with the highest crude burden were largely those with the highest adjusted odds, so the regional gradient is not merely an artefact of household composition. Because two regional strata were absent from the sampling frame and the Bay estimate derives from its urban stratum only (Additional file 1: Table S7), the regional figures apply to the sampled population.

# Between-community variation

Multilevel logistic models with a community (cluster) random intercept showed that much of the variation in dietary deprivation lay between communities rather than between children (Additional file 1: Table S2). In the null model for child food poverty the intraclass correlation coefficient was 41.4%, so more than two-fifths of the residual variation in a child's propensity to experience CFP was attributable to community of residence; the median odds ratio was 4.28. The community share for severe dietary deprivation was also substantial (ICC 27.7%, MOR 2.91). These values are large by the standards of multilevel analyses of child-health outcomes: two children with identical individual and household characteristics could face markedly different odds of deprivation purely by virtue of where they lived. Adding the full set of individual, household and regional covariates explained much of the clustering (proportional change in variance 81.8% for CFP and 73.9% for SDD, with the median odds ratios falling to 1.86 and 1.73), so measured composition and region together account for most, though not all, of the between-community heterogeneity. A residual community effect remained in both fully adjusted models.

# Sensitivity analyses

The protective nomadic association was robust across the prespecified sensitivity analyses. An unmeasured confounder would need to be associated with both nomadic settlement and the outcome by an odds ratio of about 2.9 for child food poverty and 2.4 for severe dietary deprivation, over and above the measured covariates, to explain the observed associations away; the corresponding E-values for the confidence-interval limits nearer the null were 2.25 and 1.90 (Additional file 1: Table S5). Confounding of that strength is hard to envisage given how broadly the models already adjust.

Pastoralist diets are characteristically rich in milk and other animal-source foods, so we tested whether the nomadic association merely reflected animal-source food intake by adding an animal-source food

consumption score to the models (Additional file 1: Table S6). The score was strongly and inversely associated with both outcomes, as expected. With it in the model the nomadic association for child food poverty was attenuated but stayed significant (AOR from 0.33 to 0.52, p = 0.024), while that for severe dietary deprivation was essentially unchanged (AOR 0.45 to 0.46, p < 0.001). These models are necessarily exploratory: the animal-source food score is built from food groups that also contribute to the outcomes, so adjusting for it risks over-adjustment and partial conditioning on the outcome, and they should be read as describing the role of animal-source foods rather than as an unbiased mediation analysis. At face value they suggest that animal-source food consumption accounts for part, but not all, of the nomadic advantage.

Pastoralist children's favourable diets might instead reflect transient, season-dependent milk availability rather than a durable pattern, so the models were refitted with adjustment for month and year of interview. The nomadic association stayed statistically significant, which argues against seasonal milk supply as the sole explanation. It cannot, however, rule out residual seasonal or climatic influence, since interview timing is only a partial proxy for the complex seasonality of pastoral food systems. Finally, because two regions were absent from the SHDS sampling frame and parts of a third were not sampled (Additional file 1: Table S7), we considered what this incomplete coverage implies for the national estimates; under plausible assumptions about the excluded areas the overall conclusion of near-universal deprivation and a nomadic advantage did not materially change, though the precise national percentages should be read as pertaining to the sampled population.

# Discussion

In this nationally representative analysis of children aged 6–23 months, dietary deprivation in Somalia was close to universal. Child food poverty affected 88.2% of children and severe dietary deprivation 72.9%, while only 11.8% reached minimum dietary diversity. Diets rested overwhelmingly on breast milk and starchy staples, with animal-source foods, fruits and vegetables eaten by small minorities. Three findings stand out against this uniformly high background: nomadic (pastoralist) children were consistently and substantially less deprived than rural or urban children; deprivation was strongly patterned by region; and much of the variation lay between communities rather than between individual households. To our knowledge this is the first application of the UNICEF Child Food Poverty framework[3] to nationally representative Somali data, and the first to partition the community-level burden of dietary deprivation in this setting.

The scale of deprivation observed here sits at the severe end of the wider sub-Saharan African evidence. Pooled multi-country analyses of DHS data repeatedly show that only a minority of children achieve minimum dietary diversity or a minimum acceptable diet, with adequacy commonly falling somewhere between roughly one in ten and one in three children.[6–8] A pooled sub-Saharan African analysis estimated a minimum acceptable diet in only about one in ten children, with rural residence associated with poorer dietary adequacy than urban residence.[7] Our national MDD estimate of 11.8% sits towards the lower end of these distributions, and the near-universal CFP we document fits Somalia's standing as

one of the most food-insecure and fragile settings in the region. Decomposition and multilevel analyses elsewhere have attributed much of the socioeconomic gap in dietary adequacy to maternal education and household wealth,[10, 11] gradients our data reproduce clearly.

The handful of Somalia- and Somaliland-specific studies offer the closest comparison and broadly agree with us. An analysis of the same 2020 SHDS reported inadequate meal frequency in 78.5% of children,[15] which fits the high deprivation we observed. Studies focused on Somalia's northwestern (Somaliland) regions have likewise documented a heavy burden of inadequate dietary diversity and child malnutrition with pronounced spatial clustering,[16, 17] and work in the Somali Region of Ethiopia has described similar vulnerability in neighbouring pastoral populations.[18] Our severe dietary deprivation estimate of 72.9%, which like UNICEF's severe child food poverty measure reflects consumption of no more than two food groups, exceeds the approximately 63% that UNICEF's 2024 report records for Somalia,[3] and both lie far above the global severe estimate of 27%. The UNICEF figure corroborates the same substantive conclusion, that severe dietary deprivation among young Somali children ranks among the highest documented globally, while our analysis, drawing on the SHDS 2020 sample and survey-weighted methods, places that burden even higher. Several methodological differences, among them denominator definitions, age-eligibility criteria, survey-weighting procedures, the treatment of breastfeeding, regional coverage, reference periods, and food-group coding rules, plausibly explain the remaining gap, so the two estimates are best read as mutually reinforcing rather than inconsistent.

The most distinctive finding is the comparative dietary advantage of nomadic children, who carried roughly half to one-third the adjusted odds of deprivation of rural children and ate about twice as much dairy, flesh food and egg. This cuts against the usual assumption that pastoralist populations, with their limited access to health services, markets and schooling, are uniformly the most nutritionally vulnerable; studies among pastoralist communities in the region have in fact emphasised their disadvantage on anthropometric outcomes.[18, 19] The most plausible explanation is direct household access to animal-source foods. Pastoralist families own and herd livestock, so they can give young children milk, and intermittently meat and eggs, without depending on purchasing power or market integration. Adjusting for an animal-source food consumption score fits this reading: it attenuated the nomadic association for child food poverty (adjusted odds ratio from 0.33 to 0.52) but did not abolish it, and left the association for severe dietary deprivation essentially unchanged. Because that score is built from food groups that also define the outcomes, the analysis is exploratory, exposed to over-adjustment, and unable to support a formal mediation claim; even so, it points to animal-source food consumption explaining part, but not all, of the advantage, with the remainder likely lying in feeding culture and the early, routine introduction of milk. Two cautions apply. The indicators capture dietary diversity on a single day, not the quantity, energy density or overall adequacy of the diet, nor growth, so a relative advantage in diversity does not mean nomadic children are well-nourished or food-secure in absolute terms. And pastoral milk supply is seasonal; adjusting for interview month and year left the nomadic association intact, which argues against seasonality as the sole driver, but interview timing is an imperfect proxy and residual seasonal effects cannot be excluded.

Deprivation was also strongly geographical. Survey-weighted child food poverty affected roughly three-quarters of children or more in every region, ranging from about 74% to 97%, and the highest-burden regions kept markedly elevated odds after adjustment for household composition. The largest adjusted excesses clustered in Bakool, Bari, Mudug and Nugaal, with further elevations in Hiraan and Galgaduud. These regions lie across the north-east and the south-central zones, areas that have repeatedly faced drought, armed conflict, population displacement, constrained humanitarian access and disrupted food systems and markets.[14] The analysis is ecological and the design cross-sectional, so we cannot attribute the regional differences to any of these factors directly; the pattern is, however, consistent with local food environments, market connectivity, the reach of health and nutrition services, and exposure to climatic and security shocks shaping children's diets beyond the make-up of individual households. The close agreement between crude and adjusted regional rankings points to genuine contextual effects rather than a compositional artefact.

The multilevel analysis makes this contextual character explicit. More than two-fifths of the residual variation in child food poverty (intraclass correlation 41.4%) and more than a quarter of that in severe dietary deprivation (27.7%) sat between communities, with median odds ratios of 4.28 and 2.91. A median odds ratio of 4.28 means that, comparing two otherwise similar children from two randomly chosen communities, the community alone can shift the odds of child food poverty more than four-fold, a contextual effect as large as or larger than the strongest individual-level risk factor we identified. In practical terms, where a child lives is among the strongest markers of their risk of dietary deprivation. Measured covariates and region together explained most of the between-community variance (proportional change in variance 81.8% and 73.9%), yet a residual community effect persisted in both fully adjusted models, so place is not reducible to the household and regional characteristics we measured. For policy this is consequential: programmes aimed only at household-level risk factors will leave much of the geographically concentrated burden untouched, and the community and region are themselves the natural units for targeting and delivery.

The individual- and household-level gradients were coherent and in keeping with the complementary feeding literature. Older child age went with progressively lower deprivation, reflecting the expected diversification of the diet through the second half of infancy and into the second year. Higher household wealth and higher maternal education were each independently protective, echoing the socioeconomic patterning documented across sub-Saharan Africa.[6, 7, 10, 11] The absence of any association with child sex argues against systematic sex-based discrimination in complementary feeding at this age, at least as dietary diversity captures it.

Several implications for policy and programming follow. Near-universal deprivation, sharp regional inequality and large between-community variance together argue for an explicitly geographic approach: prioritise the highest-burden regions and communities and tailor delivery to local food environments, rather than leaning on nationally uniform, household-targeted messaging alone. The pastoralist advantage argues for protecting and strengthening the animal-source food pathways that nomadic children appear to depend on, through livestock health, water and rangeland management, and measures

that preserve milk availability during shocks, while recognising that this advantage is fragile and contingent on the viability of pastoral systems. For settled rural and urban populations, where animal-source food consumption was lowest, the priorities are the affordability and availability of nutrient-dense foods alongside the established levers of maternal education and household economic strengthening. Because the burden is bound up with drought, conflict and displacement, nutrition responses will have to sit inside humanitarian and resilience programming rather than stand alone as a vertical activity. The analysis also shows that routine child food poverty monitoring in Somalia is feasible and informative using existing survey platforms.[3, 5]

The study has clear strengths. It draws on a large, nationally representative survey with a rigorous two-stage design, and every estimate carries the survey weights and clustering, so the findings generalise to the sampled population of Somali children. It is, as far as we know, the first to apply the UNICEF Child Food Poverty framework to Somalia and the first to compare nomadic, rural and urban children directly with consistent, survey-weighted methods. The multilevel models treat community as a quantity of interest rather than a nuisance, and the regional estimates and mapping locate the burden in space. A coherent set of sensitivity analyses, E-values for unmeasured confounding, additional adjustment for animal-source food consumption, adjustment for interview timing, and consideration of the excluded regions, lends confidence that the nomadic advantage is not an artefact of measured confounding, of animal-source food intake alone, or of seasonality alone.

These strengths are balanced by real limitations. The cross-sectional design rules out causal inference; the associations we report, the nomadic advantage and the regional and socioeconomic gradients among them, describe patterning rather than mechanism. Dietary intake came from maternal recall over the previous 24 hours, which carries recall and social-desirability bias and, more importantly, captures a single day rather than habitual intake, so day-to-day and seasonal variation will introduce non-differential misclassification of the food-group indicators. The indicators reflect dietary diversity, not the quantity, energy density or overall adequacy of the diet, and were not linked here to anthropometric outcomes. Residual and unmeasured confounding, for instance by maternal nutritional knowledge, livestock holdings, water access or proximity to markets, remains possible, though the E-values suggest it would need to be moderately strong to overturn the settlement finding. Coverage was incomplete: two regions were absent from the sampling frame and parts of a third were not sampled, so the national estimates pertain to the sampled population and may understate deprivation in the most insecure, unsampled areas. The animal-source food analysis is exploratory and exposed to over-adjustment because the score shares food groups with the outcomes, and adjustment for interview timing captures only part of the seasonality of pastoral food systems. The gap between our severe-deprivation estimate and the UNICEF national figure further underlines how sensitive these indicators are to definitional and operational choices.

Several directions would build on these results. Longitudinal and seasonally repeated measurements would help separate durable dietary patterns from transient, shock-driven swings, especially for pastoralist children. Linking dietary diversity to anthropometric and micronutrient outcomes would show

whether the nomadic dietary advantage translates into better growth and development. Studies that characterise community food environments directly, market access, food prices, livestock holdings and service availability, would help explain the large between-community variance and identify modifiable contextual targets. Extending coverage to the currently unsampled regions, as security allows, would complete the national picture. Evidence of this kind would sharpen the targeting of the geographically focused, context-specific interventions the present findings call for.

## Conclusions

Dietary deprivation among children aged 6–23 months in Somalia is near-universal: child food poverty reaches close to nine in ten children, severe dietary deprivation more than seven in ten, and minimum dietary diversity only about one in eight. It is patterned far more by community and region than by individual and household characteristics, and nomadic children, whose diets carry more animal-source foods, are consistently less deprived than their rural and urban peers, a pattern robust to adjustment for animal-source food intake, interview timing and plausible unmeasured confounding. Reducing this burden will take geographically targeted, context-specific action that addresses community and regional food environments and protects the food pathways the least-deprived children currently rely on, rather than strategies aimed only at household-level risk factors.

## Abbreviations

**AIC**
Akaike information criterion
**AOR**
adjusted odds ratio
**ASF**
animal-source food
**CFP**
child food poverty
**CI**
confidence interval
**DHS**
Demographic and Health Survey
**E-value**
minimum strength of association an unmeasured confounder would need with both exposure and outcome to explain away an observed association
**ICC**
intraclass correlation coefficient
**KR**
Kids Record (DHS recode file)
**LMICs**

low- and middle-income countries

**MDD**

minimum dietary diversity

**MOR**

median odds ratio

**PCV**

proportional change in variance

**SDD**

severe dietary deprivation

**SE**

standard error

**SHDS**

Somali Health and Demographic Survey

**SoNADA**

Somali National Data Archive

**STROBE**

Strengthening the Reporting of Observational Studies in Epidemiology

**UNICEF**

United Nations Children's Fund

**WHO**

World Health Organization

## Declarations

# Ethics approval and consent to participate

This study is a secondary analysis of fully de-identified, publicly available data and did not involve new contact with participants. The 2020 SHDS was conducted in accordance with the ethical standards governing DHS surveys, including voluntary informed consent obtained from respondents at the time of data collection and approval by the relevant national authorities. Permission to access and analyse the dataset was obtained through the Somali National Data Archive data-access procedure. No further ethical approval was required for this secondary analysis.

# Consent for publication

Not applicable.

# Clinical trial number

Not applicable.

# Availability of data and materials

The data analysed in this study are publicly available from the Somali National Data Archive (SoNADA) microdata library, the Somali Health and Demographic Survey 2020 (reference SOM-SNBS-SHDS-2020-V01; https://microdata.nbs.gov.so/index.php/catalog/50)[23], subject to registration and approval of a data-access request. The analytical code is available from the corresponding author on reasonable request.

# Competing interests

The authors declare that they have no competing interests.

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# Authors' contributions

All authors (AJN, MII and AM) contributed to the conception and design of the study, the analysis and interpretation of the data, and the drafting and critical revision of the manuscript. All authors read and approved the final manuscript.

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Not applicable.

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# Figures

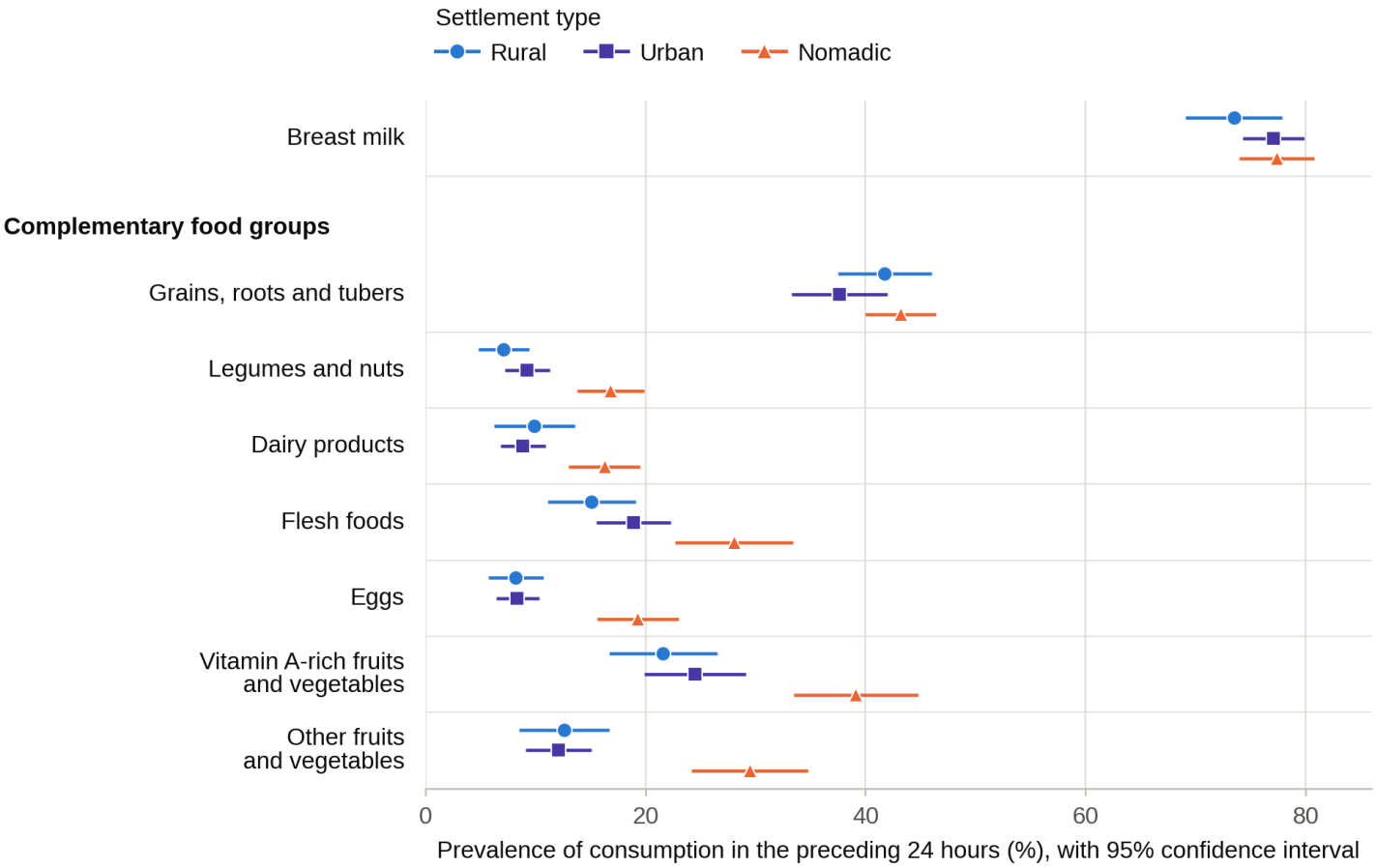



**Figure 1**

**Consumption of the eight WHO/UNICEF food groups by settlement type.** Survey-weighted prevalence (%) of consumption in the preceding 24 hours among children aged 6–23 months, Somalia SHDS 2020. Symbols show prevalence and horizontal lines show 95% confidence intervals for rural (circles), urban (squares) and nomadic (triangles) children. Breast milk is shown separately from the seven complementary food groups. Nomadic children report the highest consumption across the nutrient-dense complementary groups.

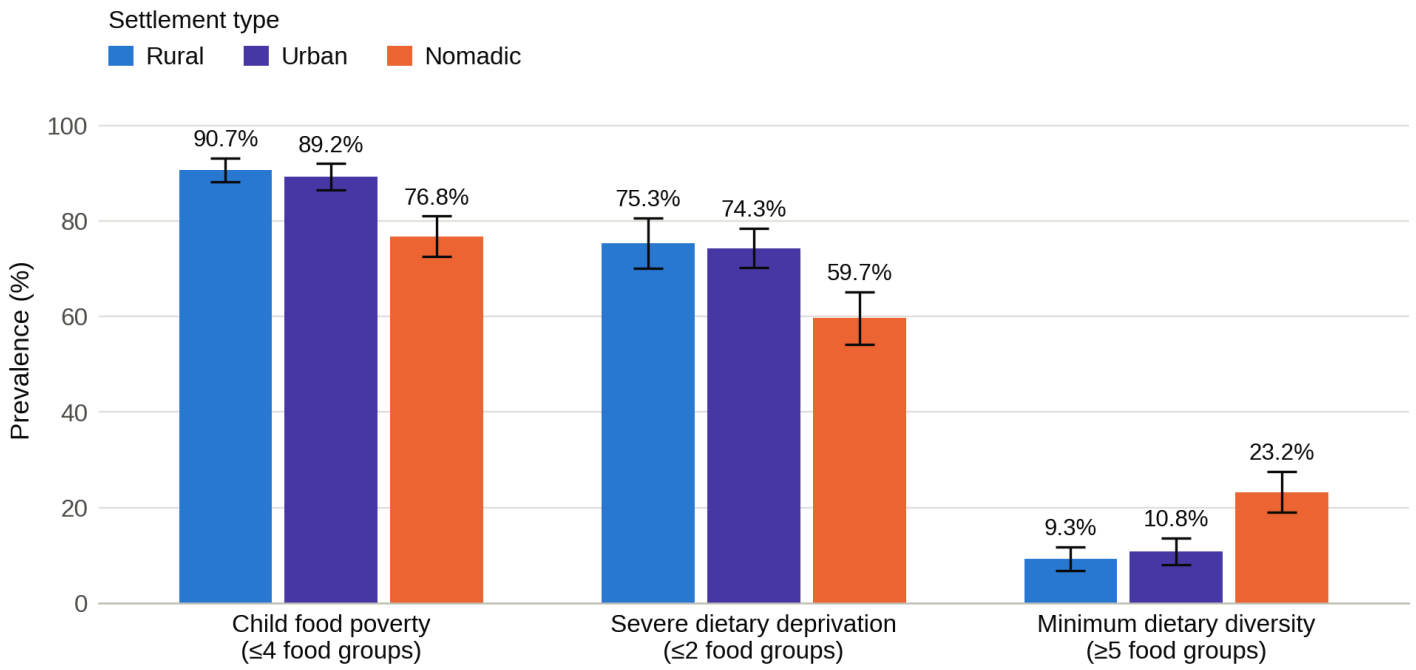
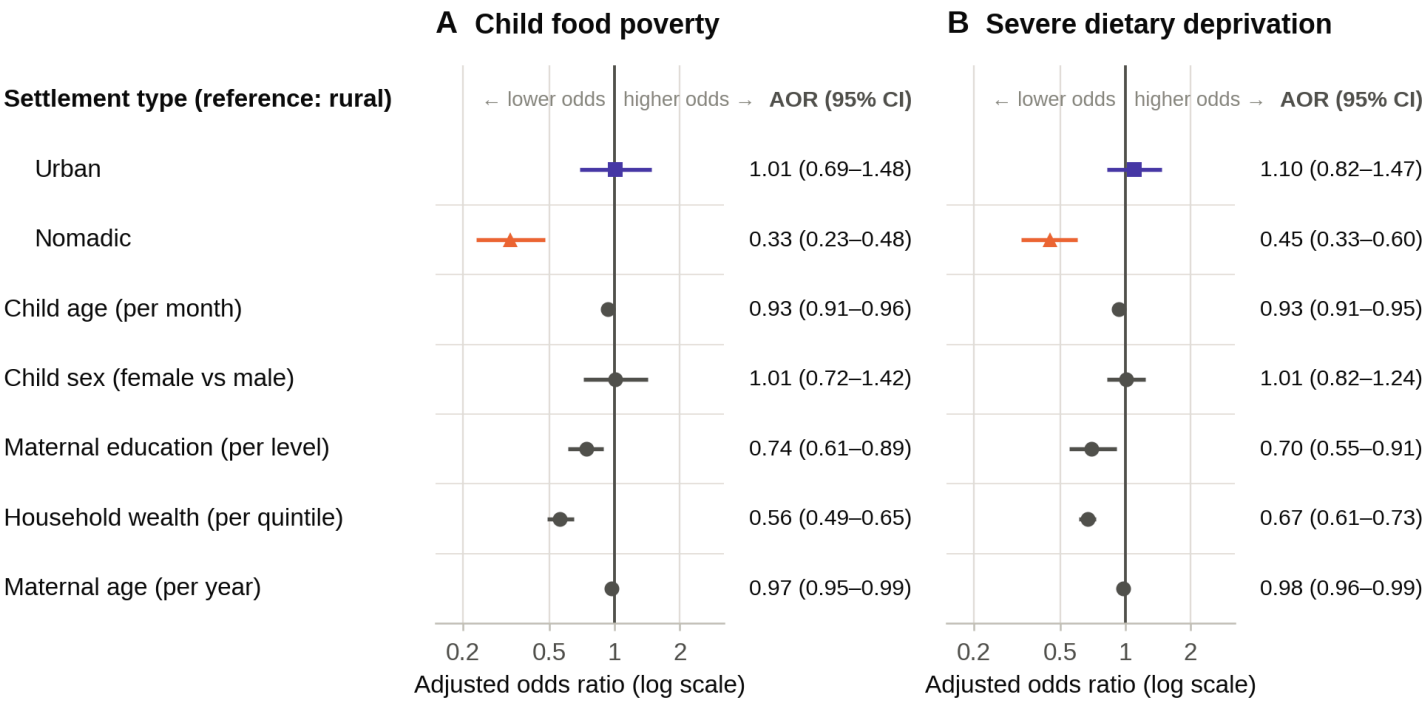



**Figure 2**

**Child food poverty, severe dietary deprivation and minimum dietary diversity by settlement type.** Survey-weighted prevalence (%) among children aged 6–23 months, Somalia SHDS 2020. Bars show prevalence for rural, urban and nomadic children, with 95% confidence intervals. Child food poverty means four or fewer of the eight food groups, severe dietary deprivation two or fewer, and minimum dietary diversity five or more. Nomadic children show consistently lower deprivation and higher dietary diversity than rural and urban children.




## Figure 3

**Adjusted odds ratios for child food poverty and severe dietary deprivation.** Adjusted odds ratios (AOR) with 95% confidence intervals from survey-weighted multivariable logistic regression (Tables 4 and 5): panel A, child food poverty; panel B, severe dietary deprivation. Rural is the reference category for settlement type. Estimates for child age, maternal education, household wealth and maternal age are per month, level, quintile and year, respectively. The horizontal axis is logarithmic and the vertical line marks AOR = 1; values to the left of the line indicate lower odds of deprivation. Both models were also adjusted for region (not shown). Of the characteristics shown, the nomadic-versus-rural contrast lies furthest from 1 for both outcomes.

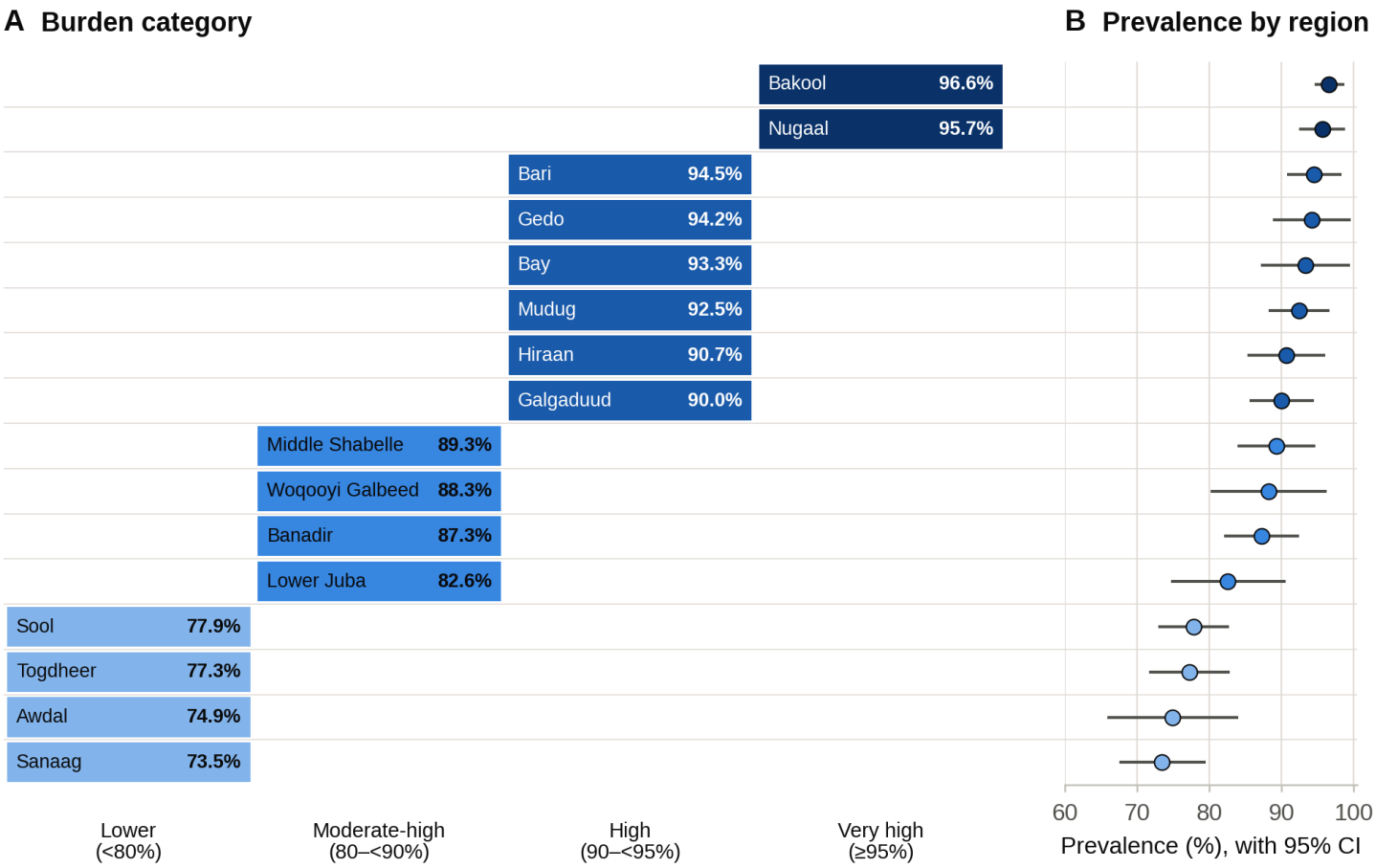



**Figure 4**

**Regional variation in child food poverty among children aged 6–23 months.** Somalia SHDS 2020. Panel A groups regions by survey-weighted prevalence of child food poverty (lower, <80%; moderate-high, 80–<90%; high, 90–<95%; very high, ≥95%). Panel B shows the prevalence in each region with its 95% confidence interval; colours follow the categories in panel A. Regional estimates apply to the sampled strata (Additional file 1: Table S7).

# Supplementary Files

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