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BMJ Open

Community-based interventions targeting multiple forms of malnutrition among adolescents in low- and middle-income countries: protocol for a scoping review

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2023-078969
Article Type:	Protocol
Date Submitted by the Author:	17-Aug-2023
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Keywords:	Adolescent, NUTRITION & DIETETICS, Health Education, Systematic Review, Anaemia < HAEMATOLOGY

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Manuscripts

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3 **1 Community-based interventions targeting multiple forms of malnutrition among adolescents**
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5 **2 in low- and middle-income countries: protocol for a scoping review**
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41 **Word count:** 3010 (not including title page, abstract, references, tables, or acknowledgement)
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73 Abstract

74 **Background:** Adolescent malnutrition is a significant public health challenge in low- and middle-income
75 countries (LMICs), with long-term consequences for health and development. Community-based
76 interventions have the potential to address multiple forms of malnutrition and improve the health outcomes
77 of adolescents. However, there is a lack of comprehensive understanding regarding such interventions'
78 content, implementation, and effectiveness. This scoping review aims to synthesize evidence on
79 community-based interventions targeting multiple forms of malnutrition among adolescents in LMICs and
80 describe their effects on nutrition and health.

81 **Methods and analysis:** A comprehensive search strategy will be implemented in multiple databases
82 including MEDLINE (through PubMed), Embase, and CENTRAL (through Cochrane Library), covering
83 the period from January 1, 2000, to July 14, 2023. The inclusion criteria encompass randomized controlled
84 trials and quasi-experimental studies focusing on adolescents aged 10-19 years. Various types of
85 interventions, such as micronutrient supplementation, nutrition education, feeding interventions, physical
86 activity, and community environment interventions, will be considered. Two reviewers will perform data
87 extraction independently, and, where relevant, risk of bias assessment will be conducted using standard
88 Cochrane risk-of-bias tools. The findings will be synthesized and presented using the Synthesis Without
89 Meta-analysis (SWiM) guidelines for scoping reviews.

90 **Ethics and dissemination:** The scope of this scoping review is restricted to publicly accessible databases
91 that do not require prior ethical approval for access. The findings of this review will be shared through
92 publications in peer-reviewed journals, and presentations at international and regional conferences and
93 stakeholder meetings in LMICs.

94 **Scoping review registration:** The final protocol was registered prospectively with the Open Science
95 Framework on July 19, 2023 (<https://osf.io/t2d78>).

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2
3 99 **Article Summary**
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5 100 Strengths and limitations of this study
6

- 7 101 • This scoping review will clearly describe the available evidence on community-based interventions
8 that address the multiple forms of malnutrition among adolescents in LMICs.
9 102
10 103 • Grey literature sources such as government reports and organization websites will be also included.
11
12 104 • Alongside consideration of the characteristics of documented interventions, we will also consider
13
14 105 measures of impact.
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16 106 • Where measures of impact are available, there will be a quality assessment of the included studies.
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18 107 • The proposed search strategy will be conducted only in three electronic databases.
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108 **Introduction**

109 The current global adolescent population surpasses 1.2 billion individuals, with approximately 90 percent
110 of them residing in low- and middle-income countries (LMICs) (1). Moreover, when considering regional
111 trends, it is expected that the proportion of young people aged 10 to 24 residing in Sub-Saharan Africa will
112 experience substantial growth, rising from 245 million in 2015 to 605 million by 2050 (2). In contrast, the
113 Asia and Pacific region is expected to undergo the most significant decrease, declining from 718 million in
114 2015 to 619 million by 2050 (2). These regional variations emphasize the unique challenges and
115 opportunities faced by different regions in terms of future demographic and health challenges, which will
116 require distinct solutions.

117
118 Adolescence is a period of rapid physical growth, cognitive development, socio-emotional development,
119 and cultural development, all of which are strongly influenced by an individual's socioeconomic, cultural,
120 and physical environments (3). Nutrition plays a crucial role in improving health and development during
121 this critical stage in life, bringing intergenerational benefits. After the first 1000 days of life, adolescence
122 is assumed to offer a second opportunity for correcting nutritional deficiencies and insufficient growth since
123 childhood (4).

124
125 Low- and middle-income countries (LMICs) are experiencing a rapid nutrition transition among
126 adolescents, accompanied on the one hand by stunting, thinness, anemia, and other micronutrient
127 deficiencies, and on the other hand by an increasing burden of obesity and non-communicable diseases (5).
128 Malnutrition was the leading cause of disability-adjusted life years (DALYs) among the 10-14 age group
129 in 2019, followed by iron deficiency anemia among adolescents aged 10-19 (6). The consumption of diverse
130 and healthy diets by adolescents from LMICs is declining, while the consumption of processed and calorie-
131 rich foods is on the rise, contributing to rising obesity rates (7). Furthermore, food insecurity has been
132 aggravated in vulnerable populations including adolescents in LMICs because of the COVID-19 pandemic,
133 political instability, and recurring climate crises in the form of flooding and droughts.

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3 134 Several systematic reviews indicate that micronutrient supplementation is effective in addressing nutritional
4
5 135 deficiencies (8). Iron supplementation can reduce anemia in adolescents; periconceptional folic acid
6
7 136 supplementation among adolescent girls can reduce neural tube defects; and adolescent girls who consume
8
9 137 high amounts of calcium (≥ 1 g daily) have lower rates of preeclampsia, preterm birth, or neonatal
10
11 138 hospitalization (9). There is limited evidence that protein-energy supplements are effective for adolescents.

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16 140 The burden of malnutrition may be reduced by several nutrition-sensitive interventions, including nutrition
17
18 141 education, dietary interventions, physical activity, and food environment interventions (10). Several
19
20 142 systematic reviews suggest promising but modest results from discrete nutrition-sensitive interventions
21
22 143 aimed at addressing malnutrition in schools (11-13). These single-domain interventions, however, target
23
24 144 either undernutrition or overnutrition and operate in *silos*. There is increased interest in addressing health
25
26 145 and nutrition behaviors through integrated interventions, generally called "double-duty actions", targeting
27
28 146 multiple forms of malnutrition and nutrition-related non-communicable diseases (14). An essential element
29
30 147 of this concept is that tackling one form of malnutrition should not prevent addressing another. There is
31
32 148 promising evidence that integrated interventions can improve the nutritional status of school-going children
33
34 149 and adolescents (10).

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39 151 Nevertheless, there are several gaps in understanding adolescent nutrition in LMICs. Currently, nutrition-
40
41 152 specific, and nutrition-sensitive interventions tend to focus on school-going adolescents, and little is known
42
43 153 about their effects on other vulnerable groups of adolescents, such as out-of-school adolescents, migrant
44
45 154 adolescents, and HIV-positive adolescents. Another important gap is that most of the school-based
46
47 155 interventions target overlapping age groups and there is little known regarding the age-appropriate
48
49 156 intervention strategies and delivery mechanisms as well as the specific impact on the adolescent population.
50
51 157 Moreover, most of these school-based interventions are delivered by schoolteachers, community health
52
53 158 workers, school nurses, or peers in classroom-based settings or during school hours. Despite the importance
54
55 159 of nutrition-sensitive and nutrition-specific interventions for the health of communities, little evidence

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3 160 exists about their form and function using community platforms. Therefore, the purpose of this scoping
4
5 161 review is to comprehensively review the literature to describe community-based interventions that address
6
7 162 the multiple forms of malnutrition such as obese, overweight, underweight, wasting, stunting, anemia, and
8
9 163 micronutrient deficiencies affecting adolescents in LMICs and describe the effects of these interventions
10
11 164 on nutrition and health.

12 165

16 166 **Methods**

18 167 **Data sources, search terms and search strategy**

20 168 We will search MEDLINE (through PubMed), Embase, and CENTRAL (through the Cochrane Library).
21
22 169 All databases will be searched for eligible studies from January 1, 2000, through July 14, 2023. We will
23
24 170 identify potentially relevant published studies using the combination of medical subject headings (MeSH)
25
26 171 and text words denoting nutrition-specific and nutrition-sensitive interventions. We will also examine
27
28 172 references and bibliographies of included studies to identify additional sources of information. This search
29
30 173 of studies will be supplemented by reviewing ClinicalTrials.gov and organizational websites such as the
31
32 174 World Health Organization (WHO), World Bank, United Nations Children's Fund (UNICEF), and United
33
34 175 Nations Population Fund (UNFPA). When possible, reports written in languages other than English will be
35
36 176 translated by colleagues who are native speakers of those languages. No study will be considered if it cannot
37
38 177 be adequately translated.

40 178

43 179 We will use the PICO model (Table 1) to guide our search strategy, but we will not be restricted by outcomes
44
45 180 to maintain a broad search. The search will use indexing terms, including MeSH terms, keywords, and free
46
47 181 text words. First, a broad search strategy (e.g., type of study [randomized controlled trials, quasi-
48
49 182 experiments, or controlled before-after studies] AND intervention domain [e.g., nutrition education] AND
50
51 183 population [adolescents] AND setting [low- and middle-income countries]) will be performed in PubMed.
52
53 184 We will confirm the sensitivity of the search strategy by identifying several sentinel articles. The PubMed
54
55 185 strategy, provided in **Supplementary File 1**, will be adapted to suit other databases. We will document the

186 following details for each search: databases searched, date of search, search strategy (i.e., subject headings
 187 and keywords, including if terms are expanded, truncated, and how they are combined), filters used, and
 188 the number of records retrieved. Additionally, a source will be provided for each publication identified
 189 through manual search (i.e., journal name, website, conference proceedings, etc.).

190

191 **Table 1 Eligibility criteria for the systematic review in PICO format**

Item	Inclusion criteria	Exclusion criteria
Population	Studies involving adolescents (10–19 years old) in the community setting in low- and middle-income countries	Studies involving adolescents (10–19 years old) but interventions applied exclusively in the school setting
Interventions, approaches or exposures of interests	Studies involving one or more of the following interventions: nutrient supplementation interventions including vitamin and nutrient supplementation, deworming, complementary feeding, nutrition education, physical education, promoting healthy diets and/or physical activity, nutrition policies, community/home garden, water, sanitation and hygiene interventions, community environment interventions, and structural interventions such as sweetened beverage tax, soda tax, and sugary drink tax	Interventions targeted towards individuals with specific medical conditions such as treatments intended for underweight, overweight, or obese adolescents

Comparison	Studies that compared the intervention with any relevant control group including comparisons with no intervention, regular nutrition education and/or physical education, or any other intervention in the community setting	Not applicable
Outcomes	Body-Mass Index (BMI) z score, anemia, change in anthropometry (e.g., height and weight status, BMI, height-for-age z scores, weight-for-age z scores, weight-for-height z scores, skin-fold thickness measures, stunting, underweight, wasting, body mass index, overweight, obesity, waist-to-height ratio, and central obesity), hemoglobin level in the blood, micronutrient deficiencies, knowledge of diet and nutrition, dietary intake (i.e. amount and frequency), dietary diversity, diet quality, physical activity, sedentary behaviors, nutrition literacy, and nutrition fluency.	Not applicable

Study design	Randomized controlled trials, quasi-experimental studies including controlled before-after studies	Non-randomized trials including controlled before-after studies that did not account for baseline differences, observational studies including cohort, case-control, and cross-sectional designs, and editorial commentaries, opinions, and review articles
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193 Eligibility

194 The inclusion and exclusion criteria for this scoping review are listed below.

195 *Inclusion criteria*

196 We will include the following studies.

- 197 • We will include randomized controlled trials (RCT), with the intervention randomized to
198 individuals or in clusters (including clubs, groups, communities, villages, homes, etc.), and quasi-
199 experimental studies including controlled before-after studies that have reported interventions to
200 address any form of adolescent malnutrition when compared to a control group.
- 201 • Studies involving adolescent boys and/or girls aged 10-19 years.
- 202 • Studies conducted in LMICs—as defined by the World Bank in the year 2023 (15).
- 203 • Studies involving interventions for one or more of the following: micronutrient supplementation,
204 feeding interventions, nutrition education, physical education, interventions to promote healthy
205 diets, interventions promoting physical activity, community and/or home gardens, food and
206 nutrition policies, community environment interventions, water sanitation and hygiene (WASH)
207 interventions, and structural interventions such as taxation of sweetened-sugary drinks.

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3 208 • The control (comparison) in each included study can be participants who did not receive any
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5 209 intervention or received standard care, received standard health/nutrition education, or any other
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7 210 intervention in the community setting.
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9 211 • We will include published articles as well as unpublished and grey literature and will include
10
11 212 ongoing studies where preliminary findings are available.
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14 213 • We will not place any restrictions on the language, sample size, or duration of the intervention.
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16 214

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18 215 ***Exclusion criteria***

19
20 216 We will not consider the following studies.

- 21
22 217 • Non-RCTs that are not quasi-experimental studies with comparator groups and controlled before-
23
24 218 after studies that did not account for the baseline differences between the study arms.
25
26 219 • Observational studies such as cohort, case-control, and cross-sectional designs.
27
28
29 220 • Editorials, commentaries, opinions, and review articles. However, we will use review articles to
30
31 221 identify additional original articles.
32
33 222 • Clinical treatments/interventions targeted towards individuals with specific medical conditions
34
35 223 such as programs intended for underweight, overweight, obese, or anemic adolescents.
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39 225 **Data management**

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41 226 EndNote X9 (Clarivate Analytics, Pennsylvania, United States) or a similar citation management software
42
43 227 will be used to store the records retrieved from electronic databases. The records will also be imported into
44
45 228 Covidence (Veritas Health Innovation, Melbourne, Australia), an Internet-based systematic review
46
47 229 management program. Detection and removal of duplicates will be performed by EndNote (or similar
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49 230 software) and by Covidence.
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54 232 **Selection of studies**
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3 233 Using Covidence, we will screen titles, abstracts, and full texts. First, two reviewers will independently
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5 234 assess all search results (i.e., titles and abstracts) and exclude irrelevant studies based on inclusion and
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7 235 exclusion criteria. Next, two reviewers will carry out the full-text screening based on the same
8
9 236 inclusion/exclusion criteria. The reviewers will discuss and resolve any difference of opinion or, if
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11 237 necessary, seek a third reviewer's opinion for resolving differences. A study flow diagram stating the
12
13 238 specific reasons for exclusion will be maintained following the PRISMA for Scoping Review statement
14
15 239 (PRISMA-ScR) (16).
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18 240

20 241 **Data extraction**

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22 242 Two reviewers will independently extract and enter data from studies included in the review. We will
23
24 243 develop and test an extraction form on five randomly selected studies. We will extract the following
25
26 244 information.

- 27
28 245 • Study details including the title, authors (first author and corresponding author), the corresponding
29
30 246 author's contact information, journal (or source for unpublished reports), calendar year of
31
32 247 publication, calendar year of intervention, country, and source of funding.
- 33
34 248 • Study methods including objectives and/or research questions, type of study, investigation
35
36 249 strategies, settings, sample size, and sample characteristics (e.g., age, sex, socioeconomic status
- 37
38 250 • Intervention strategy including target population, delivery platform and providers (including
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40 251 selection, training, supervision, support, and incentivization), types of nutrition and other
41
42 252 interventions (including content, conceptual framework and/or theoretical underpinnings, timing,
43
44 253 duration, and dosage or frequency), and comparator/control.
- 45
46 254 • Outcomes assessed and details of the measures used.
- 47
48 255 • Findings including the coverage of services, facilitators and barriers to intervention delivery and
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50 256 uptake, effectiveness findings with point estimates and measures of variance (standard errors, 95%
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3 257 confidence intervals, or *p*-values), and any other key findings related to the scoping review
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5 258 questions.
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9 260 We will contact the corresponding author via email if there is missing or inconsistent information. We will
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11 261 contact the author two times at most. The available data will be analyzed and any gaps due to missing data
12
13 262 will be discussed if the data issue cannot be resolved after contacting the authors.
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17 18 264 **Risk of bias assessment**

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20 265 For the assessment of the risk of bias in the selected studies, we will use the Cochrane Collaboration's
21
22 266 revised tool for assessing the risk of bias in randomized trials (RoB 2) (17). Two reviewers will
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24 267 independently evaluate methodological quality. Any uncertainties or disagreements will be resolved by
25
26 268 discussion or by a third reviewer, whenever needed. The tool is a domain-based evaluation, in which critical
27
28 269 assessments for risk of bias are made separately for various domains, including the randomization process,
29
30 270 deviation from intended interventions, missing outcome data, measurement of the outcome, and selective
31
32 271 outcome reporting. The risk of bias in clustered trials will be similarly assessed using the risk of bias 2 for
33
34 272 cluster-randomized trials (RoB 2 CRT) (18). Additionally, we will use the Risk of Bias in Non-randomized
35
36 273 Studies of Interventions (ROBINS-I) tool (19), to assess the risk of bias for controlled before-after studies
37
38 274 and non-randomized controlled trials.
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42 43 276 **Synthesis of evidence**

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45 277 All included studies will be systematically synthesized in the text and a table following the SWiM
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47 278 guidelines (Synthesis Without Meta-analysis) (20). In this synthesis, we will describe how many sources
48
49 279 of evidence were screened, assessed for eligibility, and included in the review, along with reasons for
50
51 280 exclusion at each stage. Our presentation of included sources of evidence will include summary
52
53 281 characteristics and citations, as well as a critical appraisal, if applicable. Studies will be grouped based on
54
55 282 methods and interventions, standardized outcomes metrics, synthesis methods, criteria used to prioritize
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3 283 results for summary, reporting of results, the certainty of results, heterogeneity in effects, as well as barriers
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5 284 and facilitators to delivering the interventions will be discussed. For continuous outcomes, effect estimates
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7 285 will be expressed as mean differences (with 95% confidence intervals) between the intervention group and
8
9 286 the control group; for dichotomous outcomes, effect estimates will be expressed as risk ratios, rate ratios,
10
11 287 hazard ratios, or odds ratios (all with a 95% confidence interval). Additionally, we will discuss the
12
13 288 limitations of the review process and provide an interpretation of the results concerning the objectives of
14
15 289 the review, as well as possible implications or next steps. We will follow the PRISMA Extension for
16
17 290 Scoping Reviews (PRISMA-ScR) checklist and guidelines to ensure a robust and replicable process (16).
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20 291

21 22 292 **Registration and reporting**

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24 293 The final protocol was registered prospectively with the Open Science Framework (<https://osf.io/t2d78>) on
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26 294 July 19, 2023, based on the PRISMA Extension for Scoping Reviews (PRISMA-ScR) (16). In the event of
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28 295 protocol amendments, the date of each amendment will be accompanied by a description of each change
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30 296 and the rationale on the Open Science Forum.
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33 34 35 298 **Discussion**

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37 299 The fight against malnutrition is one of the greatest global health challenges, influenced by economic
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39 300 growth, urbanization, and globalization, as well as shifts in the quality and quantity of human diets. For the
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41 301 period 2016-2025, the United Nations Decade of Action on Nutrition was launched, calling for specific
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43 302 coordinated actions through cross-cutting and coherent policies, programs, and initiatives to address all
44
45 303 forms of malnutrition (21). The global community has transitioned from a predominant focus on eliminating
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47 304 severe and acute undernutrition through the Millennium Development Goals (MDGs) to a broader focus on
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49 305 nutrition through the Sustainable Development Goals (SDGs). It is an opportunity for integrated action to
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51 306 address all forms of malnutrition and non-communicable diseases. According to Sustainable Development
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53 307 2030, tracking indicators are also needed to meet targets, specifically for the Global Strategy for Women's,
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3 308 Children's, and Adolescents' Health (22). In this review, we will describe and synthesize community-based
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5 309 interventions targeting the many forms of malnutrition among adolescents aged 10-19 from LMICs.
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9 311 There are a variety of interventions that could be implemented in schools, including the most common and
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11 312 longest-standing one— school feeding (10, 23). Schools provide a platform for interventions that target
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13 313 high-risk groups beyond food, including adolescent girls receiving weekly iron and folic acid supplements
14
15 314 (WIFA), nutrition and physical education, promoting a healthy diet and active lifestyle, school gardens
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17 315 and/or farms, creating positive school environments, and water and sanitation interventions (10). While
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19 316 school enrollment has increased significantly since 2000 across the globe and is acknowledged as a central
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21 317 platform for improving nutrition among school-going children and adolescents, around 37% of secondary
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23 318 school-age children in sub-Saharan Africa do not attend school and many of those who do attend are
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25 319 irregular students (24). There is, therefore, a need for new approaches that will improve nutrition literacy,
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27 320 ensure food security, and address specific nutrition challenges among out-of-school adolescents.
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29 321 Consequently, community-based nutrition-specific and nutrition-sensitive interventions targeting multiple
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31 322 forms of malnutrition outcomes of adolescents are needed to synthesize the evidence. In order to improve
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33 323 the nutritional status of adolescents, it is imperative to engage adolescents, families, and communities, and
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35 324 to allow health, education, nutrition, social protection, and other agencies to work together synergistically.
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40 326 Community-based interventions provide opportunities to engage with a range of adolescent groups and
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42 327 collaborate with various local institutions. Communities can provide interventions and support strategies to
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44 328 improve local food environments and food choices, ranging from non-governmental organizations and
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46 329 religious groups to local businesses, self-help groups, and sports or music clubs (25). Many of the most
47
48 330 effective obesity interventions consider a specific social context and are delivered in community settings in
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50 331 high-income countries. For example, in one US study, mentoring from African American community
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52 332 members increased the impact of nutrition interventions on African American young people (26). It is also
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54 333 possible to target social norms and the environmental context of nutritional choices through community
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3 334 interventions. With regard to social influences more broadly, adolescents today have access to a much wider
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5 335 range of social networks than their predecessors. As a result of social media and information technology,
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7 336 both social and commercial influences in adolescence have evolved (27). Social media has sometimes been
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9 337 associated with harmful nutrition outcomes—for example, reinforcing weight-related stigma and
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11 338 normalizing unhealthy body image—but it has also helped young people connect with people outside their
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13 339 immediate communities and transformed social opportunities for less mobile people. Despite their
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15 340 enormous potential, there is limited literature evaluating the impact of community-based interventions in
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17 341 LMICs.
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22 343 Considering the recommendations of the Lancet Commission on Adolescent Health (3), the WHO's Global
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24 344 Accelerated Action for Adolescent Health (28), and the Child and Adolescent Health Volume of Disease
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26 345 Control Priorities (29) that advocate the integration of health and nutrition, we anticipate the results of this
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28 346 review will serve to advance the application of these recommendations. Using the results of this review,
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30 347 future programs can be developed to address the immediate and growing needs of adolescents in community
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32 348 settings. In addition, future programs can include approaches to connecting such interventions with schools,
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34 349 families, and the broader community. In addition, these findings can help policymakers, researchers,
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36 350 practitioners, government agencies, and non-governmental organizations develop and implement
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38 351 interventions to improve adolescents' integrated health and address malnutrition and other health outcomes
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40 352 in LMICs.
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45 354 **Ethics and dissemination**

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47 355 This study is a scoping review that does not require ethics approval because it involves a methodical
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49 356 presentation of available resources. The protocol aims to provide an overview of the broad literature on
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51 357 community-based interventions targeting multiple forms of malnutrition among adolescents in LMICs.
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53 358 Additionally, the submitted review will help identify effective interventions, determine gaps and disparities
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3 359 among interventions, and provide insight for policymakers to develop and design as well as implement
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5 360 future programs.
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7 361 **Author Contributors**

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9 362 SS conceived the idea, developed the methods, and wrote the first draft of the manuscript. ALK, MR, and
10
11 363 UP contributed to the methods and supported the drafting and editing of the manuscript. ALK and MR
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15 365 ARISE-NUTRINT study collaborators supervised and reviewed the protocol. All authors revised and
16
17 366 approved the final manuscript.
18

19 367 **Funding**

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21
22 368 This study was funded by the European Union Horizon 2022. Views and opinions expressed are however
23
24 369 those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European
25
26 370 Union nor the granting authority can be held responsible for them.
27

28 371 **Competing interests**

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30 372 None declared.
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32 373 **Patient consent for publication**

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34 374 Not required
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36 375 **Provenance and peer review**

37
38 376 Not commissioned, externally peer-reviewed
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42 378 **References**

- 43
44
45 379 1. United Nations Children's Fund. Progress for Children: A Report Card on Adolescents No. 10.
46
47 380 2012. Available at [www.unicef.org/publications/files/Progress_for_Children_-](http://www.unicef.org/publications/files/Progress_for_Children_-_No._10_EN_04272012.pdf)
48
49 381 [_No._10_EN_04272012.pdf](http://www.unicef.org/publications/files/Progress_for_Children_-_No._10_EN_04272012.pdf).
50
51 382 2. United Nations. Department of Economic and Social Affairs, Population Division. World
52
53 383 population prospects, the 2012 revision. Available at: <https://population.un.org/wpp/>
54
55
56
57
58
59

- 1
2
3
4 384 3. Patton GC, Sawyer SM, Santelli JS, et al. Our future: a Lancet commission on adolescent health
5
6
7 385 and well-being. *Lancet* 2016;387:2423-78.
8
9
10 386 4. Patton GC, Olsson C, Skirbekk V, et al. Adolescence and the next generation. *Nature* 2018;554:
11
12
13 387 458–66.
14
15
16 388 5. Canavan CR, Fawzi WW. Addressing knowledge gaps in adolescent nutrition: Towards advancing
17
18
19 389 public health and sustainable development. *Curr Dev Nutr* 2019;3:nzz062.
20
21
22 390 6. World Health Organization. Global health estimates: leading causes of DALYs. Available at:
23
24
25 391 [https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-](https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys)
26
27
28 392 [estimates-leading-causes-of-dalys](https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys)
29
30
31 393 7. Norris SA, Frongillo EA, Black MM, et al. Nutrition in adolescent growth and development. *Lancet*
32
33
34 394 2022;299:172-84.
35
36
37 395 8. Hargreaves D, Mates E, Menon P, et al. Strategies and interventions for healthy adolescent growth,
38
39
40 396 nutrition and development. *Lancet* 2022;299:198-210.
41
42
43 397 9. Roche ML, Samson KLI, Green TJ, et al. Perspective: Weekly Iron and Folic Acid
44
45
46 398 Supplementation (WIFAS): A critical review and rationale for inclusion in the essential medicines
47
48
49 399 list to accelerate anemia and neural tube defects reduction. *Adv Nutr*. 2021;12:334-42.
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 400 10. Shinde S, Wang D, Moulton GE, et al. School-based health and nutrition interventions addressing
5
6 401 double burden of malnutrition and educational outcomes of adolescents in low- and middle-income
7
8
9 402 countries: A systematic review. *Matern Child Nutr* 2023:e13437. doi: [10.1111/mcn.13437](https://doi.org/10.1111/mcn.13437)
10
11
12 403 11. Kyere P, Veerman JL, Lee P, et al. Effectiveness of school-based nutrition interventions in sub-
13
14 404 Saharan Africa: a systematic review. *Public Health Nutr* 2020;23:2626-36.
15
16 405 12. Van Cauwenberghe E, Maes L, Spittaels H, et al. Effectiveness of school-based interventions in
17
18 406 Europe to promote healthy nutrition in children and adolescents: systematic review of published
19
20 407 and 'grey' literature. *Br J Nutr* 2010;103:781-97.
21
22 408 13. Pongutta S, Ajetunmobi O, Davey C, et al. Impacts of school nutrition interventions on the
23
24 409 nutritional status of school-aged children in Asia: A systematic review and meta-analysis.
25
26 410 *Nutrients*. 2022;14:589. doi: 10.3390/nu14030589.
27
28 411 14. Hawkes C, Ruel M, Salm L, et al. Double-duty actions: seizing programme and policy opportunities
29
30 412 to address malnutrition in all its forms. *Lancet* 2019;395:142-55.
31
32 413 15. World Bank designated developing countries 2023. World bank. Available at:
33
34 414 <https://www.endocrine.org/membership/join/developing-country-list>
35
36 415 16. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR):
37
38 416 Checklist and Explanation. *Ann Intern Med* 2018;169:467-73.
39
40 417 17. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing the risk of bias in
41
42 418 randomized trials. *BMJ* 2019;366:14898.
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 419 18. Eldridge S, Campbell M, Cambell M, et al. Revised Cochrane risk of bias tool for randomized trials
5
6
7 420 (RoB 2.0) additional considerations for cluster randomized trials. Available at:
8
9
10 421 <https://www.unisa.edu.au/contentassets/72bf75606a2b4abcaf7f17404af374ad/rob2->
11
12
13 422 [0_cluster_parallel_guidance.pdf](#)
14
15
16 423 19. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing the risk of bias in non-
17
18
19 424 randomized studies of interventions. *BMJ* 2016;355: i4919.
20
21
22 425 20. Campbell M, McKenzie JE, Sowden A, et al. Synthesis without meta-analysis (SWiM) in
23
24
25 426 systematic reviews: reporting guideline. *BMJ* 2020;368:l6890.
26
27
28 427 21. United Nations. United Nations Decade of Action on Nutrition 2016-2025. www.un.org/nutrition.
29
30
31 428 22. Kuruvilla S, Bustreo F, Kuo T, et al. The Global strategy for women’s children’s and adolescents’
32
33
34 429 health (2016–2030): a roadmap based on evidence and country experience. *Bull World Health*
35
36
37 430 *Organ* 2016;94:398–400.
38
39
40 431 23. Wang D, Shinde S, Young T, et al. Impacts of school feeding on educational and health outcomes
41
42 432 of school-age children and adolescents in low- and middle-income countries: A systematic review
43
44 433 and meta-analysis. *J Glob Health* 2021;11:04051.
45
46
47 434 24. The World Bank Adolescents out of school (% of lower secondary school age). Available at:
48
49 435 <https://data.worldbank.org/indicator/SE.SEC.UNER.LO.ZS>
50
51 436 25. Hargreaves D, Mates E, Menon P, et al. Strategies and interventions for healthy adolescent growth,
52
53 437 nutrition, and development. *Lancet* 2022;399:198-210.
54
55
56
57
58
59
60

- 1
2
3 438 26. Lofton S, Julion WA, McNaughton DB, et al. A systematic review of literature on culturally
4 adapted obesity prevention interventions for African American youth. *J Sch Nur* 2016;32:32-46.
5 439
6
7 440 27. Chau MM, Burgermaster M, Mamykina L. The use of social media in nutrition interventions for
8 adolescents and young adults-A systematic review. *Int J Med Inform* 2018;120:77-91.
9 441
10
11 442 28. World Health Organization. Global Accelerated Action for the Health of Adolescents (AA-HA!):
12 guidance to support country implementation. Geneva: World Health Organization; 2017.
13 443
14
15 444 29. Lassi Z, Moin A, Bhutta Z. Nutrition in middle childhood and adolescence. (in Eds) Bundy D,
16 de'Silva N, Horton S, Hamison DT, Patton GC. *Child and adolescent health development. Disease*
17 *Control Priorities 3rd Edition*. Washington DC: World Bank, 2017.
18 445
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Supplementary file 1: PubMed search strategy

No.	Concept	PubMed search terms
#1	Randomized controlled trial Controlled before-after studies Quasi-experimental studies	("randomized controlled trial"[pt] OR "random allocation"[mesh] OR "cross-over studies"[mesh] OR "Controlled Before-After Studies"[Mesh] OR quasi experiment*[tiab] OR quasiexperiment*[tiab] OR "quasi-experiment*"[tiab])
#2	Nutrition and health interventions (dietary supplements, healthy diet, healthy eating, healthy nutrition, weight control, weight management, micronutrient supplementation diet/nutrition education, physical activity, community/home garden, WASH, and nutrition policy)	("Health Education"[Mesh:NoExp] OR "Health Promotion"[Mesh]) OR ("Adolescent Health Services"[Mesh] OR "Preventive Health Services"[Mesh:NoExp]) OR (preventive health[tiab]) OR ("Dietary Supplements"[Mesh] OR dietary supplement*[tiab] micronutrient supplement*[tiab] OR folic acid supplement*[tiab] OR MMN[tiab] OR nutrient supplement*[tiab] OR nutritional supplement*[tiab]) OR ("Diet, Healthy"[Mesh] OR healthy diet*[tiab] OR healthy eating[tiab] OR healthy food*[tiab] OR diet education[tiab] OR dietary education[tiab] OR dietary intervention[tiab] OR healthy eating[tiab] OR healthy food*[tiab] OR healthy diet*[tiab] OR healthy nutrition*[tiab] OR nutrition counsel*[tiab] OR nutritional counsel*[tiab]) OR (nutrition education[tiab] OR nutrition intervention[tiab] OR nutritional education[tiab] OR nutritional intervention[tiab]) OR ("exercise"[MeSH] OR "exercise" [tiab] OR "physical activity"[tiab] OR fitness*[tiab] OR sport*[tiab]) OR ("nutrition policy"[MeSH] OR "nutrition"[tiab] AND "policy"[tiab] OR "nutrition policy"[tiab])
#3	Adolescents	("Adolescent"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR teen[tiab] OR teens[tiab] OR teenage*[tiab])
#4	Low- and middle-income countries	(Afghanistan*[tiab] OR Albania*[tiab] OR Algeria*[tiab] OR Samoa*[tiab] OR Angola*[tiab] OR Armenia*[tiab] OR Azerbaijan*[tiab] OR Bangladesh*[tiab] OR Bengali[tiab] OR Belarus*[tiab] OR Belize[tiab] OR Benin[tiab] OR Bhutan*[tiab] OR Bolivia*[tiab] OR Bosnia*[tiab] OR Herzegovina*[tiab] OR Botswana*[tiab] OR Brazil*[tiab] OR Bulgaria*[tiab] OR "Burkina Faso"[tiab] OR Burkinabe[tiab] OR Burundi*[tiab] OR "Cabo Verd"[tiab] OR "Cape Verd"[tiab] OR Cambodia*[tiab] OR Cameroon*[tiab] OR "Central African"[tiab] OR Chad*[tiab] OR China[tiab] OR Chinese[tiab] OR Colombia*[tiab] OR Comoros[tiab] OR Congo[tiab] OR "Costa Rica"[tiab] OR "Cote d'Ivoire"[tiab] OR "Ivory Coast"[tiab] OR Cuba[tiab] OR Cuban[tiab] OR Djibouti[tiab] OR Dominica*[tiab] OR Ecuador[tiab] OR Egypt*[tiab] OR "El Salvador"[tiab] OR Eritrea*[tiab] OR Ethiopia*[tiab] OR Fiji*[tiab] OR Gabon*[tiab] OR Gambia*[tiab] OR Georgia*[tiab] OR Ghana*[tiab] OR Grenada*[tiab] OR Guatemala*[tiab] OR Guinea*[tiab] OR Guyan*[tiab] OR Haiti*[tiab] OR Hondura*[tiab] OR India[tiab] OR Indian*[tiab] OR Indonesia*[tiab] OR Iran*[tiab] OR Iraq*[tiab] OR Jamaica*[tiab] OR Jordan*[tiab] OR Kazakh*[tiab] OR Kenya*[tiab] OR Kiribati[tiab] OR "People's Republic of Korea"[tiab] OR "North Korea"[tiab] OR Kosovo[tiab] OR Kosovar*[tiab] OR Kyrgyz*[tiab] OR Lao[tiab] OR Laos[tiab] OR Laotian*[tiab] OR Lebanon[tiab] OR Lebanes*[tiab] OR Lesotho[tiab] OR Liberia*[tiab] OR

	Libya*[tiab] OR Macedonia*[tiab] OR Madagascar*[tiab] OR Malawi*[tiab] OR Malaysia*[tiab] OR Maldives[tiab] OR Mali[tiab] OR "Marshall Island*" [tiab] OR "Mexico"[MeSH] OR Mexico[tiab] OR Mexican*[tiab] OR Micronesia*[tiab] OR Moldova*[tiab] OR Mongolia*[tiab] OR Montenegr*[tiab] OR Morocc*[tiab] OR Mozambique[tiab] OR Myanmar[tiab] OR Burmese*[tiab] OR Burma[tiab] OR Namibia*[tiab] OR Nepal*[tiab] OR Nicaragua*[tiab] OR Niger*[tiab] OR Pakistan*[tiab] OR Paraguay*[tiab] OR Peru*[tiab] OR Philippin*[tiab] OR Rwanda*[tiab] OR "Sao Tome"[tiab] OR Principe[tiab] OR Senegal*[tiab] OR Serbia*[tiab] OR "Sierra Leone*" [tiab] OR "Solomon Island*" [tiab] OR Somalia*[tiab] OR "South Africa*" [tiab] OR "Sri Lanka"[tiab] OR "St Lucia"[tiab] OR "Saint Lucia"[tiab] OR "St Vincent"[tiab] OR "Saint Vincent"[tiab] OR Grenad*[tiab] OR Sudan*[tiab] OR Suriname*[tiab] OR Swaziland*[tiab] OR Eswatini*[tiab] OR Syria*[tiab] OR Tajik*[tiab] OR Tanzania*[tiab] OR Zanzibar[tiab] OR Thai*[tiab] OR Timor*[tiab] OR Togo*[tiab] OR Tonga*[tiab] OR Tunisia*[tiab] OR Turkey[tiab] OR Turkish[tiab] OR Turkmen*[tiab] OR Tuvalu*[tiab] OR Uganda*[tiab] OR Ukrain*[tiab] OR Uzbeki*[tiab] OR Vanuatu*[tiab] OR Venezuela*[tiab] OR Vietnam*[tiab] OR "Viet nam*" [tiab] OR "West Bank"[tiab] OR Gaza*[tiab] OR Palestin*[tiab] OR Yemen*[tiab] OR Zambia*[tiab] OR Zimbabw*[tiab] OR "Western Sahara"[tiab] OR Argentin*[tiab] OR Russia*[tiab] OR Maurit*[tiab] OR Palau[tiab] OR Romania*[tiab])
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BMJ Open

Community-based interventions targeting multiple forms of malnutrition among adolescents in low- and middle-income countries: protocol for a scoping review

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2023-078969.R1
Article Type:	Protocol
Date Submitted by the Author:	23-Feb-2024
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Primary Subject Heading:	Nutrition and metabolism
Secondary Subject Heading:	Global health, Public health, Research methods
Keywords:	Adolescent, NUTRITION & DIETETICS, Health Education, Systematic Review, Anaemia < HAEMATOLOGY

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3 **1 Community-based interventions targeting multiple forms of malnutrition among adolescents**
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5 **2 in low- and middle-income countries: protocol for a scoping review**
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37 69 **Word count:** 2581 (not including title page, abstract, references, tables, or acknowledgement)
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3 **71 Abstract**
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5 **72 Background:** Adolescent malnutrition is a significant public health challenge in low- and middle-income
6
7 **73** countries (LMICs), with long-term consequences for health and development. Community-based
8
9 **74** interventions have the potential to address multiple forms of malnutrition and improve the health outcomes
10
11 **75** of adolescents. However, there is a limited understanding of the content, implementation, and effectiveness
12
13 **76** of these interventions. This scoping review aims to synthesize evidence on community-based interventions
14
15 **77** targeting multiple forms of malnutrition among adolescents in LMICs and describe their effects on nutrition
16
17 **78** and health.

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19
20 **79 Methods and analysis:** A comprehensive search strategy will be implemented in multiple databases
21
22 **80** including MEDLINE (through PubMed), Embase, CENTRAL (through Cochrane Library), and grey
23
24 **81** literature, covering the period from January 1, 2000, to July 14, 2023. We will follow the Participants,
25
26 **82** Concept, and Context (PCC) model to design the search strategy. The inclusion criteria encompass
27
28 **83** randomized controlled trials and quasi-experimental studies focusing on adolescents aged 10-19 years.
29
30 **84** Various types of interventions, such as micronutrient supplementation, nutrition education, feeding
31
32 **85** interventions, physical activity, and community environment interventions, will be considered. Two
33
34 **86** reviewers will perform data extraction independently, and, where relevant, risk of bias assessment will be
35
36 **87** conducted using standard Cochrane risk-of-bias tools. We will follow the PRISMA Extension for Scoping
37
38 **88** Reviews checklist while reporting results.

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41 **89 Ethics and dissemination:** The scope of this scoping review is restricted to publicly accessible databases
42
43 **90** that do not require prior ethical approval for access. The findings of this review will be shared through
44
45 **91** publications in peer-reviewed journals, and presentations at international and regional conferences and
46
47 **92** stakeholder meetings in LMICs.

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50 **93 Scoping review registration:** The final protocol was registered prospectively with the Open Science
51
52 **94** Framework on July 19, 2023 (<https://osf.io/t2d78>).

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54 **95**
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3 97 **Article Summary**
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5 98 Strengths and limitations of this study
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- 7 99
- A comprehensive examination of over 20 years of published data will be conducted.
- 8
- Grey literature sources such as government reports and organization websites will also be included.
- 9 100
- There will be a quality assessment of the included quantitative studies.
- 10 101
- The proposed search strategy will be conducted only in three electronic databases.
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For peer review only

103 **Introduction**

104 The current global adolescent population surpasses 1.2 billion individuals, with approximately 90 percent
105 of them residing in low- and middle-income countries (LMICs) (1). Moreover, when considering regional
106 trends, it is expected that the proportion of young people aged 10 to 24 residing in Sub-Saharan Africa will
107 experience substantial growth, rising from 245 million in 2015 to 605 million by 2050 (2). In contrast, the
108 Asia and Pacific region is expected to undergo the most significant decrease, declining from 718 million in
109 2015 to 619 million by 2050 (2). These regional variations emphasize the unique challenges and
110 opportunities faced by different regions in terms of future demographic and health challenges, which will
111 require distinct solutions.

112
113 Adolescence is a period of rapid physical growth, cognitive development, socio-emotional development,
114 and cultural development, all of which are strongly influenced by an individual's socioeconomic, cultural,
115 and physical environments (3). Nutrition plays a crucial role in improving health and development during
116 this critical stage in life, bringing intergenerational benefits. After the first 1000 days of life, adolescence
117 is assumed to offer a second window of opportunity for correcting nutritional deficiencies and insufficient
118 growth since childhood (4).

119
120 LMICs are experiencing a rapid nutrition transition among adolescents, accompanied on the one hand by
121 stunting, thinness, anemia, and other micronutrient deficiencies, and on the other hand by an increasing
122 burden of obesity and non-communicable diseases (5). Malnutrition was the leading cause of disability-
123 adjusted life years (DALYs) among the 10-14 age group in 2019, followed by iron deficiency anemia
124 among adolescents aged 10-19 (6). The consumption of diverse and healthy diets by adolescents from
125 LMICs is declining, while the consumption of processed and calorie-rich foods is on the rise, contributing
126 to rising obesity rates (7). Furthermore, food insecurity has been aggravated in vulnerable populations
127 including adolescents in LMICs because of the COVID-19 pandemic, political instability, and recurring
128 climate crises in the form of flooding and droughts (8).

1
2
3 129 Several systematic reviews indicate that micronutrient supplementation is effective in addressing nutritional
4
5 130 deficiencies (9,10). Iron supplementation can reduce anemia in adolescents; periconceptional folic acid
6
7 131 supplementation among adolescent girls can reduce neural tube defects; and adolescent girls who consume
8
9 132 high amounts of calcium (≥ 1 g daily) have lower rates of preeclampsia, preterm birth, or neonatal
10
11 133 hospitalization (11). There is limited evidence that protein-energy supplements are effective for adolescents
12
13 134 (10).

14
15 135
16
17 136 The burden of malnutrition may be reduced by several nutrition-sensitive interventions, including nutrition
18
19 137 education, dietary interventions, physical activity, and food environment interventions (12). Several
20
21 138 systematic reviews suggest promising but modest results from discrete nutrition-sensitive interventions
22
23 139 aimed at addressing malnutrition in schools (13-15). These single-domain interventions, however, target
24
25 140 either undernutrition or overnutrition and operate in *silos*. There is increased interest in addressing health
26
27 141 and nutrition behaviors through integrated interventions, generally called "double-duty actions", targeting
28
29 142 multiple forms of malnutrition and nutrition-related non-communicable diseases (16). An essential element
30
31 143 of this concept is that tackling one form of malnutrition should not prevent addressing another. There is
32
33 144 promising evidence that integrated interventions can improve the nutritional status of school-going children
34
35 145 and adolescents (12).

36
37 146
38
39 147 Nevertheless, there are several gaps in understanding adolescent nutrition in LMICs. Currently, nutrition-
40
41 148 specific, and nutrition-sensitive interventions tend to focus on school-going adolescents, and little is known
42
43 149 about their effects on other vulnerable groups of adolescents, such as out-of-school adolescents, migrant
44
45 150 adolescents, and HIV-positive adolescents. Another important gap is that most of the school-based
46
47 151 interventions target overlapping age groups and there is little known regarding the age-appropriate
48
49 152 intervention strategies and delivery mechanisms as well as the specific impact on the adolescent population.
50
51 153 Moreover, most of these school-based interventions are delivered by schoolteachers, community health
52
53 154 workers, school nurses, or peers in classroom-based settings or during school hours. Despite the importance

1
2
3 155 of nutrition-sensitive and nutrition-specific interventions for the health of communities, little evidence
4
5 156 exists about their form and function using community platforms.
6

7 157
8
9 158 The purpose of this scoping review is to comprehensively review the literature to describe community-
10
11 159 based interventions that address the multiple forms of malnutrition such as obesity, overweight,
12
13 160 underweight, wasting, stunting, anemia, and micronutrient deficiencies affecting adolescents in LMICs,
14
15 161 and describe the effects of these interventions on nutrition and health. We decided to conduct a scoping
16
17 162 review as our primary aim was to summarize the overview of the evidence on community-based
18
19 163 interventions for adolescents in LMICs, rather than to pursue a specific clinical or epidemiological question
20
21 164 related to these or provide evidence to directly inform policy or practice (17). In the context of this review,
22
23 165 community-based interventions refer to any interventions carried out in community settings other than
24
25 166 schools, to improve the health among adolescents. Examples include interventions implemented through
26
27 167 community youth centers, clubs, or religious centers. By excluding school-community interventions, which
28
29 168 have been thoroughly explored in the literature, we can concentrate on interventions that are less common,
30
31 169 less understood, and less easy to implement, but that have the potential to reach the most vulnerable groups
32
33 170 of adolescents.
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37 171

38 39 172 **Methods**

40 41 173 **Data sources, search terms, and search strategy**

42
43 174 As part of our primary strategy, we will search MEDLINE (through PubMed), Embase, and CENTRAL
44
45 175 (through the Cochrane Library). All databases will be searched for eligible studies from January 1, 2000,
46
47 176 through July 14, 2023. We will identify potentially relevant published studies using the combination of
48
49 177 medical subject headings (MeSH) and text words denoting nutrition-specific and nutrition-sensitive
50
51 178 interventions. We will also examine references and bibliographies of included studies to identify additional
52
53 179 sources of information. This search of studies will be supplemented by reviewing ClinicalTrials.gov and
54
55 180 organizational websites such as the World Health Organization (WHO), World Bank, United Nations
56
57

181 Children's Fund (UNICEF), and United Nations Population Fund (UNFPA). When possible, reports written
 182 in languages other than English will be translated by colleagues who are native speakers of those
 183 languages. No study will be considered if it cannot be adequately translated.

184
 185 We will use the Participants, Concept, and Context (PCC) model (Table 1) to guide our search strategy. The
 186 search will use indexing terms, including MeSH terms, keywords, and free text words. First, a broad search
 187 strategy (e.g., type of study [randomized controlled trials, quasi-experiments, or controlled before-after
 188 studies] AND intervention domain [e.g., nutrition education] AND population [adolescents] AND setting
 189 [low- and middle-income countries]) will be performed in PubMed. We will confirm the sensitivity of the
 190 search strategy by identifying several sentinel articles. The PubMed strategy, provided in **Supplementary**
 191 **File 1**, will be adapted to suit other databases. We will document the following details for each search:
 192 databases searched, date of search, search strategy (i.e., subject headings and keywords, including if terms
 193 are expanded, truncated, and how they are combined), filters used, and the number of records retrieved.
 194 Additionally, a source will be provided for each publication identified through manual search (i.e., journal
 195 name, website, conference proceedings, etc.).

196

197 **Table 1. Eligibility criteria for the scoping review**

Item	Inclusion criteria	Exclusion criteria
Participants	Studies involving adolescents (10–19 years old)	Studies involving children <10 years of age or adults (>19 years of age)
Concept	Studies involving one or more of the following interventions: nutrient supplementation interventions including vitamin and nutrient supplementation, deworming,	Interventions targeted towards individuals with specific medical conditions such as treatments intended for underweight, overweight, or obese adolescents

	<p>complementary feeding, nutrition education, physical education, promoting healthy diets and/or physical activity, nutrition policies, community/home garden, water, sanitation and hygiene interventions, community environment interventions, and structural interventions such as sweetened beverage tax, soda tax, and sugary drink tax.</p> <p>Studies that compared the intervention with any relevant control group including comparisons with no intervention, regular nutrition education and/or physical education, or any other intervention in the community setting</p>	
Context	Community settings in low- and middle-income countries	Interventions applied exclusively in the school setting
Types of sources	Randomized controlled trials, quasi-experimental studies including controlled before-after studies	Non-randomized trials including controlled before-after studies that did not account for baseline differences, observational studies including cohort, case-control, and cross-

		sectional designs, and editorial commentaries, opinions, and review articles
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198

199 **Eligibility**

200 The inclusion and exclusion criteria for this scoping review are listed below.

201 ***Inclusion criteria***

202 We will include the following studies.

- 203 • Randomized controlled trials (RCT), with the intervention randomized to individuals or in clusters
204 (including clubs, groups, communities, villages, homes, etc.), and quasi-experimental studies
205 including controlled before-after studies that have reported interventions to address any form of
206 adolescent malnutrition when compared to a control group.
- 207 • Studies involving adolescent boys and/or girls aged 10-19 years, based on the WHO definition of
208 adolescents (18).
- 209 • Studies conducted in LMICs—as defined by the World Bank in the year 2023 (19).
- 210 • Studies involving interventions for one or more of the following: micronutrient supplementation,
211 feeding interventions, nutrition education, physical education, interventions to promote healthy
212 diets, interventions promoting physical activity, community and/or home gardens, food and
213 nutrition policies, community environment interventions, water sanitation and hygiene (WASH)
214 interventions, and structural interventions such as taxation of sweetened-sugary drinks.
- 215 • The control (comparison) in each included study can be participants who did not receive any
216 intervention or received standard care, received standard health/nutrition education, or any other
217 intervention in the community setting.
- 218 • Published articles as well as unpublished and grey literature and will include ongoing studies where
219 preliminary findings are available.
- 220 • We will not place any restrictions on the language, sample size, or duration of the intervention.

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2
3 221 ***Exclusion criteria***
4

5 222 We will not consider the following studies.
6

- 7 223 • Non-RCTs that are not quasi-experimental studies with comparator groups and controlled before-
8
9 224 after studies that did not account for the baseline differences between the study arms.
10
11 225 • Observational studies such as cohort, case-control, and cross-sectional designs.
12
13 226 • Editorials, commentaries, opinions, and review articles. However, we will use review articles to
14 227 identify additional original articles.
15
16 228 • Studies that were conducted in the school setting and clinical interventions targeted individuals
17
18 229 with specific medical conditions such as programs intended for underweight, overweight, obese, or
19
20 230 anemic adolescents.
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26 232 **Data management**
27

28 233 The records will be imported into Covidence (Veritas Health Innovation, Melbourne, Australia), an
29
30 234 Internet-based systematic review management program. Detection and removal of duplicates, title and
31
32 235 abstract screening, and full-text screening will be performed by using Covidence.
33
34

35 236

36
37 237 **Selection of studies**
38

39 238 Using Covidence, we will screen titles, abstracts, and full texts. First, two reviewers will independently
40
41 239 assess all search results (i.e., titles and abstracts) and exclude irrelevant studies based on inclusion and
42
43 240 exclusion criteria. Next, two reviewers will carry out the full-text screening based on the same
44
45 241 inclusion/exclusion criteria. The reviewers will discuss and resolve any difference of opinion or, if
46
47 242 necessary, seek a third reviewer's opinion for resolving differences. A study flow diagram stating the
48
49 243 specific reasons for exclusion will be maintained following the PRISMA for Scoping Review statement
50
51 244 (PRISMA-ScR) (20).
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246 **Data extraction**

247 Two reviewers will independently extract and enter data from studies included in the review. We will
248 develop and test an extraction form on five randomly selected studies. We will extract the following
249 information.

- 250 • Study details including the title, authors (first author and corresponding author), the corresponding
251 author's contact information, journal (or source for unpublished reports), calendar year of
252 publication, calendar year of intervention, country, and source of funding.
- 253 • Study methods including objectives and/or research questions, type of study, investigation
254 strategies, settings, sample size, and sample characteristics (e.g., age, sex, socioeconomic status
- 255 • Intervention strategy including target population, delivery platform and providers (including
256 selection, training, supervision, support, and incentivization), types of nutrition and other
257 interventions (including content, conceptual framework and/or theoretical underpinnings, timing,
258 duration, and dosage or frequency), and comparator/control.
- 259 • Outcomes assessed and details of the measures used.
- 260 • Findings including the coverage of services, facilitators and barriers to intervention delivery and
261 uptake, effectiveness findings with point estimates and measures of variance (standard errors, 95%
262 confidence intervals, or *p*-values), and any other key findings related to the scoping review
263 questions.

264
265 We will contact the corresponding author via email if there is missing or inconsistent information. We will
266 contact the author two times at most. The available data will be analyzed and any gaps due to missing data
267 will be discussed if the data issue cannot be resolved after contacting the authors. The extraction form
268 template was provided in **Supplementary File 2**.

269

270 **Risk of bias assessment**

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3 271 As scoping reviews are exploratory in nature, risk of bias assessments are not typically required as part of
4
5 272 the guidelines for scoping reviews (17). However, we plan to assess the risk of bias among studies with an
6
7 273 available quantitative measure as a preliminary way of contextualizing the reported measures of impact on
8
9 274 the outcomes reported. For the assessment of the risk of bias in the selected studies, we will use the
10
11 275 Cochrane Collaboration's revised tool for assessing the risk of bias in randomized trials (RoB 2) (21). Two
12
13 276 reviewers will independently evaluate methodological quality. Any uncertainties or disagreements will be
14
15 277 resolved by discussion or by a third reviewer, whenever needed. The tool is a domain-based evaluation, in
16
17 278 which critical assessments for risk of bias are made separately for various domains, including the
18
19 279 randomization process, deviation from intended interventions, missing outcome data, measurement of the
20
21 280 outcome, and selective outcome reporting. The risk of bias in clustered trials will be similarly assessed
22
23 281 using the risk of bias 2 for cluster-randomized trials (RoB 2 CRT) (22). Additionally, we will use the Risk
24
25 282 of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool (23), to assess the risk of bias for
26
27 283 controlled before-after studies and non-randomized controlled trials.
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32 285 **Synthesis of evidence**

34 286 All included studies will be systematically synthesized in the text and a table following the SWiM
35
36 287 guidelines (Synthesis Without Meta-analysis) (24). In this synthesis, we will describe how many sources
37
38 288 of evidence were screened, assessed for eligibility, and included in the review, along with reasons for
39
40 289 exclusion at each stage. Our presentation of included sources of evidence will include summary
41
42 290 characteristics and citations, as well as a critical appraisal, if applicable. Studies will be grouped based on
43
44 291 methods and interventions, standardized outcomes metrics, synthesis methods, criteria used to prioritize
45
46 292 results for summary, reporting of results, the certainty of results, heterogeneity in effects, as well as barriers
47
48 293 and facilitators to delivering the interventions will be discussed. For continuous outcomes, effect estimates
49
50 294 will be expressed as mean differences (with 95% confidence intervals) between the intervention group and
51
52 295 the control group; for dichotomous outcomes, effect estimates will be expressed as risk ratios, rate ratios,
53
54 296 hazard ratios, or odds ratios (all with a 95% confidence interval). Additionally, we will discuss the
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3 297 limitations of the review process and provide an interpretation of the results concerning the objectives of
4
5 298 the review, as well as possible implications or next steps. We will follow the PRISMA Extension for
6
7 299 Scoping Reviews (PRISMA-ScR) checklist and guidelines to ensure a robust and replicable process (20).
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11 301 **Registration and reporting**

12
13 302 The final protocol was registered prospectively with the Open Science Framework (<https://osf.io/t2d78>) on
14
15 303 July 19, 2023, based on the PRISMA Extension for Scoping Reviews (PRISMA-ScR) (20). In the event of
16
17 304 protocol amendments, the date of each amendment will be accompanied by a description of each change
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19 305 and the rationale on the Open Science Forum.
20
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23 24 307 **Ethics and dissemination**

25
26 308 This study is a scoping review that does not require ethics approval because it involves a methodical
27
28 309 presentation of available resources. The protocol aims to provide an overview of the broad literature on
29
30 310 community-based interventions targeting multiple forms of malnutrition among adolescents in LMICs. We
31
32 311 anticipate that the findings of this review will be disseminated through publications in peer-reviewed
33
34 312 journals, and presentations at international and regional conferences and stakeholder meetings targeting
35
36 313 researchers, adolescents, policymakers, and governments in LMICs. Additionally, the submitted review
37
38 314 will help identify effective interventions, determine gaps and disparities among interventions, and provide
39
40 315 insight for policymakers to develop and design as well as implement future programs.
41
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43 316

44 45 317 **Patient and public involvement**

46
47 318 None. This work analyses existing research studies, and therefore, involves no patients or members of the
48
49 319 public.
50

51 320 **Author Contributors**

52
53 321 SS conceived the idea, developed the methods, and wrote the first draft of the manuscript. ALK, MR, UP,
54
55 322 and EF contributed to the methods and supported the drafting and editing of the manuscript. ALK and MR
56
57

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2
3 323 contributed meaningfully to the design of the search strategy. SO, NM, DOA, CN, SL, TB, WWF, and
4
5 324 ARISE-NUTRINT study collaborators supervised and reviewed the protocol. All authors revised and
6
7 325 approved the final manuscript.
8

9
10 326 **Funding**

11 327 This study was funded by the European Union Horizon 2022. Views and opinions expressed are however
12
13 328 those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European
14
15 329 Union nor the granting authority can be held responsible for them.
16

17
18 330 **Competing interests**

19
20 331 None declared.
21

22 332 **Patient consent for publication**

23
24 333 Not required
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26 334 **Provenance and peer review**

27
28 335 Not commissioned, externally peer-reviewed
29
30
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32
33 337 **References**

- 34
35 338 1. United Nations Children's Fund. Progress for Children: A Report Card on Adolescents No. 10.
36
37 339 2012. Available at [www.unicef.org/publications/files/Progress_for_Children_-](http://www.unicef.org/publications/files/Progress_for_Children_-_No._10_EN_04272012.pdf)
38
39 340 [_No._10_EN_04272012.pdf](http://www.unicef.org/publications/files/Progress_for_Children_-_No._10_EN_04272012.pdf).
40
41 341 2. United Nations. Department of Economic and Social Affairs, Population Division. World
42
43 342 population prospects, the 2012 revision. Available at: <https://population.un.org/wpp/>
44
45 343 3. Patton GC, Sawyer SM, Santelli JS, et al. Our future: a Lancet commission on adolescent health
46
47
48 344 and well-being. *Lancet* 2016;387:2423-78.
49
50
51 345 4. Patton GC, Olsson C, Skirbekk V, et al. Adolescence and the next generation. *Nature* 2018;554:
52
53
54
55 346 458-66.
56
57
58
59
60

- 1
2
3
4 347 5. Canavan CR, Fawzi WW. Addressing knowledge gaps in adolescent nutrition: Towards advancing
5
6
7 348 public health and sustainable development. *Curr Dev Nutr* 2019;3:nzz062.
8
9
10 349 6. World Health Organization. Global health estimates: leading causes of DALYs. Available at:
11
12
13 350 [https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-](https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys)
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16 351 [estimates-leading-causes-of-dalys](https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys)
17
18
19 352 7. Norris SA, Frongillo EA, Black MM, et al. Nutrition in adolescent growth and development. *Lancet*
20
21
22 353 2022;299:172-84.
23
24
25 354 8. Martin-Shields CP, Stojetz W. Food security and conflict: Empirical challenges and future
26
27 355 opportunities for research and policy making on food security and conflict. *World development*
28
29 356 2019;119:150-64.
30
31 357 9. Salam RA, Hooda M, Das JK, et al. Interventions to Improve Adolescent Nutrition: A Systematic
32
33
34 358 Review and Meta-Analysis. *J Adolesc Health* 2016;59:S29-S39.
35
36
37 359 10. Lassi ZS, Moin A, Das JK, et al. Systematic review on evidence-based adolescent nutrition
38
39
40 360 interventions. *Ann N Y Acad Sci* 2017;1393:34-50.
41
42
43 361 11. Roche ML, Samson KLI, Green TJ, et al. Perspective: Weekly Iron and Folic Acid
44
45
46 362 Supplementation (WIFAS): A critical review and rationale for inclusion in the essential medicines
47
48
49 363 list to accelerate anemia and neural tube defects reduction. *Adv Nutr* 2021;12:334-42.
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 364 12. Shinde S, Wang D, Moulton GE, et al. School-based health and nutrition interventions addressing
5
6 365 double burden of malnutrition and educational outcomes of adolescents in low- and middle-income
7
8
9 366 countries: A systematic review. *Matern Child Nutr* 2023:e13437.
- 11
12 367 13. Kyere P, Veerman JL, Lee P, et al. Effectiveness of school-based nutrition interventions in sub-
13
14 368 Saharan Africa: a systematic review. *Public Health Nutr* 2020;23:2626-36.
- 16 369 14. Van Cauwenberghe E, Maes L, Spittaels H, et al. Effectiveness of school-based interventions in
17
18 370 Europe to promote healthy nutrition in children and adolescents: systematic review of published
19
20 371 and 'grey' literature. *Br J Nutr* 2010;103:781-97.
- 22
23 372 15. Pongutta S, Ajetunmobi O, Davey C, et al. Impacts of school nutrition interventions on the
24
25 373 nutritional status of school-aged children in Asia: A systematic review and meta-analysis. *Nutrients*
26
27 374 2022;14:589. doi: 10.3390/nu14030589.
- 28
29 375 16. Hawkes C, Ruel M, Salm L, et al. Double-duty actions: seizing programme and policy opportunities
30
31 376 to address malnutrition in all its forms. *Lancet* 2019;395:142-55.
- 32
33
34
35 377 17. Munn Z, Peters MDJ, Stern C, et al. Systematic review or scoping review? Guidance for authors
36
37 378 when choosing between a systematic or scoping review approach. *BMC Med Res Methodol* 2018
38
39 379 19;18:143.
- 40
41 380 18. Singh JA, Siddiqi M, Parameshwar P, et al. World Health Organization Guidance on Ethical
42
43 381 Considerations in Planning and Reviewing Research Studies on Sexual and Reproductive Health
44
45 382 in Adolescents. *J Adolesc Health* 2019;64:427-29.
- 46
47
48 383 19. World Bank designated developing countries 2023. World bank. Available at:
49
50
51 384 <https://www.endocrine.org/membership/join/developing-country-list>
- 52
53
54
55
56
57
58
59
60

- 1
2
3
4 385 20. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR):
5
6 386 Checklist and Explanation. *Ann Intern Med* 2018;169:467-73.
7
8
9 387 21. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing the risk of bias in
10
11
12 388 randomized trials. *BMJ* 2019;366:l4898.
13
14
15 389 22. Eldridge S, Campbell M, Campbell M, et al. Revised Cochrane risk of bias tool for randomized trials
16
17
18 390 (RoB 2.0) additional considerations for cluster randomized trials. Available at:
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27 393 23. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing the risk of bias in non-
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30 394 randomized studies of interventions. *BMJ* 2016;355: i4919.
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33 395 24. Campbell M, McKenzie JE, Sowden A, et al. Synthesis without meta-analysis (SWiM) in
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36 396 systematic reviews: reporting guideline. *BMJ* 2020;368:l6890.
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Supplementary File 1. Search strategies in 3 different databases

Community-based interventions targeting multiple forms of malnutrition among adolescents in low- and middle-income countries: protocol for a scoping review			
No.	Concept	PubMed search terms	Number of records (As per 14th July)
#1	Randomized controlled trial Controlled before-after studies Quasi experimental studies	("randomized controlled trial"[pt] OR "random allocation"[mesh] OR "cross-over studies"[mesh] OR "Controlled Before-After Studies"[Mesh] OR quasi experiment*[tiab] OR quasiexperiment*[tiab] OR "quasi-experiment*"[tiab])	720,799 556,703 (2000-2023)
#2	Nutrition and health interventions (dietary supplements, healthy diet, healthy eating, healthy nutrition, weight control, weight management, micronutrient supplementation diet/nutrition education, physical activity, community/home garden, and WASH, and nutrition policy)	("Health Education"[Mesh:NoExp] OR "Health Promotion"[Mesh]) OR ("Adolescent Health Services"[Mesh] OR "Preventive Health Services"[Mesh:NoExp]) OR (preventive health[tiab]) OR ("Dietary Supplements"[Mesh] OR dietary supplement*[tiab] micronutrient supplement*[tiab] OR folic acid supplement*[tiab] OR MMN[tiab] OR nutrient supplement*[tiab] OR nutritional supplement*[tiab]) OR ("Diet, Healthy"[Mesh] OR healthy diet*[tiab] OR healthy eating[tiab] OR healthy food*[tiab] OR diet education[tiab] OR dietary education[tiab] OR dietary intervention[tiab] OR healthy eating[tiab] OR healthy food*[tiab] OR healthy diet*[tiab] OR healthy nutrition*[tiab] OR nutrition counsel*[tiab] OR nutritional counsel*[tiab]) OR (nutrition education[tiab] OR nutrition intervention[tiab] OR nutritional education[tiab] OR nutritional intervention[tiab]) OR ("exercise"[MeSH] OR "exercise" [tiab] OR "physical activity"[tiab] OR fitness*[tiab] OR sport*[tiab]) OR ("nutrition policy"[MeSH] OR "nutrition"[tiab] AND "policy"[tiab] OR "nutrition policy"[tiab])	865,050 687,256 (2000-2023)
#3	Adolescents	("Adolescent"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR teen[tiab] OR teens[tiab] OR teenage*[tiab])	2,310,507 1,421,658 (2000-2023)
#4	Low- and middle-income countries	(Afghanistan*[tiab] OR Albania*[tiab] OR Algeria*[tiab] OR Samoa*[tiab] OR Angola*[tiab] OR Armenia*[tiab] OR Azerbaijan*[tiab] OR Bangladesh*[tiab] OR Bengali[tiab] OR Belarus*[tiab] OR Belize[tiab] OR Benin[tiab] OR Bhutan*[tiab] OR Bolivia*[tiab] OR Bosnia*[tiab] OR Herzegovina*[tiab] OR Botswana*[tiab] OR Brazil*[tiab] OR Bulgaria*[tiab] OR "Burkina Faso"[tiab] OR Burkinabe[tiab] OR Burundi*[tiab] OR "Cabo Verd*"[tiab] OR "Cape	1,931,426 1,565,369 (2000-2023)

	<p>Verd*[tiab] OR Cambodia*[tiab] OR Cameroon*[tiab] OR “Central African”*[tiab] OR Chad*[tiab] OR China[tiab] OR Chinese[tiab] OR Colombia*[tiab] OR Comoros[tiab] OR Congo[tiab] OR “Costa Rica”*[tiab] OR “Cote d’Ivoire”[tiab] OR “Ivory Coast”[tiab] OR Cuba[tiab] OR Cuban[tiab] OR Djibouti[tiab] OR Dominica*[tiab] OR Ecuador[tiab] OR Egypt*[tiab] OR “El Salvador”*[tiab] OR Eritrea*[tiab] OR Ethiopia*[tiab] OR Fiji*[tiab] OR Gabon*[tiab] OR Gambia*[tiab] OR Georgia*[tiab] OR Ghana*[tiab] OR Grenada*[tiab] OR Guatemala*[tiab] OR Guinea*[tiab] OR Guyan*[tiab] OR Haiti*[tiab] OR Hondura*[tiab] OR India[tiab] OR Indian*[tiab] OR Indonesia*[tiab] OR Iran*[tiab] OR Iraq*[tiab] OR Jamaica*[tiab] OR Jordan*[tiab] OR Kazakh*[tiab] OR Kenya*[tiab] OR Kiribati[tiab] OR “People’s Republic of Korea”[tiab] OR “North Korea”[tiab] OR Kosovo[tiab] OR Kosovar*[tiab] OR Kyrgyz*[tiab] OR Lao[tiab] OR Laos[tiab] OR Laotian*[tiab] OR Lebanon[tiab] OR Lebanes*[tiab] OR Lesotho[tiab] OR Liberia*[tiab] OR Libya*[tiab] OR Macedonia*[tiab] OR Madagascar*[tiab] OR Malawi*[tiab] OR Malaysia*[tiab] OR Maldives[tiab] OR Mali[tiab] OR “Marshall Island”*[tiab] OR “Mexico”[MeSH] OR Mexico[tiab] OR Mexican*[tiab] OR Micronesia*[tiab] OR Moldova*[tiab] OR Mongolia*[tiab] OR Montenegr*[tiab] OR Morocc*[tiab] OR Mozambique[tiab] OR Myanmar[tiab] OR Burmese*[tiab] OR Burma[tiab] OR Namibia*[tiab] OR Nepal*[tiab] OR Nicaragua*[tiab] OR Niger*[tiab] OR Pakistan*[tiab] OR Paraguay*[tiab] OR Peru*[tiab] OR Philippin*[tiab] OR Rwanda*[tiab] OR “Sao Tome”[tiab] OR Principe[tiab] OR Senegal*[tiab] OR Serbia*[tiab] OR “Sierra Leone”*[tiab] OR “Solomon Island”*[tiab] OR Somalia*[tiab] OR “South Africa”*[tiab] OR “Sri Lanka”[tiab] OR “St Lucia”[tiab] OR “Saint Lucia”[tiab] OR “St Vincent”[tiab] OR “Saint Vincent”[tiab] OR Grenad*[tiab] OR Sudan*[tiab] OR Suriname*[tiab] OR Swaziland*[tiab] OR Eswatini*[tiab] OR Syria*[tiab] OR Tajik*[tiab] OR Tanzania*[tiab] OR Zanzibar[tiab] OR Thai*[tiab] OR Timor*[tiab] OR Togo*[tiab] OR Tonga*[tiab] OR Tunisia*[tiab] OR Turkey[tiab] OR Turkish[tiab] OR Turkmen*[tiab] OR Tuvalu*[tiab] OR Uganda*[tiab] OR Ukrain*[tiab] OR Uzbeki*[tiab] OR Vanuatu*[tiab] OR Venezuela*[tiab] OR Vietnam*[tiab] OR “Viet nam”*[tiab] OR “West Bank”[tiab] OR Gaza*[tiab] OR Palestin*[tiab] OR Yemen*[tiab] OR Zambia*[tiab] OR Zimbabw*[tiab] OR “Western Sahara”[tiab] OR Argentin*[tiab] OR Russia*[tiab] OR Maurit*[tiab] OR Palau[tiab] OR Romania*[tiab])</p>	
<p>#1 AND # 2 AND #3 AND #4</p>		<p>10,670 9,869 (2000-2023)</p>

No.	Concept	EMBASE search terms	Number of records (As per 14 th July)
#1	Randomized controlled trial Controlled before-after studies Quasi experimental studies	('randomized controlled trial':af OR 'randomization'/exp OR 'crossover procedure'/exp OR 'epidemiology'/exp OR quasi experiment*:ti,ab OR quasiexperiment*:ti,ab OR 'quasi-experiment*':ti,ab)	146,384 131,436 (2000-2023)
#2	Nutrition and health interventions (dietary supplements, healthy diet, healthy eating, healthy nutrition, weight control, weight management, micronutrient supplementation diet/nutrition education, physical activity, community/home garden, and WASH, and nutrition policy)	('health education'/de OR 'health promotion'/exp) OR ('child health care'/exp OR 'preventive health service'/de) OR (preventive health:ti,ab) OR ('dietary supplement'/exp OR dietary supplement*:ti,ab micronutrient supplement*:ti,ab OR folic acid supplement*:ti,ab OR MMN:ti,ab OR nutrient supplement*:ti,ab OR nutritional supplement*:ti,ab) OR ('healthy diet'/exp OR healthy diet*:ti,ab OR healthy eating:ti,ab OR healthy food*:ti,ab OR diet education:ti,ab OR dietary education:ti,ab OR dietary intervention:ti,ab OR healthy eating:ti,ab OR healthy food*:ti,ab OR healthy diet*:ti,ab OR healthy nutrition*:ti,ab OR nutrition counsel*:ti,ab OR nutritional counsel*:ti,ab) OR (nutrition education:ti,ab OR nutrition intervention:ti,ab OR nutritional education:ti,ab OR nutritional intervention:ti,ab) OR ('exercise'/exp OR 'exercise':ti,ab OR 'physical activity':ti,ab OR fitness*:ti,ab OR sport*:ti,ab) OR ('nutrition policy'/exp OR 'nutrition':ti,ab AND 'policy':ti,ab OR 'nutrition policy':ti,ab)	1,421,386 1,168,709 (2000-2023)
#3	Adolescents	('adolescent'/exp OR adolescent:ti,ab OR adolescents:ti,ab OR adolescence:ti,ab OR teen:ti,ab OR teens:ti,ab OR teenage*:ti,ab)	2,031,554 1,398,667 (2000-2023)
#4	Low- and middle-income countries	(Afghanistan*:ti,ab OR Albania*:ti,ab OR Algeria*:ti,ab OR Samoa*:ti,ab OR Angola*:ti,ab OR Armenia*:ti,ab OR Azerbaijan*:ti,ab OR Bangladesh*:ti,ab OR Bengali:ti,ab OR Belarus*:ti,ab OR Belize:ti,ab OR Benin:ti,ab OR Bhutan*:ti,ab OR Bolivia*:ti,ab OR Bosnia*:ti,ab OR Herzegovina*:ti,ab OR Botswana*:ti,ab OR Brazil*:ti,ab OR Bulgaria*:ti,ab OR 'Burkina Faso':ti,ab OR Burkinabe:ti,ab OR Burundi*:ti,ab OR 'Cabo Verd*':ti,ab OR 'Cape Verd*':ti,ab OR Cambodia*:ti,ab OR Cameroon*:ti,ab OR 'Central African*':ti,ab OR Chad*:ti,ab OR China:ti,ab OR Chinese:ti,ab OR Colombia*:ti,ab OR Comoros:ti,ab OR Congo:ti,ab OR 'Costa Rica*':ti,ab OR 'cote d'ivoire':ti,ab OR 'Ivory Coast':ti,ab OR Cuba:ti,ab OR Cuban:ti,ab OR Djibouti:ti,ab OR Dominica*:ti,ab OR Ecuador:ti,ab OR Egypt*:ti,ab OR 'El Salvador*':ti,ab OR Eritrea*:ti,ab OR Ethiopia*:ti,ab OR Fiji*:ti,ab OR Gabon*:ti,ab OR Gambia*:ti,ab OR Georgia*:ti,ab OR Ghana*:ti,ab OR Grenada*:ti,ab OR Guatemala*:ti,ab OR Guinea*:ti,ab OR	2,466,552 2,047,567 (2000-2023)

		<p>Guyan*:ti,ab OR Haiti*:ti,ab OR Hondura*:ti,ab OR India:ti,ab OR Indian*:ti,ab OR Indonesia*:ti,ab OR Iran*:ti,ab OR Iraq*:ti,ab OR Jamaica*:ti,ab OR Jordan*:ti,ab OR Kazakh*:ti,ab OR Kenya*:ti,ab OR Kiribati:ti,ab OR ‘People’s Republic of Korea’:ti,ab OR ‘North Korea’:ti,ab OR Kosovo:ti,ab OR Kosovar*:ti,ab OR Kyrgyz*:ti,ab OR Lao:ti,ab OR Laos:ti,ab OR Laotian*:ti,ab OR Lebanon:ti,ab OR Lebanes*:ti,ab OR Lesotho:ti,ab OR Liberia*:ti,ab OR Libya*:ti,ab OR Macedonia*:ti,ab OR Madagascar*:ti,ab OR Malawi*:ti,ab OR Malaysia*:ti,ab OR Maldives:ti,ab OR Mali:ti,ab OR ‘Marshall Island*’:ti,ab OR ‘Mexico’/exp OR Mexico:ti,ab OR Mexican*:ti,ab OR Micronesia*:ti,ab OR Moldova*:ti,ab OR Mongolia*:ti,ab OR Montenegr*:ti,ab OR Morocco*:ti,ab OR Mozambique:ti,ab OR Myanmar:ti,ab OR Burmese*:ti,ab OR Burma:ti,ab OR Namibia*:ti,ab OR Nepal*:ti,ab OR Nicaragua*:ti,ab OR Niger*:ti,ab OR Pakistan*:ti,ab OR Paraguay*:ti,ab OR Peru*:ti,ab OR Philippin*:ti,ab OR Rwanda*:ti,ab OR ‘Sao Tome’*:ti,ab OR Principe:ti,ab OR Senegal*:ti,ab OR Serbia*:ti,ab OR ‘Sierra Leone*’:ti,ab OR ‘Solomon Island*’:ti,ab OR Somalia*:ti,ab OR ‘South Africa*’:ti,ab OR ‘Sri Lanka’:ti,ab OR ‘St Lucia’:ti,ab OR ‘Saint Lucia’:ti,ab OR ‘St Vincent’:ti,ab OR ‘Saint Vincent’:ti,ab OR Grenad*:ti,ab OR Sudan*:ti,ab OR Suriname*:ti,ab OR Swaziland*:ti,ab OR Eswatini*:ti,ab OR Syria*:ti,ab OR Tajik*:ti,ab OR Tanzania*:ti,ab OR Zanzibar:ti,ab OR Thai*:ti,ab OR Timor*:ti,ab OR Togo*:ti,ab OR Tonga*:ti,ab OR Tunisia*:ti,ab OR Turkey:ti,ab OR Turkish:ti,ab OR Turkmen*:ti,ab OR Tuvalu*:ti,ab OR Uganda*:ti,ab OR Ukrain*:ti,ab OR Uzbeki*:ti,ab OR Vanuatu*:ti,ab OR Venezuela*:ti,ab OR Vietnam*:ti,ab OR ‘Viet nam*’:ti,ab OR ‘West Bank’:ti,ab OR Gaza*:ti,ab OR Palestin*:ti,ab OR Yemen*:ti,ab OR Zambia*:ti,ab OR Zimbabw*:ti,ab OR ‘Western Sahara’:ti,ab OR Argentin*:ti,ab OR Russia*:ti,ab OR Maurit*:ti,ab OR Palau:ti,ab OR Romania*:ti,ab)</p>	
	<p>#1 AND # 2 AND #3 AND #4</p>		<p>17,874 16,942 (2000- 2023)</p>

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No.	Concept	Cochrane search terms	Number of records (As of July 14 th 2023)
#1	Randomized controlled trial Controlled before-after studies Quasi experimental studies	#1 "randomized controlled trial" #2 [mh "random allocation"] #3 {OR #1-#2} #4 [mh "cross-over studies"] #5 [mh "Controlled Before-After Studies"] #6 {OR #4-#5} #7 (quasi NEXT experiment*):ti,ab #8 quasiexperiment*:ti,ab #9 (quasi-experiment*):ti,ab #10 {OR #7-#9}	702,362 664,394 (2000-2023)
#2	Nutrition and health interventions (Dietary supplements, healthy diet, healthy eating, healthy nutrition, overweight, anaemia, obesity, weight control, weight management, micronutrient supplementation diet/nutrition education, school meal, physical activity, school garden, and WASH, and nutrition policy)	#11 [mh ^"health education"] OR [mh "health promotion"] #12 [mh "Adolescent Health Services"] OR [mh ^"Preventive Health Services"] #13 [mh "Adolescent Health Services"] #14 [mh ^"Preventive Health Services"] #15 [mh "Dietary Supplements"] OR dietary supplement*:ti,ab OR micronutrient supplement*:ti,ab OR folic acid supplement*:ti,ab OR folic acid supplement*:ti,ab OR MMN:ti,ab OR nutrient supplement*:ti,ab OR nutritional supplement*:ti,ab #16 [mh "Diet, Healthy"] OR healthy diet*:ti,ab OR healthy eating:ti,ab OR healthy food*:ti,ab OR diet education:ti,ab OR dietary education:ti,ab OR dietary intervention:ti,ab OR healthy nutrition*:ti,ab OR nutrition counsel*:ti,ab OR nutritional counsel*:ti,ab #17 nutrition education:ti,ab OR nutrition intervention:ti,ab OR nutritional education:ti,ab OR nutritional intervention:ti,ab #18 [mh exercise] OR exercise:ti,ab OR physical activity:ti,ab OR fitness*:ti,ab OR sport*:ti,ab #19 [mh "nutrition policy"] OR nutrition:ti,ab AND policy:ti,ab OR "nutrition policy":ti,ab #20 {OR #11-#19}	237,951 222,406 (2000-2023)
#3	Adolescents	#21 [mh Adolescent] OR adolescent:ti,ab OR adolescents:ti,ab OR adolescence:ti,ab #22 teen:ti,ab OR teens:ti,ab OR teenage*:ti,ab #23 {OR #21-#22}	146,504 115,839 (2000-2023)
#4	Low- and middle-income countries	#24 (Afghanistan*):ti,ab OR (Albania*):ti,ab OR (Algeria*):ti,ab OR (Samoa*):ti,ab OR (Angola*):ti,ab #25 (Armenia*):ti,ab OR (Azerbaijan*):ti,ab OR (Bangladesh*):ti,ab OR (Bengali):ti,ab OR (Belarus*):ti,ab #26 (Belize):ti,ab OR (Benin):ti,ab OR (Bhutan*):ti,ab OR (Bolivia*):ti,ab OR (Bosnia*):ti,ab #27 (Herzegovina*):ti,ab OR (Botswana*):ti,ab OR (Brazil*):ti,ab OR (Bulgaria*):ti,ab OR ("Burkina Faso"):ti,ab OR Burkinabe:ti,ab #28 Burundi*:ti,ab OR (Cabo NEXT Verd*):ti,ab OR (Cape NEXT Verd*):ti,ab OR Cambodia*:ti,ab OR Cameroon*:ti,ab #29 (Central African*):ti,ab OR (Chad*):ti,ab OR (China):ti,ab OR (Chinese):ti,ab OR (Colombia*):ti,ab	128,522 124,301 (2000-2023)

		<p>#30 (Comoros):ti,ab OR (Congo):ti,ab OR ("Cook Islands"):ti,ab OR (Costa NEXT Rica*):ti,ab OR ("Cote d'Ivoire"):ti,ab #31 ("Ivory Coast"):ti,ab OR (Cuba):ti,ab OR (Cuban):ti,ab OR (Djibouti):ti,ab OR (Dominica*):ti,ab #32 (Ecuador):ti,ab OR (Egypt):ti,ab OR (El NEXT Salvador*):ti,ab OR (Eritrea*):ti,ab OR (Ethiopia*):ti,ab #33 (Fiji*):ti,ab OR (Gabon*):ti,ab OR (Gambia*):ti,ab OR (Georgia*):ti,ab #34 (Ghana*):ti,ab OR (Grenada*):ti,ab OR (Guadeloupe):ti,ab OR (Guatemala*):ti,ab #35 (Guinea*):ti,ab OR (Guyan*):ti,ab OR (Haiti*):ti,ab OR (Hondura*):ti,ab OR (India):ti,ab #36 (Indian*):ti,ab OR (Indonesia*):ti,ab OR (Iran*):ti,ab OR (Iraq*):ti,ab OR (Jamaica*):ti,ab #37 (Jordan*):ti,ab OR (Kazakh*):ti,ab OR (Kenya*):ti,ab OR (Kiribati):ti,ab OR ("People's Republic of Korea"):ti,ab #38 ("North Korea"):ti,ab OR (Kosovo):ti,ab OR (Kosovar*):ti,ab OR (Kyrgyz*):ti,ab OR (Lao):ti,ab #39 (Laos):ti,ab OR (Laotian*):ti,ab OR (Lebanon):ti,ab OR (Lebanes*):ti,ab OR (Lesotho):ti,ab #40 (Liberia*):ti,ab OR (Libya*):ti,ab OR (Macedonia*):ti,ab OR (Madagascar*):ti,ab OR (Malawi*):ti,ab #41 (Malaysia*):ti,ab OR (Maldives):ti,ab OR (Mali):ti,ab OR (Marshall NEXT Island*):ti,ab #42 [mh Mexico] OR Mexico:ti,ab OR (Mexican*):ti,ab #43 (Micronesia*):ti,ab OR (Moldova*):ti,ab OR (Mongolia*):ti,ab OR (Montenegr*):ti,ab OR (Morocc*):ti,ab #44 (Mozambique):ti,ab OR (Myanmar):ti,ab OR (Burmese*):ti,ab OR (Burma):ti,ab OR (Namibia*):ti,ab #45 Nepal*:ti,ab OR Nicaragua*:ti,ab OR Niger*:ti,ab OR Pakistan*:ti,ab OR Paraguay*:ti,ab #46 Peru*:ti,ab OR Philippin*:ti,ab OR Rwanda*:ti,ab OR "Sao Tome":ti,ab OR Principe:ti,ab OR Senegal*:ti,ab OR Serbia*:ti,ab #47 (Sierra NEXT Leone*):ti,ab OR (Solomon NEXT Island*):ti,ab OR Somalia*:ti,ab OR (South NEXT Africa*):ti,ab OR "Sri Lanka":ti,ab #48 "St Lucia":ti,ab OR "Saint Lucia":ti,ab OR "St Vincent":ti,ab OR "Saint Vincent":ti,ab OR Grenad*:ti,ab #49 Sudan*:ti,ab OR Suriname*:ti,ab OR Swaziland*:ti,ab OR Eswatini*:ti,ab OR Syria*:ti,ab OR Tajik*:ti,ab OR Tanzania*:ti,ab #50 Zanzibar:ti,ab OR Thai*:ti,ab OR Timor*:ti,ab OR Togo*:ti,ab OR Tonga*:ti,ab OR Tunisia*:ti,ab #51 Turkey:ti,ab OR Turkish:ti,ab OR Turkmen*:ti,ab OR Tuvalu*:ti,ab OR Uganda*:ti,ab OR Ukrain*:ti,ab #52 Uzbeki*:ti,ab OR Vanuatu*:ti,ab OR Venezuela*:ti,ab OR Vietnam*:ti,ab OR Viet nam*:ti,ab #53 Palestin*:ti,ab OR Yemen*:ti,ab OR Zambia*:ti,ab OR Zimbabw*:ti,ab OR "Western Sahara":ti,ab #54 Argentin*:ti,ab OR Russia*:ti,ab OR Maurit*:ti,ab OR Palau:ti,ab OR Romania*:ti,ab #55 {OR #24-#54}</p>	
	#1 AND # 2 AND #3 AND #4	(#3 OR #6 OR #10) AND #20 AND #23 AND #55	1,504 1,504 (2000-2023)

Supplementary File 2. Sample of extraction form

Publication details							
Sr. No	Title	Journal/ source	Calendar year of publication	first author	corresponding author	contact author email	funding agency

Study Methods								
Calendar year of study	Country	Study type	Study design	Target population (age, gender, socioeconomic status, etc.)	Sample size	Inclusion criteria	Exclusion criteria	Analysis methods

Intervention											
Intervention name	Timing of intervention	Duration of intervention	Guiding theory/ framework	Intervention topics	Intervention components/ activities	Frequency and duration of intervention activities	Intervention delivery mechanism	Intervention delivery agents	Selection, training, and supervision of delivery agents	Intervention coverage	Control group intervention

Outcome							
Outcome 1	Timepoint for Outcome 1 assessment	Outcome 1 Methods of measurement	Outcome 1 measure (units and tools)	Outcome X	Timepoint for outcome X assessment	Outcome X methods of measurement	Outcome X measure (units and tools)

Results

Quantitative findings	Qualitative findings	Theory to explain the success	Theory to explain the failure

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PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMATION		
Title:		
Identification	1a	Identify the report as a protocol of a systematic review Title, p1 : “Community-based interventions targeting multiple forms of malnutrition among adolescents in low- and middle-income countries: protocol for a scoping review”
Update	1b	If the protocol is for an update of a previous systematic review, identify as such NA
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number Abstract, p4 : “The final protocol was registered prospectively with the Open Science Framework on July 19, 2023 (https://osf.io/t2d78).”
Authors:		
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author Please see title pages, page 1-3
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review Page 15 : “ Author Contributors SS conceived the idea, developed the methods, and wrote the first draft of the manuscript. ALK, MR, and UP contributed to the methods and supported the drafting and editing of the manuscript. ALK and MR contributed meaningfully to the design of the search strategy. SO, NM, DOA, CN, SL, TB, WWF, and ARISE-NUTRINT study collaborators supervised and reviewed the protocol. All authors revised and approved the final manuscript.”
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments NA
Support:		
Sources	5a	Indicate sources of financial or other support for the review Page 16 : “ Funding This study was funded by the European Union Horizon 2022. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.”

Sponsor	5b	Provide name for the review funder and/or sponsor Page 16: “Funding This study was funded by the European Union Horizon 2022. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.”
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol Page 16: “Funding This study was funded by the European Union Horizon 2022. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.”
INTRODUCTION		
Rationale	6	Describe the rationale for the review in the context of what is already known Please see the Introduction, pages 6-8.
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO) Page 8: “The purpose of this scoping review is to comprehensively review the literature to describe community-based interventions that address the multiple forms of malnutrition such as obesity, overweight, underweight, wasting, stunting, anemia, and micronutrient deficiencies affecting adolescents in LMICs and describe the effects of these interventions on nutrition and health.”
METHODS		
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review Pages 9-12: Please see Table 1 and section “Eligibility”
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage Pages 8-9: “Data sources, search terms and search strategy As part of our primary strategy, we will search MEDLINE (through PubMed), Embase, and CENTRAL (through the Cochrane Library). All databases will be searched for eligible studies from January 1, 2000, through July 14, 2023. We will identify potentially relevant published studies using the combination of medical subject headings (MeSH) and text words denoting nutrition-specific and nutrition-sensitive interventions. We will also examine references and bibliographies of included studies to identify additional sources of information. This search of studies will be supplemented by reviewing

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ClinicalTrials.gov and organizational websites such as the World Health Organization (WHO), World Bank, United Nations Children’s Fund (UNICEF), and United Nations Population Fund (UNFPA). When possible, reports written in languages other than English will be translated by colleagues who are native speakers of those languages. No study will be considered if it cannot be adequately translated.”

Search strategy 10 Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated
Please see Supplementary File 1

Study records:

Data management 11a Describe the mechanism(s) that will be used to manage records and data throughout the review
Page 12: “Data management
The records will be imported into Covidence (Veritas Health Innovation, Melbourne, Australia), an Internet-based systematic review management program. Detection and removal of duplicates, title and abstract screening, and full-text screening will be performed by Covidence.”

Selection process 11b State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)
Page 12: “Selection of studies
Using Covidence, we will screen titles, abstracts, and full texts. First, two reviewers will independently assess all search results (i.e., titles and abstracts) and exclude irrelevant studies based on inclusion and exclusion criteria. Next, two reviewers will carry out the full-text screening based on the same inclusion/exclusion criteria. The reviewers will discuss and resolve any difference of opinion or, if necessary, seek a third reviewer's opinion for resolving differences. A study flow diagram stating the specific reasons for exclusion will be maintained following the PRISMA for Scoping Review statement (PRISMA-ScR).”

Data collection process 11c Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators
Pages 13: “Data extraction
Two reviewers will independently extract and enter data from studies included in the review. We will develop and test an extraction form on five randomly selected studies. We will extract the following information.

- Study details including the title, authors (first author and corresponding author), the corresponding author's contact information, journal (or source for unpublished reports), calendar year of publication, calendar year of intervention, country, and source of funding.
- Study methods including objectives and/or research questions, type of study, investigation strategies, settings, sample size, and sample characteristics (e.g., age, sex, socioeconomic status)
- Intervention strategy including target population, delivery platform and providers (including selection, training, supervision, support, and incentivization), types of nutrition and other interventions (including content, conceptual framework and/or theoretical underpinnings, timing, duration, and dosage or frequency),

and comparator/control.

- Outcomes assessed and details of the measures used.
- Findings including the coverage of services, facilitators and barriers to intervention delivery and uptake, effectiveness findings with point estimates and measures of variance (standard errors, 95% confidence intervals, or *p*-values), and any other key findings related to the scoping review questions.

We will contact the corresponding author via email if there is missing or inconsistent information. We will contact the author two times at most. The available data will be analyzed and any gaps due to missing data will be discussed if the data issue cannot be resolved after contacting the authors.”

Data items

12 List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications

Pages 13: “Data extraction

Two reviewers will independently extract and enter data from studies included in the review. We will develop and test an extraction form on five randomly selected studies. We will extract the following information.

- Study details including the title, authors (first author and corresponding author), the corresponding author's contact information, journal (or source for unpublished reports), calendar year of publication, calendar year of intervention, country, and source of funding.
- Study methods including objectives and/or research questions, type of study, investigation strategies, settings, sample size, and sample characteristics (e.g., age, sex, socioeconomic status)
- Intervention strategy including target population, delivery platform and providers (including selection, training, supervision, support, and incentivization), types of nutrition and other interventions (including content, conceptual framework and/or theoretical underpinnings, timing, duration, and dosage or frequency), and comparator/control.
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We will contact the corresponding author via email if there is missing or inconsistent information. We will contact the author two times at most. The available data will be analyzed and any gaps due to missing data will be discussed if the data issue cannot be resolved after contacting the authors.”

Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale NA – Scoping Review
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the

outcome or study level, or both; state how this information will be used in data synthesis

Page 13-14: “Risk of bias assessment

As scoping reviews are exploratory in nature, risk of bias assessments are not typically required as part of the guidelines for scoping reviews [cite: <https://bmcmmedresmethodol.biomedcentral.com/articles/10.1186/s12874-018-0611-x>]. However, we plan to assess the risk of bias among studies with an available quantitative measure as a preliminary way of contextualising the reported measures of impact on the outcomes reported. For the assessment of the risk of bias in the selected studies, we will use the Cochrane Collaboration’s revised tool for assessing the risk of bias in randomized trials (RoB 2). Two reviewers will independently evaluate methodological quality. Any uncertainties or disagreements will be resolved by discussion or by a third reviewer, whenever needed. The tool is a domain-based evaluation, in which critical assessments for risk of bias are made separately for various domains, including the randomization process, deviation from intended interventions, missing outcome data, measurement of the outcome, and selective outcome reporting. The risk of bias in clustered trials will be similarly assessed using the risk of bias 2 for cluster-randomized trials (RoB 2 CRT). Additionally, we will use the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool, to assess the risk of bias for controlled before-after studies and non-randomized controlled trials.”

18	Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised NA – Scoping review
19		15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2 , Kendall’s τ) NA – Scoping review
20		15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression) NA – Scoping review
21		15d	If quantitative synthesis is not appropriate, describe the type of summary planned Pages 14-15: “Synthesis of evidence
22			All included studies will be systematically synthesized in the text and a table following the SWiM guidelines (Synthesis Without Meta-analysis). In this synthesis, we will describe how many sources of evidence were screened, assessed for eligibility, and included in the review, along with reasons for exclusion at each stage. Our presentation of included sources of evidence will include summary characteristics and citations, as well as a critical appraisal, if applicable. Studies will be grouped based on methods and interventions, standardized outcomes metrics, synthesis methods, criteria used to prioritize results for summary, reporting of results, the certainty of results, heterogeneity in effects, as well as barriers and facilitators to delivering the interventions will be discussed. For continuous outcomes, effect estimates will be expressed as mean differences (with 95% confidence intervals) between the intervention group and the control group; for dichotomous outcomes, effect estimates will be expressed as risk ratios, rate ratios, hazard ratios, or odds ratios (all with a 95% confidence interval). Additionally, we will discuss the limitations of the review process and provide an interpretation of the results concerning the objectives of the review, as well as possible implications or next steps. We will follow the PRISMA Extension for Scoping Reviews (PRISMA-ScR) checklist and guidelines to ensure a robust and replicable process.”

Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies) NA – Scoping Review
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE) NA – Scoping Review

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.