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Systematic review of use and interpretation of dietary diversity indicators in nutrition-sensitive agriculture literature

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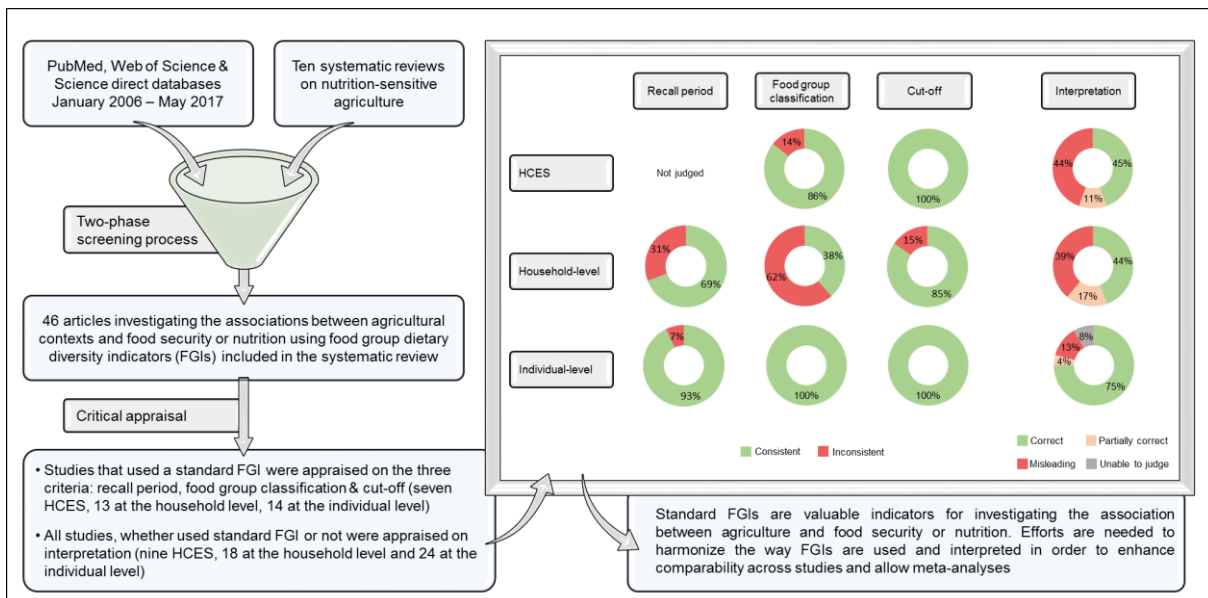
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1 **Abstract**

2 In the past decade, food group dietary diversity indicators (FGIs) have increasingly been used
3 to assess the impact of agriculture on food security or nutrition. Following a structured search
4 strategy and a two-phase screening process, 46 studies investigating associations between
5 agriculture and food security or nutrition through the use of simple FGIs were assessed for how
6 the indicators were constructed and interpreted. Most studies based on individual level FGIs
7 were consistent with published guidance, while many of the studies measuring households’
8 dietary diversity were not, particularly in terms of interpretation of the indicators or of food
9 group classification. Efforts are needed to harmonize the way FGIs are used and interpreted in
10 order to enhance comparability across studies and allow meta-analyses of the association
11 between agriculture and food security or nutrition.

12

13 **Graphical abstract**



14

15

16 **Keywords**

17 Dietary diversity; nutrition; food security; agricultural practices; agricultural contexts; critical
18 appraisal.

20 **1. Introduction**

21 Pathways through which agriculture can improve nutrition are complex (World Bank, 2007).
22 Conceptual frameworks elaborated to describe impact pathways from agriculture to nutrition
23 (Kadiyala et al., 2014) follow the model of the “conceptual framework for the analysis of the
24 causes of malnutrition”, which orders causes as immediate, underlying or basic determinants of
25 malnutrition (UNICEF, 1990). According to this framework, agriculture, as a basic
26 determinant, impacts nutrition through underlying determinants that include access to food, care
27 practices and health environment. In turn, underlying determinants impact nutritional status
28 through two immediate determinants – food intake and health.

29 The choice of indicators in studies of the nutritional impact of agricultural interventions and
30 programmes is a crucial issue (Webb and Kennedy, 2014). Many studies use nutritional status
31 as the principal impact indicator, as pointed out by several authors (Masset et al., 2012; Girard
32 et al., 2012; Pandey et al., 2016). Several reviews of relevant studies have shown little evidence
33 of an impact on child anthropometric status, partly due to methodological limitations (Masset
34 et al., 2012; Ruel and Alderman, 2013; Gillespie and van den Bold, 2017). This lack of evidence
35 may be due to the multifactorial nature of nutritional status, its low sensitivity to change and to
36 large sample requirements for detecting an impact when there is one. In a review of on-going
37 agriculture-nutrition intervention projects, Herforth and Ballard (2016) found that almost all
38 were using dietary indicators for assessing impact on nutrition, an important shift in focus
39 compared to the previous decade when anthropometry was considered the only outcome of
40 interest.

41 Dietary indicators are more specific and sensitive to change in food availability and access than
42 nutritional status and require smaller samples (Herforth and Ballard, 2016). However, assessing
43 diets is a challenging endeavour. Quantitative dietary intake assessments are cumbersome and

44 require highly specialized skills. To address this issue, several simple proxy dietary indicators
45 have been developed, among which the most widely used are indicators of dietary diversity. It
46 has been recognized that dietary diversity, a key component of diet quality, helps to ensure
47 intake of essential nutrients (Ruel, 2003). Monotonous diets are associated with multiple
48 nutrient deficiencies. Dietary diversity is a holistic feature of the diet in contrast with intake of
49 single nutrients. Moreover dietary diversity is a key feature of food-based dietary guidelines
50 (WHO, 1996).

51 Simple food group indicators (FGIs) assess whether people consume foods from specific food
52 groups, defined as a set of foods that share similar nutritional properties or biological
53 characteristics (Arimond et al., 2010). Four FGIs, developed to reflect dietary diversity of
54 households or individuals, have been validated against multi-site quantitative food intake
55 datasets in order to operationalize the measurement of dietary diversity at population level.
56 They are proxies of access to a variety of foods in the field of food security (at household level)
57 or of nutrient adequacy of the diet, one key dimension of diet quality (at individual level) (Ruel,
58 2003).

59 At the household level, a 10-country analysis showed an association between an FGI and per
60 capita energy availability (Hoddinott and Yohannes, 2002). The Household Dietary Diversity
61 Score (HDDS), constructed by counting the number of food groups consumed by the household
62 over the previous 24 hours, was proposed as an indicator of the access dimension of food
63 security. Guidelines were published to standardize the implementation of a 12-food group
64 indicator (Swindale and Bilinsky, 2006). At the individual level, simple indicators were
65 developed for monitoring progress in feeding practices for infants and young children. Ten
66 datasets were used to identify indicators correlated with the mean adequacy of the micronutrient
67 density of complementary foods across nine micronutrients. As a result, a dichotomous
68 indicator of Minimum Dietary Diversity (MDD) of four or more food groups, out of seven,

69 consumed over the previous 24 hours was validated for infants and young children six to 23
70 months old (Working Group on Infant and Young Child Feeding Indicators, 2006). Guidelines
71 for standardizing the implementation of the MDD were published by the World Health
72 Organization (WHO, 2008, 2010). In parallel, a dietary diversity indicator was developed to
73 reflect the mean probability of adequacy of women's diets across 11 micronutrients. Several
74 dietary diversity scores were validated using five datasets (Arimond et al., 2010). Guidelines
75 were published that promoted a simple nine food group dietary diversity score for women of
76 reproductive age, the Women's Dietary Diversity Score (WDDS) (FAO, 2011). This was
77 followed by an analysis of nine datasets to create and validate the Minimum Dietary Diversity
78 for Women of Reproductive Age (MDD-W), a dichotomous indicator of five or more food
79 groups, out of 10, consumed over the previous 24 hours (Women's Dietary Diversity Project
80 Study Group, 2017). FAO and FHI360 (2016) published a guidance manual.

81 The HDDS, MDD, WDDS and MDD-W have undergone extensive validation work, using
82 datasets from multiple sites, to arrive at proxy indicators of diet that are approximately
83 comparable in meaning across different contexts and over time. Their characteristics are
84 described in Table 1. These indicators require far fewer skills than quantitative intake surveys
85 for data collection, analysis and interpretation. They are based on a qualitative 24-hour recall,
86 which is less prone to bias and recall error than other methods, and results of assessments are
87 simpler to analyse (NIH-NCI, 2018). Because of their relative simplicity and demonstrated
88 validity, these four standard FGIs have been widely used by researchers from different sectors,
89 in particular in studies of the impact of agriculture on food security and nutrition (Herforth and
90 Ballard, 2016). This paper reviews published studies that investigated the association between
91 agricultural practices or agricultural contexts and food security or nutrition by using simple
92 FGIs of dietary diversity. The purpose of the review is to assess to what extent and how studies
93 used and interpreted common metrics of dietary diversity, which would improve comparability

94 across studies to produce global evidence of the impact of agriculture on nutrition and food
95 security. We acknowledge however that not all studies have an objective of comparisons across
96 settings. The intent of the review was not to judge the validity of the studies or their results.

97

98 **2. Methods**

99 2.1 Selection of studies for the review

100 Systematic reviews of research on nutrition-sensitive agriculture were examined to identify key
101 terms and the most relevant scientific literature databases for carrying out the search
102 (Balagamwala and Gazdar, 2013; Dury et al., 2015; Fiorella et al., 2016; Kadiyala et al., 2014;
103 Masset et al., 2012; Pandey et al., 2016; Penafiel et al., 2011; Powell et al., 2015; Warren et al.,
104 2015; Webb and Kennedy, 2014). Based on this first step, a structured search strategy was
105 developed to include terms related to dietary diversity and agricultural practices or contexts¹,
106 spanning publications from 2006 up to 23 May 2017. This search strategy was applied to three
107 databases: PubMed, Web of Science and Science direct. Additionally, reference lists of recent
108 systematic reviews on nutrition-sensitive agriculture and of studies included in this review were
109 examined to identify other potentially relevant studies. The search was limited to peer-reviewed
110 articles published in English. All populations and study designs were eligible for inclusion,
111 from cross-sectional studies to randomized controlled trials or other impact evaluation designs.

¹ (“diet* diversity”) AND (household* OR family OR woman OR women OR child* OR infant*) AND (“agricultur* intervention” OR “agricultur* program” OR “agricultur* growth” OR “home* food production” OR “farm* production” OR “household production” OR “crop production” OR “biomass production” OR “farm productivity” OR “agricultur* productivity” OR “food crop*” OR “cash crop*” OR “cash-cropping” OR “commercial agriculture” OR “farming contract” OR “agricultur* diversity” OR “production diversity” OR “crop diversity” OR “crop diversification” OR “product diversification” OR “biodiversity” OR “agrobiodiversity” OR “agro-biodiversity” OR “agricultural intensification” OR “aquaculture” OR “agriculture-aquaculture” OR “fisher*” OR “fishing” OR “livestock ownership” OR “livestock rearing” OR “bio-fortification” OR “biofortification” OR “irrigation” OR “women’s empowerment” OR “seed” OR “intercropping” OR “land-use”). For the PubMed search, the terms were not truncated.

112 All studies identified from the initial search strategy were filed and handled using Zotero
113 (version 4.0.28.7). A two-stage screening process was employed to select the final studies to be
114 reviewed. At each stage, the first author screened and reviewed all studies, which were also
115 divided among the three co-authors for a simultaneous review. All disagreements regarding
116 eligibility were resolved through discussion.

117 At the first stage, all titles and abstracts were examined. Studies that were obviously irrelevant,
118 such as those not investigating associations between any type of agricultural practice or context
119 and food security or nutrition, ecological studies or papers discussing the associations
120 theoretically or conceptually only, as well as reviews or meta-analyses, were excluded from
121 further review. The studies selected at the first stage underwent a full-text screen against the
122 second stage inclusion criterion: only studies that investigated associations between agricultural
123 practices or contexts and food security or nutrition and that used FGIs.

124 To facilitate the second stage full-text screening, the following information was tabulated using
125 a standardized data extraction form: (i) location of the study (e.g. country); (ii) study design
126 (e.g. cross-sectional study); (iii) subjects and sample size; (iv) purpose of the study; (v) name
127 and reference of the dietary diversity indicator used; (vi) recall period (period of time for which
128 food group consumption is reported, e.g. previous day or previous week); (vii) food group
129 classification; (viii) use of a cut-off; and (ix) interpretation of the dietary diversity indicator.

130 Reasons for exclusion of studies after the second stage full-text screening included
131 investigations of non-specific agricultural practices or contexts, such as forest cover, proximity
132 to marine protected areas or merely rural residence, and those that did not actually measure
133 diversity of the diet using an FGI.

134

135 2.2 Critical appraisal

136 Following the two screening stages, each of the remaining studies was critically appraised for
137 use and interpretation of FGIs. First, studies were categorized by whether they measured dietary
138 diversity at the household level, individual level or both. The studies were then categorized by
139 whether they used a standard FGI, i.e. HDDS, MDD, WDDS, or MDD-W. Those that did use
140 a standard FGI were assessed for consistency with the published guidance based on three
141 criteria: 1) recall period, 2) food group classification and 3) use or not of a cut-off for creating
142 a categorical indicator. Studies that did not use a standard FGI were excluded from the appraisal
143 for these three criteria. For the remaining that did use a standard FGI, the recall period was
144 judged as “consistent” if the study used a 24-hour recall, otherwise “inconsistent”. Studies using
145 secondary data from Household Consumption and Expenditure Surveys (HCES) to construct
146 an FGI were excluded from assessment of this criterion because HCES systematically use
147 longer recall periods. The food group classification was judged as “consistent” if the study used
148 the recommended number of food groups and food group definitions, otherwise “inconsistent”.
149 The use of a cut-off was judged as “consistent” if the recommended thresholds for the MDD
150 and MDD-W were used, if no ad hoc cut-off was applied to the HDDS or the WDDS since
151 these two indicators do not have recommended thresholds, or if cut points based on a quantile
152 distribution of the dietary diversity score were applied to the HDDS or WDDS. This element
153 was judged as “inconsistent” if other cut-off approaches were used or were not used when
154 appropriate to do so.

155 The full set of studies, including those that did not use one of the four standard indicators, was
156 assessed on how the FGI employed was interpreted in relation to the level of analysis. The
157 interpretation of the FGI was judged as “correct” if consistent with the level at which it was
158 applied (e.g. interpretation in terms of access to a variety of foods in the field of food security
159 for household measures and in terms of nutrient adequacy of the diet, one key dimension of diet
160 quality, for individual measures). The interpretation was judged as “misleading” if it was not

161 consistent with the objective of the study and level of analysis. An intermediate judgment of
162 “partially correct” was assigned when the interpretation of the results was consistent with the
163 level of analysis, thus correct, but either the indicator was not strictly appropriate for the
164 research question or the investigators interpreted a household level indicator as a measurement
165 of nutrition or diet quality in the introduction or discussion section of the paper.

166 All disagreements among reviewing co-authors regarding the critical assessment were resolved
167 through discussion.

168

169 **3. Results**

170 3.1 Description of the studies

171 As presented in Figure 1, the first stage of the systematic review identified 155 published
172 studies. Of these, 97 were judged as clearly irrelevant at the first stage and were excluded. In
173 addition to the remaining 58 included in the second stage, nine others were identified from
174 reference lists of the included studies and were added for a total of 67 eligible studies for full
175 text screening. Of these, 11 were subsequently eliminated because they did not specifically use
176 an FGI, two because they did not investigate agricultural practices or contexts, and eight
177 because there was no quantification of the association between agricultural practice or context
178 and FGI. Forty-six studies were thus selected for the final review.

179 Overall, there was a wide heterogeneity across the 46 studies regarding the unit of analysis, the
180 location, study design, sample size, choice of indicators and analysis of the dietary diversity
181 data (see Appendices A, B and C for a complete list of reviewed studies). Five studies measured
182 dietary diversity at both the household and individual level, 19 only at the individual level, and
183 22 only at the household level, of which nine from HCES secondary analyses. Sixteen studies

184 reported dietary diversity of children; nine of those included children older than 23 months
185 (range 24–83 months).

186 Data from 30 different countries were reported across the 46 studies: 14 from Africa, nine from
187 Asia, five from Latin America, and two from Eastern Europe; 16 countries were reported on
188 only once and 14 were reported on in more than one study. Malawi was the most frequently
189 included country, reported on in nine studies. Three of the nine studies using HCES pooled data
190 from multiple countries, ranging from four to 15.

191 Forty of the 46 studies used a cross-sectional design, five reported on impact evaluation and
192 only one used a longitudinal design. Sample sizes greatly varied from as small as 30 to over
193 10,000 (papers conducting multi-country secondary analyses of national HCES).

194

195 3.2 Critical appraisal of the use and interpretation of FGIs

196 Table 2 lists the results of the assessment based on the four criteria, shown separately for studies
197 using HCES data, other household level data and individual level data (see Appendices A, B
198 and C for detailed description of the reviewed studies).

199

200 3.2.1 Critical appraisal of the use of standard FGIs

201 Thirty of the 46 studies made reference to standard indicators (HDDS, MDD, WDDS or MDD-
202 W) for measuring dietary diversity and were included in the critical assessment for the three
203 criteria pertaining to recall period, food group classification and use of a cut-point.

204 With respect to recall period, nine out of 13 household level studies (excluding HCES studies,
205 which were not judged on recall period) and 13 out of 14 individual level studies used a 24-
206 hour recall period.

207 Of the studies using one of the four standard FGIs, five out of seven HCES, six out of 13
208 household level studies and all 14 individual level studies constructed the FGI according to the
209 recommended food group classification. The main reason for being rated “inconsistent” for
210 food group classification was using an HDDS indicator with more or fewer food groups than
211 the recommended 12 food groups.

212 With respect to the use of a score-based cut-off, all seven HCES, 11 out of 13 household level
213 and all 14 individual level indicators were consistent with published guidance. The cases rated
214 “inconsistent” either set their own thresholds that were not based on quantiles (for HDDS or
215 WDDS) or did not use the established thresholds for MDD or MDD-W.

216

217 3.2.2 Critical appraisal of the interpretation of FGIs

218 With respect to interpretation of the FGI, of the nine HCES studies, four were judged as correct,
219 one as partially correct and four as misleading. Of the 18 household level studies, eight were
220 judged as correct, three as partially correct and seven as misleading. Of the 24 individual level
221 studies, 18 were judged as correct, one as partially correct, three as misleading and two as
222 “unable to judge” (See Appendices A, B and C for more details).

223 The reason for the interpretation of the FGI being rated as “misleading” was a mismatch
224 between study objective, level of analysis and interpretation. This rating was given to studies
225 that a) specifically interpreted a household level FGI applied to households as a measure of
226 “household diet quality”, “household nutrition or nutritional status”, or “food and nutrition
227 security”; or b) applied an individual FGI indicator to individuals and interpreted results as a
228 measure of either household food security/food access or of household dietary diversity.

229 A study was rated as “partially correct” when the investigators made a correct interpretation for
230 level of analysis, but used an inappropriate indicator or incorrectly characterized the indicator

231 they used. In particular, this rating was given to studies that a) applied a standard household
232 FGI to individuals to assess nutrient adequacy of individuals, or b) applied an individual FGI
233 at household level to assess household food security/food access, or c) made statements in the
234 introduction or discussion section of the paper that household FGIs were measures of nutrition
235 or diet quality even when they correctly interpreted results according to the level of analysis in
236 the results section.

237

238 **4. Discussion**

239 This systematic review was undertaken to assess how dietary diversity indicators used in studies
240 investigating the association between agricultural practices or contexts and food security or
241 nutrition were constructed and interpreted. To our knowledge, ours is the first review of this
242 kind. For the large majority of individual level indicators, construction and interpretation were
243 correct. Most studies based on HCES used the HDDS correctly regarding food group
244 classification; however, interpretation was misleading in approximately half of the cases. For
245 the other household level studies, a majority of which used the HDDS, less than half used the
246 recommended food group classification. Similarly, less than half applied the correct
247 interpretation.

248

249 4.1 Adherence to published guidance on standard FGIs

250 The review highlighted several areas where use of the standard, validated FGIs was inconsistent
251 with accepted guidance: recall period, food group definitions and number, and use of a cut-
252 point. In these cases, the inconsistencies may have been due to intentionally adapting the
253 standard FGIs to the context-specific objectives of the studies.

254 The recommended recall period for the four standard FGIs is the previous 24 hours. While using
255 a different recall period might have internal relevance within a study for reasons pertaining to
256 the specific objective or context, it limits comparability with other studies based on standard
257 FGIs. When longer recall periods are used, higher dietary diversity scores are expected
258 (Drewnowski et al, 1997; Arimond and Ruel, 2004a), and established cut-points of MDD and
259 MDD-W, validated for 24-hour intake recall, no longer apply.

260 Food group classifications of the standard FGIs differ according to the level of analysis:
261 household or individual. The HDDS includes both nutrient-rich and non-nutrient-rich food
262 groups accessed by the household, and does not provide information on nutrient intakes of
263 individual household members. In contrast, the individual level FGIs, which were designed to
264 reflect the nutritional quality of individual diets, include only micronutrient-rich food groups.
265 Use of nonstandard food groups or different numbers of food groups with respect to standard
266 indicators precludes comparability with other studies and may compromise interpretation of the
267 dietary diversity measure.

268

269 4.2 Dietary diversity compiled from HCES consumption modules

270 Secondary analyses of HCES data is a valuable source for investigating dietary outcomes of
271 agricultural practices. HCES are conducted in a large number of countries every two to ten
272 years, enabling the analysis of trends over time. In the past two decades, data from HCES have
273 increasingly been used in an effort to derive food and nutrition information for policy decisions
274 (Fiedler et al., 2013; Coates et al., 2017; Moltedo et al., 2018).

275 Including HCES studies investigating links between agriculture and nutrition in this review has
276 highlighted a particular set of issues in relation to both recall period and food group
277 composition. Three of the nine HCES studies pooled data from multiple surveys to create a

278 common FGI from the survey-specific food lists for comparison across the different datasets.
279 However, heterogeneity of the number of food items listed in survey-specific food consumption
280 modules (ranging from 20 to 135 food items in the reviewed studies using HCES) is problematic
281 because foods representative of important food groups, such as vegetables and fruits, may be
282 missing when the number of food items is small. This lack of comprehensiveness of food items
283 making up the food groups for measuring dietary diversity across datasets limits comparability
284 and could affect interpretation of the results (Murphy et al., 2012). One study analysed dietary
285 diversity from pooled HCES data with different recall periods (ranging from seven to 365 days).
286 Problems with non-comparability of food lists and recall periods of food consumption modules
287 across HCES have been documented by the International Household Survey Network in a large
288 review (Smith et al., 2014). There is ongoing work to standardize food consumption modules
289 in HCES, and a dietary diversity indicator for household data has been proposed by FAO
290 (Moltedo et al., 2018), which should improve comparability across HCES in the future.

291

292 4.3 Age/sex population groups not represented in standard FGIs

293 Many of the reviewed studies measured dietary diversity on populations groups for which the
294 standard indicators were not validated. To date, the MDD and MDD-W have been validated
295 only for children aged six to 23 months and women of reproductive age (15–49 years),
296 respectively. Nine studies used an FGI for children older than 23 months. MDD was developed
297 to reflect adequacy of the micronutrient density of complementary foods of children aged six
298 to 23 months, and thus is not appropriate to reflect the micronutrient adequacy of diets of
299 children older than 23 months. A recent study showed that MDD-W performed better than
300 MDD for predicting micronutrient adequacy among rural Zambian children 4 to 8 years of age
301 (Caswell et al., 2018). Similarly, another recent study established that, using the MDD-W
302 among pregnant women in Bangladesh, a cut-point of 6 or more food groups performed better

303 than the cut-point of 5 or more food groups recommended for non-pregnant women (Nguyen
304 et al., 2018).

305 Dietary diversity indicators have been found to be positively correlated with the macro and/or
306 micronutrient adequacy of diets of children aged five to 11 years (Steyn et al., 2014),
307 adolescents (Mirmiran et al., 2004) or elderly subjects (Rathnayake et al., 2012; Tavakoli et al.,
308 2016) but there are no internationally validated indicators of dietary diversity currently
309 available for these age and sex groups. There is a need for multi-site validation studies for
310 indicators covering other age and sex groups.

311

312 4.4 Interpretation of the dietary diversity indicators

313 In more than half of the articles using HCES data or other household level data, the investigators
314 interpreted the FGI as measures of “household nutrition”, “nutrient adequacy of household
315 diets”, “household food and nutrition security”, or “dietary quality”. The term “nutrition” refers
316 to the nutritional status of individuals, their nutrient requirements and their diets, not to
317 households. Because nutrient requirements differ according to age and sex, and allocation of
318 food between individuals in a household depends on many factors, “household nutrition” and
319 “nutrient adequacy or quality of household diets” are inappropriate concepts.

320

321 4.5 Strengths and limitations

322 A strength of this review is the categorization of the studies in three groups (HCES, other
323 household level and individual level) which ensures a pertinent assessment for each group.
324 Another strength is the consistent use of two or more independent screeners to reduce errors in
325 data extraction, as recommended by Buscemi et al. (2006). A limitation is that the review
326 included only articles published in English.

327

328 **5. Conclusion**

329 Our critical assessment of the use of FGIs in the selected studies revealed several issues in the
330 way dietary diversity indicators were constructed or interpreted. Consequently, based on this
331 systematic review, we propose a checklist of items that authors could consider and report on to
332 ensure a consistent use and correct interpretation of dietary diversity indicators (Box1). In
333 addition we make the following recommendations:

- 334 • Investigators using a dietary diversity indicator that is not standard but suits their
335 purpose (such as focus on certain foods with more disaggregated food groups) should
336 try, whenever possible, to also construct from their data a standard FGI for comparison
337 purposes.
- 338 • Investigators using a standard FGI on an age or gender group for which the indicator
339 was not validated should clearly acknowledge and discuss this point.
- 340 • Authors should avoid pooling data from several datasets, HCES in particular, that use
341 different recall periods and that are likely to have a variable number of food items from
342 which food groups are composed.

343 FGIs are valuable indicators for investigating the association between agricultural practices or
344 agricultural contexts and food security or nutrition, and their use by research and development
345 communities is an encouraging sign. Two recent publications reviewed the literature on links
346 between diversity of production and dietary diversity in smallholder households (Jones, 2017b;
347 Sibhatu and Qaim, 2018). However, further reviews and meta-analyses would greatly benefit
348 from better efforts to harmonize the way FGIs are used and interpreted in order to enhance the
349 comparability of studies. This will be an important contribution towards building a robust body
350 of evidence of the impact of agriculture on nutrition and food security at global level.

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Figures, Tables and Boxes

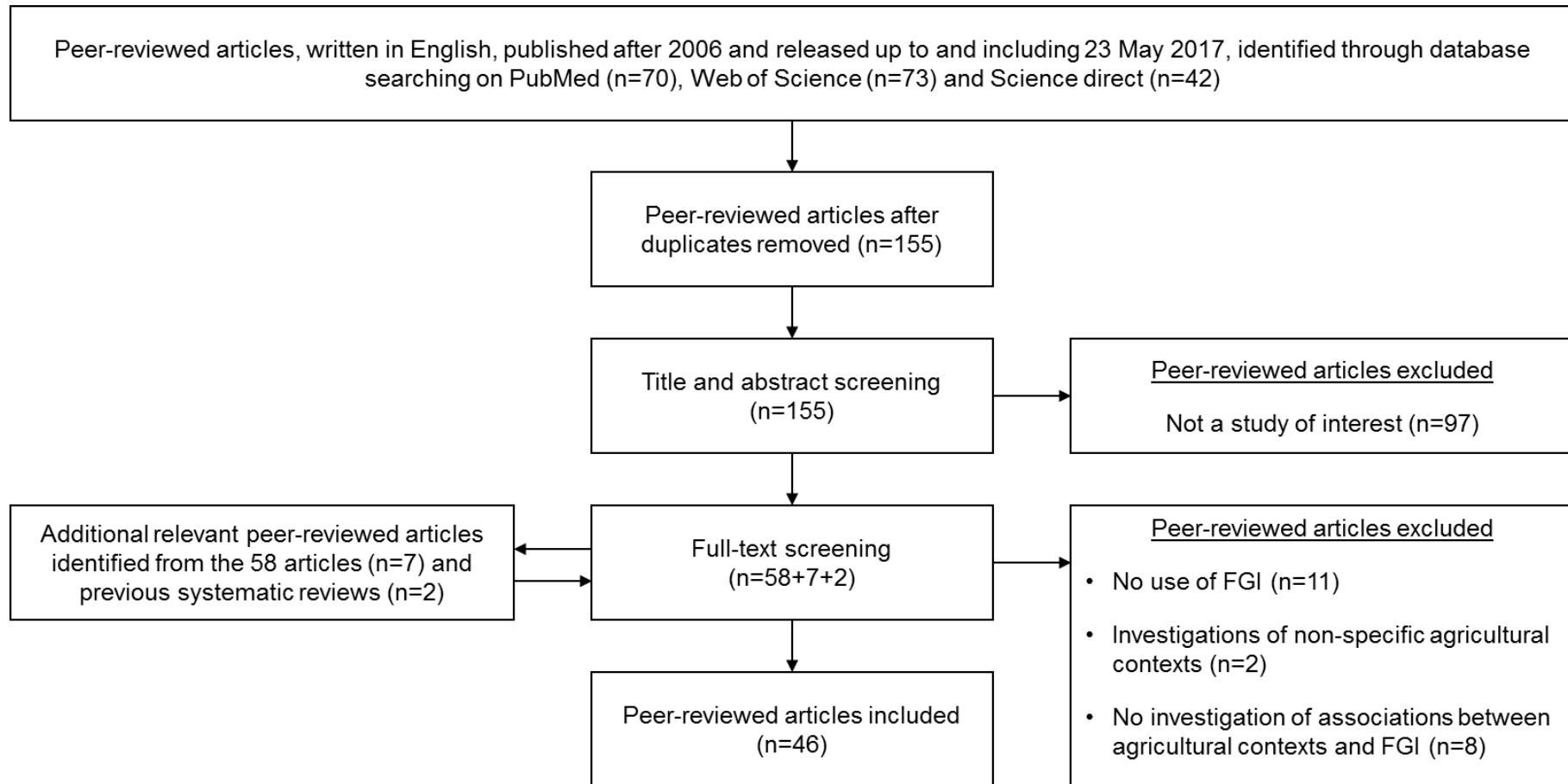


Fig. 1 Systematic literature review article selection flowchart

Table 1. Characteristics of four standard food group indicators of dietary diversity.

Characteristics	Household Dietary Diversity Score (HDDS)	Minimum Dietary Diversity (MDD)	Women's Dietary Diversity Score (WDDS)	Minimum Dietary Diversity for Women of Reproductive Age (MDD-W)
Unit of analysis	Household	Individual	Individual	Individual
Purpose	To reflect the economic ability of a household to access a variety of foods (access dimension of household food security)	Proxy of adequate micronutrient density of complementary foods of infant and young children aged 6 to 23 months	Proxy of micronutrient adequacy of diets of women of reproductive age	Proxy of micronutrient adequacy of diets of women of reproductive age
Validation	Positively associated with household per capita energy availability in datasets from 10 countries (Hoddinott and Yohannes, 2002)	Positively associated with the mean micronutrient density adequacy of complementary foods of breastfed and nonbreastfed infants and young children aged 6 to 23 months in 10 datasets (Working Group on Infant and Young, 2006)	Positively associated with the mean probability of adequacy across 11 micronutrients in 5 datasets (Arimond et al., 2010)*	Positively associated with the mean probability of adequacy across 11 micronutrients in 9 datasets (Women's Dietary Diversity Project Study Group, 2017)
Dietary assessment and reference period	24-hour recall, inclusion all of foods consumed by household members in the home (consumption outside of the home not included)	24-hour recall, inclusion of all foods eaten by the infant or child	24-hour recall, inclusion of all foods eaten by the individual (the correlation between WDDS and mean probability of adequacy was improved when foods consumed in quantities <15g were not included)	24-hour recall, inclusion of all foods eaten by the individual (the correlation between food group diversity and mean probability of adequacy was improved when foods consumed in quantities <15g were not included)
Food classification	12 food groups: Cereals; White roots and tubers; Vegetables; Fruits; Meat; Eggs; Fish and seafood; Legumes, nuts, and seeds; Milk and milk products; Oils and fats; Sweets; Spices, condiments, and beverages	7 food groups: Grains, roots, and tubers; Legumes and nuts; Dairy products; Flesh foods; Eggs; Vitamin A-rich fruits and vegetables; Other fruits and vegetables	9 food groups: Starchy staples; Dark green leafy vegetables; Other vitamin A-rich fruits and vegetables; Other fruits and vegetables; Organ meat; Meat and fish; Eggs; Legumes, nuts, and seeds; Milk and milk products	10 food groups: Grains, white roots and tubers, and plantains; Pulses; Nuts and seeds; Dairy; Meat, poultry and fish; Eggs; Dark green leafy vegetables; Other vitamin A-rich fruits and vegetables; Other vegetables; Other fruits
Score	Count of food groups consumed: 0-12	Count of food groups consumed: 0-7	Count of food groups consumed: 0-9	Count of food groups consumed: 0-10
Dichotomous indicator ^s	No dichotomous indicator but suggestion to use distribution of scores (quantiles) for analytical purposes	Minimum Dietary Diversity = 4 or more of the 7 food groups	No dichotomous indicator but suggestion to use distribution of scores (quantiles) for analytical purposes	Minimum Dietary Diversity for women = 5 or more of the 10 food groups
Guidelines	Swindale and Bilinsky (2006) and FAO (2011)	WHO (2008) and WHO (2010)	FAO (2011)	FAO and FHI 360 (2016)

*The validation study tested four different food group combinations (dietary diversity scores based on 6, 9, 13 or 21 food groups). The conclusion was that all dietary diversity scores were significantly correlated with micronutrient adequacy of the diet, the 21-food group indicator showing the highest correlation (Arimond et al., 2010). The FAO guidelines proposed to use the 9-food group indicator because it was easier to operationalize (FAO, 2011).

[§]For MDD and MDD-W, a cut-point was validated against micronutrient adequacy of diets and the indicator is expressed as the percent of individuals consuming a number of food groups equal to or above the cut-point.

Table 2. Assessment of the use and interpretation of food group indicators of dietary diversity

	Critical appraisal				
	All studies: HCES (9) Household level (18) Individual level (24) ^a	Only studies using standard indicators: HCES (7) Household level (13) Individual level (14)			All studies: HCES (9) Household level (18) Individual level (24)
Level of analysis	Reference to a published indicator	Recall period ^b	Food group classification ^c	Cut-off ^d	Interpretation ^e
HCES	HDDS (7) Other nonstandard indicator (1) No reference (1)	Not judged	“Consistent” (6) “Inconsistent” (1)	“Consistent” (7)	“Correct” (4) “Partially correct” (1) “Misleading” (4)
Household level	HDDS (13) Other nonstandard indicator (2) No reference (3)	“Consistent” (9) “Inconsistent” (4)	“Consistent” (5) “Inconsistent” (8)	“Consistent” (11) “Inconsistent” (2)	“Correct” (8) “Partially correct” (3) “Misleading” (7)
Individual level	HDDS (1) MDD (7) WDDS (6) MDD-W (2) Other nonstandard indicator (6) No reference (5)	“Consistent” (13) “Inconsistent” (1)	“Consistent” (14)	“Consistent” (14)	“Correct” (18) “Partially correct” (1) “Misleading” (3) “Unable to judge” (2)

^a Studies were assessed separately by level of measurement. Of the total of 46 studies, 24 included an individual measure, and three of those used two different indicators (children and women). Therefore a total of 27 individual level indicators were assessed under the first criterion of standard FGIs. Because five studies measured dietary diversity at both the household and individual level, the assessment was applied to 9 HCES, 18 individual level studies (13+5) and 24 individual level studies (19+5).

^b “Consistent” if used a 24-h recall.

^c “Consistent” if used 12 food groups with standard categories for HDDS, 7 food groups with standard categories for MDD; 9 food groups with standard categories for WDDS; and 10 food groups with standard categories for MDD-W.

^d “Consistent” if used the recommended cut-off for standard indicators (MDD, MDD-W) or, in the case of indicators without a recommended cut-off (HDDS, WDDS), either did not use a cut-off or applied quantiles based on the score distribution.

^e “Correct” if interpretation of the indicator was consistent with the objective of the study and the level of analysis; “partially correct” if the interpretation was consistent with the level of analysis but either the indicator was inappropriate or, somewhere in the paper, a household level indicator was mislabelled as measuring nutrition or diet quality; “misleading” if the interpretation of the indicator was not consistent with the objective of the study and level of analysis; and “unable to judge” when essential information was missing on the level of analysis or purpose of measuring dietary diversity.

Box 1. Checklist of items that should be described when reporting on use of dietary diversity indicators

Checklist item	#	Description of the item
Objective	1	Describe the objective of the measurement of dietary diversity (household food security or individual nutrient adequacy of the diet)
Unit of analysis	2	a) Identify whether dietary diversity is measured at the household and/or individual level b) If the measure is at the individual level, specify the sex and age group of the subjects, and the physiological status for women
Reference	3	Refer to a guidance manual if a standard FGI is used
Respondent	4	Describe who responded to the questions and whose diet was referred to
Recall period	5	a) Report the recall period b) If a recall period greater than 24 h is applied to an otherwise standard FGI, provide an explanation.
Food group classification	6	Provide detailed information on the food group classification used to construct the FGI (e.g. total number and names the food groups)
Score	7	Report how the FGI was computed
Cut-off point	8	Specify whether a cut-off point was used to create a dichotomous indicator or whether the distribution of the score (e.g. quantiles) was used for analytical purposes

Appendix A. Characteristics of household consumption and expenditure surveys using food group indicators of dietary diversity and assessment of their use and interpretation (n=9)

Study	Location	Study design	Subjects and sample size	Critical appraisal and details of the FGI					
				Is the FGI a standard one?	Reference	Recall period	Food group classification	Cut-off	Interpretation of the FGI
Jones et al. (2014)	Malawi	Secondary analysis of cross-sectional survey	Smallholder farmers (n=6623)	Yes	HDDS (Swindale and Bilinsky, 2006)	Not judged Previous 7 days	Consistent 12 food group classification, based on consumption of 135 food items	Consistent No use of cut-off	Correct But one sentence presenting the diversity of household diets as an important nutrition outcome associated with the nutrient adequacy of diets is misleading.
Pellegrini and Tasciotti (2014)	- Albania - Indonesia - Malawi - Nepal - Nicaragua - Pakistan - Panama - Vietnam	Secondary analysis of cross-sectional surveys	Households (sample size unknown)	Yes	HDDS (FAO, 2008)	Not judged Range of 7 to 365 days across countries	Inconsistent 13 food group classification, based on a range across countries of 24 – 75 food items	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Sraboni et al. (2014)	Bangladesh	Secondary analysis of cross-sectional survey	Farm households (n=3273)	Yes	HDDS (FAO, 2011)	Not judged Previous 7 days	Consistent 12 food group classification, based on 300 food items	Consistent No use of cut-off	Correct

Benson (2015)	Malawi	Secondary analysis of cross-sectional survey	Smallholder farmers (n=9750)	Yes	HDDS (Swindale and Bilinsky, 2006)	Not judged Previous 7 days	Consistent 12 food group classification, based on 135 food items.	Consistent No use of cut-off	Correct
Dillon et al. (2015)	Nigeria	Secondary analysis of cross-sectional survey	Smallholder farmers (n=2154)	Yes	HDDS (FAO 2011)	Not judged Previous 7 days	Consistent 12 food group classification, based on 100 food items.	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Sibhatu et al. (2015)	- Ethiopia - Indonesia - Kenya - Malawi	Secondary analysis of cross-sectional surveys	Ethiopian (n=2045), Indonesian (n=674), Kenyan (n=397) and Malawian smallholder farmers (n=5114)	Yes	HDDS (Swindale and Bilinsky, 2006) (FAO, 2011)	Not judged Previous 7 days	Consistent 12 food group classification, based on a range across countries of 25 - 135 food items.	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Snapp and Fisher (2015)	Malawi	Secondary analysis of cross-sectional survey	Smallholder farmers (n=9189)	Yes	HDDS (Swindale and Bilinsky, 2006)	Not judged Previous 7 days	Consistent 12 food group classification, based on 135 food items	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Zeza and Tasciotti, (2010)	- Ghana - Madagascar - Malawi	Secondary analysis of cross-	Urban households (n from 1154 to 5852)	No	No reference	Not judged Previous 7 days	Not judged 13 food group classification, based on a range	Not judged No use of cut-off	Partially correct Interpreted results correctly for level of analysis but

	<ul style="list-style-type: none"> - Nigeria - Bangladesh - Indonesia - Nepal - Pakistan - Vietnam - Albania - Bulgaria - Ecuador - Guatemala - Nicaragua - Panama 	sectional survey					across countries of 20 – 122 food items.		stated that the household FGI measures nutrition, diet quality.
Jones (2017a)	Malawi	Secondary analysis of cross-sectional surveys	Smallholder farming households (n=3000)	No	(FAO and FHI 360, 2016)	Not judged Previous 7 days	Not judged 10 food group classification of the MDD-W, based on 124 food items.	Not judged No use of cut-off	Correct

Appendix B. Characteristics of studies using food group indicators of dietary diversity at household level and assessment of their use and interpretation (n=18)

Study	Location	Study design	Subjects and sample size	Critical appraisal and details of the FGI					
				Is the FGI a standard one?	Reference	Recall period	Food group classification	Cut-off	Interpretation of the FGI
Remans et al. (2011)	- Ethiopia - Kenya - Malawi	Cross-sectional survey	Ethiopian (n=60), Kenyan (n=50), and Malawian smallholder farmers (n=60)	Yes	HDDS (FAO, 2008)	Consistent Previous 24 hours	Inconsistent 15 food group classification	Consistent No use of cut-off	Correct
Anderman et al. (2014)	Ghana	Cross-sectional survey	Cacao and oil palm farmers (n=100)	Yes	HDDS (FAO, 2008)	Inconsistent Previous 30 days.	Inconsistent 13 food group classification, based on 120 food items.	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Iannotti and Lesorogol (2014)	Kenya	Longitudinal study	Pastoralist households (n≈200)	Yes	HDDS (Swindale and Bilinsky, 2006)	Consistent Previous 24 hours	Inconsistent 9 food group classification	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Mango et al. (2014)	Zimbabwe	Secondary analysis of baseline survey	Smallholder farmers (n=120)	Yes	HDDS (Selvester et al., 2008)	Consistent Previous 24 hours	Inconsistent 14 food group classification	Consistent No use of cut-off	Partially correct Interpreted results correctly for level of analysis but stated that the household FGI measures nutrition, diet quality.

Kumar et al. (2015)	Zambia	Secondary analysis of baseline survey of an intervention	Household (n=2785)	Yes	HDDS (FAO, 2011)	Consistent Previous 24 hours	Inconsistent 7 food group classification of the MDD	Consistent No use of cut-off	Partially correct Interpreted results correctly for level of analysis but used an inappropriate indicator (individual FGI to reflect household food security/food access).
Mayanja et al. (2015)	Uganda	Cross-sectional survey	Pastoral (n=20) and agro-pastoral households (n=59)	Yes	HDDS (FAO, 2011)	Consistent Previous 24 hours	Inconsistent 8 food group classification	Inconsistent Cut-off of at least 4 of the 8 food groups.	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
McDonald et al. (2015)	Cambodia	Cross-sectional survey	Rural households (n=900)	Yes	HDDS (Swindale and Bilinsky, 2006)	Consistent Previous 24 hours	Consistent 12 food group classification	Inconsistent HDDS score of <3 defines a low dietary diversity	Correct
Jodlowski et al. (2016)	Zambia	Evaluation of a year-and-half intervention	Households (n=265)	Yes	HDDS (FAO, 2011)	Consistent Previous 24 hours	Inconsistent 13 food group classification	Consistent No use of cut-off	Correct
Ng'endo et al. (2016)	Kenya	Repeated cross-sectional survey	Smallholder farming households (n=30)	Yes	HDDS (FAO, 2011)	Consistent Previous 24 hours	Consistent 12 food group classification	Consistent Tertiles	Correct

Olney et al. (2016)	Burkina Faso	Evaluation of a two-year intervention (RTC)	Household (control n=506 and treatment n=766)	Yes	HDDS (Swindale and Bilinsky, 2006)	Inconsistent Previous 7 days	Consistent 11 food group classification, based on 57 food items, the egg food group not included because of an oversight	Consistent No use of cut-off	Correct
Romeo et al. (2016)	Kenya	Cross-sectional survey	Poor rural households (n=1353)	Yes	HDDS (Swindale and Bilinsky, 2006) (FAO, 2011)	Inconsistent Previous 7 days	Consistent 12 food group classification	Consistent No use of cut-off	Correct
Euler et al. (2017)	Indonesia	Cross-sectional survey	Farm households (n=664)	Yes	HDDS (FAO, 2011)	Inconsistent Previous 7 days	Inconsistent No description of the number of food groups but may have used the 12 food group classification, based on 134 food items	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Koppmair et al. (2017)	Malawi	Cross-sectional survey	Smallholder farm households (n=408)	Yes	HDDS (FAO, 2011)	Consistent Previous 24 hours	Consistent 12 food group classification	Consistent No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status
Olney et al. (2009)	Cambodia	Repeated cross-sectional surveys	Household (control n=200 and treatment n=299)	No	No reference	Not judged Previous 3 days	Not judged 6 food group classification	Not judged No use of cut-off	Correct

Gallaher et al. (2013)	Kenya	Cross-sectional survey	Sack gardening households (n=153) and non-sack gardening households (n=153)	No	No reference	Not judged Previous 24 hours	Not judged 15 food group classification	Not judged No use of cut-off	Correct
Darling (2014)	Kenya	Cross-sectional survey	Households (n=113)	No	(Arimond and Ruel, 2004b)	Not judged Previous 3 days	Not judged 7 food group classification	Not judged No use of cut-off	Partially correct Interpreted results correctly for level of analysis but used an inappropriate indicator
Rawlins et al. (2014)	Rwanda	Evaluation of a one year intervention	Households (n=369)	No	No reference	Not judged Previous 2 days	Not judged 16 food group classification	Not judged No use of cut-off	Misleading Extrapolated results from one population group to other groups
Leonardo et al. (2015)	Mozambique	Cross-sectional survey	Households (n=80)	No	(FAO, 2011)	Not judged Previous 3 days	Not judged 12 food group classification that is not fully described	Not judged No use of cut-off	Misleading Interpreted results of household dietary diversity as a measure of diet quality, household nutrition or nutritional status

Appendix C. Characteristics of studies using food group indicators of dietary diversity at individual level and assessment of their use and interpretation (n=24)

Study	Location	Study design	Subjects and sample size	Critical appraisal and details of the FGI					
				Is the FGI a standard one?	Reference	Recall period	Food group classification	Cut-off	Interpretation of the FGI
Tessema et al. (2013)	Ethiopia	Cross-sectional survey	Children 6–23 months of age (n=466)	Yes	MDD (WHO, 2008)	Consistent Previous 24 hours	Consistent 7 food group classification	Consistent Cut-off of at least 4 of the 7 food groups	Correct
Walton et al. (2014)	Kenya	Cross-sectional survey	Women (n=102)	Yes	WDDS (Wiesmann et al., 2009)	Consistent Previous 24 hours	Consistent 9 food group classification	Consistent No use of cut-off	Correct
Beyene et al. (2015)	Ethiopia	Cross-sectional survey	Children 6–23 months of age (n=920)	Yes	MDD (WHO, 2008)	Consistent Previous 24 hours	Consistent 7 food group classification	Consistent Cut-off of at least 4 of the 7 food groups	Correct
Kumar et al. (2015)	Zambia	Secondary analysis of baseline survey of an intervention	Children 6-23 months of age (n=1298)	Yes	MDD (WHO, 2010)	Consistent Previous 24 hours	Consistent 7 food group classification	Consistent Cut-off of at least 4 of the 7 food groups	Correct
Malapit and Quisumbing, (2015)	Ghana	Secondary analysis of baseline data of an intervention	Mothers (n=2027) and children 6-23 months of age (n=402)	Yes	WDDS (FAO, 2011) MDD (WHO, 2010)	Consistent for both Previous 24 hours	Consistent for women 9 food group classification Consistent for children 7 food group classification	Consistent for women No use of cut-off Consistent for children Cut-off of at least 4 of the 7 food groups	Correct for both
Malapit et al. (2015)	Nepal	Secondary analysis of cross-	Mothers (n=3076)	Yes	WDDS (Arimond et al., 2010)	Consistent Previous 24 hours	Consistent 9 food group classification that	Consistent No use of cut-off	Correct

		sectional survey					is not fully described		
Bellon et al. (2016)	Benin	Repeated cross-sectional surveys	Mothers (n=472 for the 1st round and n=482 for the 2nd round)	Yes	MDD-W (Daniels and Ballard, 2014)	Consistent Previous 24 hours	Consistent 10 food group classification	Consistent Cut-off of at least 5 of the 10 food groups	Correct
Darrouzet-Nardi et al. (2016)	Nepal	Evaluation of a two-year intervention	Children 6 months to 8 years of age (n=589)	Yes	MDD (WHO, 2010)	Consistent Previous 24 hours	Consistent 7 food group classification	Consistent Cut-off of at least 4 of the 7 food groups	Correct
Ng'endo et al. (2016)	Kenya	Repeated cross-sectional surveys	Women (n=30)	Yes	WDDS (FAO, 2011)	Consistent Previous 24 hours	Consistent 9 food group classification	Consistent Tertiles	Correct
Olney et al. (2016)	Burkina Faso	Evaluation of a two-year intervention (RTC)	Mothers of children 3-12 months of age (control n=506 and treatment n=766)	Yes	WDDS (FAO, 2011)	Consistent Previous 24 hours	Consistent 9 food group classification	Consistent No use of cut-off	Correct
Chagomoka et al. (2017)	Burkina Faso	Cross-sectional survey	Women of reproductive age (n=179)	Yes	WDDS (FAO, 2011)	Consistent Previous 24 hours	Consistent 9 food group classification that is not fully described	Consistent Classification in 3 categories based on the distribution of the WDDS in the sample: low (0-3), medium (4-5), or high (6-9)	Misleading Extrapolated results from one population group to other groups
Dangura and Gebremedhin, (2017)	Ethiopia	Cross-sectional survey	Children 6-23 months of age (n=417)	Yes	MDD (WHO, 2008)	Consistent Previous 24 hours	Consistent 7 food group classification	Consistent Cut-off of at least 4 of the 7 food groups.	Correct
Dulal et al. (2017)	Nepal	Evaluation of a two-year intervention	Mothers (n=2101) and children 6-23 months of age (n=994)	Yes	MDD-W (Martin-Prével et al., 2015)	Inconsistent for both Previous 7 days	Consistent for women 10 food group classification	Consistent for women Cut-off of at least 5 of the 10 food groups	Correct for both

					MDD (FAO, 2011)		Consistent for children 7 food group classification	Consistent for children Cut-off of at least 4 of the 7 food groups	
Koppmair et al. (2017)	Malawi	Cross-sectional survey	Mothers (n=408) and children under 5 years of age (n=519)	Yes	HDDS (FAO, 2011)	Consistent for both Previous 24 hours	Consistent for both 12 food group classification of the HDDS	Consistent for both No use of cut-off	Partially correct for both Interpreted results correctly for level of analysis but used an inappropriate indicator
Olney et al. (2009)	Cambodia	Repeated cross-sectional surveys	Mothers (control n=199 and treatment n=300) and children under 5 years of age (control n=199 and treatment n=277)	No	No reference	Not judged Previous 7 days	Not judged Same 9 food group classification for the children and women	Not judged No use of cut-off	Correct
Kalavathi et al. (2010)	India	Evaluation of a three-year intervention (repeated cross-sectional surveys)	Small and marginal coconut homesteads (n=150) implying an unknown number of adults and children below 6 years of age	No	No reference	Not judged Not reported.	Not judged 10 food group classification	Not judged Arbitrary classification in 5 categories from "very poor" to "excellent" (1-3/4-5/6-7/8-9/10)	Unable to judge Insufficient information for evaluating the relevance of the indicator
Kaufer et al. (2010)	Federated States of Micronesia	Evaluation of a two-year intervention	Women (n=40)	No	No reference	Not judged Previous 7 days	Not judged 14 food group classification, based on 33 food items	Not judged No use of cut-off	Unable to judge Insufficient information for evaluating the relevance of the indicator
Cabalda et al. (2011)	Philippines	Cross-sectional survey	Children 2-5 years of age (n=200)	No	(Kennedy et al., 2007)	Not judged Previous 24 hours	Not judged 10 food group classification	Not judged No use of cut-off	Correct

Jones et al. (2012)	Bolivia	Repeated cross-sectional surveys	Children less than 24 months of age (n=50)	No	(WHO, 2008)	Not judged Previous 24-hours	Not judged 7 food group classification	Not judged No use of cut-off	Correct
Keding et al. (2012)	Tanzania	Repeated cross-sectional surveys	Women involved in cultivation of vegetables (n=252)	No	(Reference to several articles to justify how they built the FGI)	Not judged Previous 24 hours	Not judged 14 food group classification	Not judged Terciles	Misleading Applied a non-defined FGI to individuals as a measure of household food security
De Brauw et al. (2015)	Mozambique	Evaluation of a three-year intervention (RCT)	Children 6-35 months of age (n=331)	No	(Moursi et al., 2008)	Not judged Previous 24 hours	Not judged 7 food group classification	Not judged No use of cut-off	Correct
Malapit et al. (2015)	Nepal	Secondary analysis of cross-sectional survey	Children 6-59 months of age (n=2817)	No	No reference	Not judged Previous 24 hours	Not judged 7 food group classification not fully described	Not judged No use of cut-off	Correct
Smale et al. (2015)	Zambia	Cross-sectional survey	Primary female decision maker in maize-growing farm households (n=1045)	No	(Arimond et al., 2010)	Not judged Previous 24 hours	Not judged 10 food group classification	Not judged No use of cut-off	Misleading Interpreted a nutrient-dense FGI applied to individuals as a measure of household food security/food access.
Hirvonen and Hoddinott, (2016)	Ethiopia	Secondary analysis of cross-sectional survey	Children 6-59 months of age (n=3448)	No	(WHO, 2008)	Not judged Previous 24 hours	Not judged 7 food group classification	Not judged No use of cut-off	Correct But once the authors presented the dietary diversity score of the children as

M'Kaibi et al. Kenya (2017)	Cross-sectional survey	Children 24–59 months of age (n=477)	No	(FAO, 2011)	Not judged Two repeated 24-hour food recalls. Unclear how the authors handled the 2 different days in constructing the score.	Not judged 9 food group classification	Not judged Arbitrary cut-off of at least 4 of the 9 food groups	representative for entire household Correct
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