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Artículo Original

Gaps Between micronutrient Intake and prenatal Supplement formulations in Latin American women of childbearing age

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Abstract: Introduction: Supplementation with key nutrients has been an effective strategy to meet nutritional requirements, particularly when diets alone are insufficient to fulfill needs or correct existing deficiencies. However, micronutrient deficiencies among women of childbearing age in Latin America remain a significant public health challenge, especially during the preconception period, when nutritional status critically influences maternal and fetal outcomes. **Objective:** This study aimed to analyze the micronutrient composition of commonly prescribed prenatal supplements in countries participating in the ELANS and compare it with dietary intake among women of childbearing age to identify relevant nutritional gaps relevant. **Materials and methods.** Commonly prescribed prenatal supplements in the ELANS countries were analyzed and compared with previously reported dietary intake data. A population-level model was used to estimate total micronutrient intake under a supplementation scenario. **Results.** Significant micronutrient gaps were identified, particularly for calcium, vitamin D, vitamin E, and choline. Choline intake was markedly inadequate, and none of the evaluated supplements contained this nutrient. While supplementation improved coverage for some micronutrients, it also led to potentially excessive intake of others, including iron and several B-complex vitamins. Substantial variability in supplement composition was observed across countries **Conclusions.** These findings reveal a mismatch between prenatal supplement composition and population nutritional needs, characterized by the coexistence of deficiencies and potential excesses. Tailored, evidence-based supplementation strategies are needed to better align regional nutritional gaps. **Arch Latinoam Nutr 2026; 76(2): 91-107.**

Keywords: Women of childbearing age, Latin America, ELANS, Pre-natal Supplements.

Resumen: Brechas entre la ingesta de micronutrientes y la formulación de suplementos prenatales en mujeres latinoamericanas en edad fértil. Introducción: la suplementación ha sido una estrategia eficaz para cubrir los requerimientos nutricionales, especialmente cuando la dieta por si sola no logra satisfacer las necesidades ni corregir deficiencias existentes. Sin embargo, las deficiencias de micronutrientes en mujeres en edad fértil en Latinoamérica siguen siendo un importante problema de salud pública, particularmente durante el período preconcepcional, cuando el estado nutricional influye de manera crítica en los resultados maternos y fetales. **Objetivo.** Analizar la composición de micronutrientes de los suplementos prenatales comúnmente prescritos en países participantes del ELANS y compararla con la ingesta dietaría en mujeres en edad fértil, con el fin de identificar brechas nutricionales. **Materiales y métodos.** Se analizaron los suplementos prenatales comúnmente prescritos en los países del ELANS y se compararon con los datos de ingesta dietaría previamente reportados. Se aplicó un modelo a nivel poblacional para estimar la ingesta total bajo un escenario de suplementación. **Resultados.** Se identificaron brechas importantes, especialmente en calcio, vitamina D, vitamina E y colina. La colina fue insuficiente, y no estuvo presente en los suplementos evaluados. La suplementación mejoró la cobertura de algunos micronutrientes, y en otros genero excesos potenciales, como hierro y vitaminas del complejo B. Se observó una considerable variabilidad en la composición de los suplementos entre países. **Conclusiones.** Existe un desajuste entre la composición de los suplementos prenatales y las necesidades nutricionales, con coexistencia de deficiencia y posibles excesos. Se requieren estrategias de suplementación basadas en evidencia y adaptadas al contexto regional. **Arch Latinoam Nutr 2026; 76(2): 91-107.**

Palabras clave: mujeres en edad fértil, América Latina, ELANS, Suplementos prenatales.

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Introduction

Meeting pregnancy micronutrients requirement through diet alone remains challenging, as dietary patterns often do not change during this period. Deficiencies in key micronutrients such as iron, calcium, folic acid, vitamin D, and copper persists even in populations with adequate food access (1,2), and are exacerbated by the high prevalence of unplanned pregnancies (3,4), This underscores the importance of preconception micronutrient status for pregnancy outcomes (5,6), as well as its influence on infant health during early life, given the limited bioavailability of some micronutrients such as iron and iodine in breast milk (6). From a Developmental Origins of Health and Disease (DOHaD) perspective, nutrition during preconception and pregnancy is critical for fetal development and long-term health, with suboptimal maternal micronutrient status linked to increased risk of chronic non-communicable diseases later in life (5).

Latin America continues to face a high burden of micronutrient inadequacy among women of childbearing age (WCA) despite fortification and supplementation programs. Anemia remains prevalent, and intakes of key micronutrients as calcium, vitamin D, vitamin E, choline, and long-chain omega-3 fatty acids are persistently low (7–10), coexisting with excess sodium intake and increasing overweight prevalence. Micronutrient adequacy is strongly influence by socioeconomic and behavioral factors, particularly dietary diversity, a key predictor of micronutrient adequacy in WCA (11–13), highlighting the need to evaluate whether prenatal supplementation effectively addresses population-specific nutritional gaps (14).

Population-level interventions, such as folic acid fortification, have demonstrate success in reducing neural tube defects (15,16), however, the implementation of WHO multiple micronutrient supplementation (MMS) recommendations has been slow in the region (17). Given that preconception nutritional status underpins pregnancy outcomes and dietary patterns trend to persist during gestation (17), there is a need to evaluated whether current prenatal supplements adequately address documented nutrient gaps (6,14,18). This study aimed to evaluate the micronutrient composition of commonly prescribed prenatal supplements in the ELANS countries and compare them with dietary intake and dietary diversity reported for WCA to identify gaps relevant for public health interventions.

Materials and methods

The ELANS study was designed as a cross-sectional, multicenter, household-based survey conducted between 2014 and 2015 in eight Latin American countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru and Venezuela. Its primary objective was to assess dietary patterns and micronutrient adequacy among urban residents aged 15-65 years. A multistage, stratified random sampling design was applied, ensuring representation by geographic region, sex, age, and socioeconomic status, with a maximum sampling error of 3.49% at a 5% significance level. From a total of 9,218 participants, this analysis included 3,704 non-pregnant, non-lactating women of childbearing age (15-49 years) (19), to characterize usual preconception micronutrient intake.

Dietary intake data was assessed using two non-consecutive 24-hour dietary recalls administered up to eight days apart and distributed across weekdays and weekends to capture intra-individual variability. Trained interviewers applied the United States Department of Agriculture's (USDA) five-step multiple-pass method, and portion sizes were estimated using country-specific photographic atlases and standardized household measures. Foods items were coded and linked to the Nutrition Data System for Research (NDS-R 2014), which provided estimates of energy and nutrient intake. Usual intake distribution was estimated using the Multiple Source Method (MSM) (https://msm.dife.de/tps/en), developed within the European Prospective Investigation into Cancer and Nutrition (EPIC) to adjust for within-person variability. Micronutrient intake were energy-adjusted (expressed per 1000 kcal) to account for total energy intake and reduce potential bias from misreporting (18,20).

Dietary diversity was assessed based on the number of food groups consumed, with the intake of five or more food groups indicating a diverse diet. This indicator was used to characterize dietary patterns and vulnerability to micronutrient inadequacy among WCA (7). For the supplementation analysis, scenarios were applied uniformly across the population to reflect routine clinical practice, in which prenatal supplements are typically prescribed at fixed doses regardless of individual dietary diversity. The potential differential effects of supplementation according to dietary diversity are acknowledged as a study limitation.

Information on prenatal supplementation was obtained from each ELANS country's Principal Investigator (PI), who identified the most commonly prescribed supplements based on experts' clinical practice (Supplement 1). The micronutrient composition and dosage of each supplement were verified using product labels and official technical datasheets. Supplement formulations varied across the countries, reflecting differences in product composition and dosing.

The analytical approach for supplement evaluation was adapted from DeSalvo el al. (21). Mean usual micronutrient intake derived from the ELANS dataset (7) was combined with the micronutrient composition of a representative prenatal supplement for each country, modeling a population-level supplementation scenario rather than individual intake. Total micronutrient intake (diet plus supplementation) was compared with Estimated Average Requirements (EARs), Adequate Intakes (IAs), and Tolerable Upper Intake Levels (Uls), when available, to estimate the proportion of women meeting recommendations and those potentially exceeding Uls under a daily supplementation. The model assumes full adherence to daily supplement use at recommended dosage. Supplement-derived nutrients were not energy-adjusted, and no assumptions were made regarding bioavailability across countries. These assumptions, while allowing standardized comparation, may not reflect real-world supplementation practices and are acknowledged as study limitation.

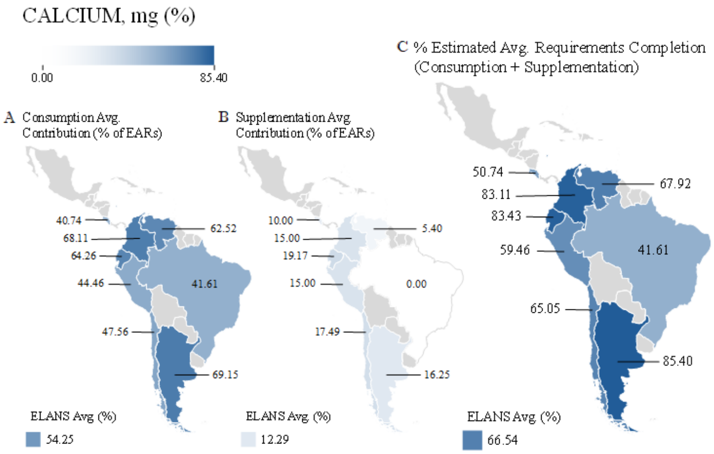

Figure 1. A) Average dietary calcium intake, (B) Contribution provided by the most consumed supplements per country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs)

All procedures were approved by the Western Institutional Review Board (protocol #20140605) and by local ethics committees in each participating country. All participants provided written informed consent prior to data collection (22).

Results

Detailed country-specific results for micronutrient intake are presented in Supplementary Tables 2, 3 (processed data) and Supplementary Tables 4, 5 (raw means and standard errors), with the key findings illustrated in Figures 1–7.

Prenatal supplement formulations show substantial variability across ELANS countries particularly in the content of key micronutrients as iron, calcium, magnesium, long-chain omega-3 fatty acids, and fat-soluble vitamins.

1. Minerals

Calcium. Mean dietary calcium intake was 542.5 mg (54.3% of recommendations), increasing to 66.5% with supplementation, remaining bellow adequacy in all countries. At the country level, supplementation improved intake but did not meet recommendations. Higher coverage was observed in Argentina, Colombia, and Ecuador (approaching approximately 85%), while Venezuela reached 67.9%. In contrast, Chile, Peru, Brazil, and Costa Rica remained below 65% even after supplementation (Figure 1).

Iron. Mean dietary iron intake was 12.3 mg (68.3%), increasing to 263.3% with supplementation, exceeding recommended levels and the tolerable upper intake level (UL).

Table 1. Composition of most commonly prescribed prenatal supplements by ELANS country

	Supplements	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Pyridoxine (mg)	Cobalamin (µg)	Vitamin A (mcg)	Vitamin D (µg)	Vitamin E (mg)	Vitamin C (mg)	Calcium (mg)	DHA (mg)	EPA (mg)	Omega 3 (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Phosphorus (mg)	Copper (mg)	Selenium (mg)
Argentina	ARSU1	1,4	1,4	18	1,9	2,6	1600	10	20	100	200	105	20	135	100	81	7,5	0	0	0
	ARSU2	1,6	1,8	19	2,6	4	1200	12,5	15	100	125,0	0	0	0	100	60	7,5	125	1	0
Brasil	BRSU1	3	3,4	17	4	2,2	799,2	10	4,5	70	0	0	0	0	0	30	15	0	0	0
	BRSU2	1,4	1,4	18	1,9	2,6	800	0	10	55	0	250	50	0	75	20	15	0	0	0,03
	BRSU3	1,2	1,3	30	1,3	2,4	600	20	10	45	0	200	0	0,3	0	27	2,5	0	0,9	0
Chile	CHISU1	1,6	1,8	19	2,6	4	22000	2,5	15	100	124,6	0	0	0	100	60	7,5	125	1	0
	CHISU2	1,7	2	20	2,5	8	650	10	20,1	60	250	200	35	0	50	28	15	0	2	0
	CHISU3	1,4	1,6	18	2	2,8	650	15	19	85	150		200	35	235	27	13	1,3	0	0
Colombia	COSU1	3	3,4	17	4	2,2	799,2	10	10	70	0	125	0	0	0	30	15	0	0	0
	COSU2	1,7	2	20	2,5	8	1200	10	13,5	60	200	200	35	235	50	28	15	0	2	0
	COSU3	1,7	2	20	2,5	8	650	10	20,1	60	250	200	35	0	50	28	15	0	2	0
Costa Rica	CRSU1	3	3,4	17	4	2,2	799,2	10	10	70	125	0	0	0	0	30	15	0	0	0
	CRSU2	3	3,4	17	4	2,2	510	10	4,5	70	125	150	0	0	0	30	15	0	0	0
	CRSU3	1,7	2	20	8	8	0	0	0	60	50	0	0	0	0	3	0	0	0	0
Ecuador	ECUSU1	1,1	1,4	16	1,4	2,5	800	5	12	80	200	240	240	0	0	14	10	0	1	0,02
	ECUSU2	3	3,4	17	4	2,2	799,2	10	10	70	125	0	0	0	0	30	15	0	0	0
	ECUSU3	1,5	2	20	2	3	2000	100	30	100	250	0	0	0	50	45	25		0,002	0,025
Perú	PESU1	1,6	1,8	19	2,6	4	1200	12,5	15	100	125,0	0	0	0	100	60	7,5	125	1	0
	PESU2	3	3,4	17	4	2,2	510	10	4,5	70	125	150	0	0	0	30	15	0	0	0
	PESU3	1,5	1,7	18	2,6	4	1200	10	11	100	200	0	0	0	0	60	25	0	0	0
Venezuela	VESU1	1,4	1,6	10	2	1	400	0	10	70	0	0	0	275	100	14	15	0	0	0
	VESU2	1,45	1,6	18	2	2,6	0	0	10,05	60	0	0	0	320	75	27	10	0	1	0,059
	VESU3	1,40	1,6	18	2	1	399,6	5	6,7	60	162	0	0	0	50	10	5	125	0,5	0,03

Although dietary intake varied (50.0% in Brazil to 83.9% in Colombia), total intake surpassed recommendations in all countries, ranging from 163.3% in Venezuela to 463.9% in Argentina, reflecting substantial variability supplement composition (Figure 2).

Magnesium. Dietary intake averaged 220.8 mg (84.9%), reaching 104.7% with supplementation. Supplement contribution varied widely across countries, with no inclusion in supplementation in Costa Rica and the highest contribution observed in Argentina (Figure 3).

Zinc, phosphorus, copper, and selenium. Dietary intake of these minerals exceeded recommended levels across the region and increase further with supplementation. Zinc reached 338.2% of recommendations with supplementation, phosphorus increase slightly from 167.9% to 172%, and copper rose from 200% to 271.4%. Selenium intake was already high from diet alone (241.6%) without supplementation.

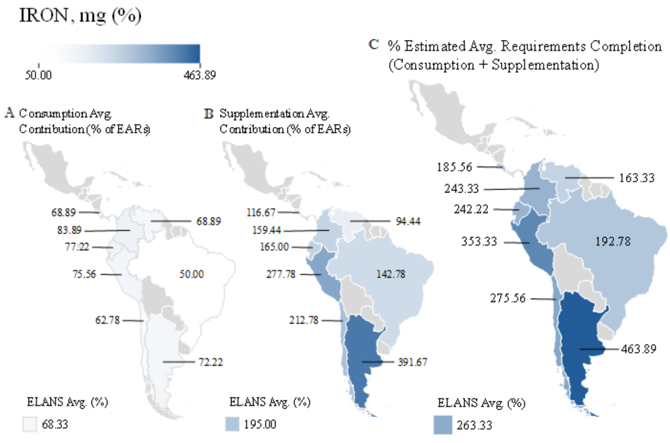

Figure 2. A) Average dietary iron intake, (B) Contribution provided by the most consumed supplements by country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs)

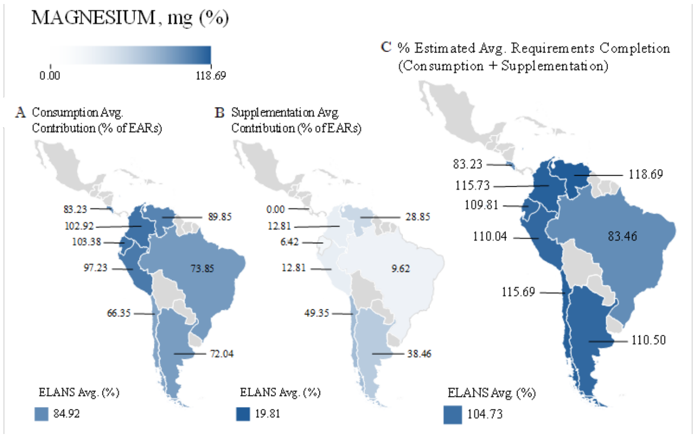

Figure 3. (A) Average dietary magnesium intake, (B)Contribution provided by the most consumed supplements by country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs)

Overall, supplementation further increased already excessive intakes, approaching or exceeding ULs and increasing potential health risk (Figures 4-5).

2. Fat-soluble vitamins

Vitamin A. Mean dietary intake was 575.6 µg (82.2%), increasing to 208.2% with supplementation and exceeding the UL. Only Colombia met requirements through diet alone, while Chile showed the lowest intake. Supplementation resulted in excessive intake across all countries.

Vitamin D. Dietary intake was low (3.5 µg; 23.3%), but increased to 104.7% with supplementation. Intake varied across countries, and was higher

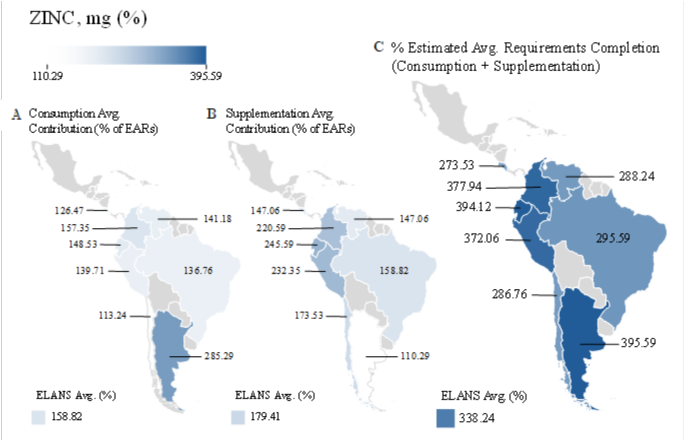

Figure 4. (A) Average dietary zinc intake, (B) Contribution provided by the most consumed supplements by country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs).

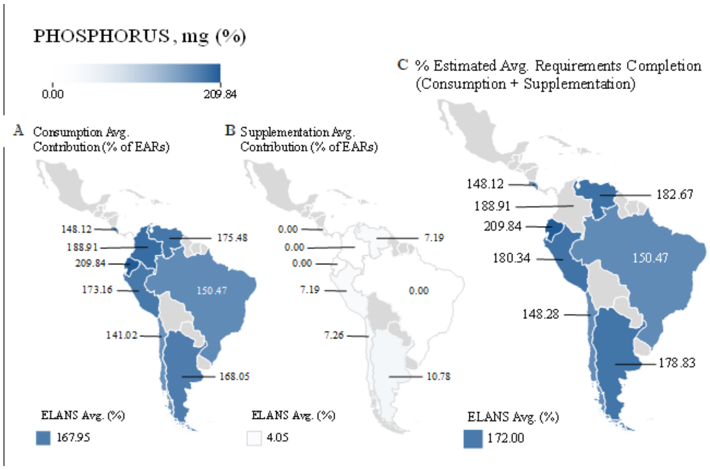

Figure 5. (A) Average dietary phosphorus intake, (B)Contribution provided by the most consumed supplements per country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs).

in Ecuador, Peru, and Colombia, and lower in Brazil and Costa Rica.

Vitamin E. Mean dietary intake was minimal (0.4 mg; 2.7%), rising to 85.3% with supplementation. Adequacy was achieved in some countries (Chile, Argentina, Ecuador, and Colombia), but intake remained insufficient in Peru, Venezuela, Brazil, and Costa Rica.

3. Water-soluble vitamins

Vitamin C. Mean intake was 125.9 mg (100.8%), indicating overall adequacy, although Costa Rica, Chile, and Argentina remained below recommendations. Supplementation increased intake above recommended levels across all countries.

B-complex vitamins. Dietary intake was already high for all B vitamins, including cobalamin (162.5%), niacin (151.4%), pyridoxine (123.1%), riboflavin (136.4%), and thiamine (145.5%). Supplementation further increased total intake, exceeding 280% of recommendations across these vitamins (Figure 6).

4. Other compounds

DHA, EPA, and omega-3 fatty acids. Intake of long-chain omega-3 fatty acids (DHA and EPA) was quantified, although no reference values for adequacy were applied. Prenatal supplements contributed relevant amounts, substantially increasing total intake.

Choline. Mean dietary intake was 305 mg (71.8% of recommendations), with no contribution from prenatal supplements. Intake was lowest in Chile and remained below recommendations across all countries (Figure 7).

Overall findings. Across ELANS countries, multiple micronutrient inadequacies were identified from diet alone, particularly for calcium, vitamin D, vitamin E, and choline. While prenatal supplementation improved intake for several nutrients, it frequently resulted in excessive intake, especially for iron, vitamin A, zinc, and B-complex vitamins. These findings highlight the coexistence of nutrient deficiencies and potential risk of excessive intake under current supplementation practices.

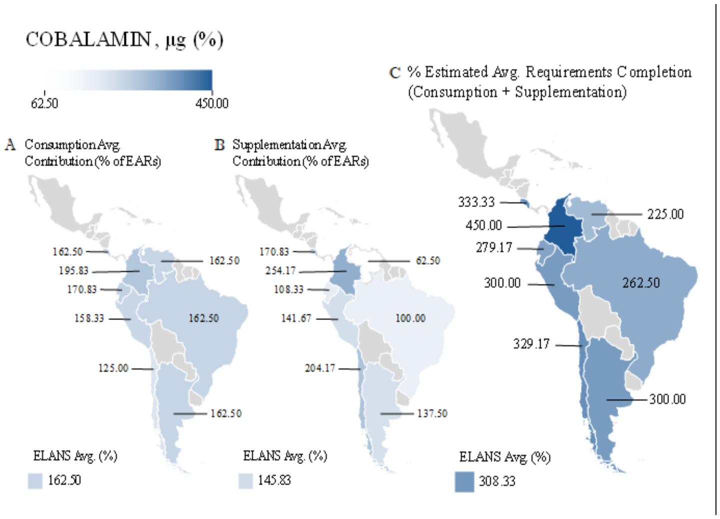

Figure 6. (A) Average dietary cobalamin intake, (B) Contribution provided by the most consumed supplements per country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs)

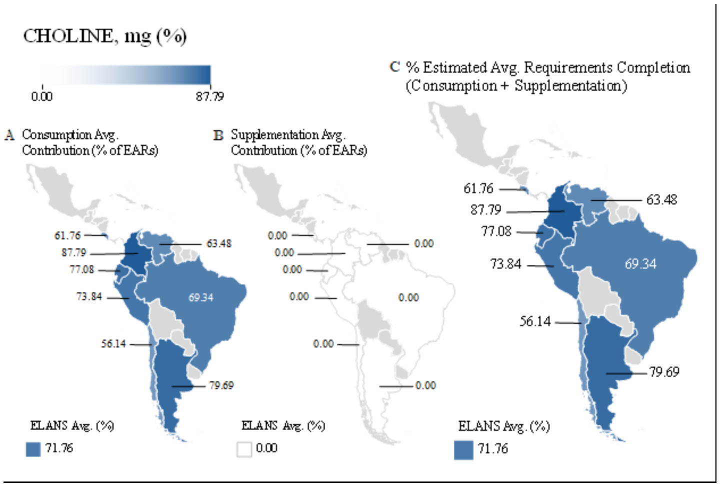

Figure 7. (A) Average dietary choline intake, (B) Contribution provided by the most consumed supplements per country, and combined values expressed as a percentage of (C) Estimated Average Requirements (%EARs).

Table 2: Micronutrient Consumption, Supplementation, and Total Coverage as a Percentage of EARs

Measured Location	Micronutrient	EARs (100%)	Consumption Average Contribution (% of EARs)	Supplementation Average Contribution (% of EARs)	Percentage of EARs Covered (Consumption + Supplementation Contribution)
ELANS (Total)	Calcium (mg)	100.00	54.25	12.29	66.54
Argentina	Calcium (mg)	100.00	69.15	16.25	85.40
Brazil	Calcium (mg)	100.00	41.61	0.00	41.61
Chile	Calcium (mg)	100.00	47.56	17.49	65.05
Colombia	Calcium (mg)	100.00	68.11	15.00	83.11
Costa Rica	Calcium (mg)	100.00	40.74	10.00	50.74
Ecuador	Calcium (mg)	100.00	64.26	19.17	83.43
Peru	Calcium (mg)	100.00	44.46	15.00	59.46
Venezuela	Calcium (mg)	100.00	62.52	5.40	67.92
ELANS (Total)	Iron (mg)	100.00	68.33	195.00	263.33
Argentina	Iron (mg)	100.00	72.22	391.67	463.89
Brazil	Iron (mg)	100.00	50.00	142.78	192.78
Chile	Iron (mg)	100.00	62.78	212.78	275.56
Colombia	Iron (mg)	100.00	83.89	159.44	243.33
Costa Rica	Iron (mg)	100.00	68.89	116.67	185.56
Ecuador	Iron (mg)	100.00	77.22	165.00	242.22
Peru	Iron (mg)	100.00	75.56	277.78	353.33
Venezuela	Iron (mg)	100.00	68.89	94.44	163.33
ELANS (Total)	Magnesium (mg)	100.00	84.92	19.81	104.73
Argentina	Magnesium (mg)	100.00	72.04	38.46	110.50
Brazil	Magnesium (mg)	100.00	73.85	9.62	83.46
Chile	Magnesium (mg)	100.00	66.35	49.35	115.69
Colombia	Magnesium (mg)	100.00	102.92	12.81	115.73
Costa Rica	Magnesium (mg)	100.00	83.23	0.00	83.23
Ecuador	Magnesium (mg)	100.00	103.38	6.42	109.81
Peru	Magnesium (mg)	100.00	97.23	12.81	110.04
Venezuela	Magnesium (mg)	100.00	89.85	28.85	118.69
ELANS (Total)	Zinc (mg)	100.00	158.82	179.41	338.24
Argentina	Zinc (mg)	100.00	285.29	110.29	395.59
Brazil	Zinc (mg)	100.00	136.76	158.82	295.59
Chile	Zinc (mg)	100.00	113.24	173.53	286.76
Colombia	Zinc (mg)	100.00	157.35	220.59	377.94
Costa Rica	Zinc (mg)	100.00	126.47	147.06	273.53
Ecuador	Zinc (mg)	100.00	148.53	245.59	394.12
Peru	Zinc (mg)	100.00	139.71	232.35	372.06
Venezuela	Zinc (mg)	100.00	141.18	147.06	288.24
ELANS (Total)	Phosphorus (mg)	100.00	167.95	4.05	172.00
Argentina	Phosphorus (mg)	100.00	168.05	10.78	178.83
Brazil	Phosphorus (mg)	100.00	150.47	0.00	150.47
Chile	Phosphorus (mg)	100.00	141.02	7.26	148.28
Colombia	Phosphorus (mg)	100.00	188.91	0.00	188.91
Costa Rica	Phosphorus (mg)	100.00	148.12	0.00	148.12
Ecuador	Phosphorus (mg)	100.00	209.84	0.00	209.84
Peru	Phosphorus (mg)	100.00	173.16	7.19	180.34
Venezuela	Phosphorus (mg)	100.00	175.48	7.19	182.67
ELANS (Total)	Copper (mg)	100.00	200.00	71.43	271.43
Argentina	Copper (mg)	100.00	457.14	71.43	528.57
Brazil	Copper (mg)	100.00	142.86	42.86	185.71
Chile	Copper (mg)	100.00	114.29	142.86	257.14
Colombia	Copper (mg)	100.00	185.71	185.71	371.43
Costa Rica	Copper (mg)	100.00	142.86	0.00	142.86
Ecuador	Copper (mg)	100.00	200.00	42.86	242.86
Peru	Copper (mg)	100.00	185.71	42.86	228.57
Venezuela	Copper (mg)	100.00	128.57	71.43	200.00
ELANS (Total)	Selenium (mg)	100.00	241.56	0.00	241.56
Argentina	Selenium (mg)	100.00	258.67	0.00	258.67
Brazil	Selenium (mg)	100.00	229.78	0.00	229.78
Chile	Selenium (mg)	100.00	214.67	0.00	214.67
Colombia	Selenium (mg)	100.00	242.22	0.00	242.22
Costa Rica	Selenium (mg)	100.00	204.67	0.00	204.67
Ecuador	Selenium (mg)	100.00	269.33	0.00	269.33
Peru	Selenium (mg)	100.00	272.44	0.00	272.44
Venezuela	Selenium (mg)	100.00	235.11	0.00	235.11

Table 3: Micronutrient: Consumption, Supplementation, and Total Coverage as a Percentage of EARs

Measured Location	Micronutrient	EARs (100%)	Consumption Average Contribution (% of EARs)	Supplementation Average Contribution (% of EARs)	Percentage of EARs Covered (Consumption + Supplementation Contribution)
ELANS (Total)	Vitamin A (µg)	100.00	82.23	125.99	208.21
Argentina	Vitamin A (µg)	100.00	76.09	200.00	276.09
Brazil	Vitamin A (µg)	100.00	72.26	104.73	176.99
Chile	Vitamin A (µg)	100.00	71.19	166.67	237.86
Colombia	Vitamin A (µg)	100.00	105.64	126.16	231.80
Costa Rica	Vitamin A (µg)	100.00	93.84	62.34	156.19
Ecuador	Vitamin A (µg)	100.00	85.79	171.39	257.17
Peru	Vitamin A (µg)	100.00	93.69	138.57	232.26
Venezuela	Vitamin A (µg)	100.00	69.04	38.07	107.11
ELANS (Total)	Vitamin D (µg)	100.00	23.33	81.33	104.67
Argentina	Vitamin D (µg)	100.00	20.67	75.00	95.67
Brazil	Vitamin D (µg)	100.00	12.67	66.67	79.33
Chile	Vitamin D (µg)	100.00	20.00	61.33	81.33
Colombia	Vitamin D (µg)	100.00	30.67	66.67	97.33
Costa Rica	Vitamin D (µg)	100.00	17.33	44.67	62.00
Ecuador	Vitamin D (µg)	100.00	40.00	255.33	295.33
Peru	Vitamin D (µg)	100.00	35.33	72.00	107.33
Venezuela	Vitamin D (µg)	100.00	18.00	11.33	29.33
ELANS (Total)	Vitamin E (mg)	100.00	2.67	82.67	85.33
Argentina	Vitamin E (mg)	100.00	3.33	116.67	120.00
Brazil	Vitamin E (mg)	100.00	1.33	54.67	56.00
Chile	Vitamin E (mg)	100.00	2.00	120.00	122.00
Colombia	Vitamin E (mg)	100.00	3.33	96.67	100.00
Costa Rica	Vitamin E (mg)	100.00	2.00	32.00	34.00
Ecuador	Vitamin E (mg)	100.00	4.00	115.33	119.33
Peru	Vitamin E (mg)	100.00	2.67	68.00	70.67
Venezuela	Vitamin E (mg)	100.00	1.33	59.33	60.67
ELANS (Total)	Vitamin C (mg)	100.00	125.87	100.80	226.67
Argentina	Vitamin C (mg)	100.00	62.13	133.33	195.47
Brazil	Vitamin C (mg)	100.00	161.07	75.60	236.67
Chile	Vitamin C (mg)	100.00	80.67	108.93	189.60
Colombia	Vitamin C (mg)	100.00	134.27	84.40	218.67
Costa Rica	Vitamin C (mg)	100.00	95.87	88.93	184.80
Ecuador	Vitamin C (mg)	100.00	169.47	111.07	280.53
Peru	Vitamin C (mg)	100.00	131.73	120.00	251.73
Venezuela	Vitamin C (mg)	100.00	146.13	84.40	230.53
ELANS (Total)	Cobalamin (µg)	100.00	162.50	145.83	308.33
Argentina	Cobalamin (µg)	100.00	162.50	137.50	300.00
Brazil	Cobalamin (µg)	100.00	162.50	100.00	262.50
Chile	Cobalamin (µg)	100.00	125.00	204.17	329.17
Colombia	Cobalamin (µg)	100.00	195.83	254.17	450.00
Costa Rica	Cobalamin (µg)	100.00	162.50	170.83	333.33
Ecuador	Cobalamin (µg)	100.00	170.83	108.33	279.17
Peru	Cobalamin (µg)	100.00	158.33	141.67	300.00
Venezuela	Cobalamin (µg)	100.00	162.50	62.50	225.00
ELANS (Total)	Niacin (mg)	100.00	151.43	131.43	282.86
Argentina	Niacin (mg)	100.00	142.14	132.14	274.29
Brazil	Niacin (mg)	100.00	138.57	155.00	293.57
Chile	Niacin (mg)	100.00	131.43	135.71	267.14
Colombia	Niacin (mg)	100.00	163.57	135.71	299.29
Costa Rica	Niacin (mg)	100.00	134.29	128.57	262.86
Ecuador	Niacin (mg)	100.00	177.14	126.43	303.57
Peru	Niacin (mg)	100.00	170.71	128.57	299.29
Venezuela	Niacin (mg)	100.00	162.86	109.29	272.14

Table 3: Micronutrient: Consumption, Supplementation, and Total Coverage as a Percentage of EARs (cont).

Measured Location	Micronutrient	EARs (100%)	Consumption Average Contribution (% of EARs)	Supplementation Average Contribution (% of EARs)	Percentage of EARs Covered (Consumption + Supplementation Contribution)
ELANS (Total)	Pyridoxine (mg)	100.00	123.08	223.08	346.15
Argentina	Pyridoxine (mg)	100.00	107.69	173.08	280.77
Brazil	Pyridoxine (mg)	100.00	107.69	184.62	292.31
Chile	Pyridoxine (mg)	100.00	100.00	184.62	284.62
Colombia	Pyridoxine (mg)	100.00	146.15	230.77	376.92
Costa Rica	Pyridoxine (mg)	100.00	107.69	407.69	515.38
Ecuador	Pyridoxine (mg)	100.00	161.54	173.08	334.62
Peru	Pyridoxine (mg)	100.00	138.46	238.46	376.92
Venezuela	Pyridoxine (mg)	100.00	123.08	153.85	276.92
ELANS (Total)	Riboflavin (mg)	100.00	136.36	190.91	327.27
Argentina	Riboflavin (mg)	100.00	154.55	145.45	300.00
Brazil	Riboflavin (mg)	100.00	118.18	181.82	300.00
Chile	Riboflavin (mg)	100.00	118.18	163.64	281.82
Colombia	Riboflavin (mg)	100.00	172.73	227.27	400.00
Costa Rica	Riboflavin (mg)	100.00	127.27	263.64	390.91
Ecuador	Riboflavin (mg)	100.00	127.27	209.09	336.36
Peru	Riboflavin (mg)	100.00	127.27	209.09	336.36
Venezuela	Riboflavin (mg)	100.00	136.36	145.45	281.82
ELANS (Total)	Thiamine (mg)	100.00	145.45	172.73	318.18
Argentina	Thiamine (mg)	100.00	154.55	136.36	290.91
Brazil	Thiamine (mg)	100.00	109.09	172.73	281.82
Chile	Thiamine (mg)	100.00	118.18	145.45	263.64
Colombia	Thiamine (mg)	100.00	154.55	190.91	345.45
Costa Rica	Thiamine (mg)	100.00	145.45	236.36	381.82
Ecuador	Thiamine (mg)	100.00	145.45	172.73	318.18
Peru	Thiamine (mg)	100.00	145.45	181.82	327.27
Venezuela	Thiamine (mg)	100.00	163.64	127.27	290.91
ELANS (Total)	Choline (mg)	100.00	71.76	0.00	71.76
Argentina	Choline (mg)	100.00	79.69	0.00	79.69
Brazil	Choline (mg)	100.00	69.34	0.00	69.34
Chile	Choline (mg)	100.00	56.14	0.00	56.14
Colombia	Choline (mg)	100.00	87.79	0.00	87.79
Costa Rica	Choline (mg)	100.00	61.76	0.00	61.76
Ecuador	Choline (mg)	100.00	77.08	0.00	77.08
Peru	Choline (mg)	100.00	73.84	0.00	73.84
Venezuela	Choline (mg)	100.00	63.48	0.00	63.48

Table 4: Average Micronutrient Consumption, Supplementation, Standard Error, and EAR Differences

Measured Location	Micronutrient	EAR	Consumption Average Contribution	Standard Error (±)	Supplementation Average Contribution	EAR-Consumption Difference	EAR-Consumption and Supplementation Difference
ELANS (Total)	Calcium (mg)	1000	542.5	3.9	122.9	-457.5	-334.6
Argentina	Calcium (mg)	1000	691.5	9.7	162.5	-308.5	-146
Brazil	Calcium (mg)	1000	416.1	7.6	0	-583.9	-583.9
Chile	Calcium (mg)	1000	475.6	10.9	174.9	-524.4	-349.5
Colombia	Calcium (mg)	1000	681.1	10.3	150	-318.9	-168.9
Costa Rica	Calcium (mg)	1000	407.4	10.1	100	-592.6	-492.6
Ecuador	Calcium (mg)	1000	642.6	10.2	191.7	-357.4	-165.7
Peru	Calcium (mg)	1000	444.6	6.6	150	-555.4	-405.4
Venezuela	Calcium (mg)	1000	625.2	10.8	54	-374.8	-320.8
ELANS (Total)	Iron (mg)	18	12.3	0.1	35.1	-5.7	29.4
Argentina	Iron (mg)	18	13	0.2	70.5	-5	65.5
Brazil	Iron (mg)	18	9	0.1	25.7	-9	16.7
Chile	Iron (mg)	18	11.3	0.2	38.3	-6.7	31.6
Colombia	Iron (mg)	18	15.1	0.2	28.7	-2.9	25.8
Costa Rica	Iron (mg)	18	12.4	0.2	21	-5.6	15.4
Ecuador	Iron (mg)	18	13.9	0.2	29.7	-4.1	25.6
Peru	Iron (mg)	18	13.6	0.1	50	-4.4	45.6
Venezuela	Iron (mg)	18	12.4	0.1	17	-5.6	11.4
ELANS (Total)	Magnesium (mg)	260	220.8	1.1	51.5	-39.2	12.3
Argentina	Magnesium (mg)	260	187.3	2	100	-72.7	27.3
Brazil	Magnesium (mg)	260	192	2	25	-68	-43
Chile	Magnesium (mg)	260	172.5	2.2	128.3	-87.5	40.8
Colombia	Magnesium (mg)	260	267.6	3.3	33.3	7.6	40.9
Costa Rica	Magnesium (mg)	260	216.4	3.5	0	-43.6	-43.6
Ecuador	Magnesium (mg)	260	268.8	3.6	16.7	8.8	25.5
Peru	Magnesium (mg)	260	252.8	2.7	33.3	-7.2	26.1
Venezuela	Magnesium (mg)	260	233.6	2.8	75	-26.4	48.6
ELANS (Total)	Zinc (mg)	6.8	10.8	0.1	12.2	4	16.2
Argentina	Zinc (mg)	6.8	19.4	0.4	7.5	12.6	20.1
Brazil	Zinc (mg)	6.8	9.3	0.1	10.8	12.6	23.4
Chile	Zinc (mg)	6.8	7.7	0.1	11.8	0.9	12.7
Colombia	Zinc (mg)	6.8	10.7	0.1	15	3.9	18.9
Costa Rica	Zinc (mg)	6.8	8.6	0.1	10	1.8	11.8
Ecuador	Zinc (mg)	6.8	10.1	0.1	16.7	3.3	20
Peru	Zinc (mg)	6.8	9.5	0.2	15.8	2.7	18.5
Venezuela	Zinc (mg)	6.8	9.6	0.1	10	2.8	12.8
ELANS (Total)	Phosphorus (mg)	580	974.1	4.9	23.5	394.7	418.2
Argentina	Phosphorus (mg)	580	974.7	11.1	62.5	394.7	457.2
Brazil	Phosphorus (mg)	580	872.7	10	0	292.7	292.7
Chile	Phosphorus (mg)	580	817.9	11.1	42.1	237.9	280
Colombia	Phosphorus (mg)	580	1095.7	13	0	515.7	515.7
Costa Rica	Phosphorus (mg)	580	859.1	13.8	0	279.1	279.1
Ecuador	Phosphorus (mg)	580	1217.1	23.3	0	637.1	637.1
Peru	Phosphorus (mg)	580	1004.3	10.2	41.7	424.3	466
Venezuela	Phosphorus (mg)	580	1017.8	12.5	41.7	437.8	479.5
ELANS (Total)	Copper (mg)	0.7	1.4	0	0.5	0.7	1.2
Argentina	Copper (mg)	0.7	3.2	0.1	0.5	2.5	3
Brazil	Copper (mg)	0.7	1	0	0.3	0.3	0.6
Chile	Copper (mg)	0.7	0.8	0	1	0.1	1.1
Colombia	Copper (mg)	0.7	1.3	0	1.3	0.6	1.9
Costa Rica	Copper (mg)	0.7	1	0	0	0.3	0.3
Ecuador	Copper (mg)	0.7	1.4	0	0.3	0.7	1
Peru	Copper (mg)	0.7	1.3	0	0.3	0.6	0.9
Venezuela	Copper (mg)	0.7	0.9	0	0.5	0.2	0.7
ELANS (Total)	Selenium (mg)	45	108.7	0.5	0	-26.3	-26.3
Argentina	Selenium (mg)	45	116.4	1.4	0	71.4	71.4
Brazil	Selenium (mg)	45	103.4	1.2	0	58.4	58.4
Chile	Selenium (mg)	45	96.6	1.3	0	51.6	51.6
Colombia	Selenium (mg)	45	109	1.2	0	64	64
Costa Rica	Selenium (mg)	45	92.1	1.6	0	47.1	47.1
Ecuador	Selenium (mg)	45	121.2	1.7	0	76.2	76.2
Peru	Selenium (mg)	45	122.6	1.4	0	77.6	77.6
Venezuela	Selenium (mg)	45	105.8	1.1	0	60.8	60.8

Table 5: Average Micronutrient Consumption, Supplementation, Standard Error, and EAR Differences

Measured Location	Micronutrient	EAR	Consumption Average Contribution	Standard Error (±)	Supplementation Average Contribution	EAR-Consumption Difference	EAR-Consumption and Supplementation Difference
ELANS (Total)	Vitamin A (μg)	700	575.6	4.7	881.9	-124.4	757.5
Argentina	Vitamin A (μg)	700	532.6	10.4	1400	-167.4	1232.6
Brazil	Vitamin A (μg)	700	505.8	11.2	733.1	-644.2	88.9
Chile	Vitamin A (μg)	700	498.3	8.4	1166.7	-201.7	965
Colombia	Vitamin A (μg)	700	739.5	14.9	883.1	39.5	922.6
Costa Rica	Vitamin A (μg)	700	656.9	19.1	436.4	-43.1	393.3
Ecuador	Vitamin A (μg)	700	600.5	16.8	1199.7	-99.5	1100.2
Peru	Vitamin A (μg)	700	655.8	10.8	970	-44.2	925.8
Venezuela	Vitamin A (μg)	700	483.3	8	266.5	-216.7	49.8
ELANS (Total)	Vitamin D (μg)	15	3.5	0	12.2	-11.5	0.7
Argentina	Vitamin D (μg)	15	3.1	0.1	11.25	-11.9	-0.65
Brazil	Vitamin D (μg)	15	1.9	0	10	-13.1	-3.1
Chile	Vitamin D (μg)	15	3	0.1	9.2	-12	-2.8
Colombia	Vitamin D (μg)	15	4.6	0.1	10	-10.4	-0.4
Costa Rica	Vitamin D (μg)	15	2.6	0.1	6.7	-12.4	-5.7
Ecuador	Vitamin D (μg)	15	6	0.2	38.3	-9	29.3
Peru	Vitamin D (μg)	15	5.3	0.1	10.8	-9.7	1.1
Venezuela	Vitamin D (μg)	15	2.7	0.1	1.7	-12.3	-10.6
ELANS (Total)	Vitamin E (mg)	15	0.4	0	12.4	-14.6	-2.2
Argentina	Vitamin E (mg)	15	0.5	0	17.5	-14.5	3
Brazil	Vitamin E (mg)	15	0.2	0	8.2	-14.8	-6.6
Chile	Vitamin E (mg)	15	0.3	0	18	-14.7	3.3
Colombia	Vitamin E (mg)	15	0.5	0	14.5	-14.5	0
Costa Rica	Vitamin E (mg)	15	0.3	0	4.8	-14.7	-9.9
Ecuador	Vitamin E (mg)	15	0.6	0	17.3	-14.4	2.9
Peru	Vitamin E (mg)	15	0.4	0	10.2	-14.6	-4.4
Venezuela	Vitamin E (mg)	15	0.2	0	8.9	-14.8	-5.9
ELANS (Total)	Vitamin C (mg)	75	94.4	1.5	75.6	19.4	95
Argentina	Vitamin C (mg)	75	46.6	1	100	-28.4	71.6
Brazil	Vitamin C (mg)	75	120.8	5.8	56.7	45.8	102.5
Chile	Vitamin C (mg)	75	60.5	1.8	81.7	-14.5	67.2
Colombia	Vitamin C (mg)	75	100.7	2.2	63.3	25.7	89
Costa Rica	Vitamin C (mg)	75	71.9	2.6	66.7	-3.1	63.6
Ecuador	Vitamin C (mg)	75	127.1	3	83.3	52.1	135.4
Peru	Vitamin C (mg)	75	98.8	2.6	90	23.8	113.8
Venezuela	Vitamin C (mg)	75	109.6	2.4	63.3	34.6	97.9
ELANS (Total)	Cobalamin (μg)	2.4	3.9	0	3.5	1.5	5
Argentina	Cobalamin (μg)	2.4	3.9	0.1	3.3	1.5	4.8
Brazil	Cobalamin (μg)	2.4	3.9	0.1	2.4	1.5	3.9
Chile	Cobalamin (μg)	2.4	3	0.1	4.9	0.6	5.5
Colombia	Cobalamin (μg)	2.4	4.7	0.1	6.1	2.3	8.4
Costa Rica	Cobalamin (μg)	2.4	3.9	0.1	4.1	1.5	5.6
Ecuador	Cobalamin (μg)	2.4	4.1	0.1	2.6	1.7	4.3
Peru	Cobalamin (μg)	2.4	3.8	0.1	3.4	1.4	4.8
Venezuela	Cobalamin (μg)	2.4	3.9	0.1	1.5	1.5	3
ELANS (Total)	Niacin (mg)	14	21.2	0.1	18.4	7.2	25.6
Argentina	Niacin (mg)	14	19.9	0.2	18.5	5.9	24.4
Brazil	Niacin (mg)	14	19.4	0.2	21.7	5.4	27.1
Chile	Niacin (mg)	14	18.4	0.3	19	4.4	23.4
Colombia	Niacin (mg)	14	22.9	0.3	19	8.9	27.9
Costa Rica	Niacin (mg)	14	18.8	0.3	18	4.8	22.8
Ecuador	Niacin (mg)	14	24.8	0.3	17.7	10.8	28.5
Peru	Niacin (mg)	14	23.9	0.3	18	9.9	27.9
Venezuela	Niacin (mg)	14	22.8	0.3	15.3	8.8	24.1
ELANS (Total)	Pyridoxine (mg)	1.3	1.6	0	2.9	0.3	3.2
Argentina	Pyridoxine (mg)	1.3	1.4	0	2.25	0.1	2.35
Brazil	Pyridoxine (mg)	1.3	1.4	0	2.4	0.1	2.5
Chile	Pyridoxine (mg)	1.3	1.3	0	2.4	0	2.4
Colombia	Pyridoxine (mg)	1.3	1.9	0	3	0.6	3.6
Costa Rica	Pyridoxine (mg)	1.3	1.4	0	5.3	0.1	5.4
Ecuador	Pyridoxine (mg)	1.3	2.1	0	2.25	2.5	4.75
Peru	Pyridoxine (mg)	1.3	1.8	0	3.1	0.5	3.6
Venezuela	Pyridoxine (mg)	1.3	1.6	0	2	0.3	2.3

Table 5: Average Micronutrient Consumption, Supplementation, Standard Error, and EAR Differences (cont.)

Measured Location	Micronutrient	EAR	Consumption Average Contribution	Standard Error (±)	Supplementation Average Contribution	EAR-Consumption Difference	EAR-Consumption and Supplementation Difference
ELANS (Total)	Riboflavin (mg)	1.1	1.5	0	2.1	0.4	2.5
Argentina	Riboflavin (mg)	1.1	1.7	0	1.6	0.6	2.2
Brazil	Riboflavin (mg)	1.1	1.3	0	2	0.2	2.2
Chile	Riboflavin (mg)	1.1	1.3	0	1.8	0.2	2
Colombia	Riboflavin (mg)	1.1	1.9	0	2.5	0.8	3.3
Costa Rica	Riboflavin (mg)	1.1	1.4	0	2.9	0.3	3.2
Ecuador	Riboflavin (mg)	1.1	1.4	0	2.3	0.3	2.6
Peru	Riboflavin (mg)	1.1	1.4	0	2.3	-0.5	1.8
Venezuela	Riboflavin (mg)	1.1	1.5	0	1.6	0.4	2
ELANS (Total)	Thiamine (mg)	1.1	1.6	0	1.9	0.5	2.4
Argentina	Thiamine (mg)	1.1	1.7	0	1.5	0.6	2.1
Brazil	Thiamine (mg)	1.1	1.2	0	1.9	0.1	2
Chile	Thiamine (mg)	1.1	1.3	0	1.6	0.2	1.8
Colombia	Thiamine (mg)	1.1	1.7	0	2.1	0.6	2.7
Costa Rica	Thiamine (mg)	1.1	1.6	0	2.6	0.5	3.1
Ecuador	Thiamine (mg)	1.1	1.6	0	1.9	0.5	2.4
Peru	Thiamine (mg)	1.1	1.6	0	2	-0.5	1.5
Venezuela	Thiamine (mg)	1.1	1.8	0	1.4	0.7	2.1
ELANS (Total)	DHA (mg)	ND	73.6	1.1	84.7	ND	NA
Argentina	DHA (mg)	ND	66.1	1	52.5	ND	NA
Brazil	DHA (mg)	ND	60.4	1.8	150	ND	NA
Chile	DHA (mg)	ND	63.4	1.8	133.3	ND	NA
Colombia	DHA (mg)	ND	65.1	1.7	175	ND	NA
Costa Rica	DHA (mg)	ND	73.2	3.9	50	ND	NA
Ecuador	DHA (mg)	ND	124.5	3.9	66.7	ND	NA
Peru	DHA (mg)	ND	91.5	1.8	50	ND	NA
Venezuela	DHA (mg)	ND	69.5	1.3	0	ND	NA
ELANS (Total)	EPA (mg)	ND	22.5	0.2	10.8	ND	NA
Argentina	EPA (mg)	ND	17.2	0.3	10	ND	NA
Brazil	EPA (mg)	ND	17.2	0.7	16.7	ND	NA
Chile	EPA (mg)	ND	18	0.7	23.3	ND	NA
Colombia	EPA (mg)	ND	20	0.6	23.3	ND	NA
Costa Rica	EPA (mg)	ND	22.2	1.4	0	ND	NA
Ecuador	EPA (mg)	ND	40.1	1.4	13.3	ND	NA
Peru	EPA (mg)	ND	31.9	0.7	0	ND	NA
Venezuela	EPA (mg)	ND	22.2	0.4	0	ND	NA
ELANS (Total)	Omega-3 (mg)	ND	1.6	0	0.1	ND	NA
Argentina	Omega-3 (mg)	ND	1.1	0	0.1	ND	NA
Brazil	Omega-3 (mg)	ND	1.6	0	0.2	ND	NA
Chile	Omega-3 (mg)	ND	1.2	0	0.2	ND	NA
Colombia	Omega-3 (mg)	ND	1.8	0	0.2	ND	NA
Costa Rica	Omega-3 (mg)	ND	1.5	0	0	ND	NA
Ecuador	Omega-3 (mg)	ND	1.5	0	0.1	ND	NA
Peru	Omega-3 (mg)	ND	1.8	0	0	ND	NA
Venezuela	Omega-3 (mg)	ND	1.9	0	0	ND	NA
ELANS (Total)	Choline (mg)	425	305	1.6	0	-120	-120
Argentina	Choline (mg)	425	338.7	4.4	0	-86.3	-86.3
Brazil	Choline (mg)	425	294.7	3.5	0	-130.3	-130.3
Chile	Choline (mg)	425	238.6	3.8	0	-186.4	-186.4
Colombia	Choline (mg)	425	373.1	4.8	0	-51.9	-51.9
Costa Rica	Choline (mg)	425	262.5	4.9	0	-162.5	-162.5
Ecuador	Choline (mg)	425	327.6	5	0	-97.4	-97.4
Peru	Choline (mg)	425	313.8	3.7	0	-111.2	-111.2
Venezuela	Choline (mg)	425	269.8	3.6	0	-155.2	-155.2

Discussion

The ELANS region exhibits a heterogeneous nutritional profile among women of childbearing age, characterized by persistent inadequacies in several essential micronutrients. Despite variability across countries, the overall pattern reflects suboptimal intake at the regional level, consistent with global evidence linking micronutrient deficiencies to socioeconomic inequalities, limited dietary diversity, and structural barriers to healthy diets (19,20,23,24).

Maternal nutrition during the preconception, pregnancy, and lactation periods plays a central role in perinatal outcomes and in shaping long-term metabolic, immune and neurodevelopmental trajectories, in line with the Developmental Origins of Health and Disease (DOHaD) framework (5). In addition, dietary patterns tend to remain stable without interventions addressing social, behavioral, and environmental determinants (18,20).

These findings raise key questions for public health and clinical practice regarding the need for supplementation, priority micronutrients, and population-specific dosing strategies. Variability in dietary patterns further complicates these decisions, as nutrient requirements may differ according to dietary models (e.g. plant-based diets), underscoring the need for context-specific approaches (25). Addressing these challenges requires harmonized data systems that integrate dietary intake and supplementation to evaluate their combined contribution to micronutrient adequacy (18).

Evidence from large-scale fortification programs in Latin America provides valuable insights into effective interventions. Mandatory folic acid fortification in countries such as Chile and Argentina have significantly reduced neural tube defects, demonstrating that population-level, evidence-based policies (16,26,27). These findings highlight the potential of regulatory strategies to address nutritional gaps that are difficult to overcome through individual behavior alone, suggesting that similar approaches could be extended to other key nutrients, including iron, vitamin D, and calcium (28).

Socioeconomic factors strongly influence dietary diversity and access to nutrition-related information, thereby affecting micronutrient adequacy. Evidence from low- and middle-income countries shows that lower income, limited educational, and reduced dietary diversity are consistently associated with inadequate micronutrient intake among WCA [24,29). These structural determinants underscore the need for integrate strategies combining supplementation with improved dietary diversity and nutrition education.

The ELANS findings confirm global evidence of inadequate intake of key "neuro-skeletal" nutrients. Intakes of vitamin D and vitamin E remain particularly low, while calcium intake is persistently insufficient, even with supplementation 7,9). These deficiencies are concerning given their roles in fetal organ development, bone health, and neurodevelopment, as well as in epigenetic and metabolic programming during critical periods (5). Although supplementation improves intake for some nutrients, it does not fully correct these deficits, highlighting a mismatch between supplement composition and population needs (5). In contrast, nutrients such as zinc, selenium, and several B-complex vitamins already exceed recommended levels through diet alone and may reach excessive levels with supplementation.

Iron represents a particularly complex case. Although intake appears relatively adequate at the population level, this may not reflect physiological status due to differences in bioavailability, dietary sources, and increased requirements associated with menstrual losses. The coexistence of apparently adequate intake with high anemia prevalence in the region underscores this limitation (8). Globally, nearly one-third of women are affected by iron-deficiency anemia (30), and intake-based assessments alone may not reflect true nutritional status (31,32). While supplementation can improve biomarkers such as hemoglobin and ferritin (33), combined intake from diet and supplements may exceed tolerable limits, emphasizing the need for more individualized, bioavailability-informed strategies (8,13).

Importantly, this study identifies a clear mismatch between prenatal supplement formulations and actual nutritional needs. While supplementation improves intake of some deficient nutrients, such as vitamin D, it frequently leads to excessive intake of others, including iron, vitamin A, and B-complex vitamins, while key nutrients such as calcium, vitamin E, and choline remain insufficient. Variability in adequacy is also influenced by dietary patterns; evidence from plant-based populations shows that gaps in vitamin B12, iron, calcium, and DHA required tailored supplementation strategies, underscoring the need to align formulations with dietary context (25).

The absence of choline in all evaluated formulations is particularly concerning given its role in fetal brain development and recent recommendations supporting its inclusion in prenatal nutrition (10,34). This finding is consistent with evidence from diverse populations, where deficiencies in choline, vitamin D, and omega-3 fatty acids persists despite supplement use, while other nutrients may exceed recommended levels (35). These results align with recent expert consensus indicating that current prenatal supplementation practices often fail to reflect updated evidence and recommending a shift from traditional iron-folic acid approaches toward more comprehensive, context-specific multiple micronutrient strategies across the life course (36).

In addition, substantial heterogeneity in supplement formulations across countries limits comparability and standardization. Differences in regulatory frameworks, market availability, and prescription practices contributed to variability in nutrient composition, complicating cross-country comparisons and the development of unified supplementation strategies.

Socioeconomic disparities further influence access to and use of supplements, potentially exacerbating nutritional inequalities. Evidence indicates that supplement use is higher among urban and higher-income populations, leaving more vulnerable groups underserved (27,32).

Emerging global recommendations emphasize the importance of preconception nutrition, recognizing that maternal status prior to pregnancy plays a critical role in fetal development and long-term health outcomes (37). Accordingly, expert consensus supports extending micronutrient interventions beyond pregnancy to include the preconception period, given that many women enter pregnancy with existing nutrient deficiencies (36). Current guidelines also support multiple micronutrient supplementation (MMS) to improve birth outcomes, although implementation remains limited in many regions (14,38.

Addressing these gaps requires coordinated public health strategies integrating dietary improvement, fortification, and evidence-based supplementation. While dietary diversification remains fundamental, it is unlikely to resolve widespread deficiencies in the short term (11). Given the intergenerational impact of maternal nutrition, interventions across the preconception, pregnancy, and lactation periods are critical to optimize health trajectories (5). These strategies must balance adequacy and safety, ensuring that supplementation addresses deficiencies without promoting excessive intake, while evolving evidence underscores the need to periodically update nutritional guidelines to reflect current scientific knowledge (39).

Limitations

This study has several limitations. The supplementation analysis represents a theoretical population-level scenario based on mean dietary intake combined with the nutrient composition of a single representative prenatal supplement per country, assuming 100% adherence, which may overestimate real-world intake. Additionally, the contribution of fortified foods was not assessed separately across population subgroups, which influence total nutrient intake.

Dietary data were obtained through self-reported 24-hour recalls and are subject to recall bias, misreporting, and measurement error despite the use of standardized methods. The ELANS sample includes only urban populations, limiting generalizability to rural settings. Nutrient estimates did not account for bioavailability or nutrient–nutrient interactions.

Comparisons between countries are constrained by variability in supplement formulations and selection criteria. Furthermore, analyses were not stratified by dietary diversity or age subgroups. Finally, findings are based on non-pregnant women and therefore reflect preconception conditions rather than actual intake during pregnancy.

Strengths

This study has several strengths. Dietary intake in the ELANS study was assessed using two non-consecutive 24-hour recalls, reducing measurement error and improving the estimation of usual intake. The large, representative sample across multiple countries enhances the generalizability of the findings with urban populations of the region. In addition, this study provides an innovative framework to evaluate prenatal supplementation practices and offers a novel approach to inform strategies for improving micronutrient adequacy among WCA in Latin America.

Conclusions

Significant micronutrient deficiencies persist among WCA in the ELANS study, while prenatal supplementation improves some nutrient intakes but leaves key gaps, particularly for calcium, vitamin E, and choline. At the same time, supplementation frequently leads to excessive intake of nutrients such as iron, vitamin A, and B-complex vitamins. These findings highlight a mismatch between supplement composition and population needs, underscoring the need for tailored, evidence-based strategies to optimize maternal nutrition.

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Conflict of Interest

This article was writing using funds from an Abbott Nutrition Research Grant. The sponsors had no role in the design, data processing and interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Authors' contributions

- MHC, MCYG, LYCS, AR developed and conceptualized the idea and methods.
- PHR, DAY was in charge of the data processing,
- YK, MF, RP, GGS revised and gave input to the manuscript.
- MW, JL revised the manuscript and edit.

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