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Review

Are Major a Posteriori Dietary Patterns Reproducible in the Italian Population? A Systematic Review and Quantitative Assessment

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A B S T R A C T

Although a posteriori dietary patterns (DPs) naturally reflect actual dietary behavior in a population, their specificity limits generalizability. Among other issues, the absence of a standardized approach to analysis have further hindered discovery of genuinely reproducible DPs across studies from the same/similar populations. A systematic review on a posteriori DPs from principal component analysis or exploratory factor analysis (EFA) across study populations from Italy provides the basis to explore assessment and drivers of DP reproducibility in a case study of epidemiological interest. First to our knowledge, we carried out a qualitative (i.e., similarity plots built on text descriptions) and quantitative (i.e., congruence coefficients, CCs) assessment of DP reproducibility. The 52 selected articles were published in 2001–2022 and represented dietary habits in 1965–2022 from 70% of the Italian regions; children/adolescents, pregnancy/breastfeeding women, and elderly were considered in 15 articles. The included studies mainly derived EFA-based DPs on food groups from food frequency questionnaires and were of "good quality" according to standard scales. Based on text descriptions, the 186 identified DPs were collapsed into 113 (69 food-based and 44 nutrient-based) apparently different DPs (39.3% reduction), later summarized along with the 3 "Mmixed-Salad/Vegetable-based Patterns," "Pasta-and-Meat-oriented/Starchy Patterns," and "Ddairy Products" and "Ssweets/Animal-based Patterns" groups, by matching similar food-based and nutrient-based groups of collapsed DPs. Based on CCs (215 CCs, 68 DPs, 18 articles using the same input lists), all pairs of DPs showing the same/similar names were at least "fairly similar" and ~81% were "equivalent." The 30 "equivalent" DPs ended up into 6 genuinely different DPs (80% reduction) that targeted fruits and (raw) vegetables, pasta and meat combined, and cheese and deli meats. Such reduction reflects the same study design, list of input variables, and DP identification method followed across articles from the same groups. This review was registered at PROSPERO as CRD42022341037.

Keywords: congruence coefficient, cross-study reproducibility of dietary patterns, a posteriori dietary patterns, factor analysis, generalizability of dietary patterns, Italy, principal component analysis, similarity of dietary patterns across studies, systematic review

Statement of significance

This is the first systematic review collecting evidence on Italian dietary patterns derived from principal component or exploratory factor analysis. The systematic review provides the basis for a qualitative and quantitative assessment of reproducibility of Italian dietary patterns, as based on text descriptions and congruence coefficients, respectively. We found that Italian dietary patterns based on fruit and (raw) vegetables, pasta and meat combined, and cheese and deli meats are reproducible across studies, although more rigorous statistical approaches may allow a better identification of reproducible dietary patterns and related causes. The established evidence base may inform dietary pattern identification in the Italian population and more generally future research on dietary pattern reproducibility across studies within the same country.

Abbreviations: AUFA, Animal Unsaturated Fatty Acids; CC, congruence coefficient; DIETSCAN, Dietary Patterns and Cancer; DP, dietary pattern; EFA, exploratory factor analysis; EPIC, European Prospective Investigation into Cancer and Nutrition; FFQ, food-frequency questionnaire; INRAN-SCAI, Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione-Studio sui Consumi Alimentari in Italia; ORDET, Ormoni e Dieta nell'Eziologia del Tumore della Mammella; PCA, principal component analysis; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; VUFA, Vegetable Unsaturated Fatty Acids.

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Introduction

Following the dietary pattern (DP) approach, multiple related dietary components (food items, food groups, or nutrients) are synthesized into combined variables reflecting key dietary profiles in a population [1,2], while overcoming well-known multiple comparison issues [3].

A posteriori DPs [3] are defined by using multivariate statistical methods (i.e., principal component analysis [PCA], exploratory factor analysis [EFA], and cluster analysis [4]) and are therefore advantageous in naturally reflecting actual dietary behavior in a population and related study- or population-specific context (e.g., geography/climate, socioeconomic status, food supply, ethnic background, culinary tradition) [5]. However, their specificity limits generalizability, especially when compared with the a priori (i.e., comparing subjects' diet against evidence-based benchmark diets) option [6].

The absence of a standardized approach to analysis (e.g., definition of input variables and their preprocessing, DP identification method, and DP labeling), poor information reporting, and subjective DP labeling (based on supposed similarities with previously published DPs) have further limited fair comparisons among sets of a posteriori DPs [7] and still hindered discovery of genuinely reproducible DPs across studies from the same or similar populations [8,9] (i.e., cross-study reproducibility [7, 10]).

A few pioneering [11,12] and more recent [13–19] articles have explored either qualitatively or quantitatively the cross-study reproducibility of DPs derived from PCA or EFA, which are by far the most commonly derived a posteriori DPs in nutritional epidemiology [3]. Following a qualitative approach, the assessment of cross-study reproducibility emerged from a narrative synthesis based on text description and/or visual inspection of loadings of potentially similar DPs. Congruence coefficients (CCs) between factor loadings and correlation coefficients between factor scores have been also used to quantitatively evaluate reproducibility of apparently similar study-specific DPs [13,15,16]. Independently of the different cut-offs used, the CC has proved to be an effective measure of reproducibility for PCA/EFA-based DPs across studies [13,15, 16]. Additionally, the potential effectiveness of more rigorous statistical approaches has been under investigation [17].

The Italian diet is traditionally recognized as a variant of the Mediterranean diet characterized by the abundance of fruit and vegetables, wheat, legumes, and olive oil [20,21]. However, per capita weekly consumption data revealed that typical Mediterranean-style foods have been consumed less than expected in 2019 [22]. A Life Cycle Inventory analysis suggested that, while intakes of milk/yogurt and legumes were in line with the Mediterranean nutritional model, as estimated by using current dietary reference values [23], fruits, vegetables, pasta, bread, and extra-virgin olive oil showed lower (24%–51%, depending on the food item/group) intakes, compensated by higher (78%–918%) intakes of meat, and higher (580%) intakes of sugar, sweets, snacks, or alcohol-free beverages [22]. While waiting for novel findings from official nation-wide food consumption surveys [24]—the most recent one dating back to the 2005–2006 "Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione-Studio sui Consumi Alimentari in Italia" (INRAN-SCAI) [25]—a systematic review of the otherwise scattered scientific evidence on Italian dietary behavior may contribute to fill in this gap, by summarizing recent evidence in the light of the old one. As recent country-specific dietary guidelines recognized the effective use of DPs as their first evidence base [2,26], a systematic review on all and more recent DPs may contribute to inform future research on DP identification in the Italian population and the development of the next Italian dietary guidelines.

Within the movement supporting reproducible research in science [27], the current article builds on the first 2 systematic reviews on reproducibility and validity of PCA/EFA-based DPs in nutritional epidemiology [7,10] and explores the cross-study reproducibility of PCA/EFA-based DPs in a case study of epidemiological interest, which is Italy. In detail, first to our knowledge, we systematically collected existing evidence on PCA/EFA-based DPs identified in Italian free-living individuals, with a focus on the DP identification process and its consistency across included articles. We also investigated DP cross-study reproducibility, to assess whether major DPs are consistently identified within Italy, by proposing a:

1. qualitative assessment of reproducibility of all available and most recently identified DPs, as based on similarity plots built on original text descriptions and factor loadings;
2. quantitative assessment of reproducibility of subsets of DPs, as based on the CCs applied on the same list of input variables.

As a third research aim, we compared the results from the qualitative and quantitative assessments of DP reproducibility, to identify possible drivers of agreement and discrepancies. This not only informs DP assessment in the Italian population but also future research utilizing a posteriori DP identification methods. A companion article will examine whether the identified DPs, grouped according to their reproducibility, are consistently related to disease outcomes, determinants, or correlates of interest, if any, as described in the original articles included in this systematic review.

Methods

This systematic review was conducted referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [28]. The review protocol was registered in the International Prospective Register of Systematic Reviews database (registration no: CRD42022341037).

Eligibility criteria

Articles were considered eligible for inclusion if they (1) were (original) full-texts articles in peer-reviewed journals; (2) enrolled human subjects living in Italy; (3) identified DPs based on PCA and/or EFA (indicated as PCA-based, EFA-based, or PCA/EFA-based DPs in the following) on dietary data, independently of any additional analysis on health outcomes, determinants, or correlates. Articles were excluded if (1) they did not provide original data, or they were case reports, in vitro and in vivo animal studies, conference abstracts or posters; (2) the reference population lived outside Italy or, in international studies, it was not possible to distinguish the Italian-specific DPs, which are of interest in the current review; (3) results concerned single nutrients, single food items, or single food groups; (4) the term DP was used to identify dietary attitudes, perceptions, or

patterns of meals; (5) DPs were identified using the a priori approach, the mixed-type approach, or the a posteriori approach but not following PCA or EFA; (6) PCA or EFA were applied on dietary behaviors; and (7) PCA or EFA were applied on lifestyle variables, including diet, to derive lifestyle patterns (details in **Supplementary Methods**). No restrictions were imposed on year of publication, population characteristics, or participants' health status.

Search strategy

An electronic literature search was conducted in parallel by 2 authors (RB and MT) on December 21, 2022 using 3 electronic databases: MEDLINE/PubMed, Embase, and Cochrane (CENTRAL and Reviews). The search strategy used both keywords and controlled vocabulary terms around the fields of "dietary patterns," "factor analysis," "principal component analysis," and "Italy." No language filters were used. No reference was made to potential health outcomes, determinants, or correlates of interest, as far as PCA/EFA-based DPs were identifiable in Italy. Details on strings were provided in **Supplementary Methods**. We used the EndNote 20 software program (Thomson Reuters, New York, NY, USA) for the electronic management of the review process.

Article selection

After duplicates were removed, titles and abstracts of the remaining articles were screened for eligibility. Subsequently, all eligible full-text articles were retrieved, screened, and included in the systematic review when appropriate. The reference lists of the articles identified during this process were also examined by hand search to further identify potentially relevant articles. Each of the previous steps was carried out in parallel by 2 authors (RB and MT); any disagreements between reviewers were resolved by discussion and consensus with a third investigator (VE).

Data extraction

Using a predefined Excel spreadsheet, data extraction was performed independently by 2 investigators (RB and MT). Data extraction was checked by other 2 investigators (VE and MS) and a third one (MF) was involved in resolving any potential disagreement. Information extracted from each study included the following: (1) general characteristics of the studies; (2) study design; (3) dietary assessment tool used; (4) DP identification method; (5) number of DPs, proportion of variance explained, name, and composition; (6) statistical methods used to relate the identified DPs to disease outcomes/determinants/correlates, and (7) main results on the relationship between identified DPs and disease outcomes/determinants/correlates (corresponding to those statistical models adjusted for all the available confounders, if models were fitted).

The current article is focused on the description of the PCA/EFA-based DPs identified in Italy, with a focus on their identification process and on their potential cross-study reproducibility. A companion review will be focused on the relationship between identified DPs and disease outcomes/determinants/correlates, by providing details on the statistical methods used to assess this relationship.

Assessment of study quality

For each aticle that met the inclusion criteria, study quality was independently evaluated by 2 reviewers (RB and MS) by using the Quality Assessment Tools from the National Institutes of Health National Heart, Lung, and Blood Institute [29]. Any disagreements were solved by discussion and consensus with a third reviewer's grade (VE). Involved researchers used the available study rating tools on the range of items provided by each tool (range: 0–14 for cohort, cross-sectional studies, or trials; 0–12 for case–control studies) to judge each study quality [29]. To better identify mid–high-quality studies, we added an extra category, "very good," to the originally suggested "poor," "fair," and "good" [29]. We categorized total scores into 4 levels in such a way that $\geq$25% (corresponding to 3 points) of item's positive answers were included in any category. Owing to the lack of previous evidence on reproducibility of DPs in Italy, we chose not to exclude studies based on their quality. Therefore, all the retrieved studies were considered in the analyses.

Narrative synthesis and qualitative and quantitative assessments of reproducibility of DPs

We first performed a narrative synthesis of the findings from the included studies in terms of study design, population characteristics, dietary assessment tool, DP identification methods, and text description of the identified DPs. Second, we performed a qualitative assessment of the reproducibility of all available DPs, as based on similarity plots built on original text descriptions and factor loadings, when available; we referred to factor loadings to assess the relative importance of dominant food groups or nutrients, in case of very rich descriptions of DPs. Third, we performed a quantitative assessment of reproducibility of DPs, as based on the CCs calculated on the same lists of input variables. The CC ($-1 \leq CC \leq 1$) is the preferred index for measuring similarity of PCA/EFA-based DPs [30,31]. In the absence of any recent and reliable information on Italian DPs, we followed a more conservative approach than the most similar systematic review on PCA/EFA-based DPs from Japan [13]. In detail, we opted for (1) calculating CCs over smaller but more comparable groups of articles sharing the same list of input variables (i.e., either nutrients or food groups), to avoid extra subjectivity in defining a common input list and potential artifacts possibly deriving from imputation of new loadings based on the original ones [13]; (2) adopting a higher cut-off (CC: 0.85 vs. 0.80 [13]) for "fair similarity" of DPs, thereby a $0.85 \leq CC \leq 0.94$ indicates "fair similarity" [15,16] in our application; (3) adopting a specific cut-off (CC: 0.95) for "equivalence" of DPs, thereby a $CC \geq 0.95$ indicates "equivalence" [15,16]; and (4) evaluating similarity of DP pairs over the entire CC distribution and not only on the median [13]. The quantitative assessment of DP reproducibility was conducted with the R software [32] and its package "psych" [33]. When needed, corresponding authors were contacted (twice, 15 days apart per protocol) to provide or confirm information on PCA/EFA loadings that allowed to calculate CCs. Finally, we carried out a sensitivity analysis (including both a qualitative and quantitative assessment of DP reproducibility) on the most recently identified DPs (i.e., those based on dietary information collected at least in part over 2013–2022), to assess if any shifting from typical Mediterranean-style habits can be tracked.

Results

Article selection process

Figure 1 shows the PRISMA flowchart of the article selection process. The electronic literature search detected 4601 records. After 734 duplicates were removed and 3675 records were excluded by title/abstract screening, 193 full-text articles (including 1 article from the reference lists of the retrieved articles) were considered eligible for a detailed analysis. Of these, 52 (all in English language) remained after exclusion criteria were applied and were summarized in the current review [11,12,34–83]. Reasons for exclusion are described in Figure 1.

Quality assessment of the identified articles

Among the selected articles, 7 (13.5%) [57,59–62,74,82] were based on studies of "very good" quality, 35 (67.3%) [12,34–56,58,65,67,68,70,73,76,77,80,81,83] on studies of "good" quality, 8 (15.4%) [63,64,66,69,71,72,78,79] on studies of "fair" quality, and 2 (3.8%) [11,75] on studies of "poor" quality; the 2 studies of "poor" quality did not refer to any outcome and therefore lost 6 over 14 points (Supplemental Table 1 for details on the single studies). Across the different quality assessment tools, sample size justification was the item that received the highest number of "No" replies (Supplemental Figure 1).

Main characteristics of the included studies

Figure 2 summarizes study design, dietary assessment tools, disease outcomes/determinants/correlates of interest, and the DP identification process used in the 52 selected articles (Supplemental Table 2 for additional details).

Target populations covered 14 out of the 20 Italian regions, with Lombardy, Friuli Venezia Giulia, Sicily, and Campania being the most represented regions. Selected articles were published between 2001 [81] and 2022 [47,65,66,75,82,83], with 21% published by 2009 and 79% from 2010 onward. Eleven articles (21%) referred to international studies including Italy [11,47,56–58,61,62,66,70,71,80], 15 (29%) were based on Italian multicentric studies [34,36–45,65,72,82,83], and 26 (50%) recruited participants from single centers/geographic areas [35,46,48–55,59,60,63,64,67–69,73–81]. Several articles were based on the same studies, including (but not limited to) those from the (Italian) Moli-sani [48–55] (8 articles), Mamma & Bambino [63–65] (3 articles), Salus in Apulia Study [74,75] (2 articles), and "Ormoni e Dieta nell'Eziologia del Tumore della Mammella" (ORDET) [59,60] (2 articles), as well as the international programs "Dietary Patterns and Cancer" (DIETSCAN) [11,12] (2 articles where the ORDET cohort represented Italy), "European Prospective Investigation into Cancer and Nutrition" (EPIC)-Elderly [56,57] (2 articles), EPIC-InterAct [58] (1 article), and the "Seven Countries Study" [61,62] (2 articles). The most frequent study design was the prospective cohort [11,12,47,54,56,57,59–65,70,74,79,80,82,83] (19 articles, of which 8 [11,47,56,63,65,70,79,83] performed cross-sectional analyses only), followed by the cross-sectional design [46,48–53,55,66–69,71–73,75,76] (17 articles), and by the case–control [34–45,81] (13 articles) one. As to the target population, 24 articles included general (males and females) adults [35–40,43–46,48–55,58,73,74,77,78,81], 3 articles included men only [41,61,62], 15 included women only [11,12,34,42,59,60,63–68,72,82,83], of which 6 were based on pregnant or breastfeeding women [63–65,72,82,83]. In addition, elderly [56,57,75,79,80], children/adolescents [47,69,70,76] and the entire household (0–75 years) [71] were considered in another 10 articles (Figure 2).

Dietary assessment

Italian dietary habits were generally assessed once, at recruitment, with a single tool and they referred to the 1965 [61,62] to 2022 [65] period. With few exceptions [47,71,78], interviewer-administered [34–46,63–68,70,72,77,83] or self-administered [11,12,48–55,59,60,69,73–75] food frequency questionnaires (FFQs) were mostly adopted (Supplemental Table 2 and Figure 2). In most studies, the FFQ reference period was either 1 [11,12,56–60,73–75,77,81] or 2 [34–45] years; shorter reference periods were mainly related to recordings during pregnancy or lactation [63–65,72,82,83]. With the exception of 2 articles [81,83], most of the FFQs were reported to be reproducible and/or valid, or based on previously validated tools. The number of food items investigated in the FFQs ranged from 31 [74] to 217 [56,57] (median: 95 items), with 48% of the FFQs showing >100 items (Supplemental Table 2).

DP identification

DPs were identified on nutrients in 18 articles [34–47,72,77,78,81] and on food groups in 33 articles [11,12,48–71,73–76,79,82,83], with one article using both input data [80] (Figure 2 and Supplemental Table 3). Selected nutrients ranged from 10 [80] to 37 [47] (median: 28 nutrients) and selected food groups from 8 [80] to 57 [56,57] (median: 37 food groups) (Supplemental Table 3). Among included articles, 10 performed PCA and 41 performed EFA, whereas one article [62] performed both; EFA was generally applied using the PCA method. Most analyses preprocessed input data, especially by using standardization. The number of components/factors to retain was mostly defined through a combination of 2 (8 articles) or 3 (35 articles) criteria including: eigenvalue>1 or 2, Scree-plot construction (or percentage of variance explained), or component/factor interpretability. Varimax rotation was the preferred orthogonal rotation method, and it was applied in 45 articles (Figure 2). Most articles adopted a quantitative labeling of components/factors, referring to cut-offs ranging from 0.1 [75] to 0.63 [34–46,72,77] in absolute value (median: 0.30, Supplemental Table 3).

Checks on matrix factorability prior to EFA were proposed in 17 articles (~33%) [35–47,72,76–78], of which 15 conducted by the same research team [35–47,72,77]. Similarly, the same research group assessed internal consistency of DPs with Cronbach's alpha in 14 articles (~27%) [35–47,72]. Finally, 28 articles (~54%) assessed internal reproducibility of DPs by using different statistical approaches [10]. Although most of them referred to the split-half approach, different EFA estimation procedures or factor score calculations were also compared [34–55,61,62,64,67,72]. Two articles assessed cross-study reproducibility [7] of DPs [70,71], whereas another 2 [11,58] assessed both internal and cross-study reproducibility of DPs (Figure 2 and Supplemental Table 3).

The number of DPs described in each article ranged from 2 to 6 (food-based DPs: 2–6, nutrient-based DPs: 3–5), with a median of 4 DPs per article. When reported, the percentage of total

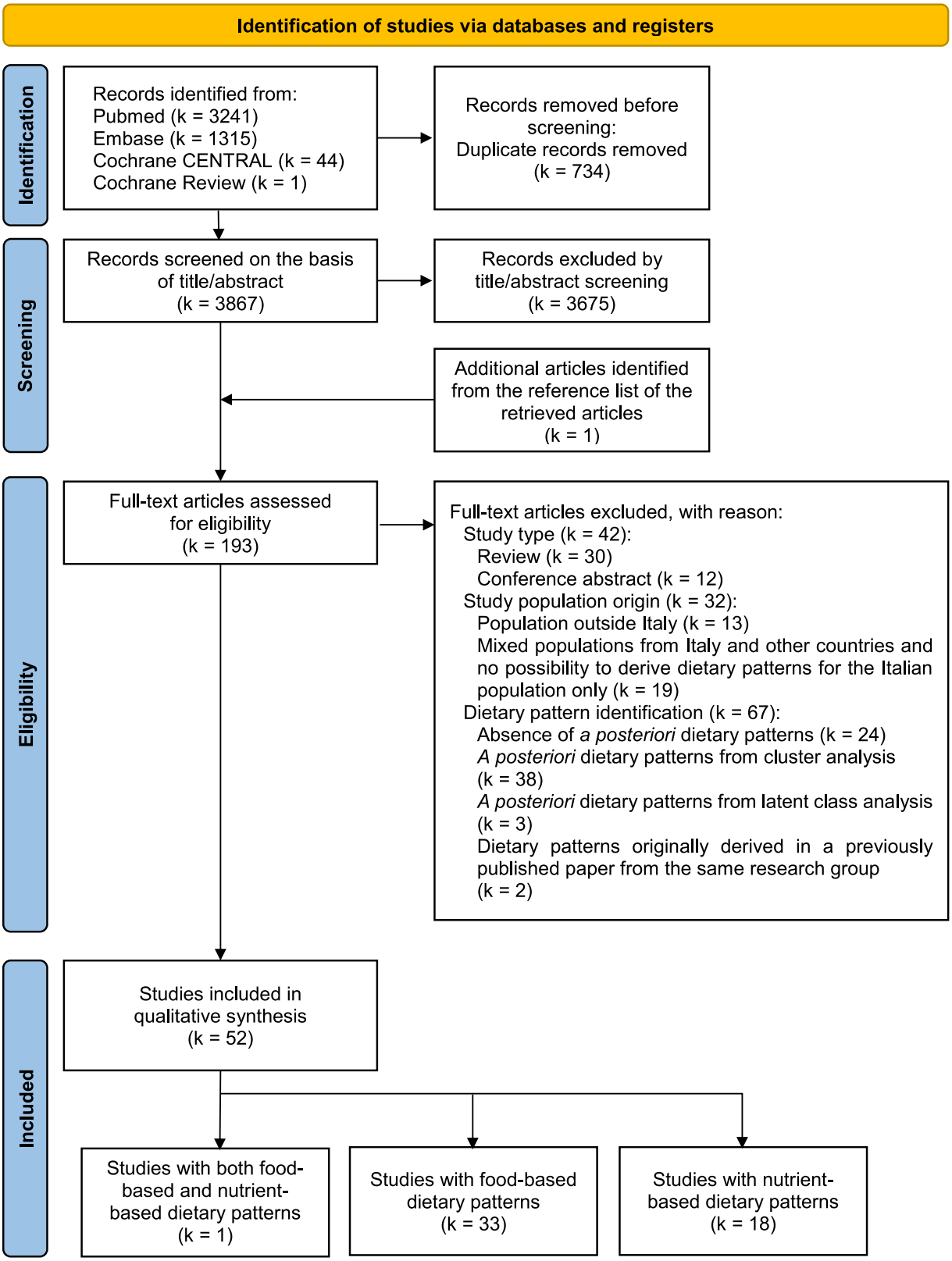


FIGURE 1. Flow diagram of the study selection process [28]. EMBASE, Excerpta Medica Database; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

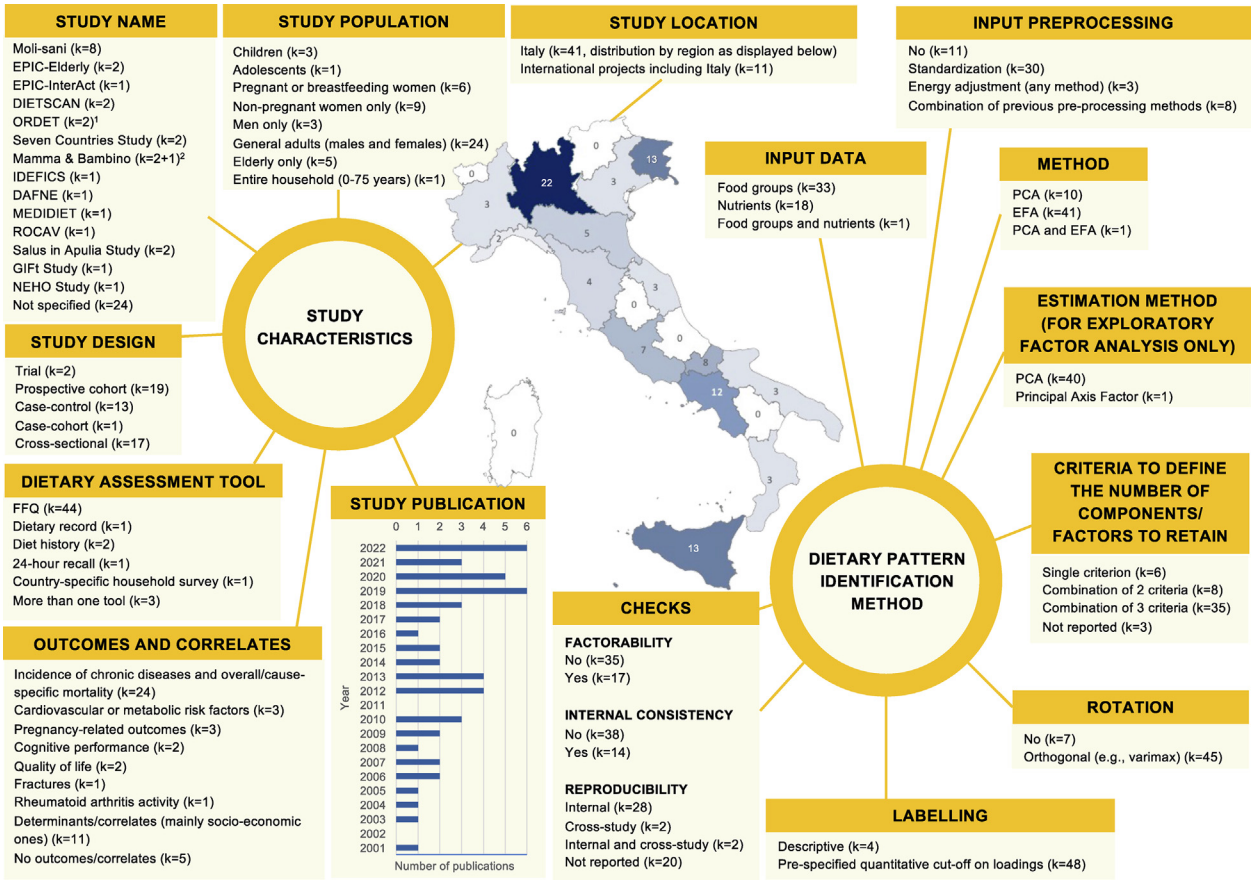


FIGURE 2. General characteristics of the studies included in the systematic review and main steps in the dietary pattern identification process: a summary of findings from the systematic review. DAFNE, Data Food Networking; DIETSCAN, Dietary Patterns and Cancer; EFA, exploratory factor analysis; EPIC, European Prospective Investigation into Cancer and Nutrition; FFQ, food frequency questionnaire; GIFt, gestational intake of food toward healthy outcomes; IDEFICS, Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS; NEHO, Neonatal Environment and Health Outcomes; ORDET, Ormoni e Dieta nell'Eziologia del Tumore della Mammella; PCA, Principal Component Analysis; ROCAV, Risk Of Cardiovascular diseases and abdominal aortic Aneurysm in Varese. [1]The DIETSCAN project included one Italian cohort – the ORDET one – which recruited women only and it was therefore classified as "nonpregnant women only" instead of "general adults (males and females)".[2]The Mamma & Bambino birth cohort was also pooled together with MAMI-MED in another study (Magnano San-Lio et al. [65]).

variance explained by the retained components/factors varied from 6.6% (3 factors, 46 food groups) [55] to 82% (2 factors, 17 food groups) [61,62], with a median percentage of 45.5%. Seventeen articles showed percentages over 75%, with most of them (15 articles) identifying nutrient-based DPs (Supplemental Table 3).

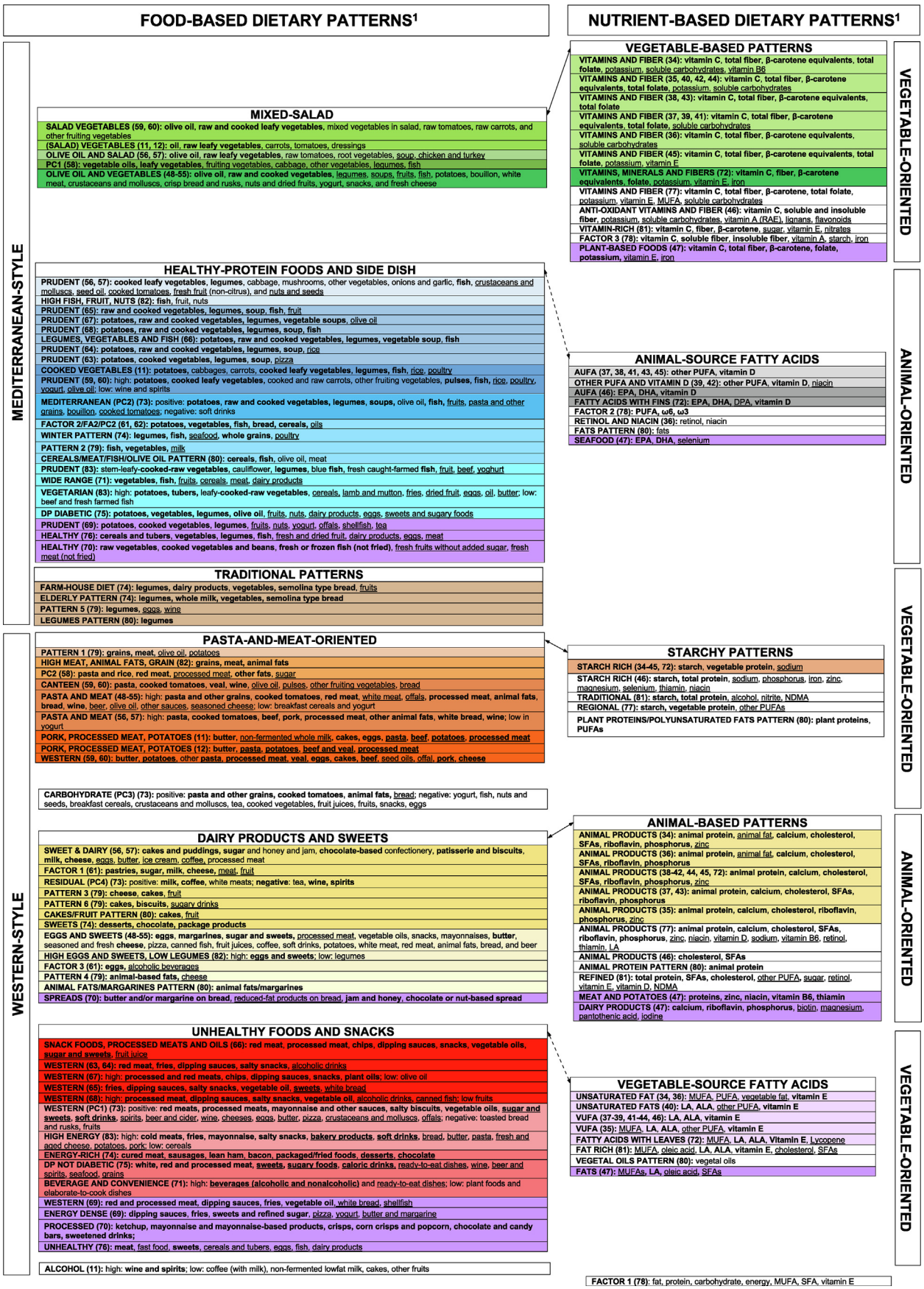
Qualitative assessment of DP reproducibility: original descriptions

Overall, 186 DPs were identified across all the included articles (food-based DPs: 102; nutrient-based DPs: 84). Except for 15 DPs without any label, the matching of the remaining 171 DPs on original names allowed to identify DPs named as "Vitamins and Fiber" (14 articles, from case–control studies on diet and cancer), "Starch-rich" (13 articles, from case–control studies on diet and cancer), "Animal Products" (13 articles, from case–control studies on diet and cancer), "Prudent" (11 articles, from a research group from Sicily, EPIC-Elderly, ORDET, and "Neonatal Environment and Health Outcomes" birth cohort), "Pasta and Meat" (10 articles, from Moli-sani and EPIC-Elderly), "Western" (9 articles, from a research group from Sicily, ORDET, and "Risk Of Cardiovascular diseases and abdominal aortic Aneurysm in Varese"), "Eggs and Sweets" (8 articles, from Moli-sani), "Olive Oil and Vegetables" (8 articles, from Moli-sani), as well as "Animal Unsaturated Fatty Acids" ("AUFA") and "Vegetable Unsaturated Fatty Acids" ("VUFA") (7 and 5 articles, respectively, from case–control studies on diet and cancer) (Supplemental Table 3).

To compensate for subjective DP labeling, we referred to text descriptions and loadings in original articles to collapse in Figure 3 the 186 identified DPs (expressed with original names) into 113 apparently different DPs (39.3% total reduction), of which 69 were food-based and 44 were nutrient-based DPs.

Food-based DPs

We organized the 69 food-based DPs into "Mediterranean-style" and "Western-style" macro-areas (Figure 3). The Mediterranean-style macro-area included 3 different groups of DPs that we defined as "Mixed-Salad," "Healthy-Protein Foods and Side Dish," and "Traditional" DPs. The "Mixed-Salad" group (in green) included DPs based on olive oil, raw (and sometimes cooked) vegetables (DPs named "Salad Vegetables") [11,12,59,60], with additional presence of legumes and fish [58], soup and



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turkey in the EPIC-Elderly study [56,57], and further inclusion of fruits and potatoes in the Moli-sani study [48–55]. The "Healthy-Protein Foods and Side Dish" group (in blue) included DPs based on the presence of at least one source of healthy proteins (i.e., fish, poultry, nuts, and/or legumes) and a side dish represented mainly by cooked vegetables [56,57,65,70,79], potatoes and/or grains [74,80], or a combination of them [11, 59–64,66–69,73,76]. In addition, fruit loaded high on a "Prudent"-like DP in 5 articles [56,57,65,73,82], one of which just expressed fish, nuts, and fruit [82]. Four DPs of the "Healthy-Protein Foods and Side Dish" group presented a wider range of components in adults [71,75,83] or children/adolescents [69, 70,76]. The DPs included in the "Traditional" group (in brown) characterized elderly populations from Apulia and Calabria (southern Italy) and shared consumption of legumes [80], integrated with semolina-type bread, dairy products, and other vegetables [74], or eggs and wine [79].

The "Western-style" macro-area included the "Pasta-and-Meat oriented," "Dairy Products and Sweets," and "Unhealthy Foods and Snacks" groups of patterns. The "Pasta-and-Meat-oriented" group (in orange) included DPs loading high on grains (e.g., pasta and/or rice), (red) meat, and animal fats [11, 12,48–60,82]. Additional dominant food groups were cooked tomatoes, (white) bread, and wine [48–57,59,60]. The "Dairy Products and Sweets" group (in yellow) included DPs loading high on sweets [74,79,80], dairy products [73,79] or spreads [80], and eggs [61], or a combination of them [48–57,61,70,79, 82]. The "Unhealthy Foods and Snacks" group (in red) included DPs loading high on processed foods, like snacks or salty snacks, dipping sauces, deli meats (including cold cut, cured meat, sausages, bacon, lean ham), desserts or sugary/soft drinks, and ready-to-eat dishes, as identified in adults (including pregnant women), or children/adolescents [63–71,73–76,83]. In addition, 5 DPs of this group also included alcoholic beverages [63, 64,68,71,73,75].

Although alcoholic beverages have been previously identified in the "Traditional," "Pasta-and-Meat-oriented," and "Unhealthy Foods and Snacks" groups as consumed at mealtime, one article identified an "Alcohol" DP alone, likely because the DIETSCAN project provided DPs based on a parallel analysis of international studies [11].

Nutrient-based DPs

Apart from a single DP [78] representing the overall diet, we organized the 44 nutrient-based DPs into the "Animal-oriented" and "Vegetable-oriented" macro-areas (Figure 3). The "Animal-oriented" macro-area included 2 different groups of DPs, "Animal-based Patterns" and "Animal-source Fatty Acids". Within the "Animal-based Patterns" group (in yellow) the "Animal Products" DP was characterized in most articles by animal protein, calcium, cholesterol, SFAs, riboflavin, phosphorus, and zinc [38–42,44,45,72]; based on a different classification of fats, 2 articles [34,36] additionally showed animal fat in the "Animal Products" DP. Although 3 DPs showed a richer DP composition in adults ("Animal Products" DP [77]) and children ("Dairy products" and "Meat and Potatoes" DPs[47]), another 2 were poorly characterized [46,80]. Finally, the "Refined" DP [81] suggested shifting toward more processed foods.

Within the "Animal-source Fatty Acids" group (in gray), most DPs from the same research group were labeled "AUFA" and were mainly characterized by vitamin D and other PUFAs [37, 38,41,43,45]. In another 3 articles, eicosapentaenoic acid, docosahexaenoic acid [46,47], and/or docosapentaenoic acid [72], omega-3 and omega-6 [78] were found as dominant nutrients, due to a different classification of fats. Three additional articles also included niacin among the "AUFA" DP-based dominant nutrients [36,39,42], of which one included niacin and retinol only [36].

The "Vegetable-oriented" macro-area included 3 different groups of DPs that we defined as "Vegetable-based Patterns," "Vegetable-source Fatty Acids," and "Starchy Patterns". Within the "Vegetable-based Patterns" group (in green), most DPs from the same research group were labeled "Vitamins and Fiber" and were all characterized by vitamin C, total fiber, and β-carotene equivalents; additional dominant nutrients were total folate, potassium, vitamin B6, vitamin E, and soluble carbohydrates, alone or in combination [34–45]. In other articles, additional dominant nutrients included MUFAs, iron, nitrates, lignans, vitamin A, flavonoids, starch, or a combination of some of them [46,47,72,77,78,81].

Within the "Vegetable-source Fatty Acids" group (in lilac), most DPs from the same research group were labeled "VUFA" and were all characterized by linoleic acid, α-linolenic acid, and vitamin E [37–39,41–44,46]. Pregnant women additionally loaded high on MUFAs and lycopene [72]. A different classification of fats allowed to identify vegetable fat as an additional dominant nutrient in 2 articles from the same research group [34,36]. The joint presence of vegetable and animal sources of fatty acids mainly characterized the "Unsaturated Fats" [40], the "VUFA" [35], and the"Fat-rich" [81] DPs in adults, as well as the "Fats" DP in children [47]. Finally, 1 article identified a "Fats Pattern" but did not provide further specification on the type of fats; however, the presence of a "Vegetal Oil Pattern" in the same article allowed us to interpret the former "Fats Pattern" as belonging to the "Animal-source Fatty

FIGURE 3. Qualitative assessment of reproducibility for all the available dietary patterns: dietary patterns identified using principal component analysis or exploratory factor analysis in Italy from 1965 to 2022, in groups based on original text descriptions and loadings. ALA, α-linolenic acid; AUFA, animal unsaturated fatty acids; DHA, docosahexaenoic acid; DP, dietary pattern; DPA, docosapentaenoic acid; EPA, eicosapentaenoic acid; FA, factor analysis (factor name from original articles); LA, linoleic acid; NDMA, N-nitrosodimethylamine; PC, principal component (analysis) (principal component names from original articles); RAE, retinol activity equivalent; VUFA, vegetable unsaturated fatty acids.

[1]Dietary patterns that look similar (based on original loadings and text description) were placed one close to the other and consistently indicated with the same color code. When dietary patterns were virtually identical, we synthetized them as one cell. Dietary patterns left in white were too far from the others to be indicated with a color code. Variants of the same color indicate different subgroups of dietary patterns within the same group, with loadings showing modest but nutritionally relevant differences across color-specific subgroups.

Results were separately displayed for food-based (left) and nutrient-based (right) patterns and for adults and children/adolescents (consistently indicated in violet). Food-based and nutrient-based patterns were juxtaposed based on correlation coefficients between nutrient-based dietary patterns and selected food groups, as provided in most of the original articles. Arrows linking the different groups indicate stronger (solid line) and weaker (dashed line) similarities between food-based and nutrient-based dietary patterns.

Acids" group and the latter "Vegetal Oil Pattern" as belonging to the "Vegetable-source Fatty Acids" group [80].

Within the ""Starchy Patterns" group (in orange), the "Starch-rich" DPs from the same research group were all characterized by starch, vegetable protein, and sodium [34–45,72]; additional nutrients included various minerals and vitamins [46], as well as PUFAs/other PUFAs [77,80]. Similarly, the "Traditional" DP from Tuscany included nitrites, alcohol, and N-nitrosodimethylamine, together with starch and total protein [81].

Food-based and nutrient-based DPs: an overall picture

Based on correlation coefficients between nutrient-based DPs and selected food groups provided in the original articles [38–45], we identified similarities between the following groups of nutrient-based and food-based DPs (Figure 3, solid line):

1. "Mixed-Salad" and "Vegetable-based Patterns,"
2. "Pasta-and-Meat-oriented" and "Starchy Patterns,"
3. "Dairy Products and Sweets" and "Animal-based Patterns."

Similarities were less clear between the "Healthy-Protein Foods and Side Dish" and "Animal-source Fatty Acids" groups and the "Unhealthy Foods and Snacks" and "Vegetable-source Fatty Acids groups", respectively (Figure 3, dashed line). As the "AUFA" DP showed fish together with red meat, liver, unspecified seed oil, olive oil, and eggs (ordered according to frequency), it generally showed a healthy source of proteins, but no side dishes. Food groups correlated with the "VUFA" DP included unspecified seed oils, together with red meat, specified seed oil, and olive oil, which might target fried foods potentially present in the "Unhealthy Foods and Snacks" group, but other relevant food groups (i.e., processed meat, soft drinks, or sugar and candies) did not show up.

Quantitative assessment of DP reproducibility: congruence coefficients

Globally, 215 CCs were calculated across 68 apparently similar DPs identified in the 18 articles that used the same lists of input variables (68/186=36.6% reduction in DPs, 18/52=~35% selected articles whose details are provided in Supplemental Table 4). All CCs suggested "fair similarity" of DPs and 80.9% suggested DP "equivalence." When collapsing DPs based on "fair similarity," the 68 DPs under evaluation ended up into 13 genuinely different DPs, 6 of which were due to the different input data lists used in the Moli-sani study [49–51,53–55]; when collapsing DPs based on "equivalence," 30 DPs ended up into 6 genuinely different DPs (with 2 "Pasta and Meat" DPs from the Moli-sani study [49–51,53–55]) (80% total reduction).

Separate summary statistics of CCs by research group and DP labels are provided in Table 1 [11,12,35,37–45,49–51,53–55,59,60,63–68,74,75,79,80] and corresponding "equivalent" DPs are summarized in Figure 4 [35,37–45,49–51,53–55,66,67]. Within the 10 available multicentric case–control studies on diet and cancer at different sites [35,37–45], the "Animal Products" and the "Vitamins and Fiber" DPs consistently showed "equivalence," as the minimum of the CC distributions already reached 0.95; the "AUFA" DP showed "equivalence" in ≥75% of its CCs (first quartile of CCs: 0.96), whereas the "Starch-rich" and the "VUFA" DPs were "equivalent" in ≥50% of the corresponding CCs (median of CCs: 0.98 and 0.96, respectively). Within the 6 available articles from the Moli-sani study [49–51,53–55], the "Olive Oil and Vegetables," "Eggs and Sweets," and "Pasta and Meat" DPs were separately compared across 4 articles considering 43 food groups [49–51,53] and 2 articles considering 46 food groups [54,55]. In the former comparison, the "Pasta and Meat" DP consistently showed "equivalence" (minimum CCs ≥ 0.95), the "Olive Oil and Vegetables" DP showed "equivalence" in 75% of its CCs (first quartile of CCs = 0.95) and the "Eggs and Sweets" DP showed "equivalence" in ≥25% of the corresponding CCs (third quartile of CCs = 0.98) [49–51,53]. In the latter comparison, the same 3 pairs of DPs were equivalent [54,55] (see Supplemental Tables 5 and 6 for details). Within 2 companion articles of a research group from Sicily [66,67], pairs of similar DPs did not reach "equivalence" (Table 1 and Figure 4) [11,12,35,37–45,49–51,53–55,59,60,63–68,74,75,79,80].

When integrating corresponding nutrient- and food-based DPs, the "Vitamins and Fiber"/"Olive Oil and Vegetables" DPs were equivalent in 98% of the CCs, the "Animal Products"/"Eggs and Sweets" DPs in 92% of the CCs, and the "Pasta and Meat"/"Starch-rich" DPs in 71% of the CCs.

Qualitative and quantitative assessment of DP reproducibility: a comparison

In the comparison between Figures 3 and 4 [35,37–45,49–51,53–55,66,67], we observed that:

1. For the "Animal Products" and "Vitamins and Fiber" DPs, different cells in Figure 3 were indicated to be all "equivalent" based on CCs, so nuances in Figure 3 did not end up into genuinely different DPs in Figure 4 [35,37–45,49–51,53–55,66,67];
2. For the "AUFA" DP, ~76% of CCs pointed to "equivalence," with all the "fairly similar" evaluations related to the bladder cancer study [45]; however, the 2 cells identified in Figure 3 did not reflect this finding, as the "AUFA" DP for bladder cancer was not separate from all the other DPs and "equivalence" was identified between bladder and esophageal cancers [39,45], whose DPs, however, were in 2 different cells;
3. For the "Starch-rich" DP, the same 3 dominant nutrients—represented with 1 cell in Figure 3—ended up into an "equivalent" DP in 67% of the CCs only, with all "fairly similar" evaluations given by gastric and bladder cancer studies [35,45];
4. For the "VUFA" DP, ~61% of CCs pointed to "equivalence," with all the "fairly similar" evaluations related to the pancreatic and gastric cancer studies (which also showed "equivalence" between the corresponding "VUFA" DPs); this finding was reflected in part by Figure 3, where gastric- and pancreatic-cancer-related DPs [35,40] were in different cells compared with the other "VUFAs", but not in the same cell;
5. For the "Pasta and Meat" and "Olive Oil and Vegetables" DPs on both available food-group lists, the DPs presented in Figure 3 were materially confirmed, as all CCs suggested "equivalence," except for 1 in the "Olive Oil and Vegetables" DP on the 43 food groups [49–51,53];
6. For the "Eggs and Sweets" DP, the DP presented in Figure 3 was confirmed on the 46 food groups [54,55], but not on the 43 food groups [49–51,53], where only 33% of CCs suggested

TABLE 1
Quantitative assessment of dietary pattern reproducibility for those dietary patterns identified on the same list of input variables: summary statistics on congruence coefficients[1] between loadings of pairs of apparently similar dietary patterns[2]

Multicentric case–control studies on diet and cancer at several sites, articles presenting the same list of 28 nutrients as input variables [35,37–45]						
Nutrient-based dietary pattern	Number involved articles	Minimum	First quartile	Median	Third quartile	Maximum
Animal Products	10	0.95	0.98	0.99	0.99	1.00
Vitamins and Fiber	10	0.95	0.97	0.98	0.99	0.99
Starch-rich	10	0.88	0.93	0.98	0.99	1.00
Animal Unsaturated Fatty Acids (AUFA)[3]	7	0.91	0.96	0.97	0.98	0.99
Vegetable Unsaturated Fatty Acids (VUFA)[4]	9	0.88	0.93	0.96	0.97	0.99
Moli-sani study, articles presenting the same list of 43 food groups as input variables [49–51,53]						
Food-based dietary pattern	Number involved articles	Minimum	First quartile	Median	Third quartile	Maximum
Olive Oil and Vegetables	4	0.94	0.95	0.95	0.98	1.00
Pasta and Meat	4	0.97	0.97	0.98	0.99	1.00
Eggs and Sweets	4	0.92	0.93	0.94	0.98	1.00
Moli-sani study, articles presenting the same list of 46 food groups as input variables [54,55]						
Food-based dietary pattern	Number involved articles			Congruence coefficient		
Olive Oil and Vegetables	2			0.98		
Pasta and Meat	2			0.98		
Eggs and Sweets	2			0.97		
Research group from Sicily, articles presenting the same list of 39 food groups as input variables [66,67]						
Food-based dietary pattern	Number involved articles			Congruence coefficient		
Snack foods, processed meats and oils/Western[5]	2			0.91		
Legumes, vegetables and fish/Prudent	2			0.90		

[1] Congruence coefficients range between 0 and 1 (in absolute value), with values between 0.85 and 0.94 indicating fair similarity, and values ≥0.95 indicating equivalence of corresponding dietary patterns.

[2] Dietary patterns identified within the ORDET cohort [11,12,59,60] were not compared one to the other because the full list of factor loadings was not available anymore from the corresponding authors, we were in contact with; similarly, dietary patterns identified in most articles from the research group from Sicily [63–65,68] were not compared because the full list of factor loadings was not available anymore from the corresponding authors; upon contact with the corresponding author, we were able to confirm that dietary patterns obtained from 2 articles from Calabria [79,80] were identified by using exactly the same study population and therefore the comparison is meaningless; finally, dietary patterns obtained from 2 articles from the Salus in Apulia Study [74,75] were not compared because the number of food groups was different across articles.

[3] Three articles [35,40,44] did not contribute to the congruence coefficient-based analyses as the Animal Unsaturated Fatty Acids dietary pattern was not identified in those articles; among the dietary patterns here named Animal Unsaturated Fatty Acids, the 2 from [39,42] were originally named Other PUFAs and Vitamin D.

[4] One article [45] did not contribute to the congruence coefficient-based analyses as the Vegetable Unsaturated Fatty Acids dietary pattern was not identified in that article; among the dietary patterns here named Vegetable Unsaturated Fatty Acids, the one from [40] was originally named Unsaturated Fats.

[5] Minor inconsistencies were detected in the names of the food groups across the 2 articles. In the current analysis, vegetable oils in [66] was considered equivalent to plant oil in [67]; sugar, sweets in [66] was considered equivalent to sweet and processed sugar in [67].

"equivalence" between DPs with the same name; most differences were related to the DPs identified for the nutrition knowledge and mass media exposure [50,51] articles, which were, however, "equivalent";

7. The 2 DPs from the research group from Sicily [66,67] were indicated in different cells in Figure 3 and were consistently indicated as "fairly similar" in Table 1 [11,12,35,37–45,49–51,53–55,59,60,63–68,74,75,79,80].

Sensitivity analysis: qualitative and quantitative assessments of reproducibility for the most recently identified DPs

Twenty articles identified PCA/EFA-based DPs on dietary habits collected in Italy during 2013 to 2022. Among these, 4 (20%) recruited children, adolescents, or university students [47,69,76,78], 6 (30%) considered pregnant/breastfeeding women [63–65,72,82,83] and 3 (15%) nonpregnant women of ~40 years attending clinical laboratories from Sicily [66–68]; in addition, 4 (20%) recruited elderly [73,75,79,80]. Middle-aged adults of both sexes were available in 3 studies only (15%), of which each sample included at least in part subjects with a disease [45,46,77]. Figure 5 shows the 68 most recently identified DPs collapsed into 65 apparently different DPs (4.4% total reduction), of which 38 were food-based and 27 were nutrient-based DPs. In the comparison between Figures 3 (i.e., all existing DPs) and 5 (i.e., most recently identified ones), the most striking differences that we observed were:

1. The "Mixed-Salad" group was no longer present in Figure 5 (100% reduction);

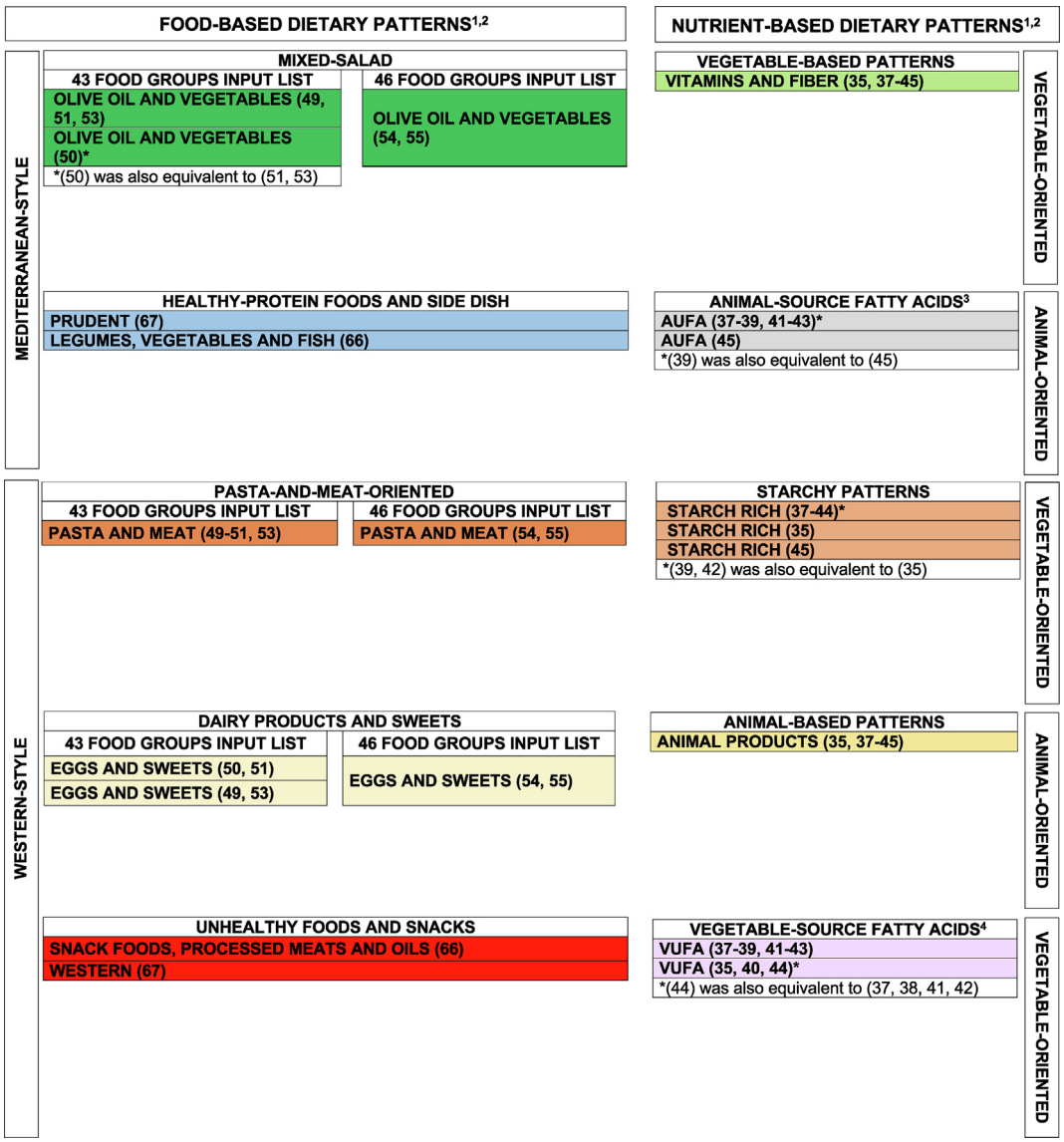

FIGURE 4. Quantitative assessment of reproducibility for those dietary patterns identified on the same list of input variables: dietary patterns identified using principal component analysis or exploratory factor analysis in Italy from 1991 to 2017 and evaluated to be equivalent. AUFA, animal unsaturated fatty acids; VUFA, vegetable unsaturated fatty acids.

[1]Each cell included only equivalent dietary patterns, as expressed by all available congruence coefficients.

[2]Congruence coefficients were computed within groups of dietary patterns presenting the same list of input variables [49–51,53] and, separately, [54,55] for the "Mixed-Salad," the "Pasta-and-Meat-oriented," and the "Dairy Products and Sweets" groups, due to different lists of food groups; [66,67] for the "Unhealthy Foods and Snacks" and the "Healthy-Protein Foods and Side Dish" groups; [35,37–45] for the "Vegetable-based Patterns" group; [37–39,41–43,45] for the "Animal-source Fatty Acids" group; [35,37–45] for the "Starchy Patterns" group; [35,37–45] for the "Animal-based Patterns" group; [35,37–44] for the "Vegetable-source Fatty Acids" group. Results were separately displayed for food-based (left) and nutrient-based (right) patterns. Food-based and nutrient-based patterns were juxtaposed based on correlation coefficients between nutrient-based dietary patterns and selected food groups, as provided in most of the original articles.

[3]Among the dietary patterns here named "AUFA", the 2 from [39,42] were originally named "Other PUFAs and Vitamin D."

[4]Among the dietary patterns here named "VUFA", the one from [40] was originally named "Unsaturated Fats."

2. The "Pasta-and-Meat-oriented" group showed a 78% reduction;
3. The "Traditional," the "Vegetable-source fatty Acids," and the "Vegetable-based Patterns" groups showed a 50% reduction;
4. The "Starchy Patterns," the "Unhealthy Foods and Snacks," and the "Animal-source Fatty Acids" groups showed at most a 25% reduction.

Discussion

The present systematic review provides a first summary of the evidence on identification methods and reproducibility of PCA/EFA-based DPs across Italian studies. Based on 52 articles published between 2001 and 2022, the included studies collected dietary habits in the 1965–2022 period and mainly derived DPs

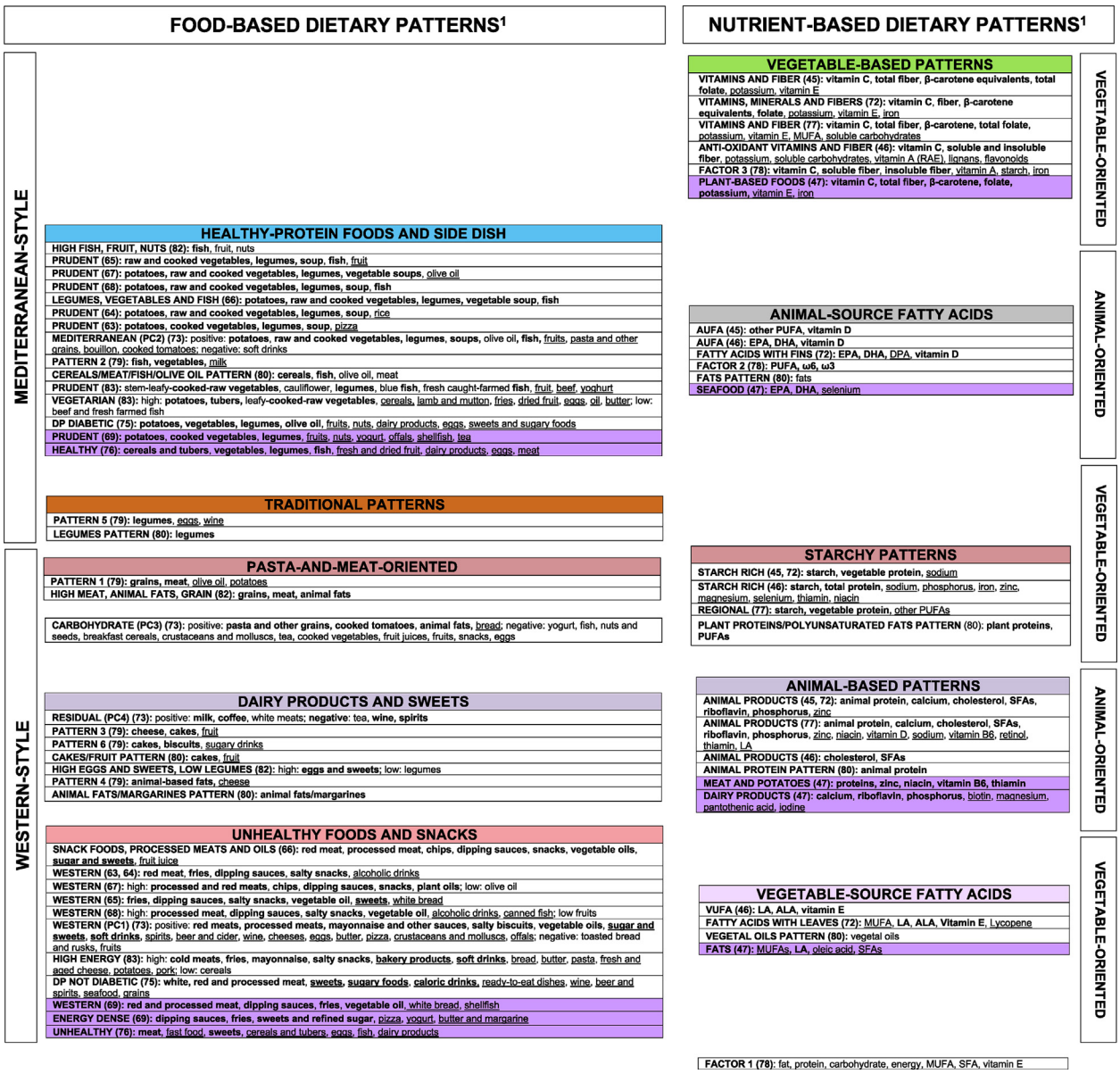

FIGURE 5. Sensitivity analysis: qualitative assessment of reproducibility for the most recently identified (i.e., latest 10 years of dietary data collection) dietary patterns—dietary patterns identified using principal component analysis or exploratory factor analysis in Italy from 2013 to 2022, in groups based on original text descriptions and loadings. ALA, alpha-linolenic acid; AUFA, animal unsaturated fatty acids; DHA, docosahexaenoic acid; DP, dietary pattern; DPA, docosapentaenoic acid; EPA, eicosapentaenoic acid; LA, linoleic acid; PC, principal component (analysis) (principal component names from original articles); RAE, retinol activity equivalent; SFA, saturated fatty acid(s); VUFA, vegetable unsaturated fatty acids.

[1]Dietary patterns that look similar (based on original loadings and text description) were placed one close to the other. When dietary patterns were virtually identical, we synthetized them as one cell.

Results were separately displayed for food-based (left) and nutrient-based (right) patterns and for adults and children/adolescents (consistently indicated in violet). Food-based and nutrient-based patterns were juxtaposed based on correlation coefficients between nutrient-based dietary patterns and selected food groups, as provided in most of the original articles.

with EFA applied over food groups obtained from FFQ-based information. Within the qualitative assessment of DP reproducibility by using similarity plots (based on original text descriptions and loadings), we identified similarities across food-based and nutrient-based groups of DPs, i.e., between the "Mixed-Salad" and "Vegetable-based Patterns" groups, between the "Pasta-and-Meat-oriented" and "Starchy Patterns" groups, and between the "Dairy Products and Sweets" and "Animal-based Patterns" groups. Within the quantitative assessment of DP reproducibility by using CCs (215 CCs comparing pairs of DPs among the 68 DPs identified in 18 articles which referred to the same input data lists), pairs of DPs indicated with the same/similar names were all "fairly similar" and ~81% of them were "equivalent." Among them, the "Vitamins and Fiber"/"Olive Oil

and Vegetables" DPs were equivalent in 98% of the CCs, the "Animal Products"/"Eggs and Sweets" DPs in 92% of the CCs, and the "Pasta and Meat"/"Starch-rich" DPs in 71% of the CCs.

The lack of a standardized approach to DP identification, the subjective labeling of DPs, and a generally poor information reporting have severely limited the ability to genuinely assess reproducibility of a posteriori DPs in different study populations from the same country [9,13,84]. This is especially critical nowadays for Italy, where the most recent nation-wide survey dated back to the INRAN-SCAI 2005–2006 [25]. The current review may provide support to either of these issues, by popularizing the good practice of assessing factorability, internal consistency, and internal reproducibility of identified DPs [10], by highlighting difficulties in using qualitative criteria for DP comparison, and by proposing a quantitative evaluation of reproducibility based on CCs.

Checks on matrix factorability allow to assess if the correlation structure is amenable to PCA/EFA [85]. They are especially useful in food-based PCA/EFA, because the correlation structure is generally weaker. Although they are available in standard statistical software, their use must be increased, to avoid meaningless applications of PCA/EFA. Additional checks on DP internal reproducibility beyond the easiest split-half approach may reassure on their similarity under different statistical options, thus unrevealing the role of subjective decisions in the final PCA/EFA solution [85].

Although DPs are frequently named following a quantitative cut-off applied after rotation, their labeling is still very subjective. In addition, as the label generally needs to be short, often names do not adequately convey to what the underlying principal component/factor is [6]. This was evident in our systematic review, where DPs with the same names did not show such a similar dietary composition, and DPs with similar loadings were given different names. We therefore provided the reader with Figure 3**,** which summarized the 186 identified DPs into 113 apparently different ones**,** based on original text descriptions and loadings. However, Figure 3 is not as effective in synthesizing Italian dietary behavior as one would expect. This is due in part to the need of integrating nutrient-based and food-based DPs in the same picture; although each of the 2 options has its pros and cons (2), matching of food-based and nutrient-based DPs is an extra step of analysis that requires subjective decisions. In addition, within each group, so many likely similar DPs (e.g., those identified by different nuances of the same color) still needs to be somehow summarized, to distinguish true differences from negligible ones or artifacts/noise.

To compensate for these issues, we proposed to quantify with the CCs [14,15,84] similarities between DPs provided in articles that are based on the same list of input variables. In the absence of any recent and reliable information on Italian DPs, we followed the strictest possible approach and provided the reader with benchmark CCs representing the same lists of input variables. In the current systematic review, however, individual research teams did generally adopt the same list of input variables across multiple articles. Therefore, while starting from the same list of variables, we obtained companion study designs, similar inclusion criteria, and dietary assessment tools, a similar preprocessing of input data, and similar DP identification methods. This is what it is reasonable to expect when the same research team develops experience in the application of the same approach over time; however, we could not separate out the contribution of study design and statistical analysis to the cross-study reproducibility of the corresponding DPs.

In this very conservative set-up, we were able to collapse the 68 DPs under evaluation into 13 genuinely different DPs. Although based on ~35% of included articles only, we believe that the "Vitamins and Fiber/Olive Oil and Vegetables" DPs, the "Animal Products"/"Eggs and sweets" DPs, and the "Pasta and Meat"/"Starch-rich" DPs do effectively summarize the overall Italian dietary behavior expressed in the studies under evaluation in this part of the analysis.

The qualitative assessment added nuances to the quantitative-based representation of the Italian diet. In detail, we identified 3 groups of DPs that we named "Mixed-Salad"/"Vegetable-based Patterns," "Pasta-and-Meat-oriented"/"Starchy Patterns," and "Dairy Products and Sweets"/"Animal-based Patterns." In line with foods typical of the Mediterranean diet, the "Mixed-Salad" or "Vegetable-based Patterns" groups are composed by DPs loading high on raw vegetables and olive oil, with fruit also contributing strongly to the "Vegetable-based Patterns" group. The "Pasta-and-Meat-oriented"/"Starchy Patterns" groups represent the internationally known Italian diet, based on main courses like lasagna, Bolognese pasta, and stuffed pasta; this DP could also encompass pasta/rice eaten at lunch and meat eaten at dinner, together with bread and wine. Finally, the "Dairy Products and Sweets"/"Animal-based Patterns" groups capture the use of cheese, milk, eggs, and sweets, with red and processed meat, butter/margarine, and mayonnaise loading also high on the "Dairy Products and Sweets" group.

Based on 3-day dietary records, the most recent available nation-wide survey INRAN-SCAI 2005–2006 [25] had confirmed results from older surveys that emphasized a large contribution to the overall diet of typical Mediterranean foods, including olive oil to fats, wine to alcoholic beverages, and bread/pasta/pizza to cereals. In 2005–2006, meat was consumed in 99% of the sample, with an alarming average for red meat of ~100 g/day/capita (raw weight) compared with 418 g/day/capita of fruit and vegetables, in line with Food and Agriculture Organization/World Health Organization recommendations. In line with INRAN-SCAI 2005–2006, recently published consumption trends of available food groups (corrected for waste) over 2000–2017 [86] revealed no important changes in cereals, legumes, pork meat, poultry, eggs, and sugars compared with a relevant decline for animal fat, beef meat, and fruits and vegetables, albeit the last two to a lesser extent. However, while looking at DP reproducibility over recently collected (i.e., last 10 y) dietary data (20 articles), the variety of specific subpopulations under investigation did not allow us to assess whether the trends identified (e.g., the "Mixed-Salad" group is no longer prevalent, the "Pasta-and-Meat-oriented" or the "Traditional" groups are less frequently followed than in past) are generalizable to the overall Italian population. The current sensitivity analysis cannot, therefore, confirm the putative shift of current Italian DPs from more traditional habits, including fruit and raw vegetables, legumes, pasta with meat and tomato sauce, to deli meat, ready-to-eat and/or energy-dense foods.

The current systematic review has strengths and limitations. First, it is based on a nonnegligible number of articles—in line with the systematic review from Japan [13]—and allowed for

tracking of Italian dietary habits over a reasonably long time period, with most of the articles covering the last 20 y. Second, it provided graphical summaries of results, synthesizing results on the DP identification process and the qualitative and quantitative assessments of DP reproducibility. Third, being first to our knowledge, we compared qualitative and quantitative evaluations of DP cross-study reproducibility. Among limitations of this systematic review, we acknowledge that it mostly included cross-sectional studies/cross-sectional analyses of cohort studies and case–control studies (73% of the included articles). Moreover, 9 research groups were responsible for ~83% of articles, and 6 Italian regions, including Sardinia and Trentino-South Tyrol, were not covered by any publication, thus reducing the possibility of identifying nuances in dietary behavior likely useful in defining Italian dietary guidelines. Even though most studies were of "good quality," reporting of statistical analysis methods and of results was poor in several articles. In the absence of published factor-loading matrices, contacts with the corresponding authors were sometimes unsuccessful, preventing the inclusion of the article in the quantitative assessment of DP reproducibility. Although simple to calculate, CCs look at pairs of DPs; when sets of 5–10 similar DPs are under comparison, this implies evaluating 10–45 CCs and it might therefore be difficult to obtain one clear picture of reproducibility. In addition, we could only apply CCs to distinct lists of nutrients and food groups, thus limiting our ability to provide a global quantitative assessment of DP reproducibility. Finally, although the high CCs obtained did reflect similarities in study design and statistical analysis, we cannot exclude that overlapping of study participants artificially inflated the CCs. In particular, we acknowledge that CCs calculated on the Moli-sani study referred the same original study population, even if the corresponding DPs were identified over the specific subpopulations under investigation in each article and sample sizes generally differed substantially across these articles.

In conclusion, the current systematic review of evidence on 186 PCA/EFA-based DPs identified in Italy confirmed that labeling of DPs is still not performed with sufficient accuracy, even when a quantitative cut-off is followed. Although a degree of subjectivity exists, a qualitative assessment of DP reproducibility, by using graphs built on text descriptions and corresponding loadings, may inform further quantitative assessments performed by using CCs. However, further analyses are needed to better assess why discrepancies, if any, were found between qualitative and quantitative assessments of DP reproducibility. The quantitative assessment of DP reproducibility was carried out following very strict criteria; in particular, we restricted the analysis to articles using the same list of PCA/EFA variables. Although this choice depicts the best-case scenario of consistent study design and analysis, future quantitative assessments of DP reproducibility should include all available articles, to test how much CCs were reduced, when calculated on DPs from independent research groups.

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Author contributions

The authors' responsibilities were as follows—VE and MF: designed overall research plan; RB and MT: screened the data, collected the relevant articles and selected those to be included in the systematic review; RB and MS: extracted the data for the systematic review and prepared corresponding tables, and prepared the figures provided in the manuscript; VE: revised all tables and figures; RB and MS: performed the risk of bias assessment for studies included in the systematic review, and performed the quantitative assessment of dietary pattern reproducibility based on congruence coefficients; VE and MF: provided supervision on statistical issues; MP provided supervision on nutritional issues; VE wrote the article with assistance from RB and MS who especially contributed to the Results section; VE: had primary responsibility for final content; all authors provided critical review of the manuscript and reviewed and approved the final version.

Conflict of interest

The authors report no conflicts of interest.

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Data availability

This systematic review made use of publicly available data from published studies. Therefore, no original data are available for sharing. Template data collection forms, data extracted from included studies, and data and analytic code used for the quantitative assessment of dietary pattern reproducibility using congruence coefficients are available upon request from the corresponding author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.advnut.2023.100165.

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Manuscript: "Are major a posteriori dietary patterns reproducible in the Italian population? A systematic review and quantitative assessment"

Rachele Bianco
Online Supplemental Material

Supplemental methods

Eligibility criteria

Articles were excluded if: 1. they did not provide original data (e.g., reviews, commentaries, editorials, or personal opinions), or they were case reports, in vitro and in vivo animal studies, conference abstracts or posters; 2. the reference population lived outside Italy, or populations from different countries, including Italy, were available, but it was not possible to separate out the Italian-specific DPs of interest; 3. results concerned single nutrients, single food items, or single food groups; 4. the term DP was used to identify dietary attitudes and perceptions (e.g., feelings felt during meal times, sense of anxiety, perception of self-body image) or patterns of meals; 5. DPs were identified using the *a priori* approach, the mixed-type approach, or the *a posteriori* approach but not following PCA or EFA (e.g., cluster analysis, latent class models, or treelet transform); 6. PCA or EFA were applied on dietary behaviors and not on dietary components; and 7. PCA or EFA were applied on lifestyle variables, including diet, to derive lifestyle risk patterns.
No restrictions were imposed on year of publication, population characteristics, or health status.

Search strategy

Each search string included the following terms: "Feeding Behavior" OR "Diet, Western" OR "diet quality" OR "dietary pattern" OR "diet pattern" OR "food pattern" OR "food intake pattern" OR "food consumption pattern" OR "eating pattern" AND "Factor Analysis, Statistical" OR "Principal Component Analysis" OR "factor" OR "component" OR "score" OR "cluster" AND "Italy" or "Italian", as both keywords and MeSH/Emtree terms. Details on the single strings used were provided below.

PubMed	("Feeding Behavior"[Mesh] OR "Diet, Western"[Mesh] OR "diet qualit*" OR "dietary pattern*" OR "diet pattern*" OR "food pattern*" OR "food intake pattern*" OR "food consumption pattern" OR "eating pattern*") AND ("Factor Analysis, Statistical"[Mesh] OR "Principal Component Analysis"[Mesh] OR factor* OR component* OR score* OR cluster*) AND (Italy OR Italian)
Embase	('dietary quality'/exp OR 'dietary pattern'/exp OR 'dietary pattern*' OR 'diet pattern*' OR 'food pattern*' OR 'food intake pattern*' OR 'food consumption pattern*' OR 'eating pattern*' OR 'diet qualit*') AND ('factor analysis'/exp OR 'component analysis'/exp OR 'factor analysis*' OR 'component analysis*' OR factor* OR component* OR cluster* OR score*) AND ('Italy'/exp OR 'italian'/exp OR Italy OR italian)

Cochrane	("Feeding Behavior" OR "Diet, Western" OR “dietary pattern*” OR “diet pattern*” OR “food pattern*” OR “food intake pattern*” OR “food consumption pattern” OR “eating pattern*” OR "diet qualit*") AND ("Factor Analysis, Statistical" OR "Principal Component Analysis" OR factor* OR component* OR score* OR cluster*) AND (Italy OR italian)

Data extraction

Using a predefined Excel spreadsheet, data extraction was performed independently by two investigators (RB and MT). Data extraction was checked by other two investigators (VE and MS) and a third one (MF) was involved in resolving any potential disagreement. Information extracted from each study included the following: 1. general characteristics of the studies (first author, year of publication, country, and study name); 2. study design and characteristics (type of design, brief description of data collection, study location, age, sex, and sample size); 3. dietary assessment tool used (type, reference period, reproducibility and validity, and form of administration); 4. DP identification method (number of foods/nutrients considered, pre-processing of foods/nutrients, estimation method, rotation, criteria for choosing the number of factors to retain, factor labelling strategy, checks of factorability, internal consistency, and internal reproducibility); 5. Number of DPs, proportion of variance explained, name and composition; 6. statistical methods used for relating the identified DPs to disease outcomes/determinants/correlates, and 7. main results on the relationship between identified DPs and disease outcomes/determinants/correlates (corresponding to those statistical models adjusted for all the available confounders, if models were fitted).

Supplemental Table 1. Quality assessment of the included studies according to study design[1]

	Case-control studies (12 items)													
	1	2	3	4	5	6	7	8	9	10	11	12	-	-
	Was the research question or objective in this paper clearly stated and appropriate?	Was the study population clearly specified and defined?	Did the authors include a sample size justification?	Were controls selected or recruited from the same or similar population that gave rise to the cases (including the same timeframe)?	Were the definitions, inclusion and exclusion criteria, algorithms or processes used to identify or select cases and controls valid, reliable, and implemented consistentlv across all studv participants?	Were the cases clearly defined and differentiated from controls?	If less than 100 percent of eligible cases and/or controls were selected for the study, were the cases and/or controls randomly selected from those eligible?	Was there use of concurrent controls?	Were the investigators able to confirm that the exposure/risk occurred prior to the development of the condition or event that defined a participant as a case?	Were the measures of exposure/risk clearly defined, valid, reliable, and implemented consistently (including the same time period) across all study participants?	Were the assessors of exposure/risk blinded to the case or control status of participants?	Were key potential confounding variables measured and adjusted statistically in the analyses? If matching was used, did the investigators account for matching during study analysis?	-	-
Edefonti, 2008 (34)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Bertuccio, 2009 (35)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Edefonti, 2010 (36)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Bravi, 2010 (37)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Edefonti, 2010 (38)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Bravi, 2012 (39)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Bosetti, 2013 (40)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-

Rosato, 2014 (41)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Bravi, 2015 (42)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Edefonti, 2015 (43)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	N	-	-
Dalmartello, 2020 (44)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Edefonti, 2020 (45)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	-	-
Palli, 2001 (81)	Y	Y	N	Y	Y	Y	NR	N	Y	Y	N	Y	-	-

Cohort and cross-sectional studies (14 items)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Was the research question or objective in this paper clearly stated?	Was the study population clearly specified and defined?	Was the participation rate of eligible persons at least 50%?	Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	Was a sample size justification, power description, or variance and effect estimates provided?	For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	Was the exposure(s) assessed more than once over time?	Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	Were the outcome assessors blinded to the exposure status of participants?	Was loss to follow-up after baseline 20% or less?	Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?
Edefonti, 2020 (46)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	NR	NA	Y

Marinoni, 2022 (47)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Centritto, 2009 (48)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Bonaccio, 2012 (49)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Bonaccio, 2012 (50)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Bonaccio, 2013 (51)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Bonanni, 2013 (52)	Y	Y	Y	Y	N	N	N	N	Y	NA	Y	Y	NA	Y
Bonaccio, 2013 (53)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Bonaccio, 2016 (54)	Y	Y	NR	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y
Bonaccio, 2018 (55)	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y
Pala, 2006 (56)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	N
Masala, 2007 (57)	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Jannasch, 2019 (58)	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	NR	Y
Balder, 2003 (11)	Y	Y	NR	N	N	NA	NA	NA	Y	NA	NA	NA	NA	NA
Männistö, 2005 (12)	Y	Y	NR	N	Y	Y	Y	Y	Y	N	Y	Y	NR	Y
Sieri, 2004 (59)	Y	Y	NR	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Sant Sant, 2007 (60)	Y	Y	NR	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Menotti, 2012 (61)	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	NR	Y
Menotti, 2018 (62)	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Maugeri, 2019 (63)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	N	NA	Y
Maugeri, 2019 (64)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	N	NA	Y
Magnano San Lio, 2022 (65)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Ojeda-Granados, 2022 (66)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	NR	NA	N

Barchitta, 2018 (67)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Barchitta, 2019 (68)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Barchitta, 2019 (69)	Y	N	NR	Y	N	N	N	Y	Y	NA	Y	Y	NA	N
Fernández-Alvira, 2014 (70)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Naska, 2006 (71)	Y	Y	NA	N	N	N	N	Y	N	NA	Y	Y	NA	N
Bravi, 2021 (72)	Y	Y	NR	Y	N	N	N	Y	Y	NA	Y	Y	NA	N
Lasalvia, 2021 (73)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
Zupo, 2020 (74)	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Tatoli, 2022 (75)	Y	Y	NR	Y	N	NA	NA	NA	Y	NA	NA	NA	NA	NA
Giontella, 2019 (76)	Y	Y	Y	N	Y	N	N	Y	Y	NA	Y	N	NA	Y
Colica, 2017 (79)	Y	Y	NR	Y	Y	N	N	Y	Y	NA	N	NR	NA	Y
Mazza, 2017 (80)	Y	Y	NR	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y
Anelli, 2022 (82)	Y	Y	NR	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Ruggieri, 2022 (83)	Y	Y	Y	Y	N	N	N	Y	Y	NA	Y	Y	NA	Y
	Trials (14 items)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14

	Was the study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?	Was the method of randomization adequate (i.e., use of randomly generated assignment)?	Was the treatment allocation concealed (so that assignments could not be predicted)?	Were study participants and providers blinded to treatment group assignment?	Were the people assessing the outcomes blinded to the participants' group assignments?	Were the groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, co-morbid conditions)?	Was the overall drop-out rate from the study at endpoint 20% or lower of the number allocated to treatment?	Was the differential drop-out rate (between treatment groups) at endpoint 15 percentage points or lower?	Was there high adherence to the intervention protocols for each treatment group?	Were other interventions avoided or similar in the groups (e.g., similar background treatments)?	Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?	Did the authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?	Were outcomes reported or subgroups analyzed prespecified (i.e., identified before analyses were conducted)?	Were all randomized participants analyzed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?
Turroni, 2021 (77)	N	Y	N	N	Y	N	Y	Y	NR	Y	Y	N	Y	Y
Donati Zeppa, 2020 (78)	N	N	N	N	NR	NA	Y	Y	Y	Y	Y	N	Y	NA

[1]For each quality assessment tool, each row reported the distribution of replies (“Yes”, “No”, “Not applicable”, and “Not reported”) to single questions. “Cannot determine” reply was never used during this quality assessment evaluation.
ABBREVIATIONS: NA, Not Applicable; NR, Not reported

Supplemental Table 2. Main characteristics of studies identifying dietary patterns using principal component and factor analyses in Italy[1]

Reference, location, study name, study quality	Study design	Participants	Dietary questionnaire
Edefonti, 2008 (34) Breast cancer: northern Italy (Milan, Genoa, Gorizia, Forli), central and southern Italy (Latina, Naples) Ovarian cancer: northern Italy (Milan, Pordenone, Padua), central and southern Italy (Latina, Naples) Good quality	Case-control study; 2 companion studies on breast and ovarian cancers; hospital based; recruitment from 1991 to 1994 for the breast cancer study and from 1992 to 1999 for the ovarian cancer study; Italian multicentric	7013 total subjects (100% Fs); 2569 breast cancer cases 25-74 ys (median: 55 ys, NA); 1031 ovarian cancers cases 18-79 ys (median: 56 ys, NA); 3413 controls 17-79 ys (median: 57 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (30 NUTs)
Bertuccio, 2009 (35) Milan (Lombardy) Good quality	Case-control study; gastric cancer; hospital based; recruitment from 1997 to 2007; single center/area	777 total subjects; 230 cases (143 Ms, 87 Fs) 22-80 ys (median: 63 ys, NA); 547 controls (286 Ms, 261 Fs) 22-80 ys (median: 63 ys, NA)	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)
Edefonti, 2010 (36) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Rome, Latina (Lazio) Good quality	Case-control study; oral cavity cancer; hospital based; recruitment from 1992 to 2005; Italian multicentric	2886 total subjects; 805 cases (659 Ms, 146 Fs) 22-78 ys (median: 58 ys, NA); 2081 controls (1302 Ms, 779 Fs); 19-79 ys (median: 58 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (29 NUTs)
Bravi, 2010 (37) Milan (Lombardy), Genoa (Liguria), Pordenone, Gorizia (Friuli Venezia Giulia), Forlì (Emilia-Romagna), Latina (Lazio), Naples (Campania) Good quality	Case-control study; colorectal cancer; hospital based; recruitment from 1992 to 1996; Italian multicentric	6107 total subjects; 1225 colon cancer cases (688 Ms, 537 Fs) 19-74 ys (median: 62 ys, NA); 728 rectum cancer cases (437 Ms, 291 Fs) 23-74 ys (median: 62 ys, NA); 4154 controls (2073 Ms, 2081 Fs) 19-74 ys (median: 58 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)

Edefonti, 2010 (38) Milan (Lombardy), Pordenone (Friuli Venezia Giulia) Good quality	Case-control study; laryngeal cancer; hospital based; recruitment from 1992 to 2000; Italian multicentric	1548 total subjects; 460 cases (415 Ms, 45 Fs) 30-80 ys (median: 61 ys, NA); 1088 controls (863 Ms, 225 Fs) 31-79 ys (median: 61 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)
Bravi, 2012 (39) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Padua (Veneto) Good quality	Case-control study; esophageal cancer; hospital based; recruitment from 1992 to 1997; Italian multicentric	1047 total subjects; 304 cases (275 Ms, 29 Fs) 39-77 ys (median: 60 ys, NA); 743 controls (593 Ms, 150 Fs) 33-77 ys (median: 60 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)
Bosetti, 2013 (40) Milan (Lombardy), Pordenone (Friuli Venezia Giulia) Good quality	Case-control study; pancreatic cancer; hospital based; recruitment from 1991 to 2008; Italian multicentric	978 total subjects; 326 cases (174 Ms, 152 Fs) (median: 63 ys, NA); 652 controls (348 Ms, 304 Fs) (median: 62 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)
Rosato, 2014 (41) Milan (Lombardy), Pordenone, Gorizia (Friuli Venezia Giulia) Latina (Lazio), Naples (Campania) Good quality	Case-control study; prostate cancer; hospital based; recruitment from 1991 to 2002; Italian multicentric	2745 total subjects (100% Ms); 1294 cases 46-74 ys (median: 66 ys, NA); 1451 controls 46-74 ys (median: 63 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)
Bravi, 2015 (42) Milan (Lombardy), Pordenone, Udine (Friuli Venezia Giulia), Naples (Campania) Good quality	Case-control study; endometrial cancer; hospital based; recruitment from 1992 to 2006; Italian multicentric	1362 total subjects (100% Fs); 454 cases 18-79 ys (median: 60 ys, NA); 908 controls 19-80 ys (median: 61 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)
Edefonti, 2015 (43) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Naples (Campania), Catania (Sicily) Good quality	Case-control study; nasopharyngeal cancer; hospital based; recruitment from 1992 to 2008; Italian multicentric	792 total subjects; 198 cases (157 Ms, 41 Fs) 18-76 ys (median: 52 ys, NA); 594 controls (471 Ms, 123 Fs) 19-76 ys (median: 52 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)

Dalmartello, 2020 (44) Milan (Lombardy), Pordenone, Udine (Friuli Venezia Giulia), Latina (Lazio), Naples (Campania) Good quality	Case-control study; renal cell cancer; hospital based; recruitment from 1992 to 2004; Italian multicentric	2301 total subjects; 767 cases (494 Ms, 273 Fs) 24-79 ys (median: 62 ys, NA); 1534 controls (988 Ms, 546 Fs) 22-79 ys (median: 62 ys, NA)	FFQ 2 ys before IA Reproducible and valid 78 FIs (28 NUTs)
Edefonti, 2020 (45) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Naples (Campania), Catania (Sicily) Good quality	Case-control study; bladder cancer; hospital based; recruitment from 2003 to 2014; Italian multicentric	1355 total subjects; 690 cases (595 Ms, 95 Fs) 25-84 ys (median: 67 ys, NA); 665 controls (561 Ms, 104 Fs) 27-84 ys (median: 66 ys, NA)	FFQ 2 ys before IA Reproducible and valid 80 FIs (28 NUTs)
Edefonti, 2020 (46) Milan (Lombardy) Good quality	Cross-sectional study; rheumatoid arthritis disease activity; recruitment from January 2018 to December 2019; single center/area with recruitment at Pini Hospital (Milan)	205 total subjects (40 Ms, 165 Fs) 18-65 ys (median: 58.46 ys, IQR: 47.81-69.03 ys)	FFQ 6 mos before IA Reproducible and valid 110 FIs (33 NUTs)
Marinoni, 2022 (47) Croatia, Greece, Italy (Friuli Venezia Giulia region) Good quality	Cross-sectional analysis nested within the NAC-II birth cohort which followed-up 632 eligible (i.e, 18-month children with neurodevelopment assessed) born from 767 mothers originally recruited between 2007 and 2009; international	379 total subjects (195 Ms, 184 Fs); mean: 7 ys, SD: 0.05 ys	3d-DR (2 weekdays and 1 weekend day, not necessarily consecutive) in the wk before IA Reproducible and valid 828 FIs (37 NUTs)
Centritto, 2009 (48) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 16704 subjects recruited from 2005 to 2008; single center/area	7646 total subjects (49% Ms, 51% Fs); age ≥ 35 ys (mean: 50 ys, SE: 10 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (45 FGs)

Bonaccio, 2012 (49) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 24325 subjects recruited from March 2005 to April 2010; single center/area	13262 total subjects (6590 Ms, 6672 Fs); age ≥ 35 ys (mean: 53.3 ys, SD: 10.6 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (43 FGs)
Bonaccio, 2012 (50) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 1132 subjects recruited from May 2009 to April 2010; single center/area	959 total subjects (479 Ms, 480 Fs) aged ≥ 35 ys (mean: 52.8 ys, SD: 9.6 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (45 FGs based on reference to a previous paper)
Bonaccio, 2013 (51) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 1132 subjects recruited from May 2009 to April 2010; single center/area	744 total subjects (50.3% Ms, 49.7% Fs); age ≥ 35 ys (mean: 52.1 ys, SD: 9.4 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (43 FGs)
Bonanni, 2013 (52) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 1571 subjects recruited from May 2009 to April 2010; single center/area	883 total subjects (442 Ms, 441 Fs); age ≥ 35 ys (mean: 52.5 ys, SD: 9.6 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (45 FGs based on reference to a previous paper)

Bonaccio, 2013 (53) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 24325 subjects recruited from March 2005 to April 2010; single center/area	16937 total subjects (48.4% Ms, 51.6% Fs); age ≥ 35 ys (mean: 53.0 ys, SD: 10.8 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (43 FGs)
Bonaccio, 2016 (54) Molise Moli-sani Good quality	Prospective cohort study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 24325 subjects recruited from March 2005 to April 2010 for a final sample of 1995 patients with type 2 diabetes followed-up for mortality until December 2011; single center/area	1995 total subjects (1319 Ms, 676 Fs); age ≥ 35 ys (mean: 62.6 ys, SD: 10.2 ys)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (46 FGs)
Bonaccio, 2018 (55) Molise Moli-sani Good quality	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; 24325 subjects recruited from March 2005 to April 2010; single center/area	11272 total subjects (46.2% Ms, 53.8% Fs) age ≥ 35 ys (mean: 52.7 ys, SD: 10.8 ys) reduced to 10812 due to unreliable medical or dietary questionnaires, implausible EIs or missing values for dietary information	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (46 FGs)
Pala, 2006 (56) Denmark, France, Germany, Greece, Netherlands, Spain, Sweden, UK, Italy (Varese, Turin, Florence, Naples, Ragusa) EPIC (EPIC-Elderly) Good quality	Cross-sectional analysis nested within a prospective cohort study; elderly (≥60 ys) participants from EPIC study recruited voluntarily from 1993 to 1998 in 5 different areas covered by cancer registries in northern, central and southern Italy; international	100 059 total subjects; 5611 Italian participants: 1536 Ms (60.0-72.2 ys, median age at enrollment: 62.3 ys, IQR: NA), 4075 Fs (60.0-77.8 ys, median age at enrollment: 62.3 ys, IQR: NA)	3 different FFQs 1 y before NA Reproducible and valid 188 FIs (Varese, Turin, Florence), 217 FIs (Ragusa), 140 FIs (Naples), (57 FGs for all centers)

Masala, 2007 (57) Denmark, France, Germany, Greece, Netherlands, Spain, Sweden, UK, Italy (Varese, Turin, Florence, Naples, Ragusa) EPIC (EPIC-Elderly) Very good quality	Prospective cohort study; elderly (≥60 ys) participants from EPIC study recruited voluntarily in 5 different areas covered by cancer registries in northern, central and southern Italy between 1993 and 1998 and followed-up for overall mortality up to 2001 or 2002 (median follow-up of 6.2 ys after applying exclusion criteria); international	100 059 total subjects; 5611 Italian participants: 1536 Ms (60.0-72.2 ys, median age at enrollment: 62.3 ys, IQR: NA), 4075 Fs (60.0-77.8 ys, median age at enrollment: 62.3 ys, IQR: NA)	3 different FFQs 1 y before NA Reproducible and valid 188 FIs (Varese, Turin, Florence), 217 FIs (Ragusa), 140 FIs (Naples), (57 FGs for all centers)
Jannasch, 2019 (58) Italy, France, Spain, UK, Netherlands, Germany, Sweden, Denmark EPIC-InterAct Good quality	Case-cohort study nested within EPIC prospective cohort study and based on incident cases of type 2 diabetes in the full EPIC cohort (cases which occurred between 1991 and the 31 December 2007 in 8 countries) and a randomly drawn subcohort stratified by center (9 centers); international	25877 total subjects of which 14694 randomly drawn subcohort subjects and 11183 verified incident type 2 diabetes cases; 719 verified incident type 2 diabetes cases overlapping with the subcohort; 1927 Italian participants in the subcohort (32.3% Ms, 67.7% Fs), mean: 50.2 ys, SD: 7.9 ys at baseline	Reproducible and valid country specific FFQs 1 y before NA FIs (36 FGs)
Balder, 2003 (11) Netherlands, Sweden, Finland, and Italy DIETSCAN Project (NLSC, SMC, ATBC, ORDET) Poor quality	Parallel analysis of 4 prospective cohort studies on diet and cancer according to the same strategy (no pooled analysis); NLSC (random subcohort of): population-based cohort of Ms and Fs from Dutch municipalities that began in 1986; SMC: population-based cohort of Fs based on a mammography screening in 2 countries in central Sweden from 1987 to 1990; ATBC: randomized placebo-controlled intervention study conducted among M smokers who lived in south-western Finland (1985–1988); ORDET: cohort study of Italian healthy volunteer Fs from the province of Varese, northern Italy (1987–1992); international	100911 total subjects; ORDET (from Italy): 9208 Fs with complete dietary data (mean age at baseline: 48.6 ys, SE: 8.6 ys, 35–69 ys); median follow-up and number of deaths not reported	4 different but validated FFQs; ORDET-FFQ: 1 y before; SA; Reproducible and valid; 107 FIs (51 FGs, but final number equal to 32, due to ORDET availability)

Männistö, 2005 (12) Netherlands, Sweden, and Italy DIETSCAN Project (NLSC, SMC, ATBC, ORDET) Good quality	Parallel analysis of 3 prospective cohort studies on diet and cancer according to the same strategy (no pooled analysis); NLSC (random subcohort of): population-based cohort of Ms and Fs from Dutch municipalities that began in 1986; SMC: population-based cohort of Fs based on a mammography screening in 2 countries in central Sweden from 1987 to 1990; all invasive breast cancer cases were identified through national or local cancer registers; ORDET: cohort study of Italian healthy volunteer Fs from the province of Varese, northern Italy (enrollment from 1987 to 1992; 9 ys follow-up); international; re-analysis of DPs originally derived in Balder et al. 2003	73849 total subjects (3271 breast cancer cases with complete information on their diet); ORDET (from Italy): 10788 Fs (mean age at baseline: 48 ys; SE: 8.5 ys, 35-69 ys), 212 breast cancer cases	3 different but validated FFQs: ORDET-FFQ: 1 y before; SA; Reproducible and valid; 107 FIs (51 FGs, but final number equal to 32)
Sieri, 2004 (59) Varese (Lombardy) ORDET Very good quality	Prospective cohort study; Italian healthy volunteer women from the province of Varese, northern Italy; cancer cases identified through local cancer registry; recruitment from 1987 to 1992; 9.5 ys of average follow-up; single center/area	8984 subjects 100% Fs (34-70 ys) based on a total of 10786 subjects; 207 incident breast cancer cases	FFQ 1 y before SA Reproducible and valid 107 FIs (34 FGs)
Sant, 2007 (60) Varese (Lombardy) ORDET Very good quality	Prospective cohort study; Italian healthy volunteer women from the province of Varese, northern Italy; cancer cases identified through local cancer registry; recruitment from 1987 to 1992; 11.5 ys of average follow-up; single center/area; re-analysis of DPs originally provided in Sieri et al. 2004	8861 subjects 100% Fs (34-70 ys) based on a total of 8984 subjects recruited in a previous ORDET study; 267 incident breast cancer cases by December 31, 2001, with availability of HER2 status in 238 of them	FFQ 1 y before SA Reproducible and valid 107 FIs (34 FGs)
Menotti, 2012 (61) Italian Rural Areas of Seven Countries Study of Cardiovascular Disease Seven Countries Study Very good quality	Prospective cohort study; enrollment in 1960 from the Italian Rural Areas cohorts, follow-up of 20 ys for CHD events and 40 ys for mortality; international	1221 total subjects (100% Ms) 45-64 ys at the 5-y follow-up in 1965 (mean: 54.9 ys, SD: 5.0 ys); at 20-y follow-up CHD events were 185 (fatal and non-fatal); at 40-y follow-up deaths were 187 for CHD, 513 for CVD, 324 for cancer, and 1148 for all-cause mortality	Dietary history; Italian Rural Areas administered at the 5-y follow-up in 1965; IA Validated NA FIs (17 FGs)

Menotti, 2018 (62) Italian Rural Areas of Seven Countries Study of Cardiovascular Disease Seven Countries Study Very good quality	Prospective cohort study; enrollment in 1960 from the Italian Rural Areas cohorts, follow-up of 40 ys for mortality; comparison of the role of 4 dietary scores in a sample of middle-aged men followed up during 40 ys for CHD mortality; international	1284 total subjects with final sample size equal to 1214 after excluding 70 subjects with major prevalent CHD (100% Ms); 45-64 ys at the 5-y follow-up in 1965; at 40-y follow-up deaths were 200 from CHD	Dietary history IA Validated NA FIs (17 FGs)
Maugeri, 2019 (63) Mamma & Bambino Catania (Sicily) Fair quality	Cross-sectional study nested within the "Mamma & Bambino" birth cohort of pregnant women referring to “Policlinico Vittorio Emanuele” (Catania, Italy) for the prenatal genetic counselling without pre-existing medical conditions and/or pregnancy complications; recruitment from November 2014 to 2019 (ongoing at publication); single center/area	332 total subjects (100% Fs); 15-50 ys (median: 37 ys, NA); gestational age at recruitment 4-20 gwks (median: 16 gwks, NA)	FFQ 1 mo before IA Adapted from a previously validated FFQ 95 FIs (39 FGs)
Maugeri, 2019 (64) Mamma & Bambino Catania (Sicily) Fair quality	Cross-sectional study nested within the "Mamma & Bambino" birth cohort enrolling pregnant women referring to “Policlinico-Vittorio Emanuele” (Catania) at 4–20 gwks (median: 16 gwks) with additional exclusion criteria related to the current paper; single center/area	232 total subjects (100% Fs); 15-50 ys (median: 37 ys, NA)	FFQ 1 mo before IA Adapted from a previously validated FFQ 95 FIs (39 FGs)
Magnano San Lio, 2022 (65) Catania (Sicily) Good quality	Cross-sectional analysis of data from two prospective cohorts; pregnant women enrolled before COVID-19 pandemic (“Mamma & Bambino” cohort, from November 2014 to December 2019, during the prenatal genetic counseling) and during COVID-19 pandemic ("MAMI-MED", from December 2020 to January 2022, during the first trimester visit) in two hospitals in Catania with the aim to evaluate how their dietary habits affect the health of mother-child pairs; Italian multicentric	1097 total subjects (100% Fs); 397 "Mamma & Bambino" (median: 37.0 ys, IQR: 4.0 ys); 801 "MAMI-MED" (median: 31.0 ys, IQR: 7.0 ys)	FFQ for both studies 1 mo before IA Adapted from a previously validated FFQ 95 FIs (39 FGs)

Ojeda-Granados, 2022 (66) Catania (Sicily), Guadalajara (Mexico) Fair quality	Cross-sectional study; age-matched Italian non-pregnant women with no history of severe diseases recruited among those referring to three clinical laboratories in Catania (Italy) from 2010 to 2017 and from the general adult population referring to University of Guadalajara (Mexico) from 2011 to 2015; international	1026 total subjects (100% Fs), age 18-72 ys; 811 Italian subjects (median: 40 ys, IQR: 19 ys); 215 Mexican subjects (median: 40 ys, IQR: 21 ys)	Italian FFQ: 1 mo before, IA, Adapted from a previously validated FFQ, 95 FIs (39 FGs); Mexican FFQ: NA reference period, IA, 64 FIs (20 FGs)
Barchitta, 2018 (67) Catania (Sicily) Good quality	Cross-sectional study; women diagnosed with an abnormal PAP test without previous treatments and referred to a cervical cancer screening unit in Catania, later classified according to hrHPV status and histological grade of CIN (from normal cervical epithelium to CIN3); recruitment from 2013 to 2015; single center/area	539 total subjects (100% Fs) of which 252 with normal cervical epithelium and 160 CIN1 (i.e., low-grade CIN); 84 hrHPV infections (+) (mean: 38.63 ys, SD: 10.53 ys) among the 251 (as reported in the text) with a normal cervical epithelium; 167 hrHPV infections (-) (mean: 43.65 ys, SD: 9.62 ys) among the 251 (as reported in the text) with a normal cervical epithelium; 127 CIN2+ (mean: 36.01 ys, SD: 8.10 ys); 411 with normal cervical epithelium or CIN1 (as reported in the text) (mean: 41.50 ys, SD: 10.21 ys)	FFQ 1 mo before IA Validated 95 FIs (39 FGs)
Barchitta, 2019 (68) Catania (Sicily) Good quality	Cross-sectional study; non-pregnant women with no history of severe diseases referring for routine physical examination to three clinical laboratories in Catania; recruitment from 2010 to 2017; single center/area	349 total subjects (100% Fs); age 12-87 ys (median: 36 ys, NA)	FFQ 1 mo before IA Adapted from a previously validated FFQ 95 FIs (39 FGs)
Barchitta, 2019 (69) Eastern Sicily Fair quality	Cross-sectional study; adolescents attending three high schools in the urban area of Eastern Sicily; single center/area	213 total subjects; age 15-18 ys (median: 16 ys; IQR: 0 ys); 102 Ms (median: 16 ys, IQR: 0 ys), 111 Fs (median: 16 ys, IQR: 1 y)	FFQ NA SA Adapted from a previously validated FFQ 95 FIs (36 FGs)

Fernández-Alvira, 2014 (70) Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany, and Spain IDEFICS Good quality	Cross-sectional analysis nested within a prospective cohort study of children aged 2–9 ys from 8 European countries (recruited between September 2007 and May 2008) with the aim to investigate the etiology of obesity and the possible interventions for its prevention; international	14233 total subjects (8028 Ms, 6205 Fs; 2-9 ys, of which 12462 with complete dietary and socioeconomic information; mean: 6.0 ys, SD: 1.8 ys at baseline); Italy 2110 subjects (NA Ms, NA Fs)	Same FFQ across all centers (Children's Eating Habits Questionnaire-FFQ) 1 mo before IA Reproducible and valid 43 FIs (14 FGs) to investigate the consumption frequency of obesity-related foods
Naska, 2006 (71) Belgium, France, Finland, Germany, Greece, Italy, Norway, Portugal, Spain, UK DAFNE Fair quality	Analysis of standardized and post-harmonized data collected through the national household budget surveys undertaken in 10 European countries during the 1990s (Italy 1996) on food, goods, and services available to household members during the reference period conducted by the National Statistical Offices of each country; international	94564 original subjects (NA Ms, NA Fs), age from 0 to over 75 ys, of which 15251 were excluded because they did not fit the pre-defined categories; Italy: 22740 original subjects (NA Ms, NA Fs) of which 16% (3638 subjects) was excluded	No dietary assessment tool used; collected data were availability of foods and beverages at the household level taking into consideration the households' purchases, contributions from all production and food items offered to members as gifts; 56 detailed original FGs further aggregated into 25 final FGs
Bravi, 2021 (72) Turin (Piemonte), Florence (Tuscany), Rome (Lazio), San Giovanni Rotondo (Apulia), Palermo (Sicily) MEDIDIET Fair quality	Cross-sectional study; exclusively breastfeeding and healthy women recruited in 5 hospital settings in northern, central and southern Italy had information on dietary habits and a sample of freshly expressed foremilk collected at 6±1 wks post-partum; recruitment between 2012 and 2014; Italian multicentric	300 total subjects (100% Fs), age 25-41 ys (mean: 33 ys, SD: 4.06 ys)	FFQ at 6±1 wks post-partum, same d of milk collection From partum to d of milk collection IA Reproducible and valid 78 FIs (31 NUTs)
Lasalvia, 2021 (73) Varese (Lombardy) ROCAV Good quality	Cross-sectional study; men and women randomly selected among residents of the Varese city (Lombardy) without main chronic diseases with the aim to investigate the relation between dietary patterns and arterial stiffness; recruitment between 2013 and 2016; single center/area	2640 total subjects (mean: 65.5 ys, SD: 6.7 ys); 1608 Ms (50-75 ys), 1032 Fs (60-75 ys)	FFQ 1 y before SA Reproducible and valid 188 FIs (41 FGs)

Zupo, 2020 (74) Castellana Grotte (Apulia) Salus in Apulia Study (from MICOL study) Very good quality	Prospective cohort study originally enrolling participants from Apulia based center of MICOL study in 1985, with a follow-up for mortality until December 31, 2017; single center/area	2472 total subjects (1429 Ms, 1043 Fs); age > 30 ys (mean: 48.00 ys, SD: 10.71 ys) in a representative sample of the population of Apulia in 1985; 990 total deaths, no additional information on causes	FFQ administered in 1985 1 y before SA Validated 31 FIs (29 FGs)
Tatoli, 2022 (75) Castellana Grotte (Apulia) Salus in Apulia Study (including also a major part of MICOL study participants) Poor quality	Cross-sectional study a part of which nested within the MICOL cohort; investigated dietary differences between subjects with and without diabetes among non-institutionalized older adults from Southern Italy, recruited between 2014 and 2018, based on health registry office list at December 31, 2014, as well as previous MICOL study participants; single center/area	1399 total subjects (mean: 73.43 ys, SD: 6.30 ys); 187 diabetic subjects (115 Ms, 72 Fs; mean: 74.66 ys, SD: 6.39 ys); 1212 non-diabetic subjects (634 Ms, 578 Fs; mean: 73.24 ys, SD: 6.26 ys)	FFQ administered between 2014 and 2018 1 y before SA with interviewer checks Validated 85 FIs (28 FGs)
Giontella, 2019 (76) Verona (Veneto) Good quality	Cross-sectional study; children were recruited from the third and fourth classes of four primary schools in the Verona South district with the aim to assess the relationship between food, PA, and main CVD risk factors; single center/area	300 total subjects (7-10 ys); 150 Ms (mean: 8.7 ys, SD: 0.8 ys), 150 Fs (mean: 8.6 ys, SD: 0.7 ys)	FFQ NA NA Validated 61 FIs (10 FGs)
Turroni, 2021 (77) Emilia-Romagna (Italy) Good quality	Pilot intervention study; based on Istituto Romagnolo per lo Studio dei Tumori "Dino Amadori" (Meldola, Emilia Romagna) recruitment from October 2018 to September 2019; 60 subjects with at least one among abdominal obesity, hypertension, dyslipidemia, impaired fasting glucose or insulin resistance, 33 of which consumed symbiotic agriculture food (SA-group) and 27 of which received probiotic supplementation (PROB-group) over 30 ds, with a follow-up of 15 ds and stool, urine, and blood samples collected over time; single center/area	60 total subjects (13 Ms, 47 Fs) 18.3-86.4 ys (median age at enrollment: 46.9 ys, IQR: NA); 33 subjects in SA-group (5 Ms, 28 Fs) 34.6-86.4 ys (median age at enrollment: 52.7 ys, IQR: NA); 27 subjects in PROB-group (8 Ms, 19 Fs) 18.3-64.2 ys (median age at enrollment: 45.3 ys, IQR: NA)	FFQ 1 y before IA Reproducible ad valid 188 FIs (27 NUTs)

Donati Zeppa, 2020 (78) Urbino (Marche) Fair quality	Trial; normal-weight M and F young adults were recruited by the University of Urbino to participate to a 9-wk HIIT program to investigate the role of PA in modulating food choices; single center/area	32 total subjects (21-24 ys at enrollment); 20 Ms (mean: 22.6 ys, SD: 1.7 ys), 12 Fs (mean: 21.5 ys, SD: 0.8 ys)	24HR in association with PHOTOdietometer for portion size estimation from 2 wks before to the end of the training session IA NA NA FIs (16 NUTs)
Colica, 2017 (79) Catanzaro (Calabria) Fair quality	Cross-sectional study nested within the cohort reported in Mazza et al. 2017; Caucasian, community-dwelling individuals from Calabria, enrolled between 2013 and 2014, without any bone metabolism disfunctions, aged ≥ 65 ys and satisfying additional criteria underwent whole-body-dual X-ray absorptiometry scan, a fasting venous blood collection, and fractures and dietary intake assessments; single center/area	177 total subjects (37% Ms, 63% Fs); age ≥ 65 ys (mean: 70 ys, SD: 4.1 ys); 41 participants had fractures (52 total fractures)	24HR + 7d-DR NA IA NA NA FIs (10 FGs)
Mazza, 2017 (80) Catanzaro (Calabria) Good quality	Cross-sectional and longitudinal analysis of a prospective cohort enrolled between 2013 and 2014 including community-dwelling, Caucasian individuals from Calabria, aged ≥ 65 ys, who underwent a neuropsychological assessment (MMSE and ADAS-Cog) at baseline and 1-y follow-up, and satisfied additional criteria (e.g., MMSE>20); dietary guidance to promote a "healthy diet" was given by a dietitian to all participants during follow-up; 1-y follow-up; single center/area	214 total subjects ≥ 65 ys at baseline (mean: 70 ys, SD: 4 ys), 144 of which had complete data on ADAS-Cog at follow-up and were included in the follow-up analysis	24HR + 7d-DR at baseline IA Validated NA FIs (8 FGs + 10 NUTs)
Palli, 2001 (81) Florence (Tuscany) Good quality	Case-control study; in high-risk area for gastric cancer in central Italy, 382 cases and 561 controls recruited from 1985 to 1987 and 142 additional controls at the end of the study period to have a more representative sample; population based; single center/area	943 total subjects; 382 cases (239 Ms, 143 Fs) 30 subjects <50 ys, 130 subjects 50-64 ys; 222 subjects >64 ys; 561 controls (328 Ms, 233 Fs) 122 subjects <50 ys, 188 subjects 50-64 ys, 251 subjects >64 ys	FFQ 1 y before NA NA 181 FIs (20 NUTs)

Anelli, 2022 (82) Milan (Lombardy), Naples (Campania) GIFt Study Very good quality	Prospective cohort study; Italian healthy normal-weight singleton pregnant women at 20±2 gwks recruited between January 2017 and June 2020 in 3 hospital settings in northern and southern Italy, followed-up until delivery for pregnancy outcomes; Italian multicentric	179 total subjects 20-40 ys at baseline (mean: 31.8 ys, SD: 4.3 ys); 85 enrolled in Milan (mean: 31.7 ys, SD: 4.5 ys); 94 enrolled in Naples (mean: 31.9 ys, SD: 4.1 ys);	7d-DR: at 25±1 gwks, IA by a trained dietitian; FFQ: at 29±2 gwks, 3 mos before (second trimester of pregnancy), SA but checked by a trained dietitian, adapted from a previously validated FFQ, 192 FIs (15 FGs)
Ruggieri, 2022 (83) Crotone (Calabria), Milazzo and Augusta-Priolo (Sicily) NEHO Study Good quality	Cross-sectional study nested within a birth cohort; healthy pregnant women with no history of chronic diseases, not requiring special diets, and living in the areas surrounding the perimeter of National Priority Contaminated Sites in Southern Italy were voluntarily recruited starting from January 2018 when admitted to the maternity units of the public hospitals in Milazzo, Syracuse (for the Augusta-Priolo area) and Crotone; Italian multicentric	816 total subjects (100% Fs), age 18-40 ys (mean: 30.6 ys, SD: 5.1 ys); 534 Augusta-Priolo (mean: 30.4 ys, SD ± 5.1 ys); 165 Crotone (mean: 30.5 ys, SD: 5.4 ys); 117 Milazzo (mean: 31.5 ys, SD: 4.5 ys); 589 subjects with available data for risk perception analyses	FFQ Gestational period until FFQ administration (from 32 gwks onwards) IA Not validated 41 FIs (38 FGs)

[1]Whenever international studies were included, summarized evidence concerned only the Italian-specific subpopulation and dietary patterns.

ABBREVIATONS: 24HR, 24-hour recall; ADAS-Cog, Alzheimer's Disease Assessment Scale - Cognitive sub-scale; ATBC, Alpha-Tocopherol Beta-Carotene Cancer; CHD, coronary heart disease; CIN, cervical intraepithelial neoplasia; COVID-19, Coronavirus disease 2019; CVD, cardiovascular disease; d, day(s); DAFNE, Data Food Networking; DIETSCAN, Dietary Patterns and Cancer; DP, dietary pattern; DR, dietary record; EI, energy intake(s); EPIC, European Prospective Investigation into Cancer and Nutrition; F, female(s); FFQ, Food Frequency Questionnaire; FG, food group(s); FI, food item(s); GIFt, Gestational Intake of Food towards healthy outcomes; gwk, gestational week(s); HER2, human epidermal growth factor receptor 2; HIIT, high intensity interval training; hrHPV, high-risk Human Papilloma Virus; IA, interviewer administered; IDEFICS, Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS; IQR, interquartile range; M, male(s); MAMI-MED, Multisettoriale Alla salute Materno-Infantile Mediante valutazione dell'Esposoma nelle Donne; MMSE, Mini Mental State Examination; mo, month(s); NA, not available; NAC-II, Northern Adriatic Cohort II; NEHO, Neonatal Environment and Health Outcomes; NLSC, Netherlands Cohort Study; NUT, nutrient(s); ORDET, Ormoni e Dieta nell'Eziologia del Tumore della Mammella; PA, physical activity; ROCAV, Risk Of Cardiovascular diseases and abdominal aortic Aneurysm in Varese; SA, self-administered; SD, standard deviation; SE, standard error; SMC, Swedish Mammography Cohort; vs., versus; wk, week(s); y, year(s)

Supplemental Table 3. Dietary patterns identified using principal component and factor analyses in Italy[1]

Reference, location, study name, study quality	Dietary pattern identification methods	Expl. Var. % (NF)	Dietary pattern composition
Edefonti, 2008 (34) Breast cancer: northern Italy (Milan, Genoa, Gorizia, Forli), central and southern Italy (Latina, Naples) Ovarian cancer: northern Italy (Milan, Pordenone, Padua), central and southern Italy (Latina, Naples) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	75.70% (4)	ANIMAL PRODUCTS: animal protein and animal fat, calcium, cholesterol, SFAs, riboflavin, zinc, and phosphorus; VITAMINS AND FIBER: vitamin C and total fiber, total folate, potassium, beta-carotene equivalents, soluble carbohydrates, and vitamin B6; UNSATURATED FAT: vegetable fat and vitamin E, MUFAs and PUFAs; STARCH-RICH: starch, vegetable protein, and sodium
Bertuccio, 2009 (35) Milan (Lombardy) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	75.09% (4)	ANIMAL PRODUCTS: animal protein, riboflavin, cholesterol, phosphorus, calcium, and zinc; VITAMINS AND FIBER: vitamin C, total fiber, potassium, total folate, beta-carotene equivalents, and soluble carbohydrates; VUFA: other PUFAs, vitamin E, MUFAs, LA, and ALA; STARCH-RICH: starch, vegetable protein, and sodium
Edefonti, 2010 (36) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Rome, Latina (Lazio) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	79.94% (5)	ANIMAL PRODUCTS: animal fat, calcium, SFAs, animal protein, phosphorus, cholesterol, and riboflavin; VITAMINS AND FIBER: vitamin C, total fiber, soluble carbohydrates, and beta-carotene equivalents; UNSATURATED FATS: vegetable fat and vitamin E, MUFAs and PUFAs; RETINOL AND NIACIN: retinol and niacin; STARCH-RICH: starch, vegetable protein, and sodium
Bravi, 2010 (37) Milan (Lombardy); Genoa (Liguria), Pordenone, Gorizia (Friuli Venezia Giulia), Forlì (Emilia-Romagna), Latina (Lazio), Naples (Campania) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	81.36% (5)	ANIMAL PRODUCTS: calcium, animal protein, phosphorus, riboflavin, SFAs, and cholesterol; VITAMINS AND FIBER: vitamin C, total fiber, beta-carotene equivalents, soluble carbohydrates, and total folate; VUFA: LA, ALA, and vitamin E; AUFA: other PUFAs and vitamin D; STARCH-RICH: starch, vegetable protein, and sodium

Edefonti, 2010 (38) Milan (Lombardy), Pordenone (Friuli Venezia Giulia) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	79.00% (5)	ANIMAL PRODUCTS: calcium, phosphorus, riboflavin, animal protein, SFAs, zinc, and cholesterol; VITAMINS AND FIBER: vitamin C and total fiber, beta-carotene equivalents, and total folate; VUFA: LA, ALA, and vitamin E; AUFA: other PUFAs and vitamin D; STARCH-RICH: starch, vegetable protein, and sodium
Bravi, 2012 (39) Milan (Lombardy), Pordenone (Friuli Venezia Giulia); Padua (Veneto) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	79.18% (5)	ANIMAL PRODUCTS AND RELATED COMPONENTS: calcium, phosphorus, riboflavin, animal protein, SFAs, cholesterol, and zinc; VITAMINS AND FIBER: vitamin C, total fiber, beta-carotene equivalents, soluble carbohydrates, and total folate; STARCH-RICH: starch, vegetable protein, and sodium; OTHER PUFAs AND VITAMIN D: other PUFAs, vitamin D, and niacin; OTHER FATS: LA, ALA, and vitamin E
Bosetti, 2013 (40) Milan (Lombardy), Pordenone (Friuli Venezia Giulia) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	75.84% (4)	ANIMAL PRODUCTS: calcium, animal protein, phosphorus, riboflavin, SFAs, cholesterol, and zinc; VITAMINS AND FIBER: vitamin C, total fiber, beta-carotene equivalents, soluble carbohydrates, total folate, and potassium; UNSATURATED FATS: LA, vitamin E, ALA, and other PUFAs; STARCH-RICH: starch, vegetable protein, and sodium
Rosato, 2014 (41) Milan (Lombardy), Pordenone, Gorizia (Friuli Venezia Giulia), Latina (Lazio), Naples (Campania) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	78.27% (5)	ANIMAL PRODUCTS: calcium, phosphorus, riboflavin, animal protein, SFAs, zinc, and cholesterol; VITAMINS AND FIBER: vitamin C, total fiber, beta-carotene equivalents, total folate, and soluble carbohydrates; VUFA: LA, vitamin E, and ALA; AUFA: other PUFAs and vitamin D; STARCH-RICH: starch, vegetable protein, and sodium

Bravi, 2015 (42) Milan (Lombardy), Pordenone, Udine (Friuli Venezia Giulia), Naples (Campania) Good quality	PCFA Standardization EIG>1, Scree plot, and interepretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	80.04% (5)	WESTERN TYPE DIET: calcium, riboflavin, phosphorus, animal protein, SFAs, cholesterol, and zinc; VITAMINS AND FIBER: vitamin C, total fiber, potassium, total folate, beta-carotene equivalents, and soluble carbohydrates; STARCH-RICH: starch, vegetable protein, and sodium; ANIMAL DERIVED NUTRIENTS AND PUFA: vitamin D, other PUFAs, and niacin; OTHER FATS: LA, ALA, and vitamin E
Edefonti, 2015 (43) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Naples (Campania), Catania (Sicily) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	79.60% (5)	ANIMAL PRODUCTS: calcium, riboflavin, phosphorus, SFAs, animal protein, and cholesterol; VITAMINS AND FIBER: vitamin C and total fibre, beta-carotene equivalents, and total folate; VUFA: LA, ALA, and vitamin E; AUFA: other PUFAs and vitamin D; STARCH-RICH: starch, vegetable protein, and sodium
Dalmartello, 2020 (44) Milan (Lombardy), Pordenone, Udine (Friuli Venezia Giulia), Latina (Lazio), Naples (Campania) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	74.52% (4)	ANIMAL PRODUCTS: calcium, animal protein, riboflavin, phosphorus, cholesterol, SFAs, and zinc; VITAMINS AND FIBER: vitamin C, total fiber, soluble carbohydrates, beta-carotene equivalents, potassium, and total folate; COOKING OIL AND DRESSING: vitamin E, LA, and ALA; STARCH-RICH: starch, vegetable protein, and sodium
Edefonti, 2020 (45) Milan (Lombardy), Pordenone (Friuli Venezia Giulia), Naples (Campania), Catania (Sicily) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	78.09% (4)	ANIMAL PRODUCTS: calcium, SFAs, riboflavin, animal protein, cholesterol, phosphorus, and zinc; VITAMINS AND FIBER: vitamin C, total fiber, beta-carotene equivalents, vitamin E, potassium, and total folate; AUFA: other PUFAs and vitamin D; STARCH-RICH: starch, vegetable protein, and sodium

Edefonti, 2020 (46) Milan (Lombardy) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)	79.85% (5)	ANIMAL PRODUCTS: cholesterol and SFAs; ANTI-OXIDANT VITAMINS AND FIBER: soluble carbohydrates, potassium, vitamin C, vitamin A (Retinol Activity Equivalent), soluble and insoluble fiber, lignans, and flavonoids; VUFA: LA, ALA, and vitamin E; AUFA: EPA and DHA, and vitamin D; STARCH-RICH: total protein, starch, sodium, phosphorus, iron, zinc, magnesium, selenium, and vitamin B1 and B3
Marinoni, 2022 (47) Croatia, Greece, Italy (Friuli Venezia Giulia region) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.60 Factorability checks DP internal consistency DP reproducibility (internal)	63.39% (5)	DAIRY PRODUCTS: calcium, biotin, magnesium, pantothenic acid, iodine, phosphorus, and vitamin B2; PLANT-BASED FOODS: total fiber, vitamin C, folate, potassium, beta-carotene, vitamin E, and iron; FATS: MUFAs, oleic acid, SFAs, and LA; MEAT AND POTATOES: niacin, vitamin B6, proteins, vitamin B1, and zinc; SEAFOOD: EPA, DHA, and selenium
Centritto, 2009 (48) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	15.7% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; PASTA AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer

Bonaccio, 2012 (49) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	NA% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; PASTA AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer
Bonaccio, 2012 (50) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	NA% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; PASTA AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer

Bonaccio, 2013 (51) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	NA% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; PASTA AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer
Bonanni, 2013 (52) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	NA% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; PASTA AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer

Bonaccio, 2013 (53) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	NA% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; MEAT AND PASTA: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer
Bonaccio, 2016 (54) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	13.5% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; PASTA AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer

Bonaccio, 2018 (55) Molise Moli-sani Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	6.6% (3)	OLIVE OIL AND VEGETABLES: olive oil, cooked and raw vegetables, legumes, soups, fruits, fish, potatoes, bouillon, white meat, crustaceans and molluscs, crisp bread and rusks, nuts and dried fruits, yogurt, snacks, and fresh cheese; ANIMAL FATS AND MEAT: high on pasta and other grains, cooked tomatoes, red meat, white meat, olive oil, animal fats, other sauces, wine, beer, bread, offals, processed meat, and seasoned cheese; low on breakfast cereals and yogurt; EGGS AND SWEETS: eggs, margarines, processed meat, sugar and sweets, vegetable oils, snacks, mayonnaises, butter, seasoned cheese, fresh cheese, pizza, canned fish, fruit juices, coffee, soft drinks, potatoes, white meat, red meat, animal fats, bread, and beer
Pala, 2006 (56) Denmark, France, Germany, Greece, Netherlands, Spain, Sweden, UK, Italy (Varese, Turin, Florence, Naples, Ragusa) EPIC (EPIC-Elderly) Good quality	EFA Standardization EIG≥NA, Scree plot Varimax rotation |FL|≥0.30 Factorability checks NA DP internal consistency NA DP reproducibility NA	21% (4)	PRUDENT: other vegetables, legumes, cooked leafy vegetables, onions and garlic, cabbage, fish, crustaceans and molluscs, mushrooms, seed oils, cooked tomatoes, fresh fruit (non-citrus), and nuts and seeds; PASTA & MEAT: high on pasta and other grains, beef, other animal fats, cooked tomatoes, wine, bread, processed meat, and pork; low on yogurt; OLIVE OIL & SALAD: olive oil, raw tomatoes, raw leafy vegetables, root vegetables, soup, and chicken and turkey; SWEET & DAIRY: sugar and honey and jam, ice cream, chocolate-based confectionery, cakes and puddings, coffee, processed meat, eggs, milk, butter, cheese, and patisserie and biscuits

Masala, 2007 (57) Denmark, France, Germany, Greece, Netherlands, Spain, Sweden, UK, Italy (Varese, Turin, Florence, Naples, Ragusa) EPIC (EPIC-Elderly) Very good quality	EFA Standardization NA EIG≥NA, Scree plot Varimax rotation |FL|≥0.30 Factorability checks NA DP internal consistency NA DP reproducibility NA	21% (4)	PRUDENT: other vegetables, legumes, cooked leafy vegetables, onions and garlic, cabbage, fish, crustaceans and molluscs, mushrooms, seed oil, fresh fruit (non-citrus), cooked tomatoes, and nuts and seeds; PASTA & MEAT: high on pasta and other grains, beef, other animal fats, cooked tomatoes, wine, white bread, processed meat, and pork; low on yogurt; OLIVE OIL & SALAD: olive oil, raw tomatoes, raw leafy vegetables, root vegetables, soup, and chicken and turkey; SWEET & DAIRY: sugar and honey and jam, ice cream, chocolate-based confectionery, cakes and puddings, coffee, processed meat, eggs, milk, butter, cheese, and patisserie and biscuits
Jannasch, 2019 (58) Italy, France, Spain, UK, Netherlands, Germany, Sweden, Denmark EPIC-InterAct Good quality	Separate PCFAs on each country Standardization EIG>1, Scree plot, and interpretability Varimax rotation Simplified sum score with different cut-offs for FL values, but final cut-off equal to |0.4| Factorability checks NA DP internal consistency NA DP reproducibility (internal and cross-study)	18.3% (2)	PC1: leafy vegetables, fruiting vegetables, cabbage, other vegetables, legumes, fish, and vegetable oils; PC2: pasta and rice, red meat, processed meat, other fats, and sugar
Balder, 2003 (11) Netherlands, Sweden, Finland, and Italy DIETSCAN Project (NLSC, SMC, ATBC, ORDET) Poor quality	Separate PCFAs on each of the 4 studies (but NLSC separate analyses for Ms and Fs) Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.35 Factorability checks NA DP internal consistency NA DP reproducibility (internal and cross-study)	ORDET: 28.5% (4)	(SALAD) VEGETABLES: raw leafy vegetables, dressings, tomatoes, oil, and carrots; PORK, PROCESSED MEAT, POTATOES: butter, non-fermented whole milk, pasta, beef, potatoes, processed meat, cakes, and eggs; COOKED VEGETABLES: legumes, cabbages, cooked leafy vegetables, fish, carrots, rice, potatoes, and poultry; ALCOHOL: high on wine and spirits; low on coffee (with milk), non-fermented lowfat milk, cakes, and other fruits

Männistö, 2005 (12) Netherlands, Sweden, and Italy DIETSCAN Project (NLSC, SMC, ATBC, ORDET) Good quality	Separate PCFAs on each of the 3 studies Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.35 Factorability checks NA DP internal consistency NA DP reproducibility NA	ORDET: 28.5% (2)	VEGETABLES (VEG): raw leafy vegetables, tomatoes, dressings, oil, and carrots; PORK, PROCESSED MEAT, POTATOES (PPP): butter, pasta, potatoes, beef and veal, and processed meat; Plus 2 additional DPs for ORDET (presented in Balder et al.) but not common to other cohorts and therefore not considered here
Sieri, 2004 (59) Varese (Lombardy) ORDET Very good quality	EFA Standardization NA EIG>NA, Scree plot Varimax rotation |FL|>0.25 Factorability checks NA DP internal consistency NA DP reproducibility NA	30% (4)	SALAD VEGETABLES: raw and cooked leafy vegetables, mixed vegetables in salad, raw tomatoes, raw carrots, olive oil and other fruiting vegetables; WESTERN: butter, potatoes, other pasta, processed meat, veal, eggs, cakes, beef, seed oils, offal, pork, and cheese; CANTEEN: pasta, cooked tomatoes, olive oil, pulses, other fruiting vegetables, veal, bread and wine; PRUDENT: high on cooked carrots, cooked leafy vegetables, rice, fish, other fruiting vegetables, pulses, poultry, raw carrots, potatoes, yogurt, and olive oil; low on wine and spirits
Sant, 2007 (60) Varese (Lombardy) ORDET Very good quality	EFA Standardization EIG>NA, Scree plot Varimax rotation |FL|>0.25 Factorability checks NA DP internal consistency NA DP reproducibility NA	30% (4)	SALAD VEGETABLES: raw and cooked leafy vegetables, mixed vegetables in salad, raw tomatoes, raw carrots, olive oil and other fruiting vegetables; WESTERN: butter, potatoes, other pasta, processed meat, veal, eggs, cakes, beef, seed oils, offal, pork, and cheese; CANTEEN: pasta, cooked tomatoes, olive oil, pulses, other fruiting vegetables, veal, bread and wine; PRUDENT: high on cooked carrots, cooked leafy vegetables, rice, fish, other fruiting vegetables, pulses, poultry, raw carrots, potatoes, yogurt, and olive oil; low on wine and spirits

Menotti, 2012 (61) Italian Rural Areas of Seven Countries Study of Cardiovascular Disease Seven Countries Study Very good quality	PCFA Standardization NA Adjustment by weight EIG>1, Scree plot Varimax rotation |FL|≥0.25 Factorability checks NA DP internal consistency NA DP reproducibility (internal) with PCA	≥82%* (3)	FACTOR 1: sugar, milk, meat, fruit, pastries, and cheese; FACTOR 2: bread, cereals, vegetables, fish, potatoes, and oils; FACTOR 3: eggs and alcoholic beverages
Menotti, 2018 (62) Italian Rural Areas of Seven Countries Study of Cardiovascular Disease Seven Countries Study Very good quality	PCA and EFA Standardization NA Energy adjustment (density method) EIG>1, Scree plot Varimax rotation |FL|≥0.30 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	≥82%* (3)	FA2 (EFA-based FACTOR2 from Menotti 2012): bread, cereals, vegetables, fish, potatoes, and oils; PCA2 (PCA-based COMPONENT2 from Menotti 2012): bread, cereals, vegetables, fish, potatoes, and oils; Plus 2 additional factors and 2 additional principal components not further investigated due to the lack of association with CHD mortality
Maugeri, 2019 (63) Mamma & Bambino Catania (Sicily) Fair quality	PCFA Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.25 Factorability checks NA DP internal consistency NA DP reproducibility NA	15.6% (2)	PRUDENT: potatoes, raw and cooked vegetables, legumes, rice, and soup; WESTERN: red meat, fries, dipping sauces, salty snacks, and alcoholic drinks

Maugeri, 2019 (64) Mamma & Bambino Catania (Sicily) Fair quality	PCFA Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.20 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	15.55% (2)	PRUDENT: potatoes, cooked vegetables, legumes, pizza, and soup; WESTERN: red meat, fries, dipping sauces, salty snacks, and alcoholic drinks
Magnano San Lio, 2022 (65) Catania (Sicily) Good quality	PCFA on the overall sample Standardization Energy adjustment, NA method EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.4 Factorability checks NA DP internal consistency NA DP reproducibility NA	15.6% (2)	PRUDENT: cooked and raw vegetables, legumes, fruits, fish, and soup; WESTERN: white bread, vegetable oil, fries, salty snacks, dipping sauces, and sweets
Ojeda-Granados, 2022 (66) Catania (Sicily), Guadalajara (Mexico) Fair quality	Separate PCFAs on each country Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.2 Factorability checks NA DP internal consistency NA DP reproducibility NA	15.3% (2)	LEGUMES, VEGETABLES AND FISH (DP1): legumes, cooked and raw vegetables, vegetable soup, potatoes, and fish; SNACK FOODS, PROCESSED MEATS AND OILS (DP2): chips, dipping sauces, snacks, processed meat, vegetable oils, red meat, sugar and sweets, and fruit juice

Barchitta, 2018 (67) Catania (Sicily) Good quality	PCFA Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.2 Factorability checks NA DP internal consistency NA DP reproducibility (internal)	14.31% (2)	PRUDENT: legumes, vegetable soups, potatoes, cooked and raw vegetables, and olive oil; WESTERN: high on chips, snacks, dipping sauces, plant oils, processed and red meats; low on olive oil
Barchitta, 2019 (68) Catania (Sicily) Good quality	PCFA Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.3 Factorability checks NA DP internal consistency NA DP reproducibility NA	17.2% (2)	PRUDENT: potatoes, cooked and raw vegetables, legumes, soup, and fish; WESTERN: high on canned fish, vegetable oil, processed meat, salty snacks, alcoholic drinks, and dipping sauces; low on fruits
Barchitta, 2019 (69) Eastern Sicily Fair quality	PCFA Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.2 Factorability checks NA DP internal consistency NA DP reproducibility NA	26.8% (3)	PRUDENT: potatoes, cooked vegetables, legumes, fruits, nuts, yogurt, offals, shellfish, and tea; WESTERN: white bread, red and processed meat, shellfish, vegetable oil, dipping sauces, and fries; ENERGY DENSE: yogurt, butter and margarine, sweets and refined sugar, dipping sauces, pizza, and fries

Fernández-Alvira, 2014 (70) Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany, and Spain IDEFICS Good quality	Separate PCFA by center Standardization NA EIG>1, Scree plot Varimax rotation |FL|≥0.3 Factorability checks NA DP internal consistency NA DP reproducibility (cross-study)	20.5% (3)	PROCESSED: crisps, corn crisps and popcorn, ketchup, chocolate and candy bars, mayonnaise and mayonnaise-based products, and sweetened drinks; HEALTHY: raw vegetables, cooked vegetables and beans, fresh fruits without added sugar, fresh or frozen fish (not fried), and fresh meat (not fried); SPREADS: reduced-fat products on bread, butter and/or margarine on bread, jam and honey, and chocolate or nut-based spread
Naska, 2006 (71) Belgium, France, Finland, Germany, Greece, Italy, Norway, Portugal, Spain, UK DAFNE Fair quality	Separate PCAs by country on daily individual food availability defined as recorded food quantities divided by the corresponding household values (defined as age and sex specific consumption units calculated on the basis of the respective average energy requirements using energy requirements of males aged 18-29 ys as the reference unit) Standardization Log-transformation of individual food availability relative to the overall average DAFNE food availability (calculated for each FG as unweighted arithmetic mean of the country-specific mean availability values) EIG>1, and interpretability Rotation NA |FL|≥0.2 Factorability checks NA DP internal consistency NA DP reproducibility (cross-study)	PC1: 15-20%; PC2: 6-8% (2)	WIDE RANGE: high on fruits, vegetables, cereals, meat, fish, and dairy products; BEVERAGE AND CONVENIENCE: high on beverages (alcoholic and nonalcoholic) and ready-to-eat dishes; low on plant foods and elaborate-to-cook dishes
Bravi, 2021 (72) Turin (Piemonte), Florence (Tuscany), Rome (Lazio), San Giovanni Rotondo (Apulia), Palermo (Sicily)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks	80.57% (5)	VITAMINS, MINERALS AND FIBERS: fiber, potassium, iron, folate, vitamin C, vitamin E, and beta-carotene equivalents; PROTEINS AND FATTY ACIDS WITH LEGS: animal protein, SFAs, cholesterol, calcium, phosphorus, zinc, and riboflavin; FATTY ACIDS WITH FINS: EPA, DHA, DPA, and vitamin D; FATTY ACIDS WITH LEAVES: MUFAs, LA, ALA, vitamin E,

MEDIDIET Fair quality	DP internal consistency DP reproducibility (internal)		and lycopene; STARCH AND VEGETABLE PROTEINS: starch, vegetable protein, and sodium
Lasalvia, 2021 (73) Varese (Lombardy) ROCAV Good quality	PCFA EIG>1, Scree plot and total variance explained Varimax rotation FL≥0.28 or FL≤-0.15 Factorability checks NA DP internal consistency NA DP reproducibility NA	24.35% (4)	WESTERN: high on red meats, animal fats, processed meats, salty biscuits, vegetable oils, mayonnaise and other sauces, spirits, cheeses, eggs, pizza, crustaceans and molluscs, beer and cider, offals, wine, soft drinks, sugar and sweets, and butter; low on toasted bread and rusks, and fruits; MEDITERRANEAN: high on olive oil, cooked vegetables, raw vegetables, legumes, pasta and other grains, bouillon, cooked tomatoes, soups, fruits, fish, and potatoes; low on soft drinks; CARBOHYDRATE: high on pasta and other grains, cooked tomatoes, bread, and animal fats; low on yogurt, fish, nuts and seeds, breakfast cereals, crustaceans and molluscs, tea, cooked vegetables, fruit juices, fruits, snacks, and eggs; RESIDUAL: high on milk, coffee, and white meats; low on tea, wine, spirits
Zupo, 2020 (74) Castellana Grotte (Apulia) Apulia (from MICOL Study) Very good quality	PCA Percentage of explained variance Varimax rotation NA Descriptive labelling Factorability checks NA DP internal consistency NA DP reproducibility NA	NA% (5)	ENERGY-RICH: cured meat, sausages, lean ham, bacon, desserts, chocolate, and packaged/fried foods; FARM-HOUSE DIET: dairy products, vegetables, legumes, fruits, and semolina-type bread; SWEETS: desserts, chocolate, and package products; WINTER PATTERN: whole grains, poultry, fish, seafood, and legumes; ELDERLY PATTERN: whole milk, semolina-type bread, legumes, and vegetables

Tatoli, 2022 (75) Castellana Grotte (Apulia) Apulia (including also a major part of MICOL Study participants) Poor quality	Separate PCAs by diabetic status Standardization NA Subjective criteria (higher loadings in each group) Varimax rotation NA |FL|≥0.1 Factorability checks NA DP internal consistency NA DP reproducibility NA	NA% (1 for each separate PCA)	DIABETIC/VEGETARIAN: dairy products, eggs, vegetables, nuts, legumes, potatoes, olive oil, fruits, sweets, and sugary foods; NOT DIABETIC: white, red and processed meat, seafood, grains, sweets, sugary foods, caloric drinks, ready-to-eat dishes, wine, beer, and spirits
Giontella, 2019 (76) Verona (Veneto) Good quality	PCA Standardization EIG>1, Scree plot NA Varimax rotation |FL|≥0.2 Factorability checks DP internal consistency NA DP reproducibility NA	45.5% (2)	HEALTHY: vegetables, fresh and dried fruit, legumes, fish, dairy products, cereals and tubers, eggs, and meat; UNHEALTHY: meat, fast food, sweets, cereals and tubers, eggs, fish, and dairy products
Turroni, 2021 (77) Emilia-Romagna (Italy) Good quality	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency NA DP reproducibility NA	80.36% (3)	ANIMAL PRODUCTS: animal protein, cholesterol, niacin, zinc, SFAs, phosphorus, vitamin D, sodium, vitamin B6, retinol, riboflavin, thiamin, calcium, and LA; VITAMINS AND FIBER: vitamin C, beta-carotene, total fiber, total folate, vitamin E, potassium, MUFAs, and soluble carbohydrates; REGIONAL: vegetable protein, other PUFAs, and starch
Donati Zeppa, 2020 (78) Urbino (Marche) Fair quality	Principal Axis Factor Analysis Standardization NA Variables are expressed in terms of difference between values at time 3 (mean of the third mesocycle of training) and values at time 0 (mean of the 2 wks-before period) EIG ≥ 1, variance explained Descriptive labelling Factorability checks DP internal consistency NA DP reproducibility NA	71.61% (3)	FACTOR 1: fat, protein, carbohydrate, energy, MUFAs, SFAs, and vitamin E; FACTOR 2: PUFAs, omega 6, and omega 3; FACTOR 3: soluble fiber, insoluble fiber, vitamin C, vitamin A, starch, and iron

Colica, 2017 (79) Catanzaro (Calabria) Fair quality	PCA (not clear which dietary assessment tool is used) Standardization EIG≥1, Scree plot Varimax rotation |FL|>0.4 Factorability checks NA DP internal consistency NA DP reproducibility NA	55% (6)	PATTERN 1: meat, grains, olive oil, and potatoes; PATTERN 2: fish, vegetables, and milk; PATTERN 3: cheese, cakes, and fruit; PATTERN 4: cheese and animal-based fats; PATTERN 5: eggs, legumes, and wine; PATTERN 6: cakes, biscuits, and sugary drinks
Mazza, 2017 (80) Catanzaro (Calabria) Good quality	Separate PCA on FGs and NUTs (not clear which dietary assessment tool is used) Standardization EIG≥1, Scree plot Varimax rotation |FL|>0.40 Factorability checks (authors' information: not reported in the paper) DP internal consistency NA DP reproducibility NA	NA% (4+4)	FOOD-BASED PATTERNS: CEREALS/MEAT/FISH/OLIVE OIL PATTERN: cereals, meat, fish, and olive oil; CAKES/FRUIT PATTERN: cakes and fruit; ANIMAL FATS/MARGARINES PATTERN: animal fats and margarines; LEGUMES PATTERN: legumes; NUTRIENT-BASED PATTERNS: ANIMAL PROTEIN PATTERN: animal protein; VEGETAL OILS PATTERN: vegetal oils; FATS PATTERN: fats;PLANT PROTEINS/POLYUNSATURATED FATS PATTERN: plant proteins, PUFAs
Palli, 2001 (81) Florence (Tuscany) Good quality	EFA Energy adjustment (residual method) EIG>NA, Scree plot NA, interpretability NA Varimax rotation |FL|≥0.40 Factorability checks NA DP internal consistency NA DP reproducibility NA	75.3% (4)	VITAMIN-RICH: sugar, fiber, vitamin C, vitamin E, beta-carotene, and nitrates; TRADITIONAL: total protein, starch, alcohol, nitrite, and N-nitrosodimethylamine; REFINED: total protein, SFAs, other PUFAs, cholesterol, sugar, retinol, vitamin E, vitamin D, and N-nitrosodimethylamine; FAT-RICH: SFA, oleic acid, MUFAs, LA, ALA, cholesterol, and vitamin E

Anelli, 2022 (82) Milan (Lombardy), Naples (Campania) GIFt Study Very good quality	PCA on the overall sample Energy adjustment (NA method) on FGs from FFQ EIG≥1.1, Scree plot NA Rotation NA Descriptive labelling Factorability checks NA DP internal consistency NA DP reproducibility NA	33,4% (3)	HIGH MEAT, ANIMAL FATS, GRAIN: meat, animal fats, and grains; HIGH FISH, FRUIT, NUTS: fish, fruit, and nuts; HIGH EGGS AND SWEETS, LOW LEGUMES: high on eggs and sweets; low on legumes
Ruggieri, 2022 (83) Crotone (Calabria), Milazzo and Augusta-Priolo (Sicily) NEHO Study Good quality	PCA Standardization NA EIG>NA, Scree plot NA, interpretability NA Rotation NA Descriptive labelling Factorability checks NA DP internal consistency NA DP reproducibility NA	24.9% (3)	PRUDENT: stem-leafy-cooked-raw vegetables, cauliflower, blue fish, fresh caught-farmed fish, fruit, legumes, beef, and yogurt; HIGH ENERGY: high on salty snacks, bakery products, cold meats, fries, mayonnaise, soft drinks, bread, butter, pasta, fresh and aged cheese, potatoes, and pork; low on cereals; VEGETARIAN: high leafy-cooked-raw vegetables, lamb and mutton, tubers, fries, cereals, dried fruit, eggs, oil, butter, and potatoes; low on beef and fresh farmed fish

[1]Whenever international studies were included, summarized evidence concerned only the Italian-specific subpopulation and dietary patterns.
ABBREVIATIONS: ALA, alpha-linolenic acid; ATBC, Alpha-Tocopherol Beta-Carotene; AUFA, Animal Unsaturated Fatty Acids; CHD, coronary heart disease; DAFNE, Data Food Networking; DHA, docosahexaenoic acid; DIETSCAN, Dietary Patterns and Cancer; DP, dietary pattern; DPA, docosapentaenoic acid; EFA, Exploratory Factor Analysis; EI, energy intake(s); EIG, eigenvalue; EPA, eicosapentaenoic acid; EPIC, European Prospective Investigation into Cancer and Nutrition; F, female(s); FA, fatty acid(s); FG, food group(s); FL, factor loading(s); GIFt, Gestational Intake of Food towards healthy outcomes;IDEFICS, Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS; LA, linoleic acid; M, male(s); MICOL, Multicenter Italian Study on Epidemiology of Cholelithiasis; MUFA, monounsaturated fatty acid(s); NA, not available; NEHO, Neonatal Environment and Health Outcomes; NLSC, Netherlands Cohort Study; NUT, nutrient(s); ORDET, Ormoni e Dieta nell'Eziologia del Tumore della Mammella; PC, principal component; PCA, Principal Component Analysis; PCFA, Principal Component Factor Analysis; PUFA, polyunsaturated fatty acid(s); ROCAV, Risk Of Cardiovascular diseases and abdominal aortic Aneurysm in Varese; SFA, saturated fatty acid(s); SMC, Swedish Mammography Cohort; VUFA, Vegetable Unsaturated Fatty Acids; wk, week(s); y, year(s)

Supplemental Table 4. Quantitative assessment of dietary pattern reproducibility for those dietary patterns identified on the same list of input variables: details of study design, participants, dietary assessment tool, and dietary pattern identification method for the papers included in this analysis

Multi-centric case-control studies on diet and cancer at several sites, papers presenting the same list of 28 nutrients as input variables (35, 37-45)

Paper	Study design	Participants	Dietary questionnaire	Dietary pattern identification methods
Bertuccio 2009 (35)	Case-control study; gastric cancer; hospital based; single center/area	777 total subjects recruited from 1997 to 2007; cases were 230 subjects with incident, histologically confirmed gastric cancer diagnosed no longer than 1 y before the interview, and with no previous diagnosis of cancer; controls were 547 subjects frequency matched to cases by age and sex	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Bravi 2010 (37)	Case-control study; colorectal cancer; hospital based; Italian multicentric	6107 total subjects recruited from 1992 to 1996; cases were 1225 subjects with colon cancer and 728 subjects with rectum cancer with histologically confirmed incident diagnosis; controls were 4154 subjects frequency matched to cases by age and sex	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Edefonti 2010 (38)	Case-control study; laryngeal cancer; hospital based; Italian multicentric	1548 total subjects recruited from 1992 to 2000; cases were 460 subjects with incident, histologically confirmed squamous cell cancer of the larynx diagnosed no longer than 1 year before the interview and with no history of cancer; controls were 1088 subjects frequency matched with cases by age, sex, and area of residence	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)

Bravi 2012 (39)	Case-control study; esophageal cancer; hospital based; Italian multicentric	1047 total subjects recruited from 1992 to 1997; cases were 304 with incident, histologically confirmed squamous cell cancer of the esophagus, and with no history of cancer; controls were 743 subjects frequency matched with cases by age, sex, period of interview, and area of residence	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Bosetti 2013 (40)	Case-control study; pancreatic cancer; hospital based; Italian multicentric	978 total subjects recruited from 1991 to 2008; cases were 326 subjects with incident, confirmed pancreatic cancer; controls were 652 subjects frequency matched to cases by study center, gender, and age	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Rosato 2014 (41)	Case-control study; prostate cancer; hospital based; Italian multicentric	2745 total subjects recruited from 1991 to 2002; cases were 1294 men with incident, histologically confirmed prostate cancer; controls were 1451 men admitted to the same network of hospitals	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Bravi 2015 (42)	Case-control study; endometrial cancer; hospital based; Italian multicentric	1362 total subjects recruited from 1992 to 2006; cases were 454 women with incident, histologically confirmed endometrial cancer; controls were 908 women frequency matched to cases by study center and age	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interepretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)

Edefonti 2015 (43)	Case-control study; nasopharyngeal cancer; hospital based; Italian multicentric	792 total subjects recruited from 1992 to 2008; cases were 198 subjects with incident, histologically confirmed nasopharyngeal cancer, diagnosed no longer than 1 year before the interview, and with no history of cancer; controls were 594 subjects frequency matched to cases by age, sex, period of interview, and area of residence	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Dalmartello 2020 (44)	Case-control study; renal cell cancer; hospital based; Italian multicentric	2301 total subjects recruited from 1992 to 2004; cases were 767 subjects with incident, histologically confirmed renal cell cancer; controls were 1534 subjects matched by study center, sex, and quinquennia of age	FFQ 2 ys before IA reproducible and valid 78 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Edefonti 2020 (45)	Case-control study; bladder cancer; hospital based; Italian multicentric	1355 total subjects recruited from 2003 to 2014; cases were 690 subjects with incident urothelial carcinoma of the bladder (almost confirmed by histology or cytology) and with no previous history of other neoplasms; controls were 665 subjects selected among those admitted to the same hospital networks of cases	FFQ 2 ys before IA reproducible and valid 80 FIs (28 NUTs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.63 Factorability checks DP internal consistency DP reproducibility (internal)
Moli-sani study, papers presenting the same list of 43 food groups as input variables (49-51, 53)				
Paper	**Study design**	**Participants**	**Dietary questionnaire**	**Dietary pattern identification methods**

Bonaccio 2012 (49)	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; single center/area	13262 total subjects with information on household income and no reported history of cardiovascular disease, cancer or diabetes, from a cohort of 24325 subjects recruited from March 2005 to April 2010 (Moli-sani Project)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (43 FGs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)
Bonaccio 2012 (50)	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; single center/area	959 total subjects with information on mass media exposure from a cohort of 1132 subjects recruited from May 2009 to April 2010 (Moli-sani Project)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (45 FGs based on reference to a previous paper)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)
Bonaccio 2013 (51)	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; single center/area	744 total subjects with nutritional knowledge assessment and available data on diet from a cohort of 1132 subjects recruited from May 2009 to April 2010 (Moli-sani Project	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (43 FGs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)

Bonaccio 2013 (53)	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; single center/area	16937 total subjects with information on health-related quality of life and dietary habits, and no reported history of cardiovascular disease or cancer quality of life assessment from a cohort 24325 subjects recruited from March 2005 to April 2010 (Moli-sani Project)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (43 FGs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)

Moli-sani study, papers presenting the same list of 46 food groups as input variables (54, 55)

Paper	Study design	Participants	Dietary questionnaire	Dietary pattern identification methods
Bonaccio 2016 (54)	Prospective cohort study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; single center/area	1995 total subjects with type 2 diabetes at time of enrollment, no reported history of cancer, reliable dietary or medical questionnaires and not lost at follow up from a cohort of 24325 subjects recruited from March 2005 to April 2010 (Moli-sani Project)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (46 FGs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)
Bonaccio 2018 (55)	Cross-sectional study; men and women living in Molise randomly recruited from city-hall registries of Molise by using electronically generated numbers; single center/area	10812 final subjects with complete information on psychological resilience and dietary information, reliable medical or dietary questionnaires, and plausible energy intakes from a random sample of 18680 participants, from an original cohort of 24325 subjects recruited from March 2005 to April 2010 (Moli-sani Project)	Modified version of the reproducible and valid EPIC FFQ to include some typical southern Italy foods NA reference period SA Validated in a different form 188 FIs (46 FGs)	PCFA Standardization EIG>1, Scree plot, and interpretability Varimax rotation |FL|≥0.15 Factorability checks NA DP internal consistency NA DP reproducibility (internal)

Research group from Sicily, papers presenting the same list of 39 food groups as input variables (66, 67)

Paper	Study design	Participants	Dietary questionnaire	Dietary pattern identification methods

Ojeda-Granados 2022 (66)	Cross-sectional study from Italy and Mexico; international	811 Italian non-pregnant women with no history of severe diseases recruited among those referring to three clinical laboratories in Catania from 2010 to 2017	Italian FFQ: 1 mo before IA Adapted from a previously validated FFQ 95 FIs (39 FGs)	Separate PCFAs on each country Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.2 Factorability checks NA DP internal consistency NA DP reproducibility NA
Barchitta 2018 (67)	Cross-sectional study; single center/area	539 women diagnosed with an abnormal PAP test without previous treatments and referred to a cervical cancer screening unit in Catania, later classified according to hrHPV status and histological grade of CIN (from normal cervical epithelium to CIN3), recruited from 2013 to 2015	FFQ 1 mo before IA Validated 95 FIs (39 FGs)	PCFA Standardization Energy adjustment (residual method) EIG>2, Scree plot, and interpretability Varimax rotation |FL|≥0.2 Factorability checks NA DP internal consistency NA DP reproducibility (internal)

ABBREVIATIONS: CIN, cervical intraepithelial neoplasia; DP, dietary pattern; EIG, eigenvalue; EPIC, European Prospective Investigation into Cancer and Nutrition; FFQ, Food Frequency Questionnaire; FG, food group(s); FI, food item(s); FL, factor loading(s); hrHPV, high-risk Human Papilloma Virus; IA, interviewer administered; NA, not available; NUT, nutrient(s); PCFA, Principal Component Factor Analysis; SA, self-administered

Supplemental Table 5. Factor congruence coefficients[1] between pairs of apparently similar dietary patterns identified in the multicentric case-control studies on diet and cancer at several sites, presenting the same list of 28 nutrients as input variables for dietary pattern computation

Animal Products

	Gastric cancer (35)	Colorectal cancer (37)	Laryngeal cancer (38)	Esophageal cancer (39)	Pancreatic cancer (40)	Prostatic cancer (41)	Endometrial cancer (42)	Nasopharyngeal cancer (43)	Renal cancer (44)	Bladder cancer (45)
Gastric cancer	1.00	**0.95**	**0.96**	**0.97**	**0.98**	**0.96**	**0.96**	**0.96**	**0.99**	**0.96**
Colorectal cancer	-	1.00	**0.99**	**0.99**	**0.99**	**0.99**	**1.00**	**1.00**	**0.98**	**0.98**
Laryngeal cancer	-	-	1.00	**1.00**	**0.99**	**0.99**	**1.00**	**0.99**	**0.98**	**0.97**
Esophageal cancer	-	-	-	1.00	**1.00**	**0.99**	**0.99**	**0.99**	**0.99**	**0.97**
Pancreatic cancer	-	-	-	-	1.00	**0.99**	**0.99**	**0.99**	**0.99**	**0.97**
Prostatic cancer	-	-	-	-	-	1.00	**1.00**	**0.99**	**0.99**	**0.98**
Endometrial cancer	-	-	-	-	-	-	1.00	**0.99**	**0.99**	**0.98**
Nasopharyngeal cancer	-	-	-	-	-	-	-	1.00	**0.98**	**0.98**
Renal cancer	-	-	-	-	-	-	-	-	1.00	**0.98**
Bladder cancer	-	-	-	-	-	-	-	-	-	1.00

Vitamins and Fiber

	Gastric cancer (35)	Colorectal cancer (37)	Laryngeal cancer (38)	Esophageal cancer (39)	Pancreatic cancer (40)	Prostatic cancer (41)	Endometrial cancer (42)	Nasopharyngeal cancer (43)	Renal cancer (44)	Bladder cancer (45)
Gastric cancer	1.00	**0.99**	**0.97**	**0.97**	**0.99**	**0.98**	**0.99**	**0.98**	**0.98**	**0.98**
Colorectal cancer	-	1.00	**0.99**	**0.99**	**0.99**	**0.98**	**0.99**	**0.98**	**0.96**	**0.97**

Laryngeal cancer	-	-	1.00	**0.98**	**0.99**	**0.99**	**0.98**	**0.99**	**0.96**	**0.95**
Esophageal cancer	-	-	-	1.00	**0.98**	**0.98**	**0.97**	**0.97**	**0.96**	**0.97**
Pancreatic cancer	-	-	-	-	1.00	**0.99**	**0.99**	**0.99**	**0.99**	**0.97**
Prostatic cancer	-	-	-	-	-	1.00	**0.99**	**0.99**	**0.97**	**0.95**
Endometrial cancer	-	-	-	-	-	-	1.00	**0.99**	**0.98**	**0.97**
Nasopharyngeal cancer	-	-	-	-	-	-	-	1.00	**0.97**	**0.96**
Renal cancer	-	-	-	-	-	-	-	-	1.00	**0.95**
Bladder cancer	-	-	-	-	-	-	-	-	-	1.00

Starch-rich

	Gastric cancer (35)	Colorectal cancer (37)	Laryngeal cancer (38)	Esophageal cancer (39)	Pancreatic cancer (40)	Prostatic cancer (41)	Endometrial cancer (42)	Nasopharyngeal cancer (43)	Renal cancer (44)	Bladder cancer (45)
Gastric cancer	1.00	0.94	0.92	**0.95**	0.90	0.93	**0.96**	0.94	0.88	0.93
Colorectal cancer	-	1.00	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**	**1.00**	**0.98**	0.92
Laryngeal cancer	-	-	1.00	**0.99**	**0.99**	**0.98**	**0.98**	**0.99**	**0.98**	0.90
Esophageal cancer	-	-	-	1.00	**0.98**	**0.98**	**0.99**	**0.99**	**0.96**	0.92
Pancreatic cancer	-	-	-	-	1.00	**0.97**	**0.97**	**0.98**	**0.99**	0.89
Prostatic cancer	-	-	-	-	-	1.00	**0.99**	**0.99**	**0.97**	0.93
Endometrial cancer	-	-	-	-	-	-	1.00	**0.99**	**0.96**	0.94
Nasopharyngeal cancer	-	-	-	-	-	-	-	1.00	**0.98**	0.93
Renal cancer	-	-	-	-	-	-	-	-	1.00	0.88

Bladder cancer	-	-	-	-	-	-	-	-	-	1.00

Animal Unsaturated Fatty Acids (AUFA)[2]

	Colorectal cancer (37)	Laryngeal cancer (38)	Esophageal cancer (39)	Prostatic cancer (41)	Endometrial cancer (42)	Nasopharyngeal cancer (43)	Bladder cancer (45)
Colorectal cancer	1.00	**0.99**	**0.96**	**0.97**	**0.99**	**0.98**	0.92
Laryngeal cancer	-	1.00	**0.97**	**0.99**	**0.99**	**0.98**	0.94
Esophageal cancer	-	-	1.00	**0.96**	**0.97**	**0.96**	**0.96**
Prostatic cancer	-	-	-	1.00	**0.98**	**0.96**	0.91
Endometrial cancer	-	-	-	-	1.00	**0.98**	0.94
Nasopharyngeal cancer	-	-	-	-	-	1.00	0.92
Bladder cancer	-	-	-	-	-	-	1.00

Vegetable Unsaturated Fatty Acids (VUFA)[3]

	Gastric cancer (35)	Colorectal cancer (37)	Laryngeal cancer (38)	Esophageal cancer (39)	Pancreatic cancer (40)	Prostatic cancer (41)	Endometrial cancer (42)	Nasopharyngeal cancer (43)	Renal cancer (44)
Gastric cancer	1.00	0.93	0.92	0.88	**0.98**	0.92	0.93	0.92	**0.98**
Colorectal cancer	-	1.00	**0.99**	**0.97**	0.94	**0.99**	**0.98**	**0.97**	**0.96**
Laryngeal cancer	-	-	1.00	**0.99**	0.93	**0.99**	**0.98**	**0.97**	**0.96**
Esophageal cancer	-	-	-	1.00	0.91	**0.97**	**0.97**	**0.95**	0.94
Pancreatic cancer	-	-	-	-	1.00	0.93	0.93	0.92	**0.99**
Prostatic cancer	-	-	-	-	-	1.00	**0.97**	**0.96**	**0.96**
Endometrial cancer	-	-	-	-	-	-	1.00	**0.97**	**0.96**
Nasopharyngeal cancer	-	-	-	-	-	-	-	1.00	0.94

Renal cancer	-	-	-	-	-	-	-	-	1.00

[1]Congruence coefficients range between 0 and 1 (in absolute value), with values between 0.85 and 0.94 indicating fair similarity and values ≥0.95 (in bold typeface in the upper triangular matrix) indicating equivalence of corresponding dietary patterns.
[2]Three papers (35, 40, 44) are missing as the *AUFA* DP was not identified there.
[3]One paper (45) is missing as the *VUFA* DP was not identified there.

Supplemental Table 6. Factor congruence coefficients[1] between pairs of apparently similar dietary patterns identified in the papers involving the Moli-sani study population for the same list of 43 and 46 food groups as input variables for dietary pattern computation, respectively

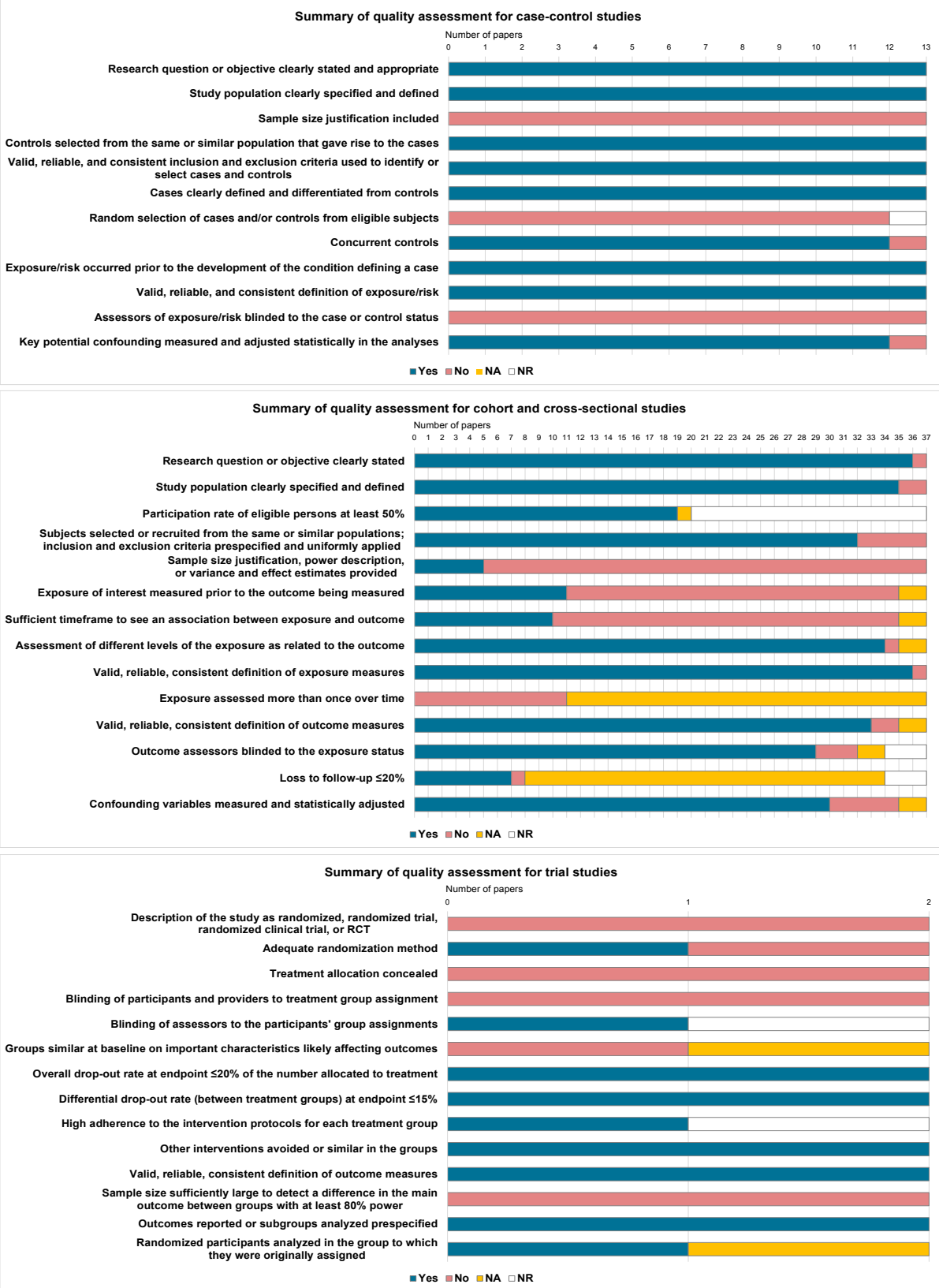
43 food groups				
Olive Oil and Vegetables				
	Household income (49)	Mass media exposure (50)	Nutrition knowledge (51)	Quality of life (53)
Household income	1.00	0.94	**0.95**	**1.00**
Mass media exposure	-	1.00	**0.99**	**0.95**
Nutrition knowledge	-	-	1.00	**0.95**
Quality of life	-	-	-	1.00
Pasta and Meat				
	Household income (49)	Mass media exposure (50)	Nutrition knowledge (51)	Quality of life (53)
Household income	1.00	**0.97**	**0.97**	**1.00**
Mass media exposure	-	1.00	**0.99**	**0.98**
Nutrition knowledge	-	-	1.00	**0.97**
Quality of life	-	-	-	1.00
Eggs and Sweets				
	Household income (49)	Mass media exposure (50)	Nutrition knowledge (51)	Quality of life (53)
Household income	1.00	0.93	0.92	**1.00**
Mass media exposure	-	1.00	**0.99**	0.94
Nutrition knowledge	-	-	1.00	0.93
Quality of life	-	-	-	1.00

46 food groups		
Olive Oil and Vegetables		
	Overall and cause-specific mortality (54)	Cognitive performance (55)
Overall and cause-specific mortality	1.00	**0.98**

Cognitive performance	-	1.00
	Pasta and Meat	
	Overall and cause-specific mortality (54)	Cognitive performance (55)
Overall and cause-specific mortality	1.00	**0.98**
Cognitive performance	-	1.00
	Eggs and Sweets	
	Overall and cause-specific mortality (54)	Cognitive performance (55)
Overall and cause-specific mortality	1.00	**0.97**
Cognitive performance	-	1.00

[1] Congruence coefficients range between 0 and 1 (in absolute value), with values between 0.85 and 0.94 indicating fair similarity and values ≥0.95 (in bold typeface in the upper triangular matrix) indicating equivalence of corresponding dietary patterns.

Supplemental Figure 1. Summary of quality assessment for studies included in the systematic review by single rating tool available from the National Institutes of Health, National Heart, Lung, and Blood Institute[1]



[1]For each quality assessment tool, each row reported the distribution of replies ("Yes", "No", "Not applicable", and "Not reported") to single questions. The "Cannot determine" reply was never used during this quality assessment.

ABBREVIATIONS: NA, Not Applicable; NR, Not reported