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The Coastal Iodine Paradox: A Narrative Review of Food Security and Dietary Patterns as Determinants of Iodine Status

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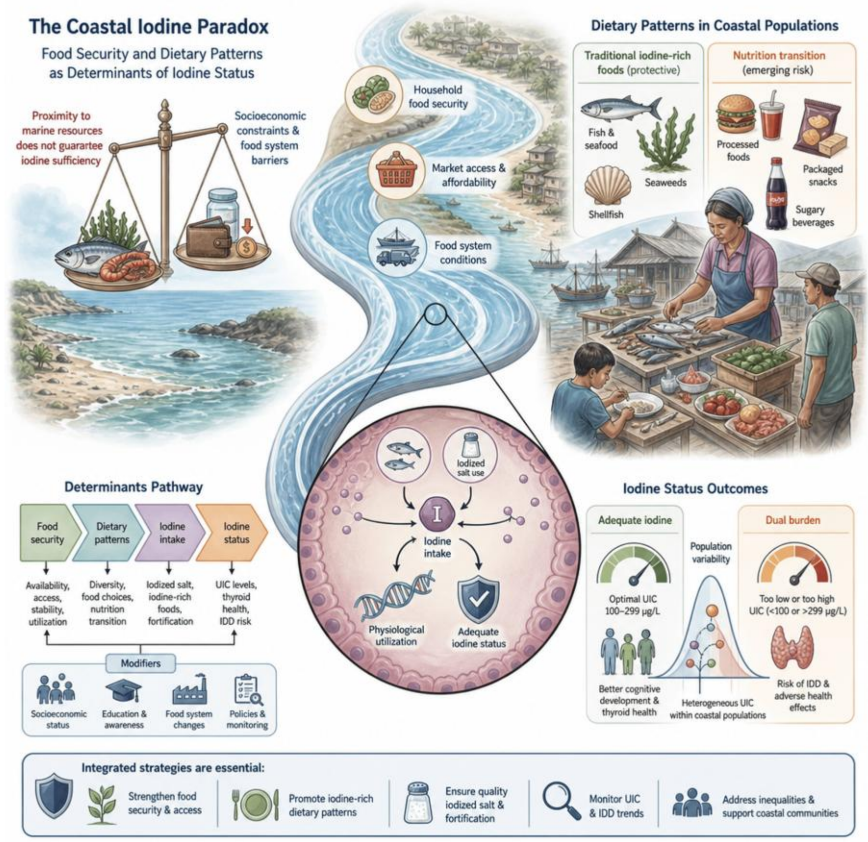
ABSTRACT

Iodine deficiency disorders (IDD) remain a persistent global public health concern, including in coastal regions traditionally assumed to have abundant iodine sources. The interrelationships between food security, dietary patterns, and iodine status in coastal populations are complex and not fully synthesized. To review and integrate international evidence on how food security shapes dietary patterns and influences iodine status among coastal populations. Methods: A structured search was conducted in PubMed, Science Direct, and Google Scholar for peer-reviewed articles published between 2015 and 2025. Keywords included iodine status, urinary iodine concentration, food security, dietary patterns, and coastal population. Studies were synthesized narratively, with thematic focus on links between household food access, dietary behavior, and measured iodine biomarkers. The review identifies a coastal iodine paradox, where proximity to marine resources does not ensure iodine sufficiency due to socioeconomic and food system constraints. Food security influences dietary diversity and intake of iodine-rich foods, while dietary patterns mediate iodine status. Ongoing nutrition transition, characterized by shifts toward processed foods, contributes to changing iodine intake. Variability in iodized salt use and fortification quality may lead to a dual burden of iodine deficiency and excess within the same population. Socioeconomic disparities, market access, and structural food system changes contribute to heterogeneity in urinary iodine concentration (UIC) and IDD prevalence. Iodine adequacy in coastal areas cannot be assumed based solely on geography. Integrated strategies addressing food security, dietary quality, and iodized salt monitoring are essential to ensure sustainable iodine nutrition in coastal communities.

Key Messages:

- This review highlights a 'coastal iodine paradox,' suggesting that geographic proximity to marine resources does not guarantee iodine sufficiency; rather, food security, dietary diversity, and consistent access to iodized salt remain the primary determinants of iodine status in coastal populations.

GRAPHICAL ABSTRACT



INTRODUCTION

Iodine is an essential micronutrient required for the biosynthesis of thyroid hormones, which play a central role in regulating metabolic processes, somatic growth, and neurodevelopment across the life course(1, 2). Adequate iodine intake is particularly critical during sensitive periods such as childhood and pregnancy, when brain development is rapid and highly vulnerable to micronutrient deficiencies(3). Insufficient iodine exposure during school age has been consistently associated with suboptimal intellectual performance, impaired academic achievement, growth retardation, and an increased risk of thyroid dysfunction, including goiter and cretinism. In addition to children, pregnant women represent another highly vulnerable group, as iodine deficiency during the first 1,000 days of life may lead to irreversible neurodevelopmental impairment in offspring(1, 4).

Over the past decades, the global implementation of universal salt iodization (USI) has substantially reduced the prevalence of severe iodine deficiency(5). Nevertheless, iodine deficiency disorders (IDD) remain a significant public health concern. It is estimated that approximately 2.2 billion individuals worldwide continue to experience inadequate iodine intake, with school-aged children and pregnant women among the most vulnerable groups(1, 4). According to the World Health Organization, nearly 36.5% of children aged 6–12 years globally are affected by iodine deficiency, with higher prevalence observed in regions such as Southeast Asia(6).

Although iodized salt programs have mitigated the burden of severe deficiency, emerging evidence indicates the coexistence of both insufficient and excessive iodine intake across diverse settings(7). In addition, public health efforts to reduce sodium intake for the prevention of hypertension may inadvertently complicate iodine fortification strategies, creating a policy-level tension between salt reduction and iodization goals. Notably, iodine deficiency has been documented even in coastal regions traditionally presumed to have adequate iodine exposure due to proximity to marine food sources. This phenomenon, referred to as the *coastal iodine paradox*, describes the disconnect between environmental iodine availability and actual biological adequacy at the population level(8).

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Urinary iodine concentration (UIC), also referred to as urinary iodine excretion (UIE), is widely recognized as a robust population-level biomarker of iodine status, as it reflects recent iodine intake(9). The World Health Organization recommends UIC as the primary indicator for monitoring iodine nutrition in school-aged children and other population groups(6). However, meaningful interpretation of iodine status requires a comprehensive understanding of the dietary and socioeconomic determinants that influence iodine consumption patterns(9).

In parallel with advances in nutritional epidemiology, research has shifted from single-nutrient approaches toward dietary pattern analysis, which captures the overall configuration of food consumption and interactions among food groups(10). This approach provides a more realistic representation of habitual diets and their contribution to micronutrient adequacy(11). Empirical evidence indicates that dietary patterns characterized by regular consumption of seafood, dairy products, and iodized salt are positively associated with adequate iodine status(4, 12). Dietary behavior is closely linked to household food security, which encompasses four key dimensions: availability, access, utilization, and stability of food resources. These dimensions determine the ability of households to obtain and consume iodine-rich foods(12).

In many coastal settings, rapid urbanization and globalization have accelerated the nutrition transition, whereby populations shift from traditional marine-based diets toward processed and ultra-processed foods(13, 14). Coastal populations are often among the first to experience these shifts due to greater exposure to globalized food systems. The iodine contribution of such foods is contingent upon the use of iodized salt in industrial food processing, which varies substantially across countries depending on regulatory frameworks and enforcement mechanisms. The replacement of traditional iodine-rich foods with processed alternatives may reduce overall iodine intake when iodized salt use is inconsistent. As a result, both iodine deficiency and iodine excess may coexist within coastal populations, reflecting structural inequities in food systems, iodization policies, and socioeconomic conditions(15, 16).

Collectively, these findings challenge the assumption that coastal residence inherently confers iodine sufficiency. Instead, iodine status appears to be shaped by a complex interplay among food security, dietary patterns, and the effectiveness of iodization strategies. Therefore, this narrative review evaluates the interplay between food security, dietary patterns, and iodine status in coastal populations, with particular emphasis on how food system dynamics and structural inequities influence iodine nutrition in these settings.

METHODS

This study adopted a narrative review design to synthesize and critically interpret existing scientific evidence on the interrelationship between food security, dietary patterns, and iodine status in coastal populations. A narrative approach was deemed appropriate given the multidimensional nature of the topic, which encompasses nutritional, socioeconomic, environmental, and policy-related determinants and includes heterogeneous study designs. Unlike meta-analytic approaches that prioritize statistical pooling, this design enables conceptual integration of findings from observational studies, ecological analyses, national surveys, and systematic reviews to develop a comprehensive and context-sensitive understanding of iodine nutrition in coastal settings.

The review focused on coastal populations globally, spanning low-, middle-, and high-income countries, with particular attention to regions undergoing rapid nutrition transition and experiencing variability in the implementation and enforcement of universal salt iodization (USI). Populations of interest included school-aged children, women of reproductive age, pregnant women, and general coastal communities whose iodine status was assessed using validated biomarkers, primarily urinary iodine concentration (UIC) or urinary iodine excretion (UIE), as recommended by the World Health Organization.

A structured literature search was conducted across four electronic databases: PubMed, ScienceDirect, and Google Scholar. The search encompassed publications from January 2015 to December 2025, with the final update performed in December 2025 prior to manuscript submission. Search strategies were developed using Boolean operators and combinations of the following keywords: “iodine status,” “urinary iodine concentration,” “iodine deficiency,” “food security,” “household food security,” “dietary

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patterns," "dietary diversity," "nutrition transition," "coastal populations," and "marine-based diet." Only peer-reviewed articles published in English were included. Duplicate records were removed prior to screening. Titles and abstracts were independently screened by two reviewers, followed by full-text assessment based on predefined eligibility criteria. Discrepancies were resolved through discussion and consensus.

Studies were eligible for inclusion if they: (1) assessed iodine status using validated biomarkers; (2) examined dietary patterns, dietary diversity, or food security indicators in relation to iodine intake or status; or (3) focused on coastal or marine-based populations. Studies were excluded if they did not report iodine-related outcomes; focused exclusively on clinical thyroid disorders without dietary context; examined solely non-dietary iodine exposure (e.g., environmental contamination) without nutritional assessment; lacked sufficient methodological transparency; or were unavailable in full text. To enhance the robustness of the synthesis, efforts were made to ensure representation of diverse geographic regions and population subgroups, thereby strengthening the external validity and transferability of the findings.

Data extraction was conducted using a structured framework to ensure consistency. Data extraction was performed independently by two reviewers using a standardized form. Extracted variables included study design, geographic location, population characteristics, sample size, iodine assessment methods, dietary assessment tools (e.g., 24-hour dietary recall, food frequency questionnaire, dietary diversity scores), food security measurement instruments (e.g., Household Food Insecurity Access Scale,

The Household Food Security Survey Module (HFSSM) or other validated tools), statistical approaches, and principal findings. Where available, laboratory procedures for urinary iodine analysis and quality control measures were documented to assess methodological comparability across studies. Data synthesis was performed using thematic narrative analysis. Included studies were categorized into four principal thematic domains: (1) global and regional iodine status in coastal settings; (2) associations between dietary patterns and iodine intake; (3) pathways linking food security dimensions—availability, access, utilization, and stability—to iodine nutrition; and (4) evidence supporting the "coastal paradox," whereby iodine deficiency persists despite geographic proximity to marine resources. Particular attention was given to identifying consistent patterns, methodological heterogeneity, contextual variability, and existing research gaps.

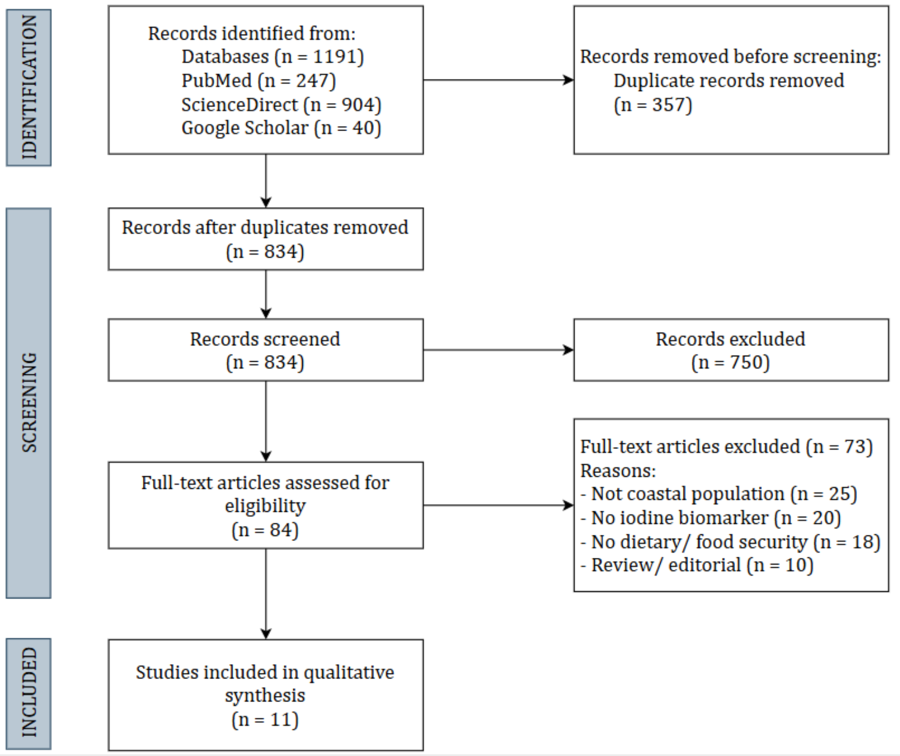

Figure 1. PRISMA Chart of the Literature Review

Methodological quality was appraised qualitatively according to criteria adapted to each study

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design. A structured domain-based appraisal approach was applied, focusing on key methodological aspects, including selection bias, validity of iodine measurement, appropriateness of dietary and food security assessment methods, control of confounding variables, and clarity of reporting. Studies with incomplete reporting of key methodological components were interpreted with caution during the synthesis process. A PRISMA flow diagram was developed to illustrate the study selection process, including the number of records identified, screened, excluded, and included in the final synthesis.

As this review was based exclusively on previously published literature and did not involve primary data collection from human participants, ethical approval and informed consent were not required. All included studies were assumed to have obtained ethical clearance from their respective institutional review boards, as reported in the original publications.

RESULTS

Characteristics of Included Studies

Table 1 summarizes eleven studies examining iodine status in relation to dietary patterns and food security–related determinants among coastal or maritime populations between 2015 and 2025. The included studies represent diverse geographical contexts across Africa, Asia, Europe, and the Pacific, encompassing low-, middle-, and high-income settings. Most studies employed cross-sectional designs, with iodine status primarily assessed using urinary iodine concentration (UIC) or urinary iodine excretion (UIE), consistent with recommendations from the World Health Organization.

Of the eleven included studies, five specifically focused on pregnant women, while the remainder examined school-age children, adolescents, or general adult populations, highlighting a strong emphasis on maternal and neonatal vulnerability. Based on the qualitative appraisal, most studies were categorized as moderate to high quality. High-quality ratings were generally attributed to the use of standardized laboratory methods (e.g., validated UIC measurements) and appropriate sampling procedures, whereas moderate-quality ratings were commonly due to inherent limitations of cross-sectional designs, including the inability to infer causality and potential recall bias in dietary assessment.

Overall, the evidence base reflects substantial contextual heterogeneity in dietary assessment methods, food security measurement tools, and regulatory environments governing salt iodization. Despite these differences, convergent patterns emerged linking household food security, dietary structure, and iodine biomarkers.

Food Security and Iodine Status

Across the reviewed studies, iodine status was consistently shaped by structural dimensions of food security—particularly access, availability, and quality of iodized salt and iodine-rich foods. Evidence from Southwest Ethiopia showed that iodine deficiency persisted among school-age children despite salt iodization programs, largely due to reliance on goitrogenic staple foods and limited dietary diversity, reflecting constrained household food security(9). Similarly, in coastal Myanmar, pregnant women exhibited inadequate median UIC (mUIC: approximately 105 μg/L, below the WHO adequacy threshold of 150 μg/L for pregnant women) despite geographic access to marine foods, primarily due to suboptimal iodized salt quality and inconsistent utilization(17).

In Zhejiang Province, China, coastal pregnant women had significantly lower UIC (mean UIC <150 μg/L) and higher neonatal TSH compared with inland counterparts, partly explained by lower household iodized salt consumption(18). These findings indicate that iodine adequacy depends not merely on environmental iodine availability but on reliable household access to adequately fortified salt within functioning food systems. In addition to deficiency, evidence also indicates a dual burden of iodine status. Multi-country analysis (China, the Philippines, and Croatia) reported substantial variability in salt iodine concentration, resulting not only in insufficiency but also in borderline excessive iodine intake in some subpopulations, highlighting risks associated with inconsistent fortification practices(7).

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Table 1. Summary of key studies on iodine status, dietary patterns, and food security in coastal populations

Ref No.	Location	Population	Dietary Pattern Assessment	Iodine Biomarker	Key Findings	Quality Rating	Iodine Status (WHO-based)
(19)	Xinjiang, China	Adults	FFQ; PCA-derived dietary patterns	UIC; FT3, FT4, TSH	Staple and fish-based dietary patterns were positively associated with UIC; lower staple intake increased iodine deficiency risk	High	Adequate (population median), with subgroups at risk
(20)	Zhejiang Province, China (coastal and inland areas)	Pregnant women	Household iodized salt assessment	UIC; household salt iodine	Coastal residence, low iodized salt use, and poor iodine knowledge were associated with lower UIC	High	Inadequate (coastal subgroup)
(9)	Southwest Ethiopia	School-age children (6–12 years)	Modified Hellen Keller's FFQ (goitrogenic foods)	UIC; TGR	High iodine deficiency linked to goitrogenic foods and poor dietary diversity	Moderate	Inadequate
(21)	Xinjiang, China	Pregnant and lactating women	FFQ; iodine knowledge questionnaire	UIC	Higher iodine knowledge was associated with better dietary iodine intake and UIC	High	Adequate
(22)	Bengkulu, Indonesia	Children aged 2–5 years	Semi-quantitative FFQ	Dietary iodine intake	Inadequate iodine intake associated with stunting	Moderate	Inadequate
(7)	China; Philippines; Croatia	School-age children, women of reproductive age, pregnant women, lactating women, infants 0–6 months, and infants 7–24 months	Salt iodine; milk iodine sources	UIC; thyroid function	Variability in iodized salt led to both deficiency and excess	High	Mixed (deficiency & excess)
(18)	Zhejiang Province, China	Pregnant women, neonates, and school-age children	Environmental iodine sources (salt consumption and drinking water)	UIC; neonatal TSH	Coastal populations had lower UIC despite iodization	High	Inadequate (pregnant women)
(17)	Mon State, Myanmar	Pregnant women	Salt use and seafood intake questionnaire	UIC	Inadequate iodine despite seafood access; poor salt quality	Moderate	Inadequate
(23)	Faroe Islands	Pregnant women	FFQ	UIC	Declining iodine status due to reduced traditional marine diet	High	Inadequate
(24)	Fujian Province, China	Adults aged 18–59 years	Iodized salt use & dietary intake	mUIC; 24-h iodine excretion	Adequate overall, but reduced salt intake lowered iodine intake in women	High	Adequate (with at-risk subgroups)
(25)	Poland	Adolescents aged 14–20 years	FFQ	Dietary iodine intake	Low iodine intake due to poor diet and low iodized salt use	Moderate	Inadequate

*FFQ: Food Frequency Questionnaire; PCA: Principal Component Analysis; UIC: Urinary Iodine Concentration; FT3: T-iodothyronine; FT4: Thyroxine; TSH: Thyroid Stimulating Hormone; TGR: Total Goiter Rate; mUIC: Median Urinary Iodine Concentration.

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Dietary Patterns as Behavioral and Nutritional Pathways

Several studies demonstrate that habitual dietary configurations mediate the relationship between household food environments and iodine biomarkers. In Xinjiang, China, principal component–derived patterns revealed that staple- and fish-based dietary patterns were positively associated with UIC, whereas lower adherence to staple patterns increased iodine deficiency risk despite an overall adequate population median(19). Among pregnant and lactating women in the same region, higher iodine knowledge and improved dietary practices were positively correlated with both iodine intake and UIC, highlighting the role of nutrition literacy in optimizing food utilization(21). Evidence from northern Poland further illustrates this mediating mechanism. Adolescents residing in coastal and lake regions demonstrated widespread inadequate iodine intake, primarily due to low consumption of iodine-rich foods and limited use of iodized salt(25). Likewise, in Fujian Province, China, adults generally exhibited adequate iodine status; however, reduced salt intake was associated with lower iodine intake among women of reproductive age, revealing a policy-level tension between salt reduction strategies and iodine sufficiency(24).

Coastal Residence and Iodine Status

Evaluation of urinary iodine concentration (UIC) and related biomarkers across settings indicates that coastal residence alone does not ensure adequate iodine nutrition. Evidence from multiple coastal populations demonstrates that geographic proximity to marine food sources is insufficient to guarantee biological adequacy. In coastal Myanmar, pregnant women exhibited suboptimal UIC (mUIC: ~105 μg/L, below WHO recommendations) despite reported seafood consumption(17). Similarly, in the Faroe Islands—a traditionally fish-consuming island population—pregnant women had median UIC (mUIC: ~80–100 μg/L, below the WHO threshold of 150 μg/L), with a declining trend over time, suggesting that a shift away from traditional marine-based dietary patterns toward more Westernized diets contributed to reduced iodine intake (nutrition transition effect)(23). In Zhejiang Province, China, coastal pregnant women showed lower UIC and higher neonatal TSH levels compared with inland residents, partly attributable to lower iodized salt utilization(18). Comparable patterns were observed in coastal Bengkulu, Indonesia, where inadequate iodine intake among children was associated with a high prevalence of stunting(22). Adolescents in northern coastal Poland also demonstrated insufficient iodine intake, largely due to low consumption of iodine-rich foods and limited iodized salt use(25).

DISCUSSION

The synthesis indicates that iodine status in coastal populations is shaped by multifactorial structural and behavioral determinants, rather than by geographic proximity to marine resources alone. While coastal settings are frequently assumed to confer inherent protection against iodine deficiency due to seafood availability, the empirical evidence demonstrates considerable heterogeneity, thereby challenging the validity of this assumption. From a thematic perspective, the findings can be broadly grouped into structural determinants related to food systems and economic access, and behavioral determinants linked to dietary patterns and cultural shifts. These dimensions interact to shape iodine intake and status across diverse coastal settings.

A central finding concerns the structural role of food systems—particularly iodized salt coverage and quality—in shaping iodine nutrition. In Southwest Ethiopia, iodine deficiency among school-age children persisted despite salt iodization policies, largely due to limited dietary diversification and frequent intake of goitrogenic staple foods(9). Similarly, in coastal Myanmar, pregnant women exhibited inadequate median urinary iodine concentration (UIC), partly attributable to suboptimal iodine content in household salt(17). Comparative data from coastal and inland Zhejiang Province, China, further showed that lower iodized salt utilization in coastal areas was associated with lower maternal UIC and higher neonatal TSH levels(18). In contrast, multicenter evidence from China, the Philippines, and Croatia demonstrated that effective implementation and monitoring of universal salt iodization (USI) can ensure adequate iodine status across vulnerable groups, although variability in salt iodine concentration may increase the risk of both deficiency and excess(7). These findings highlight the importance of economic and structural barriers to food security, including unequal access to adequately iodized salt and nutrient-rich foods. In many

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coastal regions, market integration plays a critical role, where high-quality seafood is often exported or sold to urban markets, limiting local consumption of iodine-rich foods. Consequently, coastal populations may not benefit from nearby marine resources, reinforcing the structural nature of iodine deficiency in these settings(26).

An important emerging issue is the "salt paradox," referring to the policy tension between salt reduction strategies for cardiovascular disease prevention and the reliance on iodized salt as the primary vehicle for iodine fortification. Evidence from Fujian Province illustrates that reduced salt intake, while beneficial for hypertension control, may inadvertently lower iodine intake among women of reproductive age(24). This highlights the need for integrated public health strategies that simultaneously address sodium reduction and iodine sufficiency. Synergistic monitoring approaches—linking population salt intake surveillance with urinary iodine assessment—are essential to ensure that efforts to reduce salt consumption do not undermine iodine nutrition at the population level.

Dietary patterns function as proximal mediators translating food system conditions into biological outcomes. In Xinjiang, China, principal component–derived dietary patterns revealed that staple- and fish-based patterns were positively associated with UIC, whereas lower adherence to staple patterns increased iodine deficiency risk(19, 27). Among pregnant and lactating women in the same region, higher iodine knowledge and improved dietary practices were positively correlated with iodine intake and UIC(21, 28). This finding highlights the role of nutrition literacy as a key component of the utilization dimension of food security, whereby individuals' knowledge and behavior influence the effective use of available iodine sources(29). Conversely, adolescents in northern Poland demonstrated widespread inadequate iodine intake due to limited consumption of iodine-rich natural foods and low iodized salt use, despite residence in coastal and lake regions(25).

The ongoing nutrition transition further complicates iodine nutrition in coastal settings. Globalization and urbanization have accelerated a shift from traditional marine-based diets toward westernized dietary patterns characterized by ultra-processed foods. These dietary shifts may reduce the intake of naturally iodine-rich foods such as seafood, while simultaneously increasing reliance on processed foods that may not consistently use iodized salt, depending on regulatory compliance(30). Evidence from Fujian Province further highlighted a policy-level tension: although overall iodine status among adults was sufficient, lower salt intake was associated with reduced iodine intake in women of reproductive age, underscoring the complex interaction between salt reduction initiatives and iodine sufficiency(24). These findings reinforce the notion that iodine status reflects the overall configuration of habitual dietary intake and iodized salt utilization, rather than isolated food items.

The persistence of iodine insufficiency in several coastal populations supports the existence of a "coastal iodine paradox." Pregnant women in the Faroe Islands exhibited median UIC below WHO-recommended thresholds, with a declining trend over time, suggesting that dietary transitions away from traditional marine-based patterns may erode iodine security even in island settings(23). Similarly, children in coastal Bengkulu, Indonesia, showed inadequate iodine intake associated with a high prevalence of stunting(22). Together with findings from coastal China and Myanmar, these data demonstrate that environmental iodine potential does not automatically translate into adequate intake without stable food systems, consistent iodized salt coverage, and sustained dietary diversity(17, 18). Importantly, the coastal iodine paradox can be further explained by the interaction between environmental availability and socio-economic realities. Even in regions with abundant marine resources, factors such as food market dynamics, income constraints, and changing consumer preferences may limit actual intake of iodine-rich foods at the household level.

Another dimension emerging from the reviewed studies is intra-population variability in iodine exposure. While USI has substantially reduced severe iodine deficiency globally, variability in fortification quality and dietary practices may result in simultaneous risks of inadequacy and excess within the same population(7). This "dual burden" reflects challenges in micronutrient food security, where not only the availability but also the stability and quality of iodine fortification determine optimal intake. In coastal populations, partial reliance on marine foods combined with inconsistent iodized salt quality may lead to borderline excess in some groups while others remain deficient, highlighting the need for precise

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regulation and monitoring(31). This heterogeneity underscores the importance of continuous monitoring using UIC and related biomarkers, particularly in coastal regions where seafood intake and salt consumption patterns may vary widely.

From a policy perspective, the findings suggest that iodine control strategies should move beyond geographically defined assumptions. Strengthening iodized salt regulation, ensuring quality control throughout the supply chain, and promoting dietary diversification remain critical components of iodine-secure food systems. Targeted surveillance of vulnerable groups—particularly pregnant women and neonates—is essential, as these populations represent critical windows of neurodevelopment and are consistently shown to be at higher risk of iodine deficiency even in coastal areas. Integrating surveillance of salt iodization quality with population-level biomarker monitoring may enhance early detection of vulnerable subgroups, particularly pregnant women and adolescents.

This review integrates multidisciplinary evidence spanning nutrition epidemiology and food system research; however, several limitations warrant consideration. The predominance of cross-sectional designs restricts causal inference regarding the pathways linking food systems, dietary behaviors, and iodine biomarkers(9, 17-19, 21-25). Additionally, heterogeneity in dietary assessment tools and laboratory methodologies may limit cross-context comparability. Furthermore, urinary iodine concentration reflects recent iodine intake and may not capture long-term or seasonal variations in iodine consumption, particularly in coastal populations where seafood availability may fluctuate. Geographic representation was also uneven, with limited longitudinal evidence from regions such as coastal Africa and small island developing states.

Future research should prioritize longitudinal designs to clarify causal pathways and temporal dynamics in coastal settings. Standardization of dietary iodine assessment and laboratory reporting procedures would strengthen comparability across regions. Further studies should also explore the interaction between salt reduction policies and iodine fortification strategies, as well as the role of nutrition literacy in improving iodine utilization. Expanding research in underrepresented coastal regions is essential to develop globally applicable and context-specific iodine intervention strategies.

CONCLUSION

Iodine sufficiency in coastal populations cannot be assumed based solely on geographic proximity to marine resources. This review confirms a “coastal iodine paradox”, where iodine status is primarily determined by iodized salt coverage, dietary patterns, and food system stability rather than environmental availability alone. As coastal communities undergo a nutrition transition away from traditional iodine-rich diets, they remain highly vulnerable to insufficiency—particularly pregnant women and neonates. Furthermore, inconsistent fortification practices contribute to a dual burden of deficiency and excess. Sustainable iodine control requires an integrated food systems framework that combines strengthened monitoring of universal salt iodization with strategies to improve dietary diversity and nutrition literacy. Moving beyond geographically defined assumptions is essential to achieving equitable and long-term iodine security.

DECLARATION OF THE USE OF AI

The authors declare that no artificial intelligence (AI), AI-assisted technologies, or large language models (LLMs) were used in the conception of the study, data analysis, or the drafting, writing, and editing of this manuscript. The only exception is the graphical abstract, which was created using the design platform Illustrae (https://illustrae.co/). The authors take full responsibility for the content and accuracy of the graphical abstract and the entire manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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