

Construire un score de repas explicable

Définir les dimensions,
justifier leur interprétation.

**Densité nutritionnelle et quantité
consommée répondent à deux questions.**

Modèles de qualité nutritionnelle des repas, dimensions, agrégation et programme
d'admission scientifique d'un futur Nutrikom Meal Score.

Rapport scientifique v1.0 · 11 octobre 2026

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Synthèse en français · dossier scientifique en anglais

Propulsé par MedLab

L'essentiel

Ce que cette recherche permet de retenir

01 Le repas est une unité distincte

Les modèles de repas rendent ce chantier de recherche possible. Les validations d'aliments, de menus ou de régimes ne se transfèrent pas automatiquement à un repas individuel. [Dossier 4-12]

02 Investiguer des dimensions séparées

Le rapport recommande d'étudier des caractéristiques de composition et de densité, avec quantités consommées et couverture visibles. Aucune nouvelle formule Nutrikom n'y est proposée comme validée. [Dossier 13-21, 28]

03 Ni compensation implicite ni pénalité d'absence

Poids, transformations, seuils et compensation doivent correspondre à un construit justifié. Les nutriments inconnus ne reçoivent ni zéro ni pénalité nutritionnelle. [Dossier 16-20]

04 Le score global est une option de recherche

Un candidat sur 100 reste secondaire, sous réserve de validité indépendante, robustesse et gain d'usage sur les dimensions seules. Les étapes d'admission et cas adversariaux sont proposés, non exécutés. [Dossier 22-28]

Portée et méthode

Revue critique ciblée, non exhaustive. Certaines sources ne sont accessibles que partiellement. La recherche documentaire et les conclusions n'ont pas été actualisées pour cette édition. Les propositions du dossier ne constituent ni une validation clinique de Nutrikom ni une recommandation personnelle.

Parcourir le rapport

Le dossier scientifique conserve sa pagination de référence : 01 à 34.
Les renvois internes désignent cette pagination, affichée en pied de page.

01-05	Périmètre, construit et méthode
06-12	Modèles et études comparatives
13-21	Variables, agrégation et données manquantes
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29-34	Recherche documentaire et bibliographie

Édition publique

Cette édition ajoute une synthèse française et une navigation au dossier v1.0. La présentation est harmonisée ; les mentions d'outils et d'opérations internes sont retirées. Les données, références, niveaux d'accès aux sources et réserves scientifiques sont conservés. Les propositions décrivent l'état de la recherche à la date du dossier.

NKS01 | SCIENTIFIC REPORT

Constructing and validating an explainable Nutrikom Meal Score

One entered, composed meal • Generally healthy adults

Critical evidence review and research admission contract

11 October 2026 • Version 1.0

Recommendation: investigate separate dimensions

A meal can be described and assessed for selected aspects of its nutritional composition and nutrient density. Existing meal models make this research feasible. Their validation, however, mainly concerns composition, guideline alignment or agreement with other indices. It does not establish a universally meaningful 0-100 meal score, personal nutrient adequacy, or an individual health prediction.

Nutrikom should investigate separate dimensions of nutrient provision and components to limit, with consumed amounts and data coverage displayed alongside them. Retain descriptive feedback during this investigation. A global score may be tested as a secondary research candidate, conditional on a clearly defined construct, justified compensation rules, independent validation and demonstrated user benefit over dimensions alone.

Principal findings

Finding	Consequence
The unit matters	Food, mixed dish, eating occasion, day and habitual diet are different assessment units. Validation does not transfer automatically between them.
Density and portion are distinct	Doubling a meal preserves its nutrient densities but doubles consumed energy and nutrients. A density score cannot certify that a portion suits an individual.
Reference values are not meal prescriptions	Daily population recommendations, label reference intakes and upper limits cannot be converted into universal meal requirements by dividing by three.
Unknown values remain unknown	Missing nutrients do not receive zero values or nutritional penalties. Each display has its own dependencies; incompatible or incomplete models cannot be compared silently.

No Nutrikom scoring formula is proposed as validated. No score is activated. This report specifies what must be resolved and tested before a scoring method could be admitted. The legacy 40/40/20 Index remains a historical comparator. Nutri-Score remains an external comparator under its own name and algorithm.

01 | SCOPE AND BACKGROUND

What was read, and what this review assesses

The target is one user-entered eating occasion assembled from foods, quantities and portions. It includes all foods and drinks the user intends to include, including oils, sauces and condiments. “Entered” does not prove “consumed” or “complete”. A served recipe, an estimated restaurant meal and a retrospectively entered meal require distinct provenance. Intended use is composition feedback for generally healthy adults, not therapeutic dietary assessment.

Required report	Availability and implications carried forward
DAY01 • 11 pages	Read in full. One observation cannot establish habitual intake, personal adequacy or deficiency. Intake completeness, composition completeness and dietary sampling are distinct.
REC01 • 16 pages	Read in full. Edible consumed quantities, preparation, recipe yield and serving allocation matter. Omitted ingredients and unknown quantities must remain visible.
REF01 • 20 pages	Read in full. Reference framework, population, nutrient definitions and version must be explicit. Label references are not individual requirements.
MEAL01 • 21 pages	Read in full. Composition does not reliably predict an individual glucose response, satiety duration, digestion or clinical event. Timing requires its own evidence.
IDX01 • 25 pages	Read in full. The legacy 40/40/20 structure mixes constructs and lacks sufficient validation. Its inherited nutrient, lexical and timing rules do not justify a new score.
UX01 • 22 pages	Read in full. Amounts, portions, denominator labels and factual explanations form the baseline. Objective comprehension and decision usefulness require direct testing.

All six supplied reports were available, version 1.0 dated 11 October 2026 [B1-B6]. None is unavailable. Their complete contents were retrieved, including continuation pages. They are project background reports, not independent validation of a new Nutrikom method.

Historical comparator, not an inherited design

As documented in IDX01, the legacy Index combines nutrient density (40), food characteristics (40) and timing (20). The present review does not preserve these weights or its variable list. Clock-time points, processing inferred from food names, lexical “whole food” bonuses and AI-created scoring contributions have no admission here. Authentic ingredient information may support a documented food-group variable, but does not validate processing or timing points [B5].

The report is a critical, targeted literature review and protocol proposal. It is not a registered systematic review, a meta-analysis, a clinical guideline, or an audit of current application code. No code changes, installations or live scoring-provider calls were performed.

02 | SEARCH METHODS

Reproducible search and evidence selection

Search date: 11 October 2026. Discovery sources: scholarly discovery; web search for primary PubMed/MEDLINE records, PubMed Central articles, original publisher pages and author institutional records; official WHO, EFSA and Santé publique France sources. PubMed was consulted through indexed records and targeted record retrieval, not a complete native MEDLINE export. Embase, Scopus, Web of Science and CINAHL were not searched through subscription interfaces.

Search query, verbatim	Execution
meal quality index Meal Balance Index mixed meals development validation nutrient density	Successful; meal models and original studies retrieved.
nutrient profiling SAIN LIM validation nutrient rich foods index NRF9.3 healthy eating index	Successful; food and diet profiling studies retrieved.
"meal" "nutritional quality" "score" validation nutrient profiling composed meals	Search string only; no retrieved result used.
nutritional meal quality score randomized consumer comprehension Meal Balance Index ANPS	Search string only; no retrieved result used.

Selected studies were followed by exact-title/DOI searches, primary-record verification and citation tracing between meal papers. Bibliographic records were consulted before results were used. Appendix A provides search strings and representative queries used in the targeted review. No date restriction was applied to discovery; results available by the search date, including 2025-2026 studies, were considered.

Selection rules

Prioritize original development or validation of composed adult meals; then mixed dishes; then food profiles and daily or habitual diet indices when they illuminate a specific design issue. Include human comprehension studies only as evidence for communication or decisions. Child, school-menu and clinical populations are indirect to this product. Reviews and commercial claims can locate primary sources, but do not substitute for them.

For each selected study extract unit, population, data source, inputs, denominator, transformations, weights, aggregation, validation comparator, outcomes and limitations. Evaluate independence of the criterion, shared nutrients or records, development/test separation, measurement error, population transportability, and conflicts of interest. Do not equate a paper’s use of “validated” with validation for Nutrikom’s intended use.

Access and reproducibility limits

Detailed methods were examined where publisher HTML/PDF was accessible. Some PubMed/PMC pages intermittently presented bot checks; some publisher pages returned access or rate-limit errors. NDC 2026, GDQS-Meal/Menu and selected extensions have abstract-level extraction only. Supplementary datasets and every algorithm table were not independently reimplemented. This prevents complete numerical replication of those methods. Search outputs were ranked and dynamic; exhaustive screening counts and a PRISMA flow are therefore not claimed.

03 | CONSTRUCT DEFINITION

What a single-meal assessment can legitimately mean

Construct	Meal-level interpretation and boundary
Nutrient density	Defensible as nutrient content relative to energy, mass or another stated denominator. It describes composition, not sufficient total intake. The choice of denominator changes the construct.
Nutritional composition / balance	Defensible for stated ratios, nutrients and documented ingredients. "Balance" must name the dimensions and trade-offs; it is not a self-evident universal biological property.
Alignment with population recommendations	Conditionally defensible as selected compositional features consistent with a named adult dietary framework. Daily targets do not prescribe every meal. Meal purpose and foods left for other occasions matter.
Personal nutrient adequacy	Not established by one meal. Requires individual context, appropriate requirement distributions, habitual intake and sometimes clinical information. Absorption and losses add uncertainty.
Habitual dietary quality	Requires repeated, sufficiently representative dietary observations and an appropriate whole-diet method. One meal is a contribution to a pattern, not a representative estimate of that pattern.
Physiological effects / clinical risk	Cannot be inferred as an individual prediction from a composition score. Outcome-specific physiological studies and longitudinal/intervention evidence address different questions.

Proposed research construct: **selected, explicitly specified features of the entered meal's nutritional composition, relevant to population dietary guidance for generally healthy adults, conditional on the recorded portion and available composition data.** This is a formative assessment: chosen features define the index. They need not reflect a single latent trait or correlate strongly with each other [1-13, B1-B4].

High and low must have a bounded interpretation

For a future fixed global model, a higher result could mean more favourable values under that model's stated features and trade-offs. A lower result could mean less favourable values on those same features. Neither means that the person ate well or badly overall. For dimensions, "higher" may have different directions; sodium density should remain an amount with a clear limiting role, not be ambiguously called a high score.

Prohibited claims: "meets your needs", "nutritionally complete", "prevents deficiency", "safe for you", "reduces your heart-attack risk by X", "predicts your glucose response", "keeps you full for X hours", or "100% healthy". Also prohibit diagnosis, guilt-based meal labels and inferred timing or processing benefits. A favourable composition does not certify portion suitability, cultural suitability, affordability or clinical appropriateness.

04 | EVIDENCE APPRAISAL

Direct meal evidence exists; the decisive gaps remain

The strongest direct precedents are the Healthy Meal Index, Main Meal Quality Index, Meal Balance Index and its Philippine adaptation, nutriRECIPE, and ANPS-Meal [1-9]. They show that composition-based meal assessment is possible. They differ substantially in construct, food groups, nutrient lists, units and reference assumptions. No reviewed study independently validates an original Nutrikom 0-100 score for consumer comprehension, clinical meaning and cross-cultural use together.

Validation type	What it contributes / what it cannot establish
Composition measured independently	Chemical analysis or weighed recipe observations can test the accuracy and ordering of compositional features. They do not establish a clinical effect or consumer usefulness.
Guideline or expert alignment	Tests whether a method represents its intended normative framework. If experts use the same nutrients and rules, agreement is partly built in; report that dependence.
Agreement with HEI, NRF or Nutri-Score	Convergent evidence, with expected divergence when units and constructs differ. Shared input nutrients, food tables and diet records can create circularity.
Biomarkers	Provide a partially independent criterion for particular nutrient exposures over the biomarker's time window. A urinary sodium marker does not validate fibre, saturated fat or a whole meal construct.
Prospective health associations	Support aggregate diet-pattern associations, subject to confounding and measurement error. They cannot provide an individual single-meal event probability.
Comprehension / decisions	Test whether displays are understood and help a defined decision. Ranking foods in a label task or satisfaction with an app does not validate the meal formula.

Specific risks of circularity and optimism

Selection of nutrients and weights to correlate with food groups, followed by validation against those groups, reuses a design criterion. Correlation with a larger nutrient score that shares the same inputs is especially weak evidence of independence. A random split within the same survey can assess internal prediction but does not resolve transportability, common composition errors or criterion overlap [1,2,12,13].

Internal consistency or principal-component analysis can describe redundancy. High Cronbach alpha is not an admission requirement for a formative nutrition index, and maximizing it may remove distinct useful features. A score may intentionally contain uncorrelated dimensions. Likewise, a symmetric score distribution is a design preference, not proof of nutritional validity [2,4,5,14,32].

Industry participation is reported where relevant rather than used as automatic exclusion. Several prominent meal models include manufacturer-employed authors. Independent replication, published algorithms, corrections and complete data provenance are particularly valuable. A 2025 correction to nutriRECIPE's weighting expression illustrates why exact method versions must be frozen [7,8].

05 | EVIDENCE MATRIX A

Meal and canteen models: food-based constructs

Primary DOI/PMID identifiers are provided under the matching reference numbers in the bibliography. Assessment unit and access limitations are part of each extraction.

Healthy Meal Index (HMI), Lassen et al. 2010 [3]

Extraction field	Evidence
Population / unit	180 meals from 15 Danish worksite canteens; adult diners, mean age 40. Direct canteen-meal evidence; beverages excluded.
Inputs / normalization / weights / aggregation	Fruit/vegetables, fat amount/quality, wholegrain products/potatoes. Household food units and fat-to-starch units; three equally weighted 0-2 components summed to 0-6. Normative Danish/Plate Model goals.
Comparator / endpoint	Weighed food and chemically analysed nutrients across score categories; energy density 876 to 537 kJ/100 g; fat-unit relation to measured fat energy percentage $r=0.85$.
Limits / access	Chemical analysis improves independence, but several criteria overlap inputs. No clinical or user endpoint; ingredients required; salt absent; culturally specific food units. Access: Publisher methods HTML.

Main Meal Quality Index (MMQI), Gorgulho et al. 2018 [4]

Extraction field	Evidence
Population / unit	São Paulo cross-sectional survey: 956 participants aged 12+ (350 adults); 580 with blood samples. Lunch/main meal from a 24 h recall. Direct meals, mixed ages.
Inputs / normalization / weights / aggregation	Ten equally weighted 0-10 components, summed to 0-100: fruit, vegetables, animal/total protein, fibre, carbohydrate, total fat, saturated fat, processed meat, sugary drinks/desserts, solid-food energy density. Mixes absolute portions, % energy and kcal/g.
Comparator / endpoint	Nutrient correlations, Brazilian Healthy Eating Index, smoking groups and cholesterol measures; alpha 0.70. Fat and saturated-fat components correlated $r=0.73$.
Limits / access	Cross-sectional biomarkers cannot isolate a meal effect. Food/nutrient overlap and correlated penalties; portion allocations from daily guidance are normative. Access: Original article PDF; 2018 issue, not the later website migration date.

MMQI UK application, Gorgulho et al. 2017 [5]

Extraction field	Evidence
Population / unit	UK adult dietary-survey application to main meals; sample size not independently verified in accessible material.
Inputs / normalization / weights / aggregation	Same ten-component, 0-100 concept; food quantities, macronutrient proportions and energy density. Equal component maxima.
Comparator / endpoint	Content/construct/discriminant analyses, PCA, regression and internal consistency, as reported in the abstract.
Limits / access	An external-country application, but psychometrics and shared nutrition criteria do not establish health effects. Detailed sample and algorithm replication remain necessary. Access: Abstract/record only; publisher access was intermittent.

06 | EVIDENCE MATRIX B

Meal Balance Index: density-based global models

Meal Balance Index (MBI), Mainardi et al. 2020 [1]

Extraction field	Evidence
Population / unit	NHANES 2005-2014, age 4+; 147,849 meal observations, restricted to 200-1,200 kcal. Direct composed meals, not exclusively healthy adults.
Inputs / normalization / weights / aggregation	Protein, total fat, fibre, potassium, calcium, iron, sodium, added sugar, saturated fat. % energy or density scaled to 2,000 kcal; piecewise trapezoidal 0-100 subscores. Potassium and saturated fat weights 2, seven others 1; weighted mean.
Comparator / endpoint	Weights selected from candidate combinations using distribution/food-group criteria. Exemplary menus 76 ± 14 versus survey meals 45 ± 14 . Regression from pooled meal scores predicted daily HEI ($r=0.60$ in held-out data); $r=0.89$ with a larger 16-nutrient precursor.
Limits / access	Daily HEI prediction is not individual meal clinical validation. Shared nutrients and selection criteria; micronutrient preferred bands are not upper limits. Study energy bounds cannot become universal app eligibility thresholds. Access: Full methods HTML and figure/table PDF inspection.

Philippine MBI adaptation, Mainardi et al. 2024 [2]

Extraction field	Evidence
Population / unit	Philippine 2018 survey. Abstract: 69,923 meals / 31,218 adults aged 20-59. Main-text results report 69,223 meals / 19,623 persons aged 19-95; inconsistency requires clarification.
Inputs / normalization / weights / aggregation	Protein, total fat, fibre, magnesium, calcium, vitamin C, sodium, free sugar, saturated fat. Energy-scaled references / % energy; trapezoidal contributions; fibre weight 2, others 1, weighted mean /10. Local references and data-driven selection.
Comparator / endpoint	Food-group and nutrient associations; exemplary menus 72.2 ± 13.9 versus survey meals 46.1 ± 12.9 . PCA first component 19%; eight components explain 90% of variation.
Limits / access	Shared criteria and population-reporting inconsistency limit replication. Magnesium and free sugars are not currently equivalent available Nutrikom inputs; swapping them changes the model. Manufacturer/FNRI collaboration. Access: Publisher methods HTML.

Implication for Nutrikom

MBI is an important research comparator because its unit is an eating occasion. It is not a ready-made original Nutrikom score. Its input choices, acceptable nutrient bands, weights and distribution goals must each be justified for the intended reference population. Adult-only external testing and correction of documentation discrepancies are prerequisites to replication or adaptation. Separating its components is scientifically more informative than treating the global mean as a biological measurement.

07 | EVIDENCE MATRIX C

Recipes and nutrient complementarity

Nutrient Balance Concept (NBC), Fern et al. 2015 [6]

Extraction field	Evidence
Population / unit	USDA food composition and seven-day MyPlate example menus at 2,000 kcal; foods, combinations and menus. No participant outcome cohort.
Inputs / normalization / weights / aggregation	27 qualifying and six disqualifying nutrients. Energy-relative reference fractions; separate Qualifying and Disqualifying Indices plus capped nutrient-balance quantities to illustrate complementarity. Reference-scaled aggregation; no empirically established consumer utility weights.
Comparator / endpoint	Demonstrations with foods and model menus; nutrient complementarity and ability to construct favourable combinations.
Limits / access	Proof of concept, not clinical or user validation. Large nutrient set exceeds current Nutrikom data. Reference-based balance is not personal adequacy. Nestlé-linked funding/authorship and consultant involvement. Access: Original PLOS article.

nutriRECIPE-Index, Forner et al. 2021; correction 2025 [7,8]

Extraction field	Evidence
Population / unit	106 recipes from a six-week German university-canteen menu; recipe-level composition, no human outcome participants.
Inputs / normalization / weights / aggregation	19 macro/micronutrients and five bioactive plant-food groups; German composition and supplemental food-group data. Energy-adjusted reference fraction x ; favourable $\ln(x)+1$ and unfavourable $-\ln(x)$, capped at ± 2.1 . Weighted additive index; observed 16.8-120.8%, not a bounded 0-100 scale.
Comparator / endpoint	Correlation with HMI $r=0.604$ and reversed Nutri-Score direction $r=0.591$; comparisons with a designated canteen menu line.
Limits / access	Shared compositional criteria, extensive data needs and enrichment/compensation risks. In 2025 the reported weight ratio was corrected from actual/recommended to recommended/actual intake. "100" does not mean every need is met. Access: Publisher methods and correction.

What complementarity can and cannot justify

Combining foods can change the relative nutrient profile of the assembled meal. That is a useful analytical fact. It does not imply that adding any nutrient-rich ingredient improves all dimensions, nor that a weighted sum identifies a clinically optimal combination. The reference denominator and caps determine whether fortification or a single concentrated ingredient dominates.

A recipe model also requires authentic amounts and edible yields. A dish label is insufficient to recover its ingredients, processing or food-group proportions. Plant-food groups can enrich an explanation when quantities are documented; they should not automatically be added as a second reward for the same fibre or potassium signal. These are design questions for independent validation rather than consequences of successful arithmetic [6-8, B2].

08 | EVIDENCE MATRIX D

Recent Japanese and mixed-dish models

ANPS-Meal, Jinzu et al. 2025 [9]

Extraction field	Evidence
Population / unit	1,816 Japanese meals: recipe combinations, hospital-supervised recipe books, bento and restaurant products. Direct meal representations; adult reference context.
Inputs / normalization / weights / aggregation	Protein, vegetables, saturated fat, sodium; four equal 0-10 components scaled to 100. Portion anchors allocate one-third daily references: protein 22 g, vegetables 116.7 g, saturated fat ≤ 7.41 g, sodium ≤ 917 mg for maximum components.
Comparator / endpoint	Mean 73.7 ± 15.5 ; Spearman correlations with metric HEI 0.59 and NRF 0.40; nutrient patterns across quartiles.
Limits / access	Convergent recipe evidence only; one-third allocation is normative, not a universal meal requirement. Estimated composition for some products. All authors affiliated with Ajinomoto. Access: Publisher full methods.

ANPS-Day biomarker extension, Jinzu et al. 2026 [10]

Extraction field	Evidence
Population / unit	324 healthy Japanese adults aged 20-69; four-day semi-weighted records and two nonconsecutive 24 h urine collections. Daily intake, indirect to one meal.
Inputs / normalization / weights / aggregation	Protein, vegetables, saturated fat and sodium inherited from ANPS; daily scoring and an energy-adjusted version. Detailed daily transformation not fully extracted.
Comparator / endpoint	Crude score weak/inconsistent; energy-adjusted score correlated with urinary-derived potassium intake $r=0.25$ and Na/K ratio $r=-0.24$. Saturated-fat points had no association with these biomarkers.
Limits / access	Partially independent nutrient-exposure evidence; modest, not comprehensive criterion validity. Different time window and score version; industry-academic affiliations. Access: Primary PubMed abstract; full text blocked.

Nutrient Density Calculator (NDC), Maillot et al. 2026 [11]

Extraction field	Evidence
Population / unit	1,570 FNDDS 2021-2023 mixed dishes; observed serving sizes from NHANES 2017-2020/2021-2023. Dish/recipe, indirect to a whole occasion.
Inputs / normalization / weights / aggregation	NDC643: protein, fibre, calcium, iron, potassium, vitamin D; fruit/vegetables, whole grains, pulses, nuts/seeds; saturated fat, sugar, sodium. NDC343 retains protein/fibre/calcium. Per serving; alternative component weights including equal weighting. Added- or total-sugar versions.
Comparator / endpoint	Nutri-Score correlations -0.64/-0.70 and HSR -0.74/-0.75 for abbreviated/full models; sensitivity to recipe reformulation.
Limits / access	Agreement and reformulation sensitivity are not independent clinical or consumer validation. Caps and full transformation require methods access; sugar versions cannot be interchanged silently. Access: Primary indexed abstract and fetched bibliographic record; full text blocked.

09 | EVIDENCE MATRIX E

Food-level and institutional models: indirect evidence

NRF9.3 development and Dutch evaluation [12,13]

Extraction field	Evidence
Population / unit	US NHANES 1999-2002 foods / energy-weighted daily intake; Dutch survey 2,106 adults with two recalls. Food/day units, indirect to one meal.
Inputs / normalization / weights / aggregation	Nine encouraged nutrients: protein, fibre, A, C, E, calcium, iron, potassium, magnesium; three limiting: saturated fat, added sugars, sodium. Unweighted reference fractions; capped positives minus limits; 100 kcal or customary serving. Dutch main variant used total mono/disaccharides, not the original added sugars.
Comparator / endpoint	US model selection against HEI; six/nine nutrients performed best. Dutch DHD model $R^2=0.34$ (score alone about 0.32); Spearman 0.60.
Limits / access	Food-table and criterion overlap; agreement does not prove clinical utility. Total/added-sugar variants differ. Nutrikom lacks magnesium and vitamin E, so cannot claim NRF9.3 using substitutions. Access: Development abstract/record; Dutch full article.

SAIN,LIM, Darmon et al. 2009 [14]

Extraction field	Evidence
Population / unit	French INCA food-consumption/composition data; food classes evaluated in modelled whole diets. Food-level, indirect.
Inputs / normalization / weights / aggregation	Two axes: SAIN qualifying reference fractions (core protein, fibre, vitamin C, calcium, iron) per 100 kcal; LIM saturated fat, added sugars, sodium per 100 g. Mean fractions; four classes; original system also permits optional nutrients.
Comparator / endpoint	Linear programming assessed feasibility of diets satisfying 40 nutrient recommendations or contrary constraints using class-restricted foods.
Limits / access	Useful non-collapsed axes; nutrient constraints partly reuse profiling inputs. Modelled diet feasibility is not a human health endpoint. Full optional-rule replication not performed. Access: Primary PubMed abstract; core method from meal-model comparisons.

GDQS-Meal / GDQS-Menu, Bell et al. 2025 [15]

Extraction field	Evidence
Population / unit	Institutional meals/menus, including school-feeding contexts; multi-age implementation context. Meal unit direct, adult self-entry validation indirect.
Inputs / normalization / weights / aggregation	Healthy and unhealthy food-group submetrics, fortification/biofortification and diversity. Ingredient/food-group data required. Exact cut-offs, weights and aggregation not fully accessible.
Comparator / endpoint	Method-development article; no independent adult Nutrikom-like validation endpoint verified in accessible abstract.
Limits / access	Parent whole-diet GDQS evidence cannot be inherited by a meal adaptation. Fortification reward needs specific justification; full specification is required before implementation. Access: Primary record/abstract.

10 | EVIDENCE MATRIX F

Single lunches, whole-diet indices and communication

Four-index single-meal comparison, Bullock et al. 2022 [16]

Extraction field	Evidence
Population / unit	8,070 lunch observations from 379 adults in North Carolina business cafeterias, 2015-2017; tray-photo based secondary analysis.
Inputs / normalization / weights / aggregation	HEI-2015, DASH, MMQI and NRF applied with their differing nutrient/food-group densities, targets and weights; alternative definitions of a meal.
Comparator / endpoint	Index correlations 0.26-0.68; meal definition changed results differently between indices.
Limits / access	Demonstrates non-equivalence. Agreement alone supplies no independent gold standard or clinical outcome; repeated lunches require person-level clustering. Access: Primary full article.

HEI-2015 development/evaluation, Krebs-Smith / Reedy et al. 2018 [17,18]

Extraction field	Evidence
Population / unit	Whole-day/diet-quality method; evaluation includes exemplary menus, NHANES and prospective adult cohort data. Indirect to a single occasion.
Inputs / normalization / weights / aggregation	13 adequacy/moderation components; food groups per 1,000 kcal, fatty-acid ratio, % energy for added sugars/saturated fat; normative 5/10-point maxima, total 100.
Comparator / endpoint	Menu and subgroup construct tests; relation to mortality in whole-diet evaluation. Component profiles are informative alongside the sum.
Limits / access	Daily food-group diversity is not required in each meal. Meal application can misclassify intentionally complementary occasions. Chronically favourable patterns do not validate one meal. Access: Primary records and background-reviewed methods; no fresh full-text replication.

Packaged-food understanding and digital meal feedback [19,20]

Extraction field	Evidence
Population / unit	Egnell 2018: 12,015 adults in 12 countries, packaged-food ranking task. Liu 2024: 153 Shanghai workplace adults, four-month meal-feedback intervention.
Inputs / normalization / weights / aggregation	Label formats or bundled premeal traffic lights/postmeal reports. Neither develops an original Nutrikom meal algorithm.
Comparator / endpoint	Objective food-ranking comprehension in Egnell; meal selections/records in Liu. The latter combines features, so their separate contributions cannot be isolated.
Limits / access	Communication and choice evidence only. Packaged-food ranking is indirect to composed-meal interpretation; neither proves absence of an adequacy or health halo for a global meal score. Access: Primary references reviewed in UX01; limited new record verification.

HEI/DASH meal adaptations are experimental comparators, not independent meal gold standards. Matching numerical endpoints do not make indices equivalent.

11 | EVIDENCE MATRIX G

Nutri-Score: an external comparator with indirect health evidence

Nutri-Score is a food-product profile and front-of-pack label. The updated algorithm uses per-100 g/ml composition, category-specific rules and points involving energy, sugars, saturated fat, salt, fibre, protein and fruit/vegetable/pulse content. It includes conditional and category rules; it is not a generic average of food-letter classes. The 2022/2023 update entered French use in March 2025 [21]. A composite-meal adaptation would require its own construct and validation.

FSAm-NPS and mortality, Deschasaux et al. 2020 [22]

Extraction field	Evidence
Population / unit	501,594 EPIC adults in ten European countries; median follow-up 17.2 years. Habitual diet, indirect.
Inputs / normalization / weights / aggregation	Energy-weighted dietary mean of original food-level FSA-m-NPS profiles; baseline dietary questionnaires, not one entered meal.
Comparator / endpoint	Highest versus lowest dietary-index fifth: all-cause mortality HR 1.07, 95% CI 1.03-1.10; observational adjusted cohort analysis.
Limits / access	Residual confounding, dietary measurement error and historical algorithm. Does not estimate individual single-meal risk or validate the updated version. Access: Original indexed abstract/PDF record.

Updated profile and CVD, Deschasaux-Tanguy et al. 2024 [23]

Extraction field	Evidence
Population / unit	345,533 EPIC participants in seven European countries; 16,214 first CVD events; median 12.3 years. Habitual diet, indirect.
Inputs / normalization / weights / aggregation	2023-updated food scores, energy-weighted dietary index; country-specific baseline dietary questionnaires; adjusted Cox models.
Comparator / endpoint	Total CVD HR per one dietary-index SD 1.03, 95% CI 1.01-1.05.
Limits / access	Supports a diet-pattern association for the update. Shared dietary exposures, observational confounding and European scope; no inference about a single meal. Access: Primary PubMed abstract; publisher blocked.

Updated profile and mortality, Khoury et al. 2026 [24]

Extraction field	Evidence
Population / unit	7,212 PREDIMED participants aged 55-80 at high CVD risk; 425 deaths over median six years. Indirect; outside generally healthy-adult scope.
Inputs / normalization / weights / aggregation	Cumulative repeated-FFQ dietary index using the 2023 food profile; time-dependent adjusted Cox analysis.
Comparator / endpoint	Highest versus lowest quintile: all-cause HR 1.64, 95% CI 1.19-2.28.
Limits / access	Observational analysis within a trial, not randomization to score exposure. Older/high-risk population; cannot transfer this hazard ratio to a meal. Access: Publisher methods HTML.

Keep the official name, version and unit. Do not rename Nutri-Score “Nutrikom”, average its letters, or map A-E to an invented 0-100 metric.

12 | VARIABLE SELECTION A

Energy and macronutrients: inclusion is a research decision

The following status is for the proposed dimensional research prototype, not an authorized numeric formula. “Required” means necessary for that particular calculation. No transported field is automatically a mandatory global input. Evidence from dietary recommendations remains indirect to optimal per-meal point functions [1-14,25-29,33,34].

Candidate / role / units	Reliability, redundancy and proposed status
Energy • denominator and consumed amount kcal and/or kj; edible consumed portion	Usually available from labels/tables but affected by recipe yield and energy factors. Required for energy densities and % energy, optional for unrelated absolute nutrient amounts. Do not penalize energy independently in a density construct: that duplicates the denominator and confuses density with portion suitability.
Protein • amount and optional compositional dimension g; % energy using stated energy factors	Common labels/tables; nitrogen-to-protein factors and food match matter. Provision is meaningful, but more is not universally better and g/kg/day is not a meal quota. Correlates with animal foods and minerals. Descriptive/optional research feature; no automatic monotonic reward or enrichment bonus.
Fibre • provision density g portion; g/1,000 kcal	Plausible core research dimension; WHO carbohydrate-quality guidance supports dietary fibre and preferred food sources [33], not a universal meal target. Labels often optional; analytical definitions differ. Required only for fibre dimension. Correlates with whole grains/legumes/vegetables: avoid counting all as independent bonuses.
Saturated fat • limiting composition g portion; % energy	Strong population-diet rationale; replacement nutrient matters. Often available on labels. Required only for saturated-fat dimension. Overlaps total fat and animal-food penalties; avoid simultaneously rewarding low fat and low saturated fat without a distinct construct.
Total fat • macro description g; % energy	Available; fatty-acid quality and replacement make a universal low-fat penalty unsuitable. Already contributes energy and saturated-fat context. Retain graphic and amounts; exclude from initial points unless independently justified. Unmeasured unsaturated fats prevent a complete fat-quality score.
Carbohydrate • macro description g; % energy only with known definition	Available carbohydrate differs from carbohydrate by difference; fibre/polyols may be included in some systems. A high/low carbohydrate percentage alone is not meal quality. Correlated with fat due to energy closure. Retain description; exclude as initial scored variable.
Sodium • limiting density plus absolute amount mg portion; mg/1,000 kcal	Population dietary rationale; often label/table data, but discretionary salt/sauces may be missing. Required for sodium dimension. Salt equivalent is the same information, not an additional input. Show consumed amount because an energy-density view can obscure high absolute exposure.

Energy, fat, carbohydrate and protein percentages sum under a constrained denominator; their correlations can be mathematical rather than biological. A macro-energy graphic must state whether percentages are of estimated total food energy or only of the three displayed macronutrients [B3,B6].

13 | VARIABLE SELECTION B

Sugars and micronutrients: definitions and missingness matter

Candidate / units / evidence role	Source, overlap and inclusion decision
Total sugars • g Mono/disaccharides across sources	Common on labels/tables, often more available than added/free sugars. Includes fruit and milk sugars, so is not equivalent to a free-sugar exposure. Descriptive in the initial prototype; do not penalize total sugars merely because available, and do not use as an unlabelled substitute.
Added sugars • g, % energy Added during manufacture/preparation	Available in some jurisdictions and recipes; not universally labelled. Plausible separately named research limiting dimension when definition and provenance are known. Required only for that dimension. Do not count added and total/free sugars as three separate penalties.
Free sugars • g, % energy Added sugars plus sugars in honey, syrups, juices/concentrates	WHO definition; not currently a separate transported Nutrikom field. Cannot be reconstructed safely from total sugars or a food name. Include only after a documented ingredient-based method or reliable source is admitted. WHO daily limits are not per-meal pass/fail thresholds [26,28].
Potassium • mg Optional provision density	Relevant to population diets; tables/analysis more common than labels. Correlated with plant foods and several micronutrients; a sodium/potassium ratio also reuses both. Optional descriptor/research expansion; not a universal mandatory global input.
Calcium • mg Optional provision density	Tables and fortified-food labels; product variation and enrichment matter. Correlated with dairy/protein. Optional, with cap/fortification sensitivity required before points. A calcium-poor meal can be complemented elsewhere; not inadequacy.
Iron • mg Optional provision density	Food tables often available; haem/non-haem form, enhancers/inhibitors and menstrual requirements complicate interpretation. Correlates with protein/fortification. Optional descriptor; exclude absorption or adequacy claims and initial global necessity.
Vitamin A • µg with named RE or RAE convention	Tables may report incompatible activity units or IU. Preformed retinol and carotenoid forms require explicit conversion data. Optional only when compatible; do not aggregate RE and RAE silently or infer toxicity from meal totals.
Vitamin C • mg; vitamin D • µg	C varies with storage/preparation; D often sparse and fortification-dependent. Both optional descriptors or tested expansion. D status involves sunlight and other determinants; food content is not status. Do not let a missing C or D block fibre/sodium descriptions.

Nutrikom transports 15 fields: energy, protein, carbohydrate, fat, fibre, total sugars, added sugars, saturated fat, sodium, potassium, calcium, iron, A, C and D. These are a data inventory, not a scientific variable-selection argument. NRF9.3 also requires magnesium and vitamin E; Philippine MBI requires magnesium and free sugars. Substitution would create a different method [2,12,13].

14 | DATA AND REFERENCE SEMANTICS

Documented food characteristics and compatible inputs

Feature	Admission or exclusion rationale
Food groups and ingredient proportions	Potentially relevant: documented vegetables, fruit, legumes, whole grains, nuts/seeds, and other locally justified groups. Require actual ingredient quantities and explicit classification rules. Generic dish names and lexical matching are insufficient. Count overlapping nutrient/food signals deliberately, not automatically.
Processing classification	Exclude from initial meal score. Even a verified classification is a distinct construct; mixed meals require explicit ingredient handling and independent incremental justification. Do not infer NOVA or “whole food” status from names, ingredient count or AI.
Timing	Exclude. Acute circadian or metabolic findings do not justify arbitrary clock-time points for a generally healthy adult meal. Personal schedules and repeated patterns are not in this construct [B4,B5].
Energy density / liquid status	Describe with explicit solid/beverage handling. Water dilution and soup classification make it unsuitable as a generic health bonus. No automatic penalty for liquids or reward for a lexical solid-food category.
Bioactive groups / diversity / fortification	Potential research extensions only. Require reproducible data, explicit relevance and incremental validation. Diversity within a meal is not diversity across a diet; fortification is not unlimited favourable quality.

Minimum semantic checks before any relevant calculation

Record source and date/version, edible basis (as sold/prepared/consumed), quantity and unit, raw/cooked state, recipe yield/retention assumptions, serving allocation and nutrient definitions. Prefer an appropriate analysed or documented product value; generic table substitutions and estimates must be labelled. A label rounded to zero, measured absence, trace value and missing field are different states [B2,B3,31].

Convert sodium mg to salt-equivalent g by sodium $\times 2.5/1,000$ when using the European convention [30]; salt is not additional sodium information. Total/added/free sugars are nested but not interchangeable. Do not reconstruct available carbohydrate by subtraction unless the source system and fibre/polyol definitions permit it. Compare stated energy with reconstructed energy using documented factors and rounding tolerance; discrepancies flag compatibility, not user dishonesty.

Reference types remain distinct

AR/EAR: average group requirement. **PRI/RDA:** recommended intake intended to cover nearly all members of the specified group. **AI:** adequate intake used when requirements cannot support an AR; intake below it does not prove inadequacy. **UL:** chronic upper intake level, not a target or acute meal danger boundary. **Label RI/NRV:** standardized communication references. None is an individualized meal requirement [29,30,35,B3].

Daily WHO saturated-fat, sodium and free-sugar guidance supplies a population rationale [25-27]. It does not identify clinically calibrated meal slopes, exchange rates or endpoints. EFSA did not establish a safe intake/UL for sugars [28]; this is not permission to invent a meal toxicity threshold.

15 | NORMALIZATION

Choose the denominator to match the claim

Basis	What it measures / failure mode / disposition
Consumed portion	Amount actually entered: kcal, g or mg. Doubles under proportional portion change. Useful for dose context, but meal-size and purpose differences preclude universal adequacy rankings. Retain alongside any normalized dimension.
100 g or 100 ml	Composition per mass/volume; useful for food/recipe reformulation. Added water lowers densities without changing consumed nutrients. Soup, drinks and mixed dishes become incomparable if denominator rules differ. Exploratory comparator, not preferred core meal normalization.
100 kcal / 1,000 kcal	Nutrient density relative to energy; invariant to uniform scaling and pure added water. Small energy denominators amplify errors. Adding oil changes the denominator and can reduce sodium density while increasing energy and reducing fibre density. Preferred provision descriptor with amount context.
% energy	Relative macro or sugar/saturated-fat energy. Invariant to uniform scaling and water; not personal adequacy. Uses source-compatible factors (typically 4 kcal/g protein/available carbohydrate/sugars and 9 kcal/g fat). Total energy can include fibre, alcohol and polyols.
Combination	Report consumed amounts plus energy-relative features; do not hide them inside an undocumented sum. If a global model mixes bases, it must explicitly accept partial portion dependence and be tested by purpose/size.

Mixed dishes and different meal purposes

Calculate ingredient nutrient totals after appropriate edible-yield/retention handling, then allocate the consumed portion. Summing rounded food-level scores is generally not equivalent to scoring the composed nutrient totals: nonlinear transforms and caps break equivalence. Include drinks according to one fixed occasion rule; exclude water from energy but not from documented mass when mass density is displayed.

A snack, light breakfast and large dinner may serve different roles without either being “wrong”. A density comparison can span sizes if labelled as density. A portion-based balance model must define its comparison set and meal purpose without inventing a universal energy allotment. The MBI study’s 200-1,200 kcal restriction is a study design limit, not an evidence-based universal app threshold [1].

Descriptive arithmetic, not a scoring formula

For energy $E > 0$ kcal and a nutrient quantity q : density per 1,000 kcal = $1,000q/E$. Saturated-fat energy share = $100 \times 9 \times \text{saturated-fat grams} / E$, when the energy convention is compatible. These transformations are mathematically specified descriptors. They introduce no points, weights, desirable bands or claim that every meal should match the daily diet.

At zero or insufficiently reliable energy, energy-based densities are unavailable; absolute amounts can remain. A very small meal can have favourable density while supplying little nutrient mass. A large meal can have the same density with large absolute sodium or energy. Displaying both resolves this interpretive limitation without an arbitrary nutritional penalty.

16 | WEIGHTING AND AGGREGATION

A computable sum is not a validated construct

Design choice	Critical assessment and research requirement
Additive mean / sum	Readable contributions, but fully compensatory: protein or vitamins can offset salt/saturated fat. Equal weights are still normative and depend on scaling. Correlated fibre, plant groups and minerals can receive unintended multiple weight.
Non-compensatory rules	Separate axes preserve trade-offs. Minimum-component, geometric or veto rules can prevent complete offsetting but introduce bottlenecks, zeros and thresholds. No evidence here establishes universal meal veto levels. Investigate explicitly; do not invent cut-offs.
Caps and floors	Limit domination by fortified foods and produce bounded scores. A cap does not prevent multiple simultaneous enrichment rewards. Floors lose severity information and may create ties. Test saturation, discontinuity and threshold sensitivity.
Nonlinear contributions	Plateaus/bands can reflect a chosen target range; smooth slopes can reduce threshold jumps. Exact breakpoints are not inferred from the existence of daily recommendations. Upper micronutrient bands are not ULs.
Empirical weights	Estimate against a prespecified independent decision/construct criterion, with uncertainty, penalization if needed and held-out validation. PCA loadings, food correlations and distribution symmetry do not identify health utility weights.
consensus weights	A defensible explicit policy option after structured expert/user deliberation; label normative, publish dissent and sensitivity. Do not describe consensus or equal weights as empirically optimal.
0-100 scaling	A monotone rescaling can improve readability but adds no validity. Endpoints must mean the model's defined minimum/maximum, never percent health, adequacy or risk. Percentile endpoints are cohort-relative; fixed endpoints need attainable meaning.

A global candidate must specify variables, units, transformations, weights, bounds, reference framework and compensation rules before evaluation. Published MBI coefficients are comparators, not evidence that the same coefficients suit Nutrikom. The corrected nutriRECIPE ratio demonstrates the need for an immutable formula identifier and independent checking [1,2,7,8,32].

Enrichment and substitution tests

Add protein powder or a vitamin/mineral premix while leaving sodium and saturated fat unchanged. A large global improvement would require a principled justification, not merely an increase in available nutrient values. Test both naturally occurring nutrient differences and fortification. A replacement of saturated fat with unsaturated fat differs from simply adding oil: the score must not imply identical health effects for those operations.

Do not assign weights to obtain a visually pleasing score distribution or preserve legacy 40/40/20. No exact new point formula is scientifically justified by the present evidence alone. Publish a sensitivity envelope over justified candidate choices before choosing a global scale.

17 | CANDIDATE APPROACHES

Compare designs before selecting an algorithm

Approach	Strength / limitation / current decision
Descriptive amounts + factual explanation	Most defensible current release: quantity, macro-energy graphic and one traceable composition statement. No artificial aggregation. Less compact for comparisons; remains the baseline in user studies.
Separate nutrient provision and limiting features	Best research direction: distinguishes benefits and limitations, accommodates local missingness, avoids implicit exchange rates. Needs clear denominator labels and testing of display burden. No within-dimension numerical collapse initially.
Original global 0-100 candidate	Potential compact comparison tool; direct meal precedents justify investigation. Requires a chosen construct, new weights/threshold justification, meaningful scope, robust missing-data rules and evidence of incremental comprehension/usefulness.
Published meal model replication	Useful benchmark: exact adult-scope MBI or another accessible fixed method, with original name/version. It may require unavailable inputs or culturally specific portion assumptions. Replication cannot confer validation on an altered Nutrikom formula.
Food-profile adaptation / Nutri-Score	Useful external sensitivity comparator for dishes where complete appropriate inputs exist. Per-mass category rules and long-term dietary evidence are indirect. Not a default Nutrikom algorithm or invented 0-100 scale.

Smallest defensible experimental prototype

Investigate a **non-aggregated composition panel**: (1) provision descriptors, initially fibre density and optional protein amount/energy share; (2) limiting descriptors, initially saturated-fat energy share and sodium density plus consumed sodium; (3) separately named added-sugar or free-sugar descriptors only with their own valid inputs. Keep energy/portion amounts visible. Documented food-group quantities may appear in an optional companion panel.

No positive/negative points, category colours, global grade or daily quota are assigned. Micronutrient values are optional descriptors, not inferred adequacy. A dimension containing several descriptors does not have an invented internal weighted score. The initial selection is provisional: nutrients are chosen for plausibility, interpretability and different informational roles, not because they are already transported.

Provisional assumptions and outstanding evidence

Assumptions: the occasion is defined consistently; edible quantities and energy are sufficiently reliable; nutrient definitions are compatible; adult population guidance is an appropriate interpretive context; users can distinguish density, amount and coverage. Required evidence: source/entry accuracy, construct/content review, independent recipe and cultural external validation, uncertainty/adversarial testing, and user comprehension versus the factual baseline. The panel is an experimental feedback design, **not a validated Nutrikom Score**.

18 | MISSING-DATA CONTRACT

Unknown is neither zero nor a nutritional penalty

Rule	Required behavior
State every relevant value	Use known, documented zero, bounded trace, source-based estimate, or unknown. Preserve provenance and definition. No AI imputation or undocumented substitution; missing is never zero.
Dependencies are local	An absolute sodium amount needs sodium and quantities; sodium density also needs energy. Missing vitamin D must not block fibre density. Missing energy blocks energy-relative outputs, not known absolute amounts.
Fixed required set	A numeric model has one published mandatory input set. Every mandatory nutrient must cover all materially contributing meal items with compatible values or an explicitly admitted estimation method.
No omission-and-renormalization	Dropping an unavailable variable and rescaling remaining weights changes the construct and can inflate the result. Such outputs are not the original score. Do not silently compare them.
Optional fields stay optional	Unavailable non-model micronutrients or food-group descriptors do not block unrelated results. Optional data may enrich an explanation but cannot alter a fixed score without changing its version.
Quantities and ingredients matter	A nutrient field may exist while an oil/salt ingredient or serving fraction is absent. Declared entry review is a self-report, not verified completeness. Unknown materially relevant quantities block affected totals/densities unless bounded.
Coverage is separate	Never multiply score by completeness or subtract missing-data points. Report usable required inputs and nutrient-specific coverage. Completeness is not accuracy or confidence.

Precisely when a point estimate may be displayed

For a future admitted model: its version and input profile are fixed; the meal is within validated scope; mandatory definitions/units are compatible; material quantities and recipe allocation are available; every required input is known or estimated by a prevalidated, declared method; and propagated input/model uncertainty meets prospectively specified display tolerances. Round to the precision justified by that uncertainty. These tolerances must be justified during validation; none is invented here.

Even with complete inputs, a research global point may be displayed only in a controlled study as “experimental”, with the model interpretation and limitations. It is not a production-validated score. Direct descriptive amounts may already be estimated, if their status is clear. Complete food-table data do not imply laboratory accuracy or certainty that the entry represents all consumed foods.

19 | MISSING-DATA STATES

Intervals, reduced models and abstention

Policy / display state	Admissibility and comparability
Strict inputs / point	Strong semantic consistency. Show a point only under the preceding Missing-data contract. Coverage may be 100% for mandatory inputs while accuracy remains uncertain.
Fixed reduced model	Possible only as a separately specified and independently validated method, with its own identifier, construct and reference range. Different inputs cannot silently yield interchangeable scores. Cross-model comparison needs a bridging study.
Score interval	If missing/estimated inputs have credible bounds, propagate their joint feasible ranges through the complete fixed formula: minimum to maximum attainable score. Do not choose a midpoint by default. Nonlinear caps and correlated quantities must be handled.
Qualified estimate	Use an explicitly declared, prevalidated imputation/source method and show uncertainty when material. A generic table match is an estimate, not measured truth. Do not infer ingredients or added/free sugars from a name.
Abstention	When bounds are uninformative, required data incompatible, missing ingredients unbounded, or scope unsupported, stop the affected score. Continue unaffected amounts and factual feedback. No “low score” substituted for unavailable.

Coverage measurement contract

For each fixed model display **K of K required inputs usable**, together with which requirements fail. Usability means compatible definition and coverage of the material consumed ingredients, not merely a non-null aggregate. Also expose variable-level status: for example “Sodium available for 3 of 4 entered items; sauce unknown”. A global x/15 transported-field count may be supplementary only, with its dictionary and no implication of scoring confidence.

Item-count coverage weights a pinch and a main ingredient equally. Mass-weighted coverage needs complete comparable edible masses; energy-weighted coverage needs reliable energy and can hide salt/oil relevance. If used, state the denominator and unknown-denominator limitations. Report entry completeness and composition coverage separately. Do not call any of these “accuracy”, “confidence” or “percentage of your diet assessed”.

When uncertainty must accompany an output

Use a range or an “estimated” qualifier whenever admitted quantity/source uncertainty could change a displayed category, rank, contribution sign or decision beyond the prespecified tolerance. A plausible scenario range is not a 95% confidence interval. A probabilistic interval requires justified error distributions, correlations and calibration against independent data. A narrow numerical range cannot compensate for an invalid construct.

Comparisons are permitted only for the same model/version, reference framework, nutrient definitions, eligible occasion types, denominator and admissible input profile, with uncertainty shown when it may reverse the ordering. Method changes require explicit versioning and re-evaluation; historical scores must not be silently rewritten or merged.

20 | EXPLAINABILITY CONTRACT

Only computed and supported contributions may be explained

Element	Contract
Traceable input	Every quantity maps to a source, food/ingredient and edible portion, with known/estimated/unknown status. Every conversion and reference is identifiable.
Transformation	Show the unit and denominator. For a fixed future point function, publish the transformation, cap/band and reference rationale; distinguish normative choices from estimated parameters.
Contribution	In an additive model, display actual component points/weights whose accounting reproduces the score. In a non-compensatory model, explain the binding rule and interactions; do not pretend contributions are independent.
Food attribution	Show measured amounts contributed by foods. Allocation of global nonlinear points to foods requires a published attribution rule; component changes under a substitution are model counterfactuals, not causal health effects.
Coverage and uncertainty	Present separately, with the failed dependency and affected outputs. A known zero can count as data. Do not convert unknown nutrients into negative contributions.
Language generation	Explanations may restate verified facts and model arithmetic. AI cannot add nutrients, ingredients, processing, timing benefits, point changes or clinical conclusions. Any generated wording must preserve the same factual contract.
Auditability	Publish method identifier, reference/date, required inputs, acceptable estimates, scope, validation record and change log. Users must be able to understand why the result changed.

Concise English wording: proposed study and production states

State	English wording
Experimental global score	“Experimental meal composition score: [x]/100. It reflects selected features of this entered meal, not your overall diet or personal nutrient needs.”
Dimensional display	“Meal composition: fibre density, saturated-fat energy share and sodium amount. Each measure describes a different feature.”
Coverage	“Data coverage: [k] of [K] required inputs usable. Coverage does not measure accuracy.”
Uncertainty	“Estimated range: [a]-[b]. Portion or composition uncertainty may change the result.”
Partial data	“Sodium is unavailable for [item]. Other available measures are shown.”
Unavailable score	“Score unavailable: [required input/reason]. Available nutrient amounts are still shown.”
Different model	“Different method/input profile. These scores are not directly comparable.”

Bracketed values are display placeholders, not proposed thresholds or simulated results. Use amounts first and a brief supported explanation; do not imply that a change of ten points has a known clinical effect [B6].

21 | VALIDATION STAGES 1 AND 2

Correct arithmetic and a defensible construct

Stage 1: computational correctness

Question: does the method exactly implement its published specification? **Data:** independently hand-calculated examples, authoritative units/conversions, fully weighed recipes with known yields, boundary values and alternative representations. **Endpoints:** nutrient-total and normalized-output errors, exact cap/threshold behavior, deterministic reproducibility and dependency/abstention correctness. These are software/method checks to be conducted later, not completed tests of a Nutrikom prototype.

Use a second independent calculation or implementation for the scientific reference algorithm. Check sodium versus salt, kj versus kcal, vitamin activity units, raw/cooked weights, serving fractions, retained/discarded cooking liquid, fibre/polyol energy and compatible carbohydrate definitions. Test that null does not become zero, optional missing fields do not block unrelated outputs and unknown mandatory values never trigger weight renormalization.

Admission: no unresolved semantic/unit or dependency defects; all prespecified mathematical invariants and boundary checks pass within documented rounding rules. Correctness is necessary but does not establish nutritional validity. Freeze specification and version before subsequent stages.

Stage 2: content and construct validity

Question: do selected features represent the claimed meal construct, and do exclusions make sense? Convene independent nutrition scientists/dietitians with expertise in nutrient profiling, food composition and relevant cuisines, plus adult users. Declare interests and include disagreements. Use structured review, optionally Delphi rounds, to assess relevance, redundancy, compensability, reference framework and understandable interpretation.

Build blinded paired-meal contrasts before observing algorithm results: more salt with otherwise identical composition; replacing refined starch with a documented alternative; same recipe at different quantities; fortification; soups; and intentionally complementary meals. Specify which contrasts have a directional hypothesis and which should remain unordered because of trade-offs. An expert panel seeing the same nutrients is a normative construct comparator, not an independent clinical gold standard.

Methods: content-validity ratings with rationale, paired ordinal agreement and uncertainty, rank disagreement investigation, component correlations and multicollinearity diagnostics. Avoid optimizing the score to reproduce the panel and then treating the same panel examples as external validation. Keep derivation and adjudication/test panels or recipe sets separate.

Admission: a published construct, supported input roles, explicit denominators and trade-offs, acceptable scoped content coverage, and a defensible interpretation of endpoints. Do not require high alpha or a unidimensional PCA solution. If consensus cannot justify collapse, continue dimensions without a global score.

22 | VALIDATION STAGE 3

External validity and cultural transportability

Independent datasets and comparators

Use a held-out corpus of genuinely composed adult eating occasions, with ingredients, edible quantities, recipe yields and compatible composition fields. Candidate resources include adult subsets of NHANES with FNDDS/food-pattern equivalents, national weighed/recall surveys with recipe detail, and independently collected local meals. Datasets used to select variables or weights must not serve as the definitive test set. Split by person, recipe family, site and time to avoid near-duplicate leakage.

For independent compositional verification, collect a stratified weighed-recipe/duplicate-meal substudy with laboratory analysis of selected key nutrients and energy where feasible. Compare entered quantities and source-derived composition with weighed observations and analysed values. Nutrient-specific laboratory verification tests input accuracy; it is not a global meal-health criterion.

Compare a candidate with exact versions of MBI, HMI/MMQI when ingredient data allow, NRF, SAIN/LIM and official Nutri-Score where appropriate. Report these as convergent/divergent evidence.

Independently assessed food groups not used in development can supply complementary content evidence, while remaining related to dietary guidance. Repeated-day HEI or similar indices assess whether aggregated observations relate to a diet construct; they do not label every meal adequate.

Populations and transportability

Sample healthy adults across age groups, sex, socioeconomic conditions and dietary patterns, including plant-based diets, varied food access, restaurant/packaged/home meals and small versus large occasions. Include major cuisines in the intended market, with local dietitian review. If Pacific or other island communities are intended users, evaluate relevant roots, fish, coconut preparations, shared dishes and discretionary sauces with locally documented recipes; do not assume an existing representative corpus.

Compare food-table systems such as Ciquil and appropriate local/US tables after semantic harmonization. Differences in fortification, analytical fibre, carbohydrate definitions, sodium coding and recipe preparation can change results. Estimate between-table and within-food variability separately from population differences. Pregnant/lactating adults, children, athletes with special requirements and clinical diets need separate scopes; routine healthy-adult validity does not admit those claims.

Analysis and admission

Use cluster bootstrap confidence intervals for recipe/person-level dependence; apply survey weights when population inference is intended. Spearman/Kendall measures compare ordering. ICC or Bland-Altman analysis is appropriate only for quantities intended to measure the same construct and scale, not arbitrary differences between different 0-100 indices. Use weighted kappa for prespecified categories; examine subgroup disagreement, calibration to independent composition and cross-country consistency.

Predefine acceptable ranking/measurement error relative to intended decisions and source uncertainty. Recipe/substudy sample sizes follow desired interval precision for agreement or nutrient error, pilot variance, recipe/person clustering and cuisine-stratum coverage. Evaluate held-out performance and uncertainty, not only significance. External disagreement may reveal a different construct. Admission requires acceptable prespecified performance within stated populations and food-data systems; otherwise restrict scope or retain descriptors.

23 | VALIDATION STAGE 4A

Adversarial tests: mathematical and nutritional behavior

These are proposed tests, not executed scoring results. Expected behavior depends on the declared construct; a global candidate must state its response before results are examined. A mathematically expected change can still expose a poor product interpretation.

Challenge	Required expectation or investigation
Proportional portion change	Multiply all consumed quantities by a positive factor. Energy densities/% energy remain equal; absolute amounts scale. A portion-based score may change only according to its declared construct. Explanations must not infer equal adequacy.
Added water	Hold nutrient and energy amounts constant. Energy-relative dimensions remain equal; per-100 g values decrease. No automatic health improvement or liquid penalty. Distinguish dilution from discarding nutrient-containing cooking liquid.
Added oil	Increase energy/fat according to oil type. Sodium density may fall while absolute sodium stays constant; fibre density falls and saturated-fat share depends on oil. A global gain must not be described as universal improvement.
Added salt	Increase sodium and salt equivalent consistently. Sodium amount/density rise if energy unchanged; unrelated provision descriptors stay equal. An additive model's possible offsetting must be disclosed.
Nutrient fortification	Increase isolated protein/micronutrients without changing other composition. Test caps, multiple rewards and class/rank improvements. No protein or vitamin supplement should erase an adverse feature without a justified compensation rule.
Very small meal	Densities may look favourable but total provision is tiny; small denominators magnify error. Show amounts and uncertainty; do not imply complete meal adequacy. Eligibility bounds require validation, not arbitrary calories.
High-energy meal	Compare same-density meals of different size. Energy and sodium amounts increase. Do not certify portion appropriateness from a density score; test whether users understand this.
Missing micronutrients	Remove only vitamin D/iron/etc. An unrelated fibre/sodium display remains available. A model requiring that nutrient abstains or shows a defensible interval; it does not drop the weight or penalize nutrition.

Robustness analysis

Perturb portions, food matches, recipe retention and nutrient values using errors estimated from independent data. Include correlated errors, systematic omissions and both random and food-type-related missingness. Recalculate rank reversals, category changes, point/interval widths and explanation changes. Evaluate documented normative weight/threshold alternatives as model uncertainty, separately from measurement uncertainty.

Report results by cuisine, preparation type, portion size and coverage pattern. A score unstable under plausible input errors should display uncertainty, restrict its scope or abstain. Perfect stability would not alone establish content or clinical validity.

24 | VALIDATION STAGE 4B

Representation equivalence and missing-data stress tests

Challenge	Admission expectation
Ambiguous carbohydrate definition	Switch available carbohydrate versus carbohydrate by difference with fibre/polyols. Detect incompatibility; do not silently convert energy shares or reconstruct sugars. Known unrelated nutrients remain usable.
Incomplete ingredient list	Remove sauce, oil, salt, drink or a serving fraction. Flag affected dependencies and unbounded totals. Do not certify a complete meal because all remaining food records have all fields.
Equivalent recipe representations	Represent a verified recipe as one composite record or its ingredients, with identical yield/consumed fraction. Equivalent compatible nutrient totals must give the same composed result within rounding. Food-group attribution must also reconcile.
Ingredient splitting / merging	Split the same quantity into duplicate entries or merge entries. Result must not change because of ingredient count, lexical category or rounding order. This directly challenges the legacy food-characteristics logic.
Serving / raw-cooked mismatch	Swap a prepared serving with raw ingredient weights or omit cooking yield. The method must detect basis incompatibility or show a documented estimate, not an apparently precise point.
Missing limiting nutrient	Remove sodium or added-sugar data from a high-contribution ingredient. No favourable score can arise through deletion and weight renormalization. Bounds must include plausible adverse values.
Different source tables	Score matched recipes across harmonized tables and product-specific data. Quantify definition, preparation and fortification effects. No systematic cultural penalty caused by poorer data coverage.
Sugar variant substitution	Replace added sugar with total or free sugar. Method/profile must change or calculation stop. Do not compare outputs as the same score merely because both values are in grams.

Uncertainty protocol

Maintain separate uncertainty sources: entry/portion error, composition-source variation, missing values, and model/reference uncertainty. For bounded cases propagate feasible ranges respecting shared energy/ingredient constraints. For probabilistic cases use validated joint distributions and verify interval calibration against independently observed composition. Do not assume independent nutrient errors by default.

Include missingness related to food type and culture: discretionary sauces, local foods with sparse tables, fortified products and restaurant meals. Compare abstention rates and interpretability, not just scores among complete cases. A complete-case evaluation can exclude precisely the meals for which the consumer app must behave honestly.

Admission: every prespecified invariant passes; conditional/non-monotone behaviors are documented and understood; error-induced decision reversals and uncertainty coverage satisfy prospectively justified thresholds; score availability does not conceal systematic exclusions. No new threshold is assigned in this report.

25 | VALIDATION STAGE 5

User comprehension and decision usefulness

Study arms and meaningful endpoints

Conduct a randomized, preferably preregistered comparison: (A) adequate descriptive baseline with amounts, labelled macro-energy graphic and a short factual explanation; (B) the same baseline plus dimensions; (C) the same baseline plus an experimental global score and its true contributions. Keep food entry, information quantity and coverage visibility comparable. Comparing a score with an intentionally weak baseline would exaggerate benefit [B6].

Primary comprehension tasks should test whether users distinguish density from portion amount, meal from habitual diet, population references from personal needs, coverage from accuracy, and missing from zero. Use teach-back and objective questions with realistic complete/incomplete meals, including small meals and same-density large portions. Measure critical misconceptions separately rather than allowing good recall to offset a clinical misunderstanding.

Decision tasks should specify a goal, such as reducing sodium for an otherwise comparable meal, and permit trade-offs or “insufficient data”. Assess correct choices, valid input corrections, time/burden and calibrated confidence. Do not define the researcher’s preferred cuisine as the correct choice. Collect adverse interpretations such as chasing 100, unjustified food avoidance, or excessive trust; satisfaction and perceived clarity remain secondary.

Include varied nutrition literacy/numeracy, languages used by the product, cultural food practices, screen-reader users and different device contexts. Use text/unit cues rather than colour alone, accessible contrast and a tested reading order. The retrieved packaged-label and bundled meal-intervention studies motivate testing but do not establish this display’s usefulness [19,20].

Sample sizes must follow precision and effect targets

For a critical binary misconception rate, choose the maximum acceptable rate and desired confidence-interval precision before recruitment. Planning may use $n \approx z^2 p(1-p)/h^2$ (p from pilot data, or 0.5 conservatively), then use a suitable binomial interval/design in analysis. The tolerance h must reflect an admission decision, not a convenient sample size. If the endpoint is zero observed critical errors, calculate its upper confidence bound; zero observations does not mean zero risk.

For randomized differences, specify the smallest useful improvement, expected baseline rate/variance, significance level, power, allocation and attrition. For paired recipes or repeated user tasks, incorporate within-person/recipe dependence; a simple cluster design effect $1+(m-1)ICC$ is only a planning approximation when its assumptions fit. Provide precision for key language/culture/literacy strata and multiplicity handling. Pilot feasibility work supplies variance and recruitment estimates, not a validated final effect.

Admission: justified critical-error tolerances and meaningful decision/comprehension benefit, assessed prospectively. Admit a global score only if it adds value over dimensions without unacceptable misunderstanding or source/missingness inequity. Otherwise keep dimensions or the descriptive baseline.

26 | CLAIM AND ADMISSION GATES

Match evidence to claims, then decide on implementation

Evidence achieved	Claims it may support / claims it does not support
Composition and correctness studies	“Describes these calculated features of the entered meal”; quantified agreement with weighed/analysed composition within scope. Does not support personal adequacy or health outcomes.
Independent content review	“Represents specified aspects of alignment with [named framework]”. Normative content validity, with documented trade-offs. Does not demonstrate clinical utility.
Human comprehension study	“Users in this study understood [specified distinctions]”; decision usefulness for tested goals. Does not validate biological effects or all consumers/populations.
Choice intervention	Changes in entered/selected/eaten foods under tested conditions, with independent measurement where possible. A multi-feature intervention cannot isolate the global score’s causal contribution.
Longitudinal outcomes	Associations of appropriately aggregated dietary exposure with specified population outcomes, with confounding and measurement caveats. A predictive model requires calibration/discrimination and external validation.
Acute physiology trial	Effects for a particular meal contrast/protocol/population and measured endpoint. Cannot establish a universal health score or individual clinical-event prediction.

Implementation admission criteria, all required for the proposed claim

G1 Specification: public construct, unit, scope, required input dictionary, references, transformations, compensation, missing-data and version rules. **G2 Correctness:** independent calculations and all relevant invariants pass. **G3 Content:** defensible variables and trade-offs, with no lexical/timing/AI contributions or inherited weights without evidence.

G4 External validity: held-out datasets and intended-population/cuisine evidence, with declared comparator dependence and source accuracy. **G5 Robustness:** error propagation, adversarial behavior and missingness tests satisfy prespecified justified tolerances. **G6 Communication:** objective understanding and usefulness meet the defined goal; critical misinterpretations are controlled. **G7 Governance:** reproducible documentation, provenance, corrections, method identifiers and revalidation after material changes.

A global release additionally requires supported collapse/compensation and incremental benefit over separate dimensions. All admitted scores remain composition claims unless stronger outcome-specific evidence is obtained. Numerical pass thresholds must be fixed in advance using intended decisions, pilot variance and stakeholder risk tolerance; inventing convenient percentages now would substitute an unsupported rule for validation.

Failing a gate stops the corresponding score or claim, not available descriptive feedback. An approved composition study cannot bypass the user-study gate, and a clear interface cannot bypass construct validity. An individual clinical-event prediction from one meal remains outside this report’s admissible claim set.

27 | FINAL RECOMMENDATION

Investigate dimensions; keep current feedback descriptive

Selected recommendation: investigate separate dimensions. Direct meal research supports the feasibility of transparent assessment of composition. It does not establish a universal scalar construct or scientifically determined exchange rates among provision, limitation, food groups and portion size. Dimensions preserve these differences, accommodate missing data locally and make their interpretation more explainable. Descriptive feedback remains the current product baseline until the proposed dimensions themselves have been tested.

A global score is not ruled out. It should remain a secondary, explicitly experimental candidate whose benefit and error behavior are compared with dimensions. Scaling to 0-100 is a presentation decision only after the model is defined; it must not supply a false appearance of clinical calibration. No new weights, cut-offs or score endpoints are asserted here.

Smallest unresolved questions needed to advance

Decision	Minimum evidence or answer needed
1. What comparison is intended?	Choose composition/density versus portion suitability; define eating occasion and beverage inclusion, eligible meal purposes and adult reference market. Keep personal adequacy outside this construct.
2. Which features and data are defensible?	Confirm initial fibre/saturated-fat/sodium roles, choose a separately defined sugar exposure, and justify optional protein/micronutrient/food-group additions. Establish compatible source coverage and realistic error bounds.
3. Does collapse add value?	If proposing a global candidate, justify compensation, weights, caps and endpoints against an independent criterion; demonstrate robust incremental user comprehension/decision benefit over dimensions. Without this evidence, do not collapse.

Research deliverables before a scoring decision

Publish a frozen scientific specification and input dictionary; an independent composed-meal benchmark with source/portion uncertainty; a content-validation record; an adversarial/transportability analysis; and a preregistered user study. Sample sizes derive from precision, relevant effect sizes and clustering. Full methods access and clarification are needed before exact replication of abstract-only models or inconsistent study populations.

Limitations of this review

This targeted review used ranked search tools, selected primary articles, official sources and six supplied reports. It did not conduct exhaustive database exports, duplicate independent screening, pooled effect estimates, full algorithm reimplementations or new experiments. Abstract-only papers cannot support complete numerical replication. Findings concern generally healthy adults and composition feedback; extension to clinical groups or individual physiology requires separate research.

The scientific objective is a truthful, useful interpretation of the entered meal. A missing value should reduce what can be concluded, and a favourable composition should never be presented as proof of an adequate diet or a healthy person.

APPENDIX A | SEARCH RECORD

Repeatable discovery strings and access register

The four discovery queries on page 3 are verbatim executed strings. Representative web discovery/verification queries actually executed during this review include the following; exact-title/DOI retrieval and backward citation tracing completed the targeted search. Their ranked output is not a reproducible exhaustive database set.

"Deschasaux" "m3173" "501" mortality
"Evaluation of the psychometric properties" "main meal" "sample"
"Nutri-Score" "2024" "00173" cardiovascular EPIC updated algorithm
"Development" "ANPS" "1568181" PMID
"Nutrient Density" "2282" "42514351"
"Validity of the Ajinomoto" "Urinary" "1623" 2026
"Nutritional quality of diet" "101006" "PubMed"
site.pubmed.ncbi.nlm.nih.gov 30146073 Evaluation Healthy Eating Index 2015

Native PubMed strategy for a formal update (proposed, not an exported search here)

(meal*[tiab] OR "mixed dish"[tiab] OR recipe*[tiab]) AND ("nutrient profil"[tiab] OR "meal quality"[tiab] OR "meal balance index"[tiab] OR "healthy meal index"[tiab] OR "nutrient density"[tiab]) AND (develop*[tiab] OR validat*[tiab] OR reproducib*[tiab] OR understand*[tiab])

Supplement with named-model searches: (NRF OR "nutrient rich foods" OR SAIN OR LIM OR "Healthy Eating Index" OR "Nutri-Score") AND (develop* OR validat*), plus reference/citation searches. Search all years through the update date; screen assessment unit manually rather than imposing an adult filter that could discard mixed-population meal studies. Record exports, deduplication and reasons for exclusion in a subsequent systematic review.

Access category	Studies / limitations
Detailed original methods	MBI; Philippine MBI; HMI; Brazilian MMQI; NBC; nutriRECIPE and its correction; ANPS-Meal; Bullock; Dutch NRF; Khoury 2026. Selected figures/tables inspected where needed; not every supplement reimplemented.
Abstract/record or limited extraction	NRF original; SAIN/LIM original; MMQI UK; GDQS-Meal/Menu; NDC; ANPS-Day biomarkers; EPIC 2020/2024. Do not claim complete method replication.
Background-reviewed evidence	HEI detailed framework and selected human-feedback papers were available in the fully read REF/IDX/UX reports; primary identifiers checked where possible. Clearly indirect, not new Nutrikom validation.
Official guidance	WHO guideline pages, EFSA sugar opinion and SPF current algorithm information. REF01 supplies the detailed reference-type distinctions. Some official PDF redirects/blocked pages prevented full fresh retrieval.

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Primary studies and reference documents

DOIs are clickable. PMID is provided when located; a missing PMID is not a claim that none exists. Access level is specified in the evidence matrix and Appendix A. Background reports are listed separately below.

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Supplied Nutrikom reports and abbreviations

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Abbreviations

Term	Meaning
AI / AR / EAR / PRI / RDA / UL	Adequate intake / average requirement / estimated average requirement / population reference intake / recommended dietary allowance / tolerable upper intake level.
CVD / HR / CI	Cardiovascular disease / hazard ratio / confidence interval.
FNDDS / NHANES / FPED	Food and Nutrient Database for Dietary Studies / National Health and Nutrition Examination Survey / Food Patterns Equivalents Database.
HEI / HMI / MBI / MMQI / NRF	Healthy Eating Index / Healthy Meal Index / Meal Balance Index / Main Meal Quality Index / Nutrient Rich Foods index.
ICC / PCA / % energy	Intraclass correlation coefficient / principal-component analysis / proportion of energy, with denominator and factors stated.
RI / NRV / SFA	Reference intake / nutrient reference value / saturated fatty acids.

Authorship note: prepared as an evidence synthesis for Nutrikom. Research recommendations and admission rules are proposals from this review; they are not findings from an executed Nutrikom validation programme. No new numerical score was fitted or tested.