

Forensic Nutrition Profiling (FNP): A Proposed Conceptual Framework and Research Agenda for Investigating Nutritional Contributions to Aggression Vulnerability

Swetha Thomas and Riya Raj C A*

Assistant Professor, Department of Forensic Science, School of Biological and Forensic Sciences, Kristu Jayanti Deemed-to-be University, India

*Corresponding Author: Riya Raj C A, Assistant Professor, Department of Forensic Science, School of Biological and Forensic Sciences, Kristu Jayanti Deemed-to-be University, India.

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Abstract

Background: Conventional forensic risk assessment instruments rely predominantly on psychosocial, developmental, and criminological variables to estimate the likelihood of violent and antisocial behaviour. Despite a substantial and growing evidence base in nutritional psychiatry and behavioural neuroscience, no established forensic framework systematically considers nutritional status or metabolic physiology as candidate correlates of aggression.

Objective: This paper introduces Forensic Nutrition Profiling (FNP) as a conceptual framework and research agenda and not a validated assessment instrument. It proposes how nutritional biomarkers, diet-quality indices, stress-physiology markers, and behavioural measures might be organised and, critically, empirically tested for relevance to aggression vulnerability. FNP is offered to stimulate and structure future research; it is expressly not presented as ready for clinical, forensic, or legal use.

Proposed structure: As a heuristic starting point for investigation, the paper sketches four candidate domains: Nutritional Biomarkers, Diet Quality, Stress and Physiology, and Behavioural Markers. Any domain weightings, composite score, and risk tiers presented here are explicitly hypothetical and illustrative. They have not been empirically derived, calibrated, or validated; they are not accompanied by development or validation samples, discrimination or reliability statistics, or prospective outcome data; and no predictive claims are made on their basis. Candidate biomarkers (e.g., omega-3 index, 25(OH)D, ferritin, B-vitamins, zinc, magnesium, cortisol rhythm, C-reactive protein, glycaemic markers) are noted because

they are analytically measurable using established laboratory methods, not because any composite forensic interpretation has been established.

Rationale: The biological plausibility of FNP draws on mechanistic and observational evidence linking nutritional status to neurotransmitter synthesis, HPA-axis regulation, neuroinflammation, and executive function. Randomised controlled trials indicate that nutritional supplementation can produce modest reductions in aggression (meta-analytic average effect size of approximately $d = 0.22$; Raine & Brodrick, 2024; Gajos & Beaver, 2016). This supports the value of further forensic investigation but does not validate a composite risk-classification tool.

Significance and limitations: FNP's contribution is conceptual. It identifies an under-examined biological dimension of aggression vulnerability and sets out a staged validation pathway — development sample and item selection, weighting derivation and calibration, discrimination and reliability testing, prospective predictive validation, and incremental validity against established forensic instruments — that must be completed *before* any assessment, clinical, or legal application is proposed.

Keywords: Forensic nutrition profiling; FNP; nutritional biomarkers; aggression; nutritional psychiatry; conceptual framework; research agenda; biological plausibility; validation pathway; omega-3 fatty acids; antisocial behaviour

1. Introduction

The assessment and prediction of violent and antisocial behaviour constitute foundational challenges in forensic science, psychiatry, and criminology. Over several decades the field has developed increasingly sophisticated risk instruments, from the Historical Clinical Risk Management scheme [1,2] and the Violence Risk Appraisal Guide–Revised [3] to dynamic tools such as the Short-Term Assessment of Risk and Treatability [4]. These instruments have substantially advanced the precision of violence-risk estimation. They share, however, a common feature: they conceptualise violence risk almost exclusively in psychosocial, criminological, and psychiatric terms, leaving biological and metabolic dimensions of vulnerability largely unaddressed [5].

A growing interdisciplinary literature in nutritional psychiatry, behavioural endocrinology, and neuroscience suggests that this exclusion may be worth re-examining. Nutrients serve not only as substrates for physical health but as regulators of brain chemistry, neural-circuit integrity, and the physiological stress response — processes that plausibly modulate the propensity for impulsive and reactive aggression [6,7]. Omega-3 fatty acids are implicated in neuronal membrane composition and neuroinflammation; B-vita-

mins and zinc act as cofactors in monoamine synthesis; iron supports myelination and dopaminergic neurotransmission; and cortisol dysregulation is associated with stress-reactive behaviour. Deficiencies in several of these nutrients are not rare in community, custodial, and forensic populations, and are in principle remediable through dietary modification and supplementation [8,9].

Notably, randomised controlled trials indicate that broad-spectrum nutritional supplementation can reduce aggressive and antisocial behaviour in juvenile and adult populations, although the pooled effect is modest average $d \approx 0.22$; [8,10,11]. This experimental signal is encouraging and, importantly, supports the case for investigating nutritional variables within forensic research. It does not, by itself, establish that a composite nutritional profile can classify forensic risk.

It is within this context that the present paper proposes Forensic Nutrition Profiling (FNP): a conceptual framework intended to organise candidate nutritional, metabolic, physiological, and behavioural variables so that their relevance to aggression vulnerability can be studied systematically. FNP does not assert that nutritional deficiency causes violent behaviour; rather, it treats nutritional status as one potentially modifiable biological factor, analo-

gous in its hypothesised role to sleep disturbance or substance use, that may interact with psychosocial determinants. Crucially, FNP is presented here as a hypothesis-generating structure and research agenda, not as a measurement instrument ready for application.

The paper sets out the theoretical motivation, a candidate (and explicitly provisional) structure, the rationale for candidate biomarkers, and most importantly a staged validation pathway that would have to be completed before FNP could be considered for clinical, forensic, or legal use. Throughout, the paper distinguishes carefully between what current evidence supports (biological plausibility and a modest supplementation effect) and what it does not yet support (composite forensic interpretation, risk classification, and legal application).

2. Background and Rationale: A Nutritional Gap Worth Investigating

2.1 What Current Forensic Risk Frameworks Do and Do Not Capture

Contemporary forensic risk instruments have been refined over decades of actuarial and clinical research. Structured professional judgement tools such as the HCR-20 (Version 3) integrate static historical variables with dynamic clinical indicators and risk-management considerations. Actuarial tools such as the VRAG-R assign weighted scores based on criminological and diagnostic predictors. Both approaches demonstrate useful predictive validity for institutional violence and community recidivism, with reported AUC values commonly in the 0.70–0.80 range, although performance varies by setting and outcome [12].

These instruments do not assess the individual's concurrent neurobiological or physiological state. An individual's HCR-20 score is unaffected by whether their omega-3 index, iron status, or diurnal cortisol pattern lies at one extreme of the population distribution or the other. Whether such biological information would add incremental predictive value is, at present, an open empirical question rather than an established fact. FNP is proposed as a structured way to formulate and test that question, not as a demonstrated improvement on existing tools.

This is therefore a research gap rather than a validated deficiency in current practice. If nutritional factors prove to be reliably associated with aggression in forensic populations, and if that association adds incremental value beyond established predictors, then their omission would become practically important. Establishing whether these conditions hold is precisely the work that FNP is intended to motivate.

2.2 Nutritional Psychiatry and Behavioural Neuroscience: Plausibility and Its Limits

The case for investigating nutritional variables in forensic assessment rests on three lines of evidence of differing strength: (i) mechanistic studies describing pathways from nutritional status to neurochemical and physiological processes relevant to behaviour; (ii) observational studies reporting associations between dietary patterns or deficiencies and aggression or antisocial behaviour; and (iii) randomised controlled trials testing whether supplementation reduces aggression. It is important to be explicit that much of this literature establishes biological plausibility, or pertains to adjacent outcomes such as mood and cognition, rather than directly predicting aggression or violence in forensic settings.

Mechanistically, serotonergic and dopaminergic signalling depend on dietary precursors and cofactors, and disruption of these systems has been linked to impulse control and affect regulation [6,13,14]. Omega-3 fatty acids have proposed roles in membrane function, receptor signalling, and neuroinflammation [15]. These are mechanistic and largely preclinical or correlational lines of evidence; they motivate hypotheses about aggression but do not establish nutritional status as a forensic predictor.

Several frequently cited findings in this area concern outcomes other than forensic aggression and are presented here on that basis. [16] report an association between vitamin D status and depression; [17] demonstrate that dietary improvement can reduce symptoms of major depression; and [18] examines glucose effects on general mood and behaviour. These studies support biological plausibility within nutritional psychiatry; they are not evidence that nutritional profiles predict violence, and are cited with that limitation in mind.

The most directly relevant evidence comes from randomised trials of supplementation. [8] reported a significant reduction in disciplinary incidents among young adult prisoners receiving vitamins, minerals, and essential fatty acids relative to placebo. [10] found that omega-3 supplementation reduced externalising and internalising problems in children. A meta-analysis by [11], synthesising 28 RCTs (35 independent samples; $N \approx 3,918$), reported a modest average effect size of approximately $d = 0.22$ for omega-3 supplementation on aggression, broadly consistent with the earlier estimate of Gajos and Beaver (2016; $d \approx 0.20$ – 0.24). This is a meaningful and replicable effect that justifies further forensic investigation. It is, however, a modest effect on aggression outcomes following supplementation; it does not validate any composite, biomarker-based forensic classification, which is a separate and far stronger claim.

2.3 Positioning FNP: A Complementary Research Direction

If pursued, FNP would be positioned as a complementary biological line of inquiry within a broader multi-domain approach to understanding aggression, consistent with the biosocial perspective in criminology [5]. It is not proposed as a replacement for, or competitor to, established instruments. A distinctive feature of nutritional and dietary variables is that they are potentially modifiable, which, should associations be confirmed, would make them attractive intervention targets. That potential is a reason to study FNP, not evidence that it works.

3. Methods

Because FNP is a conceptual framework rather than an empirical study, the methods reported here describe how the framework was developed: the literature on which it draws, and the principled process by which candidate domains, indicators, an illustrative scoring scheme, and a validation pathway were assembled. No human participants, biological samples, or primary data were involved, and no composite score was estimated, calibrated, or tested. The account below is therefore a transparent description of a synthesis-and-design process, offered so that the framework's provenance and limits are explicit and so that the proposal can be scrutinised and revised.

3.1 Literature Review Approach

The framework was developed from a structured narrative review of the literature spanning four bodies of work: forensic and actuarial risk assessment; nutritional psychiatry; behavioural neuroscience and endocrinology; and analytical and laboratory methods for nutritional biomarkers. This was a narrative rather than a systematic review: the aim was to map and integrate evidence across disciplines that are rarely considered together, not to produce a pooled effect estimate, and the search was not preregistered. That choice is itself a limitation and is noted as such.

Bibliographic searches were conducted across PubMed, PsycINFO, Web of Science, and Scopus, supplemented by backward and forward citation tracking of key reviews and meta-analyses. Search terms combined nutrition-related concepts ("omega-3," "micronutrient," "vitamin D," "iron," "zinc," "magnesium," "diet quality," "cortisol," "inflammation") with behavioural and forensic concepts ("aggression," "antisocial behaviour," "violence," "impulsivity," "forensic risk assessment"). Established forensic instruments (HCR-20, VRAG-R, START, PCL-R) were identified from standard reference works and validation reviews.

Sources were appraised along two dimensions: the strength of the design (mechanistic or preclinical, observational, or randomised controlled trial and meta-analysis) and the proximity of the outcome to forensic aggression (direct measures of aggression or antisocial behaviour versus adjacent outcomes such as mood, depression, or cognition). This two-dimensional appraisal was used deliberately to avoid over-reading plausibility evidence as predictive evidence, and it is reflected throughout the paper — most explicitly in the "nature of evidence" column of Table 2, where each candidate biomarker is tagged by the type and directness of its supporting evidence.

3.2 Framework-Development Approach

Candidate variables were organised against three a priori design principles: biological plausibility (a documented mechanistic link to neurotransmitter synthesis, neural-circuit function, stress physiology, or neuroinflammation); analytical tractability (measurability using validated labora-

tory methods already available in clinical and forensic biochemistry); and potential actionability (modifiability, such that confirmed associations could eventually inform intervention research). Applying these principles produced four candidate domains — Nutritional Biomarkers, Diet Quality, Stress and Physiology, and Behavioural Markers — each populated with indicators meeting the principles above.

To make the proposal concrete and therefore testable, an illustrative composite was specified: each domain was assigned an a priori weight reflecting the relative density of existing plausibility evidence, domain sub-scores were defined on a simple ordinal basis, and hypothetical risk tiers were sketched. These weights, cut-offs, and tiers are placeholders, not estimates; they were chosen to define a concrete object that empirical work could derive, evaluate, and very likely revise or reject, and they are presented as such throughout. Finally, the requirements of psychometric and actuarial validation — development sampling, empirical weighting and calibration, discrimination and reliability testing, prospective predictive validation, incremental validity against established instruments, and interventional and cross-cultural confirmation — were mapped onto the framework to yield the staged validation pathway that constitutes the paper's central contribution (Section 11).

4. Results

The synthesis-and-design process yielded three principal outputs: a four-domain conceptual structure with an illustrative composite; a defined set of candidate domains and biomarkers selected for plausibility and measurability; and a staged validation pathway specifying what would have to be established before any application. Each output is summarised below and specified in detail in the sections and tables that follow. Consistent with the framing of the paper, every quantitative element presented here is hypothetical and illustrative; none has been empirically derived, calibrated, or validated.

4.1 The Proposed FNP Framework

FNP is structured as four candidate domains feeding an illustrative composite scaled to a 0–100 range. The domains, their candidate indicators, and their illustrative weights are summarised in Table 1; the candidate biomark-

er panel, with analytical methods and the nature of the supporting evidence, is given in Table 2; a hypothetical tiering of composite scores is shown in Table 3; and the framework's design intentions relative to established instruments are set out in Table 4. The structure itself, including its design principles, is specified in Section 5, and the hypothetical scoring scheme in Section 7. The composite is presented solely to give the proposal a concrete, testable form, not as an operational scoring rule.

4.2 The Four Candidate Domains

Four candidate domains emerged from the development process. Nutritional Biomarkers (illustrative weight 40%) assembles indicators with direct mechanistic links to neurochemical and physiological processes — the omega-3 index, vitamin D, ferritin, B-vitamins, zinc, and magnesium — and is the only domain with direct experimental support for an effect on aggression itself. Diet Quality (20%) captures upstream, modifiable determinants of nutritional status. Stress and Physiology (20%) captures candidate physiological correlates such as diurnal cortisol rhythm, high-sensitivity C-reactive protein, and sleep quality. Behavioural Markers (20%) anchors any biological profile to validated measures of aggression, impulsivity, and emotion regulation. The larger weight on Nutritional Biomarkers reflects both its direct experimental support and its greater breadth of indicators rather than a claim that any single nutritional marker is more informative than any single behavioural measure. Each domain, and the rationale for each candidate biomarker, is detailed in Section 5.

4.3 The Proposed Validation Pathway

The third and central output is a staged validation pathway that specifies, in sequence, what would be required to move FNP from concept to evidence: assembling a development sample and selecting items; deriving and calibrating weights empirically; establishing discrimination and reliability in independent samples; testing prospective predictive validity against incident aggression; demonstrating incremental validity beyond established instruments; and confirming findings through interventional and cross-cultural studies. Each stage is a precondition for the next, and the full sequence is a precondition for any clinical, forensic, or legal consideration. The pathway is presented in full in Sec-

tion 11 and frames the ethical and application boundaries discussed in Sections 9 and 10.

5. A Candidate Structure for the FNP Framework

Important framing note: The structure described in this section is a hypothetical, a priori proposal intended to organise candidate variables for empirical study. The choice of domains, the assignment of weights, the construction of a composite score, and the definition of risk tiers are all provisional design choices, not validated findings. Where specific numbers appear (weights, score ranges, cut-offs), they are illustrative placeholders to make the proposal concrete and testable; they should not be read as recommended operating parameters.

5.1 Design Principles

Three principles guide the candidate structure. First, biological plausibility: candidate biomarkers are selected because they have documented mechanistic links to neurotransmitter synthesis, neural-circuit function, stress physiology, or neuroinflammation. Second, analytical tractability: candidate biomarkers are quantifiable using validated laboratory methods already present in clinical and forensic biochemistry settings, so that the framework could in principle be operationalised for research without novel infrastructure. Third, potential actionability: because several candidate variables are modifiable, confirmed associations could eventually inform intervention research. None of these principles implies that the assembled structure has predictive validity; that remains to be tested.

5.2 Candidate Domains

Four candidate domains are proposed for investigation: Nutritional Biomarkers, Diet Quality, Stress and Physiology, and Behavioural Markers. The rationale for each candidate biomarker is summarised below. The illustrative weight shown for each domain reflects only the relative density of existing plausibility evidence as judged by the authors; it is not an empirically estimated coefficient and is included solely to make the proposed composite concrete for later testing and revision.

The 40% allocation to Nutritional Biomarkers, against 20% for each of the remaining three domains, re-

flects three considerations rather than an arbitrary split. First, Nutritional Biomarkers is the only domain with direct experimental support for an effect on aggression itself: the meta-analytic omega-3 supplementation effect ($d \approx 0.22$) [7,11] is drawn from randomised trials that measured aggression as the outcome, whereas the evidence underlying Diet Quality and Stress and Physiology is largely observational or concerns adjacent outcomes such as mood and inflammation. Second, Nutritional Biomarkers aggregates six mechanistically distinct indicators (the omega-3 index, vitamin D, ferritin, B-vitamins, zinc, and magnesium), each with its own evidentiary basis, whereas the other domains are each anchored by two or three indicators; the larger weight is intended to reflect this greater breadth of underlying evidence rather than a claim that any single nutritional biomarker is four times as informative as any single behavioural measure. Third, Diet Quality, Stress and Physiology, and Behavioural Markers are weighted equally because, although each is biologically plausible, none yet has experimental support for aggression specifically that would justify favouring one over another; equal weighting avoids implying a precision among these three domains that the evidence does not support. Consistent with the framing set out above, these proportions remain an a priori judgement, offered to be tested and superseded by the empirically derived weights specified in the validation pathway (Section 11) rather than read as a finding in their own right.

5.3 Domain I — Nutritional Biomarkers (illustrative weight: 40%)

This domain assembles biomarkers with mechanistic links to neurochemical and physiological processes relevant to behaviour. Candidate markers include the omega-3 index (erythrocyte EPA+DHA), vitamin D (25(OH)D), ferritin (iron status), B-vitamins (B6, B9, B12), zinc, and magnesium. Each is selected for biological plausibility and analytical measurability; their independent relevance to aggression in forensic populations is, in most cases, not established and would need to be tested. For example, omega-3 status has the strongest experimental support, whereas the independent contribution of individual micronutrients such as zinc and magnesium to forensic aggression is, at present, weakly characterised [9].

5.4 Domain II — Diet Quality (illustrative weight: 20%)

Diet quality is included as an upstream determinant of nutritional status and a candidate modifiable factor. Proposed assessment approaches include quantification of ultra-processed food intake (e.g., NOVA classification), estimation of glycaemic load from dietary recall, and composite diet-quality indices (e.g., AHEI or DASH). Associations between diet quality and mental-health outcomes have been reported [17], but it should be noted that this evidence largely concerns mood rather than forensic aggression, and is included here as a plausibility-based candidate domain for study.

5.5 Domain III — Stress and Physiology (illustrative weight: 20%)

This domain captures candidate physiological correlates of nutritional and lifestyle status: diurnal cortisol rhythm (salivary sampling at standardised time points), high-sensitivity C-reactive protein (hsCRP) as a marker of low-grade inflammation, and a sleep-quality index (e.g., PSQI or actigraphy). Cortisol dysregulation and inflammation have been associated with behavioural dysregulation in the broader literature [19,20]; their specific value as forensic

indicators within a composite remains to be tested.

5.6 Domain IV — Behavioural Markers (illustrative weight: 20%)

Validated behavioural instruments are included to anchor any biological profile to observable tendencies and to provide concurrent-validity benchmarks during future testing. Candidate instruments include the Buss–Perry Aggression Questionnaire (AQ-29), the Barratt Impulsiveness Scale (BIS-11), and the Difficulties in Emotion Regulation Scale (DERS). Their inclusion is methodological — to enable validation of any biomarker-derived index — rather than a claim that the composite is already valid.

6. Illustrative (Hypothetical) Summary Tables

Caveat applying to all tables in this section. Tables 1–4 are presented to make the proposed framework concrete and to support future empirical work. All domain weights, score ranges, biomarker–behaviour mappings, risk tiers, and response pathways shown are hypothetical and have not been empirically derived, calibrated, reliability-tested, or validated. They must not be used to assess, classify, or manage any individual. The comparison in Table 4 describes design intentions, not demonstrated performance.

Table 1: Candidate FNP domains, indicators, and illustrative (hypothetical) weightings

Domain	Candidate indicators	Illustrative weight (%)
Nutritional Biomarkers	Omega-3 index (EPA+DHA); vitamin D (25(OH)D); ferritin; B-vitamins (B6, B9, B12); zinc; magnesium	40
Diet Quality	Ultra-processed food intake; glycaemic load; fruit/vegetable frequency; dietary-pattern scores	20
Stress & Physiology	Diurnal cortisol rhythm; C-reactive protein (hsCRP); sleep-quality index	20
Behavioural Markers	Impulsivity (BIS-11); aggression (Buss–Perry AQ); emotion regulation (DERS)	20
Illustrative composite	Hypothetical weighted aggregation of the four candidate domains	100

Note. Weights are a priori, illustrative values reflecting the authors' judgement of the relative density of plausibility evidence. They are not empirically estimated and are expected to change under empirical derivation. BIS-11 = Barratt Impulsiveness Scale-11; AQ = Aggression Questionnaire; DERS = Difficulties in Emotion Regulation Scale.

Table 2: Candidate biomarker panel: analytical methods and the nature of the supporting evidence.

Candidate biomarker	Matrix	Analytical method	Hypothesised correlate	Nature of evidence
Omega-3 index (EPA+DHA)	Erythrocytes	GC-MS / LC-MS	Impulsivity; reactive aggression	RCT (modest effect); Raine & Brodrick, 2024
Vitamin D (25(OH)D)	Serum/plasma	LC-MS/MS; ELISA	Mood; irritability	Plausibility (depression); Anglin et al., 2013
Ferritin (iron)	Serum	Immunoassay	Dopaminergic function; cognition	Mechanistic; Beard, 2008
B6, B9, B12	Plasma	HPLC; immunoassay	Monoamine cofactor supply	Mechanistic; Kennedy, 2016
Zinc	Serum/plasma	ICP-MS; AAS	NMDA signalling; inhibition	Mechanistic/review; Choy, 2023
Magnesium	Serum/RBC	Spectrophotometry	HPA reactivity; volatility	Mechanistic/review; Choy, 2023
Cortisol (diurnal)	Saliva	ELISA; LC-MS/MS	Stress-reactive behaviour	Observational; McEwen, 2007
hsCRP	Serum	High-sensitivity ELISA	Inflammation; mood	Observational; Miller et al., 2009
Tryptophan/tyrosine	Plasma	HPLC; LC-MS	Monoamine precursor supply	Mechanistic; Benton, 2010
Glucose/insulin	Serum	Immunoassay; glucose oxidase	Glycaemic stability; mood	Plausibility; Benton, 2007

Note. The final column makes explicit that supporting evidence ranges from direct (modest-effect RCTs on supplementation) to indirect (mechanistic, observational, or pertaining to mood rather than aggression). Inclusion reflects measurability and plausibility, not demonstrated forensic predictive value. GC/LC-MS = gas/liquid chromatography–mass spectrometry; ICP-MS = inductively coupled plasma–MS; AAS = atomic absorption spectrometry; HPLC = high-performance liquid chromatography; ELISA = enzyme-linked immunosorbent assay.

Table 3: Hypothetical illustration of how a validated instrument might eventually stratify scores. This table is entirely illustrative and is not for use.

Hypothetical tier	Illustrative score	Illustrative profile	Illustrative interpretation (NOT a recommendation)
Lower	0–24	Adequate across candidate domains	Would denote low biological vulnerability if validated; no action implied by this paper
Intermediate	25–49	Few candidate deficiencies; suboptimal diet	Would warrant further research-based evaluation if validated
Elevated	50–74	Several candidate deficiencies; raised hsCRP	Hypothesised higher vulnerability; intervention questions for research only

High	75–100	Multi-domain candidate deficits; dysregulation	Hypothesised highest vulnerability; a target for future controlled study
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Note. Every value in this table is a hypothetical placeholder. The tiers, score ranges, profile mappings, and interpretations have not been derived from data, calibrated, or validated against any outcome, and the framework makes no clinical, custodial, or forensic recommendation on their basis. The deliberately neutral tier labels and the removal of prescriptive ‘forensic response’ actions reflect that no validated decision rule exists.

Table 4: Design intentions of FNP relative to established instruments (not a performance comparison)

Instrument	Domains assessed	Validation status	Output
HCR-20 V3	Historical, clinical, risk-management items	Validated, widely studied	Structured professional judgement
VRAG-R	Actuarial criminal/clinical history	Validated	Actuarial risk category
START	Dynamic psychosocial strengths/risks	Validated	SPJ with treatment planning
PCL-R	Psychopathy traits	Validated	Dimensional score
FNP (proposed)	Candidate nutritional, dietary, physiological, behavioural variables	Not validated; conceptual only	No validated output; research agenda only

Note. This table contrasts established, validated instruments with FNP as a conceptual proposal. It is not a claim that FNP performs comparably; FNP has no demonstrated predictive performance. HCR-20 = Historical Clinical Risk Management (Version 3); VRAG-R = Violence Risk Appraisal Guide–Revised; START = Short-Term Assessment of Risk and Treatability; PCL-R = Psychopathy Checklist–Revised; SPJ = structured professional judgement.

7. A Hypothetical Scoring Scheme (Proposed for Derivation, Not Application)

Status of this section. The scoring scheme below is presented to make the framework concrete and testable. It is a hypothetical proposal awaiting empirical derivation. The weights are not regression coefficients; the cut-offs are not calibrated thresholds; the composite has no established reliability or validity. Nothing in this section should be implemented.

7.1 Within-Domain Scoring (illustrative)

As one possible scheme, indicators within each domain could be scored against reference ranges on a simple ordinal scale (e.g., adequate / borderline / deficient) and aggregated to a domain sub-score. Specific reference values (for example, vitamin D, omega-3 index, ferritin, or hsCRP thresholds) would be drawn from clinical laboratory norms but would require empirical examination of their relevance

to behavioural outcomes before use. The scheme described here is illustrative and is offered as a starting point for methodological work, not as a finalised algorithm.

7.2 Composite Calculation (illustrative)

A composite could be formed as a weighted sum of domain sub-scores, scaled to a 0–100 range, using the illustrative weights in Table 1. It must be emphasised that these weights are a priori placeholders. In a proper development programme, item selection, weighting, and any composite would be derived from data (for example, via regression or penalised regression / machine-learning methods on a development sample) and then tested on independent validation samples. The illustrative formula is provided only to define a concrete object that such work could derive, evaluate, and very likely revise or reject.

7.3 Interpretation Principles

Even in a future validated form, several principles

would constrain interpretation. Any score would be a biological correlation, not a prediction of violent acts; it would have to be interpreted within the full psychosocial context of the individual; it would be dynamic and re-assessable; and it would require administration by appropriately trained practitioners. At present, because no validated score exists, these principles describe how a hypothetical instrument should be handled rather than current practice.

8. Analytical Feasibility of Candidate Biomarkers

A practical reason to study FNP is that its candidate biomarkers are measurable with established, validated methods. This section summarises feasibility; it does not bear on whether the composite is valid.

8.1 Blood and Saliva Matrices

Fasting venous blood, collected in the morning, supports measurement of the proposed panel. The erythrocyte omega-3 index can be quantified by GC-MS on membrane phospholipids, providing an integrated measure of EPA+DHA status; serum 25(OH)D by LC-MS/MS; ferritin, hsCRP, and insulin by validated immunoassays; B-vitamins and amino-acid precursors by HPLC or LC-MS; and zinc by ICP-MS or atomic absorption spectrometry. Salivary cortisol can be sampled at standardised time points using validated collection kits, with strict pre-analytical controls, and quantified by ELISA or LC-MS/MS.

8.2 Hair and Nail Matrices

Hair and nail segments offer a complementary record of chronic trace-element status over a multi-month window via ICP-MS, which could be of interest for retrospective research questions about nutritional status preceding a behavioural event. Their interpretive value within a forensic framework would itself require validation.

8.3 Emerging Approaches

Rapid screening methods such as ATR-FTIR spectroscopy on dried blood spots, and untargeted metabolomics (LC-MS), may in future enable broader nutritional and metabolic phenotyping from minimal material [9]. These are noted as research opportunities, not validated FNP components.

9. Where Future Research Could Be Conducted and Why Application Is Premature

9.1 Custodial and Correctional Settings (research context)

Custodial settings, with relatively controlled diets and a documented prevalence of nutritional deficiency, offer a practical context for the studies needed to test FNP. The Gesch et al. (2002) trial provides proof of concept that supplementation can reduce disciplinary incidents in such settings. This supports conducting further controlled research; it does not license routine FNP screening, which has no validated basis.

9.2 Forensic Psychiatric Services (research context)

Forensic psychiatric services could host longitudinal and interventional studies examining whether nutritional variables track with, or add incremental value to, established dynamic risk assessment. Any integration into actual care planning would be contingent on positive results from such studies.

9.3 Community and Preventive Settings (research context)

Community forensic and youth-justice settings could support preventive research questions about nutrition and behaviour. Again, these are described as research opportunities; FNP is not a screening tool and should not be deployed as one.

9.4 Why Legal and Expert-Witness Application Is Currently Premature

The legal use of FNP is not supported at this time and is discussed here only to set an explicit boundary. The reliable measurement of individual biomarkers does not validate a composite forensic interpretation linking biomarker profiles to vulnerability to aggression. Because FNP has no development or validation sample, no calibration, no discrimination or reliability statistics, and no incremental-validity evidence, it does not meet the threshold for scientific evidence under standards such as Daubert or Frye, and FNP findings should not be offered as expert testimony, mitigation, or any other legal claim. Whether FNP could ever satis-

fy such standards is contingent on the successful completion of the validation agenda set out in Section 11. Until then, presenting FNP-derived scores in legal proceedings would be a misuse of the framework.

10. Ethical Considerations and Boundaries

Because FNP could be misunderstood as more developed than it is, ethical boundaries are stated emphatically. First, FNP is a conceptual research framework, not a diagnostic or risk-classification test; no score from it indicates dangerousness or culpability. Second, any biological sampling in research must follow full voluntary informed consent (Declaration of Helsinki and applicable regulation), with particular safeguards against coercion in custodial settings and no linkage between participation and sentencing, parole, or security decisions. Third, biomarker data are sensitive health information and must be governed accordingly. Fourth, deterministic misuse — invoking nutritional status to justify detention or prosecution — would violate the framework's intended scope and is expressly prohibited. Fifth, any future instrument would have to be validated within, not merely applied to, the diverse populations in which it might be used, since reference ranges and dietary patterns vary substantially across populations.

11. A Staged Validation Pathway (the Central Contribution)

The principal contribution of this paper is to specify what would be required to move FNP from concept to evidence. The following stages are proposed in sequence; each is a precondition for any clinical, forensic, or legal consideration.

Item selection and a development sample. Assemble a development sample in the target forensic population, characterise the distribution of candidate variables, and select items based on their association with validated aggression and impulsivity measures.

Weighting derivation and calibration. Derive domain/item weights empirically (e.g., regression or penalised regression) rather than a priori, and calibrate any composite so that scores correspond to observed outcome frequencies.

Discrimination and reliability. Quantify discrimi-

nation (e.g., AUC) for relevant outcomes and establish internal consistency, inter-rater, and test-retest reliability, all in independent samples.

Prospective predictive validation. Follow individuals with varying baseline profiles (e.g., 12–24 months) to test whether scores predict incident aggression after adjustment for established psychosocial predictors.

Incremental validity. Test whether FNP adds predictive value beyond established instruments (HCR-20 V3, VRAG-R, START) — for example, whether it improves AUC over those tools alone.

Interventional and cross-cultural studies. Conduct RCTs of biomarker-guided intervention, and validate reference ranges and any thresholds across diverse ethnic, socioeconomic, and cultural populations before generalisation.

Only after these stages — and not before — could questions of clinical implementation or legal admissibility be appropriately raised. This ordering is itself a core claim of the paper.

12. Discussion

Forensic Nutrition Profiling is offered as a conceptual framework and research agenda. Its value lies in identifying an under-examined biological dimension of aggression vulnerability and in specifying, transparently, the empirical work that would be needed to evaluate it. The framework draws on mechanistic, observational, and modest-effect experimental evidence; it does not claim that this evidence already supports a composite forensic instrument, and it explicitly separates plausibility from validation.

The most defensible contribution of FNP is the reframing of certain nutritional factors as potentially modifiable correlates worth studying in forensic populations. If future work confirms reliable, incrementally valid associations, this could open intervention-oriented avenues consistent with the modest but replicable supplementation effects observed to date. If future work does not confirm them, the framework will have served its purpose by making testable a set of hypotheses that are currently dispersed across adjacent literatures.

Limitations

The limitations are fundamental rather than incidental. FNP has no development or validation sample, no empirically derived weights, no calibration, no discrimination or reliability statistics, no prospective outcome data, and no incremental-validity evidence. The supporting literature is heterogeneous in quality and partly concerns outcomes other than forensic aggression (e.g., depression and cognition). The reported supplementation effect on aggression is modest ($d \approx 0.22$). Accordingly, the composite score and risk tiers presented here are hypothetical illustrations, and no part of the framework is suitable for clinical, custodial, or legal use in its present form.

13. Conclusion

This paper introduces Forensic Nutrition Profiling (FNP) as a conceptual framework and research agenda for investigating whether nutritional, metabolic, physiological, and behavioural variables are relevant to aggression vulnerability in forensic populations. It assembles candidate domains and biomarkers on the basis of biological plausibility and analytical feasibility, presents an explicitly hypothetical scoring scheme to make the proposal concrete and testable, and most importantly sets out a staged validation pathway that must be completed before any assessment, clinical, or legal application is contemplated. FNP is not a validated instrument and makes no predictive claims. Its aim is to organise dispersed evidence into testable hypotheses and to invite the rigorous empirical scrutiny on which any future forensic application would have to depend.

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