

Nutritional Status and Micronutrient Deficiencies Among Children Under Five Collected at the National Institute of Nutrition, and Dietary Recommendations to Enhance Immune Resistance in Children

Phan Bich Nga^{1*}, Hoang Thi Hang¹, Pham Quynh Chi²

¹National Institute of Nutrition, Hanoi, Viet Nam

²Hanoi – Amsterdam High School for the Gifted, Vietnam. Email: pquynhchi21042009@gmail.com

* Corresponding author. E-mail: phanbichnga.ninvn@gmail.com

Abstract: Undernutrition and micronutrient deficiency remain interlocking determinants of impaired immune resistance in Vietnamese children. This cross-sectional study described the nutritional status, nutrition-related morbidity, dietary intake and maternal feeding practice of 960 children aged 0–59 months attending a first nutrition consultation at the National Institute of Nutrition, Hanoi, in 2023, and used the deficits identified to derive a structured set of dietary recommendations aimed at strengthening immune resistance. Children were recruited into five equal age strata. Anthropometry was converted to Z-scores using the WHO 2006 Child Growth Standards; diagnoses followed Ministry of Health and IMCI criteria; dietary intake was assessed by 24-hour recall and a food frequency questionnaire; and maternal knowledge and practice were assessed by structured interview. Haemoglobin and serum iron were measured in 256 children. Underweight, stunting and wasting affected 29.8%, 30.0% and 14.3% of children respectively, whereas only 1.8% were overweight or obese; a further third to two-fifths were at risk on each index, and the burden peaked at 36–47 months, where 41.9% were stunted. Stunted children were 1.87 times as likely to be anaemic and 1.6 times as likely to be iron deficient as their non-stunted peers. Anorexia syndrome (50.5%), risk of malnutrition (41.3%) and established malnutrition (32.1%) were the commonest diagnoses, while respiratory infection within the preceding two weeks affected 36.6% of children and rickets 10.2%. Energy intake met the recommended allowance in only 53.2% of children, 52.3% consumed lard less than monthly, and only one mother of 960 identified the need to add fat to complementary meals. Timely initiation of breastfeeding was achieved by 24.4%. A ten-domain, evidence-linked dietary package is proposed.

Keywords: child undernutrition; micronutrient deficiency; anaemia; immune resistance; complementary feeding; Viet Nam

1. Introduction

Child undernutrition remains one of the most consequential health problems of early life. The 2025 UNICEF/WHO/World Bank joint estimates indicate that stunting, wasting and overweight continue to coexist in most low- and middle-income countries and that progress towards the 2030 global nutrition targets has slowed [1]. Undernutrition acts less as an isolated deficit of energy than as a systemic condition in which impaired linear growth, depleted micronutrient stores and recurrent infection reinforce one another; in the most recent comprehensive attribution analysis it accounted for about 45% of all deaths in children under five, largely because a poorly nourished child mounts a weaker response to the pathogens that cause pneumonia and diarrhoea [2,3].

Viet Nam has achieved substantial reductions in child undernutrition over three decades, but micronutrient deficiency has become the dominant residual problem: anthropometric indicators have improved faster than biochemical status. The General Nutrition Survey 2020 reported stunting in 10.9% of children aged 6–23 months and

15% of those aged two to four years, with anaemia and iron deficiency each affecting 13.9–15.2% of children aged 6 months to 9 years and low serum zinc affecting 53.1% [4]. SEANUTS II Viet Nam found 60.8% of children aged 6 months to 11.9 years to have low serum zinc and 95.0% to fall below the recommended vitamin D intake [5]. The immunological consequences are well characterised: iron, zinc, vitamin A and vitamin D act at multiple points of innate and adaptive defence, and correcting deficiency shortens diarrhoeal episodes, reduces respiratory infection and improves vaccine responsiveness [6–10].

Children brought to a nutrition clinic are not a community sample; they are selected by parental concern about slow weight gain, poor appetite or short stature, which concentrates precisely those children in whom the nutrition–infection cycle is already established. Persistent picky eating is a particularly relevant phenotype, being associated with restricted dietary variety, lower weight and height and reduced respiratory infection after nutritional intervention [11,12]. Vietnamese facility-based data describing anthropometry, morbidity, diet and caregiver practice within a

single cohort remain scarce, and previous reports from this setting have not translated their findings into explicit dietary guidance [13]. This study therefore aimed to describe the nutritional status and nutrition-related morbidity of children under five attending the National Institute of Nutrition in 2023, to characterise their dietary intake and maternal feeding practice, and to convert the deficits identified into a structured, evidence-linked set of dietary recommendations for strengthening immune resistance.

2. Materials and Methods

2.1. Design, setting and participants

This hospital-based, descriptive cross-sectional study was conducted throughout 2023 at the Department of Child Nutrition Counselling, National Institute of Nutrition (NIN), Hanoi - the principal tertiary referral service for paediatric nutrition in northern Viet Nam. Eligible participants were children aged 0–59 months attending for a first nutrition consultation whose parent or guardian consented; children with congenital or chronic disease affecting growth independently of nutrition were excluded. Sample size was calculated from the single-proportion formula with $z = 1.96$, an anticipated malnutrition prevalence of 30% based on earlier work at the same facility and an absolute precision of 6.5%, giving 192 children per age stratum. Five strata were defined (0–11, 12–23, 24–35, 36–47 and 48–59 months), yielding 960 children recruited consecutively with balanced representation of boys and girls. Reporting follows the STROBE recommendations.

2.2. Anthropometry and classification

Weight was measured to the nearest 0.1 kg on a calibrated SECA electronic scale, recumbent length to the nearest 0.1 cm in children under 24 months and standing height to the nearest 0.1 cm thereafter. Weight-for-age, height-for-age and weight-for-height Z-scores were derived with WHO Anthro software and the WHO 2006 Child Growth Standards [14]. Children were classified as malnourished at $Z < -2$ SD, at risk at $-2 \text{ SD} \leq Z < -1$ SD and normal at $Z \geq -1$ SD; overweight or obesity was defined as weight-for-height $Z > +2$ SD. A fixed team of trained anthropometrists performed all measurements, scales were calibrated daily, and data were double-entered and cross-checked.

2.3. Morbidity and laboratory assessment

Clinical diagnoses were made by the attending paediatrician using national Ministry of Health and NIN guidance together with the WHO/UNICEF Integrated Management of Childhood Illness algorithms, covering anorexia syndrome, acute diarrhoea, constipation, vitamin D-deficiency rickets, acute respiratory infection, pneumonia and nutritional anaemia [15]. Parents reported the reason for attendance, digestive symptoms in the preceding two weeks and the occurrence and frequency of respiratory infection over the preceding two

weeks and six months. Venous blood was obtained from the subset of children in whom laboratory investigation was clinically indicated ($n = 256$; 26.7%); haemoglobin was measured on an automated analyser and serum iron by colorimetric assay, with anaemia defined as haemoglobin below 110 g/L [16].

2.4. Dietary and maternal assessment

Dietary intake was assessed by a single interviewer-administered 24-hour recall using standard household measures and food models. Energy was computed from the Vietnamese Food Composition Table and expressed as a percentage of the age- and sex-specific Vietnamese recommended dietary allowance (RDA), categorised as below 80%, 80–100% and above 100% [17]. Habitual intake was characterised with a semi-quantitative food frequency questionnaire covering the principal food groups. Mothers were interviewed with a structured questionnaire on knowledge and practice of breastfeeding and complementary feeding, each item scored as adequate or inadequate against national infant and young child feeding recommendations.

2.5. Statistical analysis and ethics

Analyses were performed in SPSS 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean $\pm$ standard deviation and categorical variables as counts and percentages. Proportions were compared using the chi-square test or Fisher exact test where expected cell counts were below five, and the association between linear growth failure and micronutrient deficiency was expressed as a prevalence ratio. Two-sided p values below 0.05 were considered significant. The protocol was approved by the Scientific Council and the Ethics Committee of the National Institute of Nutrition; parents or guardians gave informed consent, participation was voluntary and all data were de-identified before analysis.

3. Results

3.1. Nutritional status

Of the 960 children enrolled, mean weight and height were higher in boys (11.2 ± 3.0 kg and 86.2 ± 12.8 cm) than in girls (10.0 ± 3.1 kg and 81.4 ± 12.9 cm); these are unadjusted values and reflect the age composition of each sex within the five strata rather than a sex difference in growth, and comparisons between the sexes should therefore be based on the Z-scores below. Mean weight-for-age and height-for-age Z-scores were below -1 SD in both sexes, placing the cohort as a whole within the at-risk band of the WHO reference rather than around the reference median. The parallel displacement of the weight and height distributions indicates a chronic rather than an acute deficit.

Underweight, stunting and wasting affected 29.8%, 30.0% and 14.3% of children respectively, whereas only 1.8% were overweight or obese (Table 1). A further large fraction fell into

the at-risk band 39.1%, 33.7% and 36.5% respectively, so that roughly two-thirds of the cohort carried either established or incipient growth failure on at least one index. Underweight was least frequent in infants aged 0–11 months (23.0%), among whom the proportion classified as normal was highest (42.9%), and peaked at 36–47 months (38.2%). Risk of underweight was lowest at 12–23 months (33.2%) and highest

at 48–59 months (46.8%). The burden was clearly concentrated at 36–47 months, where 41.9% of children were stunted with a further 38.2% at risk, and where wasting reached 17.7% with a further 40.9% at risk.

Table 1. Nutritional status and nutrition-related morbidity of children aged 0–59 months attending a first nutrition consultation at the National Institute of Nutrition, 2023 (n = 960).

Indicator	% of children	Age group with highest burden
Nutritional status (WHO 2006 Z-scores)		
Underweight (weight-for-age $Z < -2$ SD)	29.8	36–47 mo (38.2%)
At risk of underweight ($-2 \leq Z < -1$ SD)	39.1	48–59 mo (46.8%)
Stunted (height-for-age $Z < -2$ SD)	30.0	36–47 mo (41.9%)
At risk of stunting ($-2 \leq Z < -1$ SD)	33.7	36–47 mo (38.2%)
Wasted (weight-for-height $Z < -2$ SD)	14.3	36–47 mo (17.7%)
At risk of wasting ($-2 \leq Z < -1$ SD)	36.5	36–47 mo (40.9%)
Overweight or obese ($Z > +2$ SD)	1.8	0–11 mo (2.6%)
Clinical diagnosis		
Anorexia syndrome	50.5	—
At risk of malnutrition	41.3	—
Malnutrition (any form)	32.1	—
Constipation	13.5	—
Rickets (vitamin D deficiency)	10.2	—
Morbidity in the preceding two weeks		
Any digestive disturbance	25.4	—
constipation / diarrhoea / loose stools	15.9 / 4.9 / 4.6	—
Respiratory infection	36.6	—
Recurrent respiratory infection (past 6 months)	25.3	—
Micronutrient status (tested sub-sample, n = 256)		
Anaemia in stunted vs non-stunted children	PR 1.87	—
Iron deficiency in stunted vs non-stunted children	PR 1.6	—

Dietary energy (24-hour recall)

Mean energy intake (kcal/day)	970.5 ± 290.2	—
Meeting > 100% of the Vietnamese RDA	53.2	—
Meeting 80–100% of the RDA	23.8	—
Meeting < 80% of the RDA	23.0	—

SD, standard deviation; PR, prevalence ratio; RDA, recommended dietary allowance. Prevalence ratios compare stunted with non-stunted children within the sub-sample in whom haemoglobin and serum iron were measured ($n = 256$). Percentages for digestive symptoms and respiratory infection refer to the two weeks preceding the consultation.

3.2. Nutrition-related morbidity and micronutrient status

The commonest reason for attendance was parental concern about slow weight gain (73.9%), followed by poor appetite (56.8%), slow linear growth (43.9%), irritability with disturbed sleep (18.1%) and constipation (11.9%). Compared with the survey conducted at the same facility in 2018, the three leading reasons had all increased (Figure 1), indicating a growing orientation of caregivers towards growth and appetite as the trigger for consultation.

Anorexia syndrome was the most frequent diagnosis (50.5%), followed by risk of malnutrition (41.3%), established malnutrition (32.1%), constipation (13.5%) and rickets (10.2%)

(Table 1). One child in four (25.4%) had experienced a digestive disturbance in the preceding two weeks, comprising constipation (15.9%), diarrhoea (4.9%) and loose stools (4.6%). Respiratory infection in the preceding two weeks was reported for 36.6% of children, and 25.3% had recurrent respiratory infection over the preceding six months, with episodes recurring every two weeks in 12.4% of that subgroup. Among the 256 children in whom haemoglobin and serum iron were measured, micronutrient deficiency clustered with linear growth failure: stunted children were 1.87 times as likely to be anaemic and 1.6 times as likely to be iron deficient as children who were not stunted.

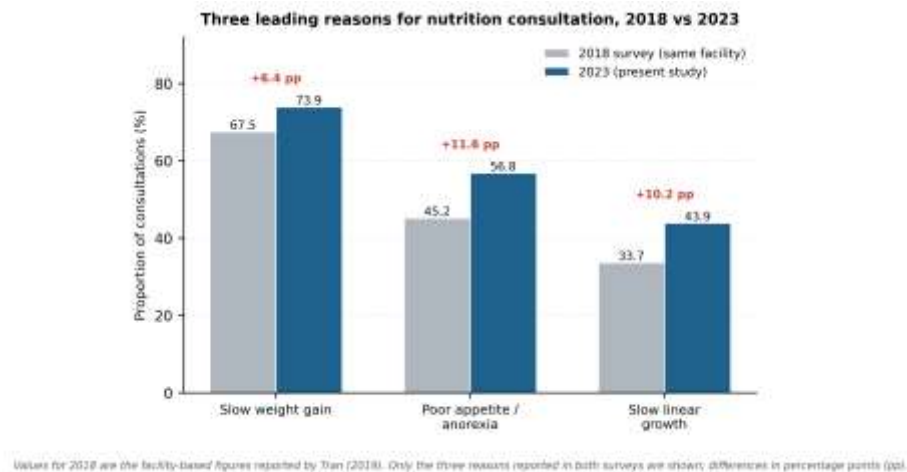


Figure 1. The three leading parent-reported reasons for nutrition consultation in 2023 compared with the 2018 survey conducted at the same department. Only the reasons reported in both surveys are shown; differences are expressed in percentage points.

3.3. Maternal knowledge and practice

Maternal knowledge exceeded 80% for the four breastfeeding items assessed — timing of the first feed, benefits of breastfeeding, duration of exclusive breastfeeding and maternal diet during lactation — but fell to 32.9% for the appropriate age at weaning and 56.8% for the consequences of malnutrition (Table 2). The gap between knowledge and practice was substantial. Although 86.3% of mothers correctly did not discard colostrum, only 46.7% achieved exclusive breastfeeding to six months, only 31.9% avoided prelacteal

feeds and only 24.4% initiated breastfeeding within the recommended interval after delivery; adequate practice regarding the age at weaning was reported by just 5.4%. Mothers attributed delayed initiation and prelacteal feeding mainly to perceived delayed lactogenesis or separation after caesarean delivery, and early weaning to perceived insufficient milk. For complementary feeding, only 44.2% had adequate knowledge of the appropriate age of introduction and 49.7% practised it correctly; 83.3% could identify suitable complementary foods, but only one mother in the entire

sample identified the need to add oil or fat to complementary meals.

Table 2. Maternal knowledge and practice of infant and young child feeding (n = 960 mothers), % achieving the adequate standard.

Item	Knowledge, %	Practice, %	National reference, %
Breastfeeding			
Timing of first breastfeed after delivery	> 80	24.4	23.5 [23]
Benefits of breastfeeding	> 80	—	—
Exclusive breastfeeding to 6 months	> 80	46.7	45.4 [23]
Maternal diet during lactation	> 80	—	—
Not discarding colostrum	—	86.3	—
No prelacteal feeds before first breastfeed	—	31.9	—
Appropriate age at weaning	32.9	5.4	—
Complementary feeding			
Appropriate age of introduction	44.2	49.7	—
Appropriate complementary foods	83.3	—	—
Need to add oil or fat to complementary meals	0.1 (1 of 960)	—	—
General nutrition knowledge			
Consequences of malnutrition for the child	56.8	—	—

National reference values are from the Viet Nam SDGCW Survey 2020–2021 [23]. The source reports adequate knowledge above 80% collectively for the four breastfeeding items shown; items for which no knowledge or practice figure was reported are shown as —.

3.4. Dietary energy and food consumption

Mean 24-hour energy intake was 970.5 ± 290.2 kcal. Intake exceeded the Vietnamese recommended dietary allowance in 53.2% of children (n = 511), met 80–100% of it in 23.8% (n = 228) and fell below 80% in 23.0% (n = 221); almost half of the cohort therefore failed to meet the recommended intake, which is consistent with the observed prevalence of underweight and wasting. Food consumption was diverse across most groups: home-cooked porridge or rice was consumed daily by 77.0% of children, instant cereal porridge by 36.7% and infant or growing-up formula by 80.2%, while yoghurt was consumed one to four times weekly by close to half. Meat, fish and eggs were consumed one to four times weekly and vegetables and fruit two to four times weekly in most children. The clear exception was added dietary fat: 52.3%

of children consumed lard never or less than once a month, and 21.6% likewise for cooking oil.

4. Discussion

4.1. Comparison with national estimates and the age pattern of growth failure

The anthropometric prevalences observed here are two to three times the corresponding national figures stunting 30.0% against 10.9% at 6–23 months and 15% at two to four years in the General Nutrition Survey 2020 [4]. This divergence is the defining feature of a referral population: attendance is triggered by parental concern, so the sample is enriched for children already failing to thrive, and facility-based cohorts from other low- and middle-income settings show the same amplification [26]. Their value lies in characterising the referred phenotype rather than in estimating population

prevalence. Underweight here (29.8%) exceeded the 27.1% recorded at the same facility in 2018 [13], and the three leading reasons for attendance all rose over that interval, more plausibly reflecting growing demand for specialist consultation than deterioration in the underlying population. The concentration of stunting and wasting at 36–47 months appears discordant with the established finding that most linear growth faltering occurs before 24 months [18], but in a clinic population the deficit accrues during the complementary feeding transition and becomes conspicuous and therefore prompts referral only once the height gap is visible to the family. Referral in this setting occurs one to two years after the window in which intervention would be most effective.

4.2. Growth failure, micronutrient deficiency and infection

Stunted children in this cohort were 1.87 times as likely to be anaemic as their non-stunted peers. This is directionally consistent with a 2024 systematic review and meta-analysis in developing-country paediatric populations, which reported an odds ratio of 2.27 (95% CI 1.30–3.95) for stunting in children with iron-deficiency anaemia, and with pooled Demographic and Health Survey data from 28 countries in which the two conditions co-segregate [19,20]. That meta-analysis rests on

four cross-sectional and retrospective studies with substantial heterogeneity and low certainty of evidence, so it describes co-occurrence rather than a causal effect. The relationship is bidirectional and has at least three plausible mechanisms: a shared dietary aetiology, since diets low in bioavailable iron and zinc are also low in energy and quality protein; inflammation from repeated infection, which raises hepcidin and restricts iron for erythropoiesis while suppressing growth signalling; and environmental enteric dysfunction, which impairs absorption and sustains subclinical inflammation [27]. More than one-third of children here had a respiratory infection within the preceding two weeks and a quarter had recurrent infection over six months, placing this cohort at the centre of that cycle (Figure 2). Zinc deserves particular emphasis in Viet Nam, where SEANUTS II found low serum zinc in 60.8% of children and multiple-micronutrient supplementation improved status in a Vietnamese randomised trial [5,28]; zinc deficiency also blunts taste acuity and appetite and is linked to the anorexia phenotype that dominated the diagnoses here, which in Vietnamese clinic populations has itself been associated with micronutrient deficiency [29,30].

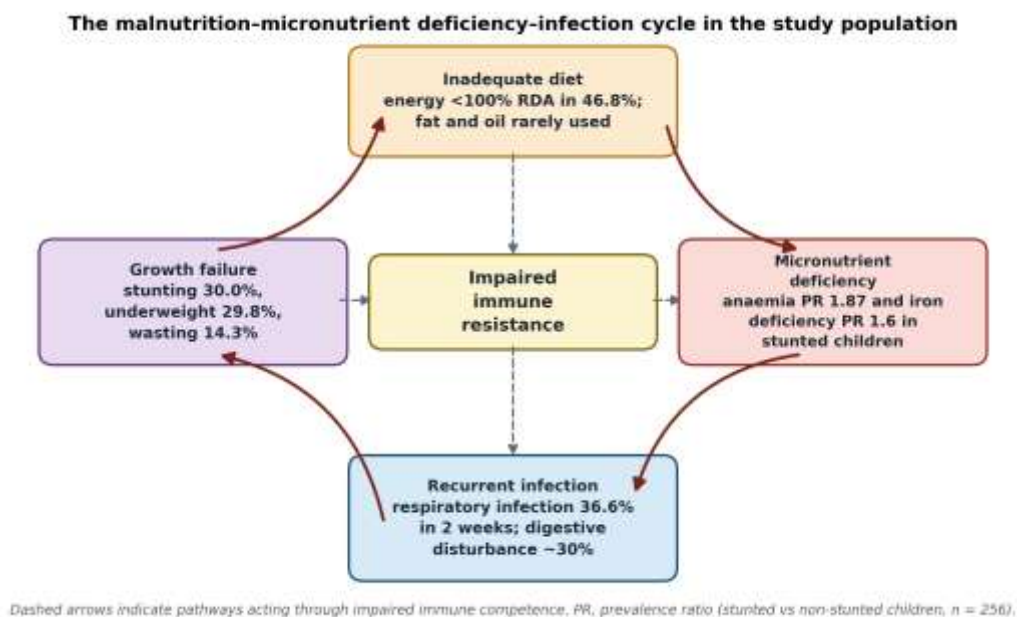


Figure 2. The malnutrition–micronutrient deficiency–infection cycle as observed in this cohort. Solid arrows show the self-reinforcing cycle; dashed arrows indicate pathways operating through impaired immune competence. PR, prevalence ratio (stunted versus non-stunted children, n = 256).

4.3. Dietary gaps and the knowledge–practice gap

Two dietary findings stand out. First, 46.8% of children did not meet their recommended energy intake despite a mean intake close to 1,000 kcal, indicating a shortfall of energy density rather than of meal frequency. Second, added dietary fat was largely absent: 52.3% of children consumed lard never or less than monthly and only one mother of 960 identified the need to add fat to complementary meals. Dietary lipid is the most

energy-dense macronutrient, supplies essential fatty acids required for neurodevelopment, and is necessary for absorption of vitamins A, D, E and K [21]. In a diet built on rice porridge, omitting 5–10 mL of oil per meal removes roughly 45–90 kcal and compromises retinol and vitamin D absorption, plausibly linking the observed dietary pattern to both the growth deficit and the micronutrient findings. Timely initiation of breastfeeding was achieved by 24.4% of mothers, almost

identical to the national figure of 23.5%, and exclusive breastfeeding to six months by 46.7% against a national 45.4% [23], so the gap is national rather than peculiar to the referred population. The barriers mothers reported are system-level and amenable to maternity-ward interventions such as immediate skin-to-skin contact, rooming-in and structured lactation support. Of the four breastfeeding items for which maternal knowledge exceeded 80%, none was matched by a comparable level of practice: timely initiation was achieved by 24.4% of mothers and exclusive breastfeeding to six months by 46.7%. For the age of introduction of complementary foods the pattern was reversed, practice (49.7%) slightly exceeding knowledge (44.2%), which suggests that some mothers follow family or community norms that happen to align with the recommendation without being able to articulate it. Taken together these findings indicate that information-only counselling is insufficient and that behaviourally oriented, skills-based support is required [24,25].

4.4. A dietary package to strengthen immune resistance

Table 3 sets out ten domains of dietary recommendation derived from the deficits identified in this cohort and linked to

Table 3. Evidence-linked dietary recommendations to enhance immune resistance, mapped to the deficits identified in this cohort.

Domain	Recommendation	Rationale and immune mechanism	Deficit observed
Energy density and dietary fat	Add 5–10 mL of vegetable oil, or an equivalent fat source, to every complementary meal from 6 months; counsel explicitly on this at the first visit.	Raises the energy density of rice-based porridge, supplies essential fatty acids and enables absorption of vitamins A, D, E and K [21,22].	46.8% below RDA; lard < 1×/month in 52.3%; 1 of 960 mothers aware
Animal-source foods	Meat, fish, egg or liver every day from 6 months of age; liver or shellfish once or twice weekly where affordable.	Provides haem iron and highly bioavailable zinc, supporting lymphocyte proliferation, phagocyte function and antibody generation [3,6,22].	Stunting–anaemia PR 1.87
Iron and anaemia	Measure haemoglobin at the first consultation in every stunted child and every child with recurrent infection; treat confirmed iron-deficiency anaemia per national protocol; pair iron-rich meals with vitamin C-rich fruit and avoid tea or large milk volumes at those meals.	Corrects impaired oxygen delivery and lymphocyte function; ascorbate enhances non-haem iron absorption while tannins and calcium inhibit it [19,20].	Stunting–anaemia PR 1.87; iron deficiency PR 1.6
Zinc	20 mg/day for 10–14 days as adjunctive therapy in acute diarrhoea (10 mg/day under 6 months); build dietary zinc through meat, shellfish, egg and legumes.	Shortens diarrhoeal episodes, reduces pneumonia incidence, restores intestinal epithelial integrity, and restores taste acuity and appetite [5,7,29].	Anorexia syndrome 50.5%; diarrhoea 4.9%

the supporting evidence. The package is organised around four principles: restore energy density through added fat, secure bioavailable iron and zinc through daily animal-source foods, correct established deficiency through targeted screening and supplementation, and address the feeding behaviour that sustains the anorexia phenotype. Each recommendation is deliberately specific enough to be delivered within a single consultation and audited subsequently. Adding 5–10 mL of oil to every complementary meal is the highest-yield single message generated by this study — inexpensive, culturally acceptable, immediately actionable, and aligned with the 2023 WHO complementary feeding guideline [22]. Three service-level changes follow: measure haemoglobin routinely at the first consultation in every stunted child and every child reporting recurrent infection; deliver the counselling package in written, behaviourally framed form and reinforce it at a scheduled follow-up; and strengthen community growth monitoring during the 6–24 month window so that referral occurs while linear growth remains modifiable.

Vitamin A	Maintain the national biannual high-dose supplementation programme for children aged 6–59 months; serve orange and dark-green vegetables daily together with added fat.	Reduces all-cause mortality and diarrhoea incidence; maintains epithelial barrier integrity and mucosal immunity [8].	Recurrent digestive and respiratory morbidity
Vitamin D and bone health	400 IU/day to 12 months and 600 IU/day thereafter where dietary intake is inadequate; 15–30 minutes of safe daily sun exposure; actively screen for and treat rickets.	Reduces the burden of acute respiratory infection; induces antimicrobial peptides and modulates T-cell responses [5,9].	Rickets 10.2%; respiratory infection 36.6%
Breastfeeding	Immediate skin-to-skin contact and initiation within one hour of birth; no prelacteal feeds; exclusive breastfeeding to 6 months; continued breastfeeding to 24 months.	Transfers secretory IgA, lactoferrin and human milk oligosaccharides; shapes the infant gut microbiota and reduces early infection [22,23].	Timely initiation 24.4%; exclusive breastfeeding 46.7%
Dietary diversity and feeding behaviour	At least five of eight food groups daily; responsive feeding with 8–15 repeated neutral exposures to refused foods; meals of 20–30 minutes with no forced feeding and no screens; limit milk to 500 mL/day or less after 12 months.	Improves micronutrient adequacy and addresses the anorexia phenotype; excessive milk displaces iron-rich solids and promotes iron deficiency [11,12,22].	Anorexia syndrome 50.5%; formula daily in 80.2%
Gut health	Treat constipation with adequate fluid, age-appropriate fibre and toilet training; consider probiotic or prebiotic adjuncts where indicated; reinforce hand hygiene and safe water and food hygiene.	Reduces environmental enteric dysfunction and the chronic inflammation that drives anaemia and suppresses linear growth [27].	Constipation 13.5%; digestive disturbance 25.4%
Delivery of counselling	Deliver a standardised, written, behaviourally framed counselling plan at the first visit; re-weigh and re-measure at 1 and 3 months; refer children below –2 SD with recurrent infection to the specialist clinic.	Knowledge in this population was already adequate while practice was not; behavioural, repeated and skills-based support is required for translation [10,24,25].	Knowledge > 80% but practice 5.4–49.7%

PR, prevalence ratio; RDA, recommended dietary allowance; IU, international units; SD, standard deviation. Supplementation doses follow current national and WHO guidance and should be adjusted to local protocol; all supplementation is intended as an adjunct to, not a substitute for, dietary improvement.

4.5. Limitations

The cross-sectional design means the reported associations cannot establish direction of causation. The sample is a facility-based convenience sample and is not representative of Vietnamese children generally; prevalence estimates are inflated by referral selection and should not be read as population figures. Biochemical data were available for only

256 of 960 children and testing followed clinical judgement rather than protocol, which may have selected more symptomatic children; iron status was assessed by serum iron rather than ferritin with soluble transferrin receptor, and inflammation markers were not measured, so biomarkers could not be adjusted for the acute-phase response. A single 24-hour recall characterises group mean intake but cannot

estimate usual intake for an individual child, and the food frequency questionnaire was semi-quantitative. Knowledge and practice were self-reported and subject to social desirability and recall bias, and immune outcomes were captured as parent-reported infection history rather than verified clinical diagnosis. Finally, the dietary recommendations were derived from external evidence and from the deficits observed; they were not tested prospectively in this cohort, and their effect on infection frequency and growth requires evaluation in an interventional design.

5. Conclusion

Children aged 0 - 59 months attending a first nutrition consultation at the National Institute of Nutrition in 2023 carried a heavy and multidimensional nutritional burden. Underweight, stunting and wasting affected 29.8%, 30.0% and 14.3% respectively, with a further third to two-fifths at risk on each index and the burden concentrated at 36–47 months, whereas overweight and obesity remained rare at 1.8%. Micronutrient deficiency tracked linear growth failure closely, stunted children being 1.87 times as likely to be anaemic. Anorexia syndrome, recurrent respiratory infection and constipation dominated the clinical picture, describing a population caught in the malnutrition–micronutrient deficiency–infection cycle. The dietary and caregiver data identify where that cycle can be interrupted. Almost half of the children did not meet their recommended energy intake, added dietary fat was effectively absent for a majority, and only one mother in 960 recognised the need to add oil or fat to complementary meals. Maternal knowledge exceeded 80% for most items yet translated into adequate practice in only a minority timely initiation of breastfeeding in 24.4% and appropriate weaning practice in 5.4%. These findings support a shift from information-only counselling towards the standardised, behaviourally framed dietary package proposed here: added fat at every complementary meal, daily animal-source foods for bioavailable iron and zinc, protocol-driven screening and correction of anaemia, responsive feeding for the child with poor appetite, and reinforcement of breastfeeding support at the maternity ward. Strengthening growth monitoring during the 6–24 month window would allow intervention to reach children while linear growth remains modifiable. Prospective evaluation of this package against infection frequency and growth is the logical next step.

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