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Complementary feeding practices and the associated risk of childhood obesity among ethnic minority groups living in high-income countries: protocol for a systematic review and meta-analysis

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Manuscripts

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3 **1 Protocol**

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6 **3 Complementary feeding practices and the associated risk of childhood obesity among**
7 **4 ethnic minority groups living in high income countries: protocol for a systematic review**
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9 **5**
10 **and meta-analysis**

11
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56 29 **ABSTRACT**
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9 30 **Introduction**
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11 31 Complementary feeding (CF) defined as the period beginning when exclusive breast milk and
12 32 formula are no longer sufficient for meeting the nutritional needs of the infant. The CF period
13 33 occurs from birth to 23 months of age. Though recommended by guidelines for the introduction
14 34 of CF from around six months of age, data available indicates some infants are introduced to
15 35 food earlier than six months which can predispose children to the risk of obesity and
16 36 overweight. Obesity in ethnic minority group (EMG) children is higher than their native
17 37 counterparts and often tracks into adulthood. Hence, we aim to conduct a systematic review
18 38 and meta-analysis on the available literature in high-income countries (HIC) to identify the risk
19 39 of childhood obesity associated with CF practices in EMG children living in HIC.

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29 40 **Methods and Analysis**

30 41 A methodological literature search surrounding childhood obesity and overweight (COO) risk
31 42 associated with complementary feeding (CF) practices will be conducted in May 2021
32 43 following PRISMA-P guidelines. The following academic databases will be methodologically
33 44 searched: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library and the
34 45 WHO Global Index Medicus. Three independent researchers will be involved in independent
35 46 screening and will review the included articles based on the pre-defined inclusion and
36 47 exclusion criteria. Where conflicts arise during the screening process, it will be resolved
37 48 through discourse until a consensus is reached. Information on CF practices and
38 49 anthropometric measurements will be extracted to ascertain risk of childhood obesity and
39 50 overweight. For this study, WHO Body Mass Index (BMI) for age and sex percentiles, Centre
40 51 for Disease Control (CDC) classification and other recognised country specific classifications
41 52 will be utilised for the outcome.

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53 53 **Ethics and Dissemination**
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55 54 Formal ethical approval is not needed as the results will be drawn from currently available
56 55 published literature. Outcomes of the review will be shared through peer-reviewed
57 56 publications.

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57 **Key Words:** Complementary feeding practices; infant feeding; childhood overweight;
58 childhood obesity; ethnicity; race; culture; high income countries; ethnic minorities.

59 **PROSPERO registration number:** CRD42021246029

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For peer review only

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56 62 **Strengths and Limitations of the study**
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9 63 ➤ First systematic review considering extensive analysis of Childhood overweight and
10 64 obesity and the risk in multiple ethnic minority group children in high income
11 65 countries pertaining to complementary feeding practices
12
13 66 ➤ Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols
14 67 (PRISMA-P) and PRISMA 2009 guideline is followed for the systematic review and
15 68 meta-analysis.
16
17 69 ➤ Expert librarian specialized in database search strategy has developed the search
18 70 protocol.
19
20 71 ➤ Our review will capture a small number of studies that are likely to meet the inclusion
21 72 criteria due to language restriction and heterogeneity between studies is expected to
22 73 be high
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24 74 ➤ In the reported effect estimates, lack of uniformity may be one of our limitation
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79 **Background**

80 Childhood obesity and overweight (COO) is a global health problem in high-income countries
81 (HIC) although it has also emerged as a problem in low and middle countries according to the
82 World Health Organization [1]. Evidence implies that COO, feeding practices, and mean
83 nutrient disparities are associated with race and ethnicity and often entangled with income
84 (Davis *et al.*, 2021). Due to international migration, disparities in COO should be expected.
85 International migration to HIC has continued to increase globally with 57% of migrants living
86 in HIC, where communities have become more diverse. In 2010, the International Organisation
87 for Migration estimated the worldwide migration was comprised of 214 million people (2010)
88 [2]. However, research on ethnicity related obesity risk in childhood is considerably limited
89 [3]. Given the increasing rate of migration from poorer to HIC it means that COO in ethnic
90 minority groups (EMG) presents a potential public health concern, warranting further research
91 to better contributing factors.

92 Complementary feeding (CF) is defined as “the process starting when breast milk is no longer
93 sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids
94 are needed, along with breast milk”[4] CF usually occurs from six to 23 months, even when
95 breastfeeding continues over two years of age[4]. CF has always been focused on providing
96 nutritious, clean, safe and adequate food to meet the nutritional requirements of infants and
97 children. CF aims to reduce malnutrition and infections although there have been growing
98 concerns regarding its potential contribution to childhood overweight and obesity (COO) [5].
99 Poor CF practices and breastfeeding are widespread with just 34.8% infants exclusively
100 breastfed and majority of infants given food or liquids before the recommended 6 months
101 [1]. Some studies suggest that COO is less common in children and adolescents who have
102 been exclusively breastfed [4,6]. Conversely, introducing solid foods earlier than the
103 recommended six months has been shown to predispose children to overweight/obesity, as
104 highlighted in several reviews [6–8]. Studies have discovered that early rapid weight gain
105 during infancy is related to subsequent COO risk [9,10]. The relationship between rapid weight
106 gain and later childhood obesity further emphasises the potential programming that occurs very
107 early on in life resulting in COO and associated health problems and may be related to CF
108 practices. A cohort study by Ardic *et al.*, (2019) found that early feeding habits might be
109 permanent and therefore pose risk to later health outcomes [11].

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3 110 EMG children are the offspring of migrant families who live in a different country from their
4
5 111 parent's country of origin. Immigration can be diverse and varied from country to country.
6
7 112 EMG in the USA comprise a third of the population [12]. The immigrant population of Canada
8
9 113 is 21% [2] whereas the United Kingdom is comprised of 13% [13]. Although diversity is
10
11 114 considered based on country of birth, this can pose problems due to within country diversity
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13 115 from the country of origin [14]. Identifying the causes of COO amongst different EMG can be
14
15 116 complex and challenging.

16
17 117 Differences across EMG in relation to CF practices and COO prevalence have been identified
18
19 118 in at least two different studies [6,12]. The differences are embedded in social and household
20
21 119 contexts in either increasing or decreasing the risk of obesity. However, Kumanyika (2008) has
22
23 120 highlighted that available evidence can be sparse, heterogenous and difficult to meaningfully
24
25 121 summarise. Two studies have explored cultural influences of CF practices among Chinese and
26
27 122 South Asian children[15,16]. However, overweight/obesity risk in relation to CF practices has
28
29 123 not yet been collectively analysed in different EMG children. Furthermore, it is known that CF
30
31 124 practices are associated with early COO, yet the extent of the problem is unknown for EMG
32
33 125 children living in HIC. Considering the substantial global burden of COO, it is important to
34
35 126 understand the association between CF practices and COO, specifically amongst EMG children
36
37 127 living in HIC. We propose in this protocol to run a systematic review and meta-analysis to
38
39 128 address this research question.

129 **Methods/Design**

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41 130 This protocol follows the Preferred Reporting Items for Systematic Review and Meta-
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43 131 Analysis Protocols (PRISMA-P) guidelines [17] and has been informed by the Cochrane
44
45 132 Handbook for Systematic Reviews of Interventions [18]. The final review will be reported in
46
47 133 accordance to the 2020 Preferred Reporting Items for Systematic Review and Meta-
48
49 134 Analysis (PRISMA) statement [19]. The prospective review is registered with the
50
51 135 PROSPERO (registration no. CRD42021246029). The start date for the review will be June
52
53 136 2021 and the estimated date for completion would be May 2022.

54 **Eligibility criteria**

57 **Inclusion Criteria**

139 We will include randomised controlled trials, cohort studies, case-control studies and cross-
 140 sectional studies. We will include studies reporting direct and/or indirect effect sizes in children
 141 who were exposed to CF from 0-24 months. All studies should have estimates of the association
 142 between the measured exposure (CF) and the outcomes (weight gain). Such estimates reported
 143 should be calculated, or calculable, The systematic review will be conducted using the PICOS
 144 approach (participants, exposure, comparator, outcome(s) and type of study) from which
 145 studies are identified. [18,20,21] Inclusion and exclusion criteria are listed according to PICOS
 146 in table 1.

147 **Table 1: Pre-defined inclusion and exclusion study criteria according to PICOS**

PICOS	Inclusions	Exclusions
Participants	Ethnic minority children aged between 0-2 years; living in HIC	Pre-term and low-birth-weight children; children with medical problems that can affect body weight e.g. Prader Willi Syndrome, failure to thrive, metabolic disorders, Hypothyroidism, Cushing syndrome, growth hormone deficiency etc.
Interventions	CF practices including timing of introduction of semi solid, solid and soft foods, meal frequency and dietary diversity.	Studies reporting exclusively on breastfeeding outcomes alone
Comparisons	Children who followed recommended CF guidelines by WHO/UNICEF	
Outcomes of interest	Risk of obesity and overweight as classified by BMI z -scores and BMI percentiles	Studies that do not include obesity or overweight as an outcome
Study design	Risk of obesity and overweight as classified by BMI z -scores and BMI percentiles	Studies not published in English, Studies with no full text available

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149 HIC = High-Income Countries; CF = Complementary Feeding; RCTs = Randomised
 150 Controlled Trials

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3 151 The study population will be children from ethnic minority groups aged 0-2 years who reside
4
5 152 in HIC. The study outcome will investigate the association between CF practices and the risk
6
7 153 of COO. The outcomes will include anthropometric measurements including BMI z-scores or
8
9 154 BMI percentiles. The results of the review on CF will be evaluated using the recommended
10
11 155 optimum CF guidelines by WHO (2008). It is recommended that exclusive breastfeeding
12
13 156 continues until six months and up to two years and beyond. Introduction of solids, soft and
14
15 157 other liquids, other than breast milk or formula, is recommended from six months onwards.
16
17 158 The outcome of the study (COO), will be classified according to WHO BMI for age and sex
18
19 159 percentiles and the Centres for Disease Control and Prevention (CDC) classification and other
20
21 160 recognised classifications. According to the CDC, overweight is defined as BMI $\geq 85^{\text{th}}$ and
22
23 161 $<95^{\text{th}}$ percentile, while obesity is BMI of $\geq 95^{\text{th}}$ percentile for children < 18 years of the same
24
25 162 age and sex [22]. These two classifications have previously been compared by Gaffney *et al.*,
26
27 163 (2016) who found that 1 standard deviation unit above median of the WHO growth curve
28
29 164 population approximates 85^{th} percentile.[23] As BMI does not measure body fat, skinfolds
30
31 165 measurements, dual energy x-ray absorptiometry (DXA) and other methods will be used, if
32
33 166 available.

32 167 **Exclusion Criteria**

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35 168 Studies which are not published in English and those that do not present original data will not
36
37 169 be included. Other studies that will be excluded are narrative reviews, systematic reviews and
38
39 170 meta-analysis, opinion articles, editorials, letters to the editor, published abstracts without a
40
41 171 published full-text, student dissertations/theses, and blog posts. Studies that do not include
42
43 172 anthropometric measurements in EMG children as part of the outcome will be excluded.

44 173 **Search Strategy**

47 174 *Developing research question and search query domains*

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50 175 We will search for papers published between 2000 until search date. A systematic search of
51
52 176 the literature will be conducted in May 2021 by a specialist medical librarian (LÖ). The
53
54 177 electronic databases: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library
55
56 178 the WHO Global Index Medicus will be included in the search and covered from 2000 to the
57
58 179 search date. No filters or limitations will be applied. A preliminary search in PubMed was
59
60 180 carried out in April 2021 to identify relevant search terms and search technical solutions (LÖ).

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3 181 The search terms were systematically identified with support of PubMed's MeSH, by analysing
4
5 182 the indexing of previous, relevant studies which was informed by input from the subject
6
7 183 specialists (MT and MK). A copy of the preliminary search strategy in PubMed is available in
8
9 184 Supplementary file 1. Hand screening of reference lists of the studies that meet the pre-defined
10
11 185 criteria will also be conducted.

12
13 186 Detailed search documentation for all included databases will be appended to the final review
14
15 187 to allow search reproducibility and transparent appraisal of the search strategy and results.
16
17 188 Finally, Cabell's Predatory Reports in Cabell's Scholarly Analytics will be consulted to ensure
18
19 189 that none of the finally selected studies published in open-access journals that are listed as
20
21 190 potential predatory journals.

22 23 191 **Data Extraction and Management**

24 25 192 *Screening and study selection*

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28 193 Covidence systematic review software by Veritas Health Innovation (2021), will be used to
29
30 194 automatically de-duplicate and blind screen all records identified in the database search. After
31
32 195 duplicated studies have been removed, unique records will be screened based on the title and/or
33
34 196 abstract by two independent reviewers (MT & MK). Articles which do not meet the criteria
35
36 197 will be excluded. Eventual disagreements will be resolved through blinded conflict resolution
37
38 198 through Covidence by a third reviewer (LÖ) which will further reduce bias risk. In a similar
39
40 199 way, full-text review will be carried by two independent reviewers (MT & MK), resolving
41
42 200 conflicts for ambiguous inclusion by a third reviewer (LÖ) through Covidence. Details from
43
44 201 the screening and selection process, including reasons for exclusion of the omitted full-text
45
46 202 studies, would be documented in a PRISMA 2020 flow diagram.

47 203 *Data Extraction*

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50 204 For extraction of data, a piloted form will be used. Data will be extracted for each study that
51
52 205 meets the eligibility criteria by two researchers and the third researcher will resolve any
53
54 206 discrepancies. The following data if available will be extracted: surname of the first author,
55
56 207 publication year, HIC, participant's ethnicity, study design, sample size, participant's age,
57
58 208 breast-feeding duration, CF timing and frequency, primary outcome, anthropometric

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3 209 measurements, length of follow-up and types of CF, effect size (OR/RR) and mean difference.
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5 210 HIC list provided in supplementary file 2.
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10 212 Ethnicity of the child will be determined by the country of birth of the parents although
11 213 ethnicity identification by country of birth has caveats because diversity of the country-of-
12 214 origin can differ[14]. In addition, diversity collection practices differ among Organisation for
13 215 Economic Cooperation and Development (OECD) countries, some countries collect
14 216 indigenous identity, others race and ethnicity as well as migrant statuses.
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20 217 *Output*

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23 218 The study will present a PRISMA flow diagram including the summary of the search results
24 219 and study selection. Rated, quality of the included studies will be presented in a comprehensive
25 220 table of the study characteristics. The risk of COO identified from all studies will be
26 221 summarised and synthesised to identify the overall risk in multiple EMG children residing in
27 222 HIC at the time the study was conducted.
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33 223 *Risk of Bias in primary study*

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36 224 Two authors (MT and MK) will assess the quality of studies independently using the Newcastle
37 225 Ottawa Scale (NOS) and modified NOS for assessing quality of non-randomised studies in the
38 226 meta-analysis. The tool assesses participant selection, comparability of groups, and outcome
39 227 or exposure depending on the type of study.[24] A point is given for each item in the three
40 228 sections if the study meets the criteria. The maximum score for cross-sectional studies is ten
41 229 and nine for cohort studies. Assessment of internal validity of primary studies is crucial in
42 230 systematic reviews for identifying the risk of bias. It has been noted that, whilst the NOS quality
43 231 assessment scale is challenging, and more subjective in non-randomised studies compared to
44 232 randomised controlled trials (RCTs), there is no other widely accepted tool for non-randomised
45 233 studies. [25] Grading of Recommendations Assessment, Development and Evaluation
46 234 (GRADE) quality review tool will be used for RCTs. Disagreements with grading will be
47 235 resolved through discourse and revisiting the inclusion criteria by both authors.
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58 236 *Analysis and Data Synthesis*

237 Descriptive analysis will be performed to report on the association between COO and breast-
238 feeding duration, timing of CF and frequency, as well as variety of feeds. Both narrative text
239 and table summaries will be presented.

240 The results of the included studies will be synthesised using pooled estimates and pooled
241 odds ratios or risk ratios applying random effects model with 95% confidence intervals (CI)
242 where data permits to conclude the pooled COO risk. Random effects meta-analysis will be
243 limited to studies that reported on pooled estimates and with at least ten studies with low to
244 moderate heterogeneity for meaningful results. Heterogeneity will be assessed using the I^2
245 and visual inspection of forest plots. For dichotomous data, risk ratios (RR) and 95% CI will
246 be calculated and for continuous data mean difference (MD) and 95% CI will be used. MD
247 will be converted to RR if possible. Forest plots will be used to visually present the estimated
248 weighted results from different studies.

249 *Bias Minimisation*

250 The review will include multiple databases to ensure all studies published are included if they
251 meet inclusion criteria. Funnel plots, which is a plot of effect size, will be used to assess
252 publication bias and estimated by Begg's or Eggers tests using R package. Assessment of the
253 quality of primary studies by both authors using NOS and GRADE tools will further minimise
254 bias. Disagreements with grading will be resolved through discourse. We will also perform
255 sensitivity analysis for the meta-analysis and repeat to include only studies that are deemed to
256 be good quality. Analyses will be conducted using Stata version 16 (StataCorp).

257 *Patient and public involvement*

258 Patient will not be involved at any stage of the study. The proposed study is primarily a
259 review of published data available in the indicated electronic databases.

260 **Discussion**

261 Our review is unique, and to our knowledge is the only review considering extensive analysis
262 of COO risk in multiple EMG children residing in HIC, pertaining to CF practices. A similar
263 review which explored COO in relation to CF was conducted in the general population without
264 stratification on EMG or HIC. [8] Although another review on CF practices focused on South

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3 265 Asian children in HIC as a EMG, they did not report on obesity risk but identified significant
4
5 266 differences in CF practices that were obesogenic.[15] On the other hand, one earlier review
6
7 267 identified a clear association amongst the general population in developed countries.[26] This
8
9 268 means that with a combined multiple ethnicities review, there is a possibility to have
10
11 269 statistically meaningful results that will identify COO risk in EMG children residing in HIC.
12
13 270 Moreover there has been an disparity in bodyweight changes among children and especially
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15 271 among ethnic minorities.[27–29] Our study will contribute to the efforts in the prevention of
16
17 272 COO within EMG that are often under-researched and marginalised. Furthermore, we envisage
18
19 273 our study to contribute to enhancing reduction in health disparities experienced by EMG
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21 274 through subsequent targeted interventions.

22 275 **Strengths and Limitations**

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24 276 To our knowledge, is the first review considering extensive analysis of COO risk in multiple
25
26 277 EMG children residing in HIC, pertaining to CF practices. COO has been confirmed to be
27
28 278 higher in EMG compared to native groups. If CF practices among EMG are a contributory
29
30 279 factor in COO, our review will bring evidence for targeted interventions to prevent rather than
31
32 280 cure COO by promoting health weight throughout childhood years. It will also highlight the
33
34 281 scarcity of research within marginalised EMG by identifying gaps and making
35
36 282 recommendations for future studies in CF practices.

37
38 283 The review is not without limitations. First, most studies included will be observational.
39
40 284 Second, studies amongst EMG in HIC tend to be limited with ethnic groups making up small
41
42 285 samples. Additionally, language barrier difficulties may be present in the host country. It is
43
44 286 therefore likely that our review will capture a small number of studies that are likely to meet
45
46 287 the inclusion criteria and heterogeneity between studies is expected to be high. Population
47
48 288 diversity will further increase heterogeneity risk. There is potential that some studies, which
49
50 289 include EMG, may be missed due to countries using varied ethnicity classifications, paired
51
52 290 with the subjective nature of ethnicity.

53 291 **Authors Contribution**

54
55 292 MT and MK were involved in all aspects of the study from conceptualization, protocol
56
57 293 development and developing the preliminary search strategy. LÖ developed the preliminary
58
59 294 search strategy, contributed with text for the methods part of the manuscript and will conduct
60

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2
3 295 the final literature search and the reference management in Covidence. Further screening of
4 296 literature and data extraction will be carried out by MT and data validated by MK. TA revised
5 297 the first draft for intellectual content and will assist with drafting and revising content in the
6 298 final project. OMO will oversee the data extraction process and complete all aspects of the
7 299 meta-analysis.

300 **Support: Source and sponsor**

301 No funding declared.

302 **Competing interests**

303 None declared.

304 **Patient and Public involvement**

305 No involvement and therefore patient consent not required.

306 **Data Statement**

307 Data will be submitted as a supplementary appendix.

308 **Amendments:** In the event of minor amendments of this protocol, the changes will be updated
309 and transparent reported in the online PROSPERO registration for the review:
310 CRD42021246029

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Supplementary materials file 1: preliminary search strategy in PubMed

Source: PubMed

Search date: 2021-04-30

Search specifications: All search terms are searched in the search field "Title/Abstract" and in MeSH (when available). Filters for English language and publication year range: January 1st, 2000- April 30th, 2021 is applied

Result: 2,951 records

Preliminary search strategy:

```
(((weight*[Title/Abstract] OR obesity[Title/Abstract] OR obese[Title/Abstract] OR obesities[Title/Abstract] OR "Obesity"[Mesh] OR "Body Weight"[Mesh:NoExp] OR BMI[Title/Abstract] OR "body mass index"[Title/Abstract] OR "Body Mass Index"[Mesh] OR "Overweight"[Mesh] OR overweight[Title/Abstract]) AND ("Infant Nutritional Physiological Phenomena"[Mesh] OR "Infant nutrition*[Title/Abstract] OR "infant feeding*[Title/Abstract] OR "Infant Food"[Mesh] OR "infant food*[Title/Abstract] OR "baby nutrition*[Title/Abstract] OR "baby feeding*[Title/Abstract] OR "baby food*[Title/Abstract] OR "supplementary feeding*[Title/Abstract] OR "complementary feeding*[Title/Abstract] OR "replacement feeding*[Title/Abstract] OR "Infant Formula"[Mesh] OR "infant formula*[Title/Abstract] OR "baby formula*[Title/Abstract] OR "solid food*[Title/Abstract] OR "soft food*[Title/Abstract] OR "complementary food*[Title/Abstract] OR "Breast Feeding"[Mesh] OR breastfed[Title/Abstract] OR "breast feed*[Title/Abstract] OR "breast fed" [Title/Abstract] OR "wet nursing"[Title/Abstract] OR "Feeding Behavior"[Mesh] OR "feeding behavior*[Title/Abstract] OR "feeding-related behavior*[Title/Abstract] OR "feeding related behavior*[Title/Abstract] OR "feeding pattern*[Title/Abstract] OR "feeding habit*[Title/Abstract] OR "food habit*[Title/Abstract] OR "feeding behaviour*[Title/Abstract] OR "feeding-related behaviour*[Title/Abstract] OR "feeding related behaviour*[Title/Abstract] OR "food fussiness"[Title/Abstract] OR "food prefer*[Title/Abstract] OR "Eating Behavior*[Title/Abstract] OR "Eating Habit*[Title/Abstract] OR "Dietary Habit*[Title/Abstract] OR "Diet Habit*[Title/Abstract] OR "family diet"[Title/Abstract] OR "weaning"[Title/Abstract] OR "Weaning"[Mesh] OR "Bottle Feeding"[Mesh] OR bottlefe*[Title/Abstract] OR "feeding duration*[Title/Abstract] OR "dietary varia*[Title/Abstract] OR "breast milk"[Title/Abstract] OR "Milk, Human"[Mesh] OR "human milk"[Title/Abstract] OR "Lactation"[Mesh] OR lactation[Title/Abstract] OR "liquid food*[Title/Abstract])) AND ("Infant"[Mesh] OR "Child"[Mesh] OR child*[Title/Abstract] OR infant*[Title/Abstract] OR "newborn*[Title/Abstract] OR baby[Title/Abstract] OR babies[Title/Abstract] OR "toddler*[Title/Abstract])) AND ("Minority Groups"[Mesh] OR "Ethnic Groups"[Mesh] OR "Population Groups"[Mesh] OR "Continental Population Groups"[Mesh] OR ethnic*[Title/Abstract] OR "population group*[Title/Abstract] OR nationalit*[Title/Abstract] OR "ethnic minorit*[Title/Abstract] OR "cultural group*[Title/Abstract] OR "population minorit*[Title/Abstract] OR "racial stock*[Title/Abstract] OR race[Title/Abstract] OR races[Title/Abstract] OR Black[Title/Abstract] OR Blacks[Title/Abstract] OR African*[Title/Abstract] OR "Afro-American*[Title/Abstract] OR "Afro American*[Title/Abstract] OR "American Native*[Title/Abstract] OR "Native American*[Title/Abstract] OR Indian*[Title/Abstract] OR "American Amerind*[Title/Abstract] OR "Indigenous Canadian*[Title/Abstract] OR "Canadian Native*[Title/Abstract] OR Amish[Title/Abstract] OR Arab[Title/Abstract] OR Arabs[Title/Abstract] OR Arabic[Title/Abstract] OR Palestinian*[Title/Abstract] OR Asian*[Title/Abstract] OR Hispanic*[Title/Abstract] OR Mexican*[Title/Abstract] OR "Spanish American*[Title/Abstract] OR "Puerto Rican*[Title/Abstract] OR Latinos[Title/Abstract] OR Latino[Title/Abstract] OR Latinas[Title/Abstract] OR Latina[Title/Abstract] OR Cuban*[Title/Abstract] OR Hispanic*[Title/Abstract] OR Japanese[Title/Abstract] OR Chinese [Title/Abstract] OR Vietnamese[Title/Abstract] OR Cambodian*[Title/Abstract] OR Hmong*[Title/Abstract] OR
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3 Korean*[Title/Abstract] OR Filipino*[Title/Abstract] OR Filipina*[Title/Abstract] OR "Indigenous
4 people*" [Title/Abstract] OR Alaska*[Title/Abstract] OR Inuit[Title/Abstract] OR Inuits[Title/Abstract] OR
5 Kalaallit*[Title/Abstract] OR Inupiat*[Title/Abstract] OR Aleut*[Title/Abstract] OR
6 Eskimo*[Title/Abstract] OR "first nation people*" [Title/Abstract] OR "Native People*" [Title/Abstract] OR
7 Roma[Title/Abstract] OR Romanies[Title/Abstract] OR Romani[Title/Abstract] OR Romany[Title/Abstract]
8 OR Gypsies[Title/Abstract] OR Gipsy[Title/Abstract] OR Hawaiian*[Title/Abstract] OR "Pacific
9 Islander*" [Title/Abstract] OR Maori*[Title/Abstract] OR Aboriginal[Title/Abstract] OR
10 Aborigine*[Title/Abstract] OR Jew[Title/Abstract] OR Jews[Title/Abstract] OR Jewish[Title/Abstract] OR
11 migrant*[Title/Abstract] OR Emigrant*[Title/Abstract] OR immigrant*[Title/Abstract] OR "Emigrants and
12 Immigrants" [Mesh]
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List of High-Income economies [1]

Andorra	Greece	Palau
Antigua and Barbuda	Greenland	Panama
Aruba	Guam	Poland
Australia	Hong Kong SAR, China	Portugal
Austria	Hungary	Puerto Rico
Bahamas, The	Iceland	Qatar
Bahrain	Ireland	Romania
Barbados	Isle of Man	San Marino
Belgium	Israel	Saudi Arabia
Bermuda	Italy	Seychelles
British Virgin Islands	Japan	Singapore
Brunei Darussalam	Korea, Rep.	Sint Maarten (Dutch part)
Canada	Kuwait	Slovak Republic
Cayman Islands	Latvia	Slovenia
Channel Islands	Liechtenstein	Spain
Chile	Lithuania	St. Kitts and Nevis
Croatia	Luxembourg	St. Martin (French part)

Curaçao	Macao SAR, China	Sweden
Cyprus	Malta	Switzerland
Czech Republic	Mauritius	Taiwan, China
Denmark	Monaco	Trinidad and Tobago
Estonia	Nauru	Turks and Caicos Islands
Faroe Islands	Netherlands	United Arab Emirates
Finland	New Caledonia	United Kingdom
France	New Zealand	United States
French Polynesia	Northern Mariana Islands	Uruguay
Germany	Norway	Virgin Islands (U.S.)
Gibraltar	Oman	

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Reporting checklist for protocol of a systematic review and meta analysis.

Based on the PRISMA-P guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the PRISMA-Preorting guidelines, and cite them as:

Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4(1):1.

		Reporting Item	Page Number
Title			
Identification	#1a	Identify the report as a protocol of a systematic review	1-4
Update	#1b	If the protocol is for an update of a previous systematic review, identify as such	n/a
Registration			
	#2	If registered, provide the name of the registry (such as PROSPERO) and registration number	3
Authors			
Contact	#3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1

1	Contribution	#3b	Describe contributions of protocol authors and identify the guarantor of the review	12-13
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4	Amendments			
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7		#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	n/a
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14	Support			
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16	Sources	#5a	Indicate sources of financial or other support for the review	13
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18	Sponsor	#5b	Provide name for the review funder and / or sponsor	n/a
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21	Role of sponsor or funder	#5c	Describe roles of funder(s), sponsor(s), and / or institution(s), if any, in developing the protocol	n/a
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25	Introduction			
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27	Rationale	#6	Describe the rationale for the review in the context of what is already known	5-8
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31	Objectives	#7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	7
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36	Methods			
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38	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	6-7
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45	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	8-9
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52	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	16-17
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1	Study records -	#11a	Describe the mechanism(s) that will be used to manage	8-9
2	data management		records and data throughout the review	
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4	Study records -	#11b	State the process that will be used for selecting studies	9-11
5	selection process		(such as two independent reviewers) through each phase	
6			of the review (that is, screening, eligibility and inclusion in	
7			meta-analysis)	
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11	Study records -	#11c	Describe planned method of extracting data from reports	9-10
12	data collection		(such as piloting forms, done independently, in duplicate),	
13	process		any processes for obtaining and confirming data from	
14			investigators	
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18	Data items	#12	List and define all variables for which data will be sought	7-9
19			(such as PICO items, funding sources), any pre-planned	
20			data assumptions and simplifications	
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24	Outcomes and	#13	List and define all outcomes for which data will be sought,	10-11
25	prioritization		including prioritization of main and additional outcomes,	
26			with rationale	
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29	Risk of bias in	#14	Describe anticipated methods for assessing risk of bias of	11
30	individual studies		individual studies, including whether this will be done at the	
31			outcome or study level, or both; state how this information	
32			will be used in data synthesis	
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36	Data synthesis	#15a	Describe criteria under which study data will be	10-11
37			quantitatively synthesised	
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40	Data synthesis	#15b	If data are appropriate for quantitative synthesis, describe	10-11
41			planned summary measures, methods of handling data and	
42			methods of combining data from studies, including any	
43			planned exploration of consistency (such as I ² , Kendall's τ)	
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46	Data synthesis	#15c	Describe any proposed additional analyses (such as	10-11
47			sensitivity or subgroup analyses, meta-regression)	
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50	Data synthesis	#15d	If quantitative synthesis is not appropriate, describe the	10-11
51			type of summary planned	
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54	Meta-bias(es)	#16	Specify any planned assessment of meta-bias(es) (such as	10-11
55			publication bias across studies, selective reporting within	
56			studies)	
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1 Confidence in [#17](#) Describe how the strength of the body of evidence will be 10
2 cumulative assessed (such as GRADE)
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6 The PRISMA-P elaboration and explanation paper is distributed under the terms of the Creative
7 Commons Attribution License CC-BY. This checklist was completed on 24. May 2021 using
8 <https://www.goodreports.org/>, a tool made by the [EQUATOR Network](#) in collaboration with
9 [Penelope.ai](#)
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BMJ Open

Complementary feeding practices and the associated risk of childhood obesity among ethnic minority groups living in high-income countries: protocol for a systematic review and meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-053821.R1
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Date Submitted by the Author:	26-Dec-2021
Complete List of Authors:	Tsenoli, Maido; University of South Wales; Birmingham Community Healthcare NHS Foundation Trust Khan, Moien; United Arab Emirates University, Department of Family Medicine Östlundh, Linda; United Arab Emirates University College of Medicine and Health Sciences, National Medical Library Arora, Teresa; Zayed University, College of Natural & Health Sciences Omar, Omar; Qatar University, College of Health Sciences
Primary Subject Heading:	Public health
Secondary Subject Heading:	General practice / Family practice, Nutrition and metabolism, Paediatrics
Keywords:	NUTRITION & DIETETICS, PAEDIATRICS, EPIDEMIOLOGY, PUBLIC HEALTH

SCHOLARONE™
Manuscripts

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3 **1 Protocol**

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6 **3 Complementary feeding practices and the associated risk of childhood obesity among**
7 **4 ethnic minority groups living in high-income countries: protocol for a systematic review**
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9 **5**
10 **and meta-analysis**

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12 6 Maido Tsenoli^{1,2}; Moien AB Khan^{3,4}; Linda Östlundh⁵; Teresa Arora⁶; Omar Omar⁷

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53 26 Word Count: 3306

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28 **ABSTRACT**

29 **Introduction**

30 Complementary feeding (CF) is defined as the period from when exclusive breast milk and
31 formula are no longer sufficient for meeting the infant's nutritional needs. The CF period occurs
32 from birth to 23 months of age. Though the recommended guidelines for introducing CF is
33 from around six months of age, data indicates that some infants are introduced to food earlier
34 than six months which can predispose children to obesity and overweight. Obesity in ethnic
35 minority groups (EMG) is higher than their native counterparts and often tracks into adulthood.
36 Hence, our aim was to conduct a systematic review and meta-analysis on the available literature
37 to identify the risk of childhood overweight/obesity associated with CF practices concerning
38 their timing, as well as the frequency and type of CF food introduced. We focused specifically
39 on EMG children living in high-income countries (HIC).

40 **Methods and Analysis**

41 A methodological literature search surrounding childhood obesity and overweight (COO) risk
42 associated with complementary feeding (CF) practices will be conducted in May 2021
43 following PRISMA-P guidelines. The following academic databases will be methodologically
44 searched: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library and the
45 WHO Global Index Medicus. Three independent researchers will be involved in independent
46 screening and review the included articles based on the pre-defined inclusion and exclusion
47 criteria. Where conflicts arise during the screening process, it will be resolved through
48 discourse until a consensus is reached. Information on CF practices and anthropometric
49 measurements will be extracted to ascertain the risk of childhood obesity and overweight. For
50 this study, WHO Body Mass Index (BMI) for age and sex percentiles, Centre for Disease
51 Control (CDC) classification and other recognised country-specific classifications will be
52 utilised for the outcome.

53 **Ethics and Dissemination**

54 Formal ethical approval is not needed as the results will be drawn from currently available
55 published literature. Outcomes of the review will be shared through peer-reviewed
56 publications.

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57 **Key Words:** Complementary feeding practices; infant feeding; childhood overweight;
58 childhood obesity; ethnicity; race; culture; high-income countries; ethnic minorities.

59 **PROSPERO registration number:** CRD42021246029

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56 62 **Strengths and Limitations of the study**
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- 8
9 63 ➤ First systematic review considering extensive analysis of Childhood overweight and
10 64 obesity and the risk in multiple ethnic minority group children in high-income
11 65 countries on complementary feeding practices
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13 66 ➤ Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols
14 67 (PRISMA-P) and PRISMA 2009 guidelines follow the systematic review and meta-
15 68 analysis.
16 69 ➤ Expert librarian specialising in database search strategy has developed the search
17 70 protocol.
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19 71 ➤ Our review will capture a small number of studies that are likely to meet the inclusion
20 72 criteria due to language restriction and heterogeneity between studies is expected to
21 73 be high
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23 74 ➤ In the reported effect estimates, lack of uniformity may be one of our limitations
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79 **Background**

80 Childhood obesity and overweight (COO) is a global health problem in high-income countries
81 (HIC), although it has also emerged as a problem in low and middle-income countries,
82 according to the World Health Organization [1]. Evidence implies that COO, feeding practices,
83 and mean nutrient disparities are associated with race and ethnicity and are often entangled
84 with income (Davis *et al.*, 2021). Due to international migration, disparities in COO should be
85 expected. International migration to HIC has continued to increase globally, with 57% of
86 migrants living in HIC, where communities have become more diverse. In 2010, the
87 International Organisation for Migration estimated the worldwide migration was estimated to
88 be 214 million people (2010) [2]. However, research on ethnicity related obesity risk in
89 childhood is considerably limited [3]. Given the increasing migration rate from poorer to HIC,
90 COO in ethnic minority groups (EMG) presents a potential public health concern, warranting
91 further research to better understand and identify contributing factors. Ethnic minorities are
92 parents who are born to two foreign-born parents outside of the current resident HIC and who
93 have migrated to HIC.

94 Complementary feeding (CF) is defined as “the process starting when breast milk is no longer
95 sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids
96 are needed, along with breast milk”[4] CF usually occurs from six to 23 months, even when
97 breastfeeding continues over two years of age [4]. CF has always been focused on providing
98 nutritious, clean, safe and adequate food to meet the nutritional requirements of infants and
99 children. CF aims to reduce malnutrition and infections, although there have been growing
100 concerns regarding its potential contribution to COO [5]. It is recommended to exclusively
101 breastfeed (EBF) for the first six months of life and continue for up to two years or beyond
102 with appropriate, adequate, and safe CF [6]. Poor CF practices and breastfeeding are
103 widespread, with just 34.8% of infants exclusively breastfed and most infants given food or
104 liquids before the recommended six months [1,7–9]. Some studies suggest that COO is less
105 common in children and adolescents who have been exclusively breastfed [4,9–12] although
106 differences are negligible in other studies or present conflicting findings [8].

107 The World Health Organisation defines exclusive breastfeeding for the first six months of
108 life to achieve appropriate growth and development [13]. The age of introduction of

1
2
3 109 complementary feeding varies among different European countries between 4-6 months [14],
4
5 110 with studies confirming the early introduction of solid foods in Australia [15], the UK [16]
6
7 111 and the USA [17]. One of the reasons for early recommendation by healthcare professionals
8
9 112 could be because many of the infants are started early CF are also formula-fed (FF) [18].
10
11 113 Many assumptions have less scientific evidence leading to major variations in the
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13 114 recommendations of CF in different HIC.

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15 115 Introducing solid foods earlier than the recommended six months has been shown to
16
17 116 predispose children to overweight/obesity, as highlighted in several reviews [9,19,20].
18
19 117 Recommendations surrounding the optimal timing of the introduction of solid are limited and
20
21 118 vary between countries, cultures, and food availability [21]. For instance, the UK
22
23 119 recommends weaning around six months alongside breastfeeding until at least one years old.
24
25 120 Other European countries recommend trial foods or small tastes between 4 and 6 months
26
27 121 [21]. Composition of diet and how parents' approach CF is closely aligned to culture and
28
29 122 other factors. Bangladeshi, Indian or Pakistani mothers prefer introducing sweet food earlier.
30
31 123 In contrast, compared to African and Caribbean origin, mothers prefer introducing savoury
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33 124 food-types [22]. Recommendations for starting solid foods by different countries are often in
34
35 125 line with the WHO, thus making it plausible to follow the same guidance for our study.
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37 126 Studies have discovered that early rapid weight gain during infancy is related to subsequent
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39 127 COO risk [23,24]. The relationship between rapid weight gain and later childhood obesity
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41 128 further emphasises the potential programming that occurs very early in life, resulting in COO
42
43 129 and associated health problems related to CF practices. A cohort study by Ardic *et al.* (2019)
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45 130 found that early feeding habits might be permanent and pose a risk to later health outcomes
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47 131 [25]. In line with this study, Baran (2019), Pearce (2016) and Wang (2013) also found that
48
49 132 breastfeeding less than six months and introducing adults' meals before 12 months were
50
51 133 contributory factors for the prevalence of overweight and obesity in preschool children.

52
53 134 In at least two different studies, differences across EMG concerning CF practices and COO
54
55 135 prevalence have been identified [9,26]. The differences are embedded in social and household
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57 136 contexts in either increasing or decreasing the risk of obesity. However, Kumanyika (2008) has
58
59 137 highlighted that available evidence can be sparse, heterogeneous and difficult to meaningfully
60
138 summarise. Two studies have explored the cultural influences of CF practices among Chinese
139
140 and South Asian children [27,28]. However, overweight/obesity risk in relation to CF practices
has not yet been collectively analysed in different EMG children. Our research will review the

1
2
3 141 parent-child dyads where the EMG groups parents, who have indicated their ethnicity, have
4
5 142 migrated to HIC.
6
7

8 143 Furthermore, it is known that CF practices are associated with early COO, yet the extent of
9
10 144 the problem is unknown for EMG children living in HIC. Considering the substantial global
11
12 145 burden of COO, it is important to understand the association between CF practices and COO,
13
14 146 specifically amongst EMG children living in HIC. We propose to conduct a comprehensive
15
16 147 systematic review and meta-analysis to address this research question in this protocol. Hence,
17
18 148 in our systematic review and meta-analysis, we aim to identify the risk of childhood obesity
19
20 149 during the complementary feeding period associated with CF timing, frequency, and the type
21
22 150 of CF food introduced.

23 151 **Methods/Design**

24
25
26 152 This protocol follows the Preferred Reporting Items for Systematic Review and Meta-
27
28 153 Analysis Protocols (PRISMA-P) guidelines [29] and has been informed by the Cochrane
29
30 154 Handbook for Systematic Reviews of Interventions [30]. The final review will be reported
31
32 155 according to the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis
33
34 156 (PRISMA) statement [31]. The prospective review is registered with the PROSPERO
35
36 157 (registration no. CRD42021246029). The start date for the review will be June 2021, and the
37
38 158 estimated date for completion will be May 2022.

39 159 **Eligibility criteria**

40 41 42 160 Inclusion Criteria

43
44
45 161 We will include randomised controlled trials, cohort studies, case-control studies and cross-
46
47 162 sectional studies. We will include studies reporting direct and/or indirect effect sizes in children
48
49 163 who were exposed to CF at any age from 0-24 months. All studies should estimate the
50
51 164 association between the measured exposure (CF) and the outcomes (weight gain). Such
52
53 165 estimates reported should be calculated or calculable. The systematic review will be conducted
54
55 166 using the PICOS approach (participants, exposure, comparator, outcome(s) and type of study)
56
57 167 from which studies are identified. [30,32,33] Inclusion and exclusion criteria are listed
58
59 168 according to PICOS in table 1.
60

169 **Table 1: Pre-defined inclusion and exclusion study criteria according to PICOS**

PICOS	Inclusions	Exclusions
Participants	Ethnic minority children aged between 0-2 years; living in HIC. Ethnicity self-identified by participants including all migrants' generations.	Pre-term and low-birth-weight children; children with medical problems that can affect body weight e.g. Prader Willi Syndrome, failure to thrive, metabolic disorders, Hypothyroidism, Cushing syndrome, growth hormone deficiency etc.
Interventions	CF practices include the timing of introduction of semi-solid, solid and soft foods, meal frequency and dietary diversity.	Studies reporting exclusively on breastfeeding outcomes alone
Comparisons	Children who followed recommended CF guidelines by WHO/UNICEF or country recommendation	
Outcomes of interest	Risk of obesity and overweight as classified by BMI z -scores and BMI percentiles in the 0-24 months age group	Studies that do not include obesity or overweight
Study design	Risk of obesity and overweight as classified by BMI z -scores and BMI percentiles	Studies not published in English, Studies with no full text available

170

171 HIC = High-Income Countries; CF = Complementary Feeding; RCTs = Randomised
 172 Controlled Trials

173 The study population will be children from ethnic minority groups aged 0-2 years who reside
 174 in HIC. The study outcome will investigate the association between CF practices and the risk
 175 of COO. The outcomes will include anthropometric measurements, including BMI z-scores or
 176 BMI percentiles. The review results on CF will be evaluated using the recommended optimum
 177 CF guidelines by WHO (2008). It is recommended that exclusive breastfeeding continues until
 178 six months and up to two years and beyond. Introduction of solids, soft and other liquids, other
 179 than breast milk or formula, is recommended from six months onwards. The study's outcome
 180 (COO) will be classified according to WHO BMI for age and sex percentiles and the Centres

1
2
3 181 for Disease Control and Prevention (CDC) classification and other recognised classifications.
4
5 182 According to the CDC, overweight is defined as BMI \geq 85th and <95th percentile, while obesity
6
7 183 is BMI of \geq 95th percentile for children < 18 years of the same age and sex [34]. These two
8
9 184 classifications have previously been compared by Gaffney *et al.* (2016), who found that one
10
11 185 standard deviation unit above the median of the WHO growth curve population approximates
12
13 186 the 85th percentile [35]. BMI does not measure body fat. If available, skinfolds measurements,
14
15 187 dual energy x-ray absorptiometry (DXA), and other methods will be used.

16 188 **Exclusion Criteria**

17
18
19 189 Studies that are not published in English and do not present original data will not be included.
20
21 190 Other studies that will be excluded are narrative reviews, systematic reviews and meta-
22
23 191 analyses, opinion articles, editorials, letters to the editor, published abstracts without a
24
25 192 published full-text, student dissertations/theses, and blog posts. Studies that do not include
26
27 193 anthropometric measurements in EMG children as part of the outcome before the age of two
28
29 194 years will be excluded.

30 31 195 **Search Strategy**

32 33 34 196 *Developing research question and search query domains*

35
36
37 197 We will search for papers published between 2000 until search date. A systematic search of
38
39 198 the literature will be conducted in May 2021 by a specialist medical librarian (LÖ). The
40
41 199 electronic databases: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library
42
43 200 the WHO Global Index Medicus will be included and covered from 2000 to the search date.
44
45 201 No filters or limitations will be applied. A preliminary search in PubMed was carried out in
46
47 202 April 2021 to identify relevant search terms and search technical solutions (LÖ). The search
48
49 203 terms were systematically identified with the support of PubMed's MeSH, by analysing the
50
51 204 indexing of previous, relevant studies which was informed by input from the subject specialists
52
53 205 (MT and MK). A copy of the preliminary search strategy in PubMed is available in
54
55 206 Supplementary file 1. Hand screening of reference lists of the studies that meet the pre-defined
56
57 207 criteria will also be conducted.

58
59 208 Detailed search documentation for all included databases will be appended to the final review
60
209 to allow search reproducibility and transparent appraisal of the search strategy and results.

1
2
3 210 Finally, Cabell's Predatory Reports in Cabell's Scholarly Analytics will be consulted to ensure
4
5 211 that none of the finally selected studies published in open-access journals are listed as potential
6
7 212 predatory journals.
8

9 213 **Data Extraction and Management**

10 214 *Screening and study selection*

11
12
13
14
15 215 Covidence systematic review software by Veritas Health Innovation (2021) will be used to
16
17 216 automatically de-duplicate and blind screen all records identified in the database search. After
18
19 217 duplicated studies have been removed, unique records will be screened based on the title and/or
20
21 218 abstract by two independent reviewers (MT & MK). Articles that do not meet the criteria will
22
23 219 be excluded. Eventual disagreements will be resolved through blinded conflict resolution
24
25 220 through Covidence by a third reviewer (LÖ), further reducing bias risk. Similarly, full-text
26
27 221 review will be carried by two independent reviewers (MT & MK), resolving conflicts for
28
29 222 ambiguous inclusion by a third reviewer (LÖ) through Covidence. Details from the screening
30
31 223 and selection process, including reasons for exclusion of the omitted full-text studies, will be
32
33 224 documented in a PRISMA 2020 flow diagram.

34 225 *Data Extraction*

35
36
37 226 For extraction of data, a piloted form will be used. Data will be extracted for each study that
38
39 227 meets the eligibility criteria by two researchers and the third researcher will resolve any
40
41 228 discrepancies. The following data if available will be extracted: surname of the first author,
42
43 229 publication year, HIC, participant's ethnicity, study design, sample size, participant's age,
44
45 230 breast-feeding duration, CF timing and frequency, primary outcome, anthropometric
46
47 231 measurements, length of follow-up and types of CF, effect size (OR/RR) and mean difference.
48
49 232 HIC list provided in supplementary file 2.

50 233

51
52
53 234 The child's ethnicity will be determined by the country of birth of the parents, although
54
55 235 ethnicity identification by country of birth has caveats because a diversity of the country-of-
56
57 236 origin can differ [36]. In addition, diversity collection practices differ among Organisation for
58
59
60

237 Economic Cooperation and Development (OECD) countries. Some countries collect
238 indigenous identity, others race and ethnicity, and migrant statuses.

239 *Output*

240 The study will present a PRISMA flow diagram, including the search results and study
241 selection summary. Rated quality of the included studies will be presented in a comprehensive
242 table of the study characteristics. The risk of COO identified from all studies will be
243 summarised and synthesised to identify the overall risk in multiple EMG children residing in
244 HIC when the study was conducted.

245 *Risk of Bias in the primary study*

246 Two authors (MT and MK) will assess the quality of studies independently using the Newcastle
247 Ottawa Scale (NOS) and modified NOS for assessing quality of non-randomised studies in the
248 meta-analysis. The tool assesses participant selection, comparability of groups, and outcome
249 or exposure depending on the type of study [37]. A point is given for each item in the three
250 sections if the study meets the criteria. The maximum score for cross-sectional studies is ten
251 and nine for cohort studies. Assessment of the internal validity of primary studies is crucial in
252 systematic reviews to identify the risk of bias. It has been noted that, whilst the NOS quality
253 assessment scale is challenging and more subjective in non-randomised studies compared to
254 randomised controlled trials (RCTs), there is no other widely accepted tool for non-randomised
255 studies. [38] Grading of Recommendations Assessment, Development and Evaluation
256 (GRADE) quality review tool will be used for RCTs. Disagreements with grading will be
257 resolved through discourse and revisiting the inclusion criteria by both authors (MT and MK).

258 *Analysis and Data Synthesis*

259 Descriptive analysis will be performed to report on the association between COO and
260 breastfeeding duration, the timing of CF and frequency, and variety of feeds. Both narrative
261 text and table summaries will be presented.

262 The results of the included studies will be synthesised using pooled estimates and pooled
263 odds ratios or risk ratios (RR) applying random-effects model with 95% confidence intervals
264 (CI) where data permits to conclude the pooled COO risk. Random-effects meta-analysis will

1
2
3 265 be limited to studies reported on pooled estimates and at least ten studies with low to
4
5 266 moderate heterogeneity for meaningful results. Heterogeneity will be assessed using the I^2
6
7 267 and visual inspection of forest plots. For dichotomous data, RR and 95% CI will be calculated
8
9 268 and for continuous data, mean difference (MD) and 95% CI will be used. MD will be
10
11 269 converted to RR if possible. Forest plots will be used to visually present the estimated
12
13 270 weighted results from different studies.

14 15 271 *Bias Minimisation*

16
17 272 The review will include multiple databases to ensure all studies published are included if they
18
19 273 meet our pre-defined inclusion criteria. Funnel plots, which is a plot of effect size, will be used
20
21 274 to assess publication bias and estimated by Begg's or Eggers tests using the R package.
22
23 275 Assessment of the quality of primary studies by both authors using NOS and GRADE tools
24
25 276 will further minimise bias. Disagreements with grading will be resolved through discourse. We
26
27 277 will also perform sensitivity analysis for the meta-analysis and repeat to include only studies
28
29 278 deemed to be good quality. Analyses will be conducted using Stata version 16 (StataCorp) and
30
31 279 completed by the team's statistician (OMO).

32 33 280 *Patient and public involvement*

34
35 281 Patients nor public will not be involved at any stage of the study. The proposed study
36
37 282 primarily reviews published data available in the indicated electronic databases.

38 39 40 283 **Discussion**

41
42
43 284 Our review is unique, and to our knowledge, is the only review considering extensive analysis
44
45 285 of COO risk in multiple EMG children residing in HIC about CF practices. EMG children are
46
47 286 the offspring of migrant families who live in a different country from their parent's country
48
49 287 of origin. Immigration can be diverse and varied from country to country. EMG in the USA
50
51 288 comprises a third of the population [26]. The immigrant population of Canada is 21% [2],
52
53 289 whereas the UK is 13% [39]. Although diversity is considered based on country of birth, this
54
55 290 can pose problems due to within-country diversity from the country of origin [36].

56 291 Identifying the causes of COO amongst different EMG can be complex and challenging. It
57
58 292 could be hypothesised from previous studies that there can be multiple reasons for the EMG
59
60

1
2
3 293 families to adopt CF prematurely. FF is more common in HIC and, in contrast to LIC, where
4
5 294 FF is expensive, parents are more likely to resort to FF and early CF in HIC. With
6
7 295 immigration comes more work responsibilities, increased stress and poor diet. Furthermore,
8
9 296 the stress has been exacerbated by the current pandemic. [40,41] This can potentially result
10
11 297 in lower breastfeeding rates and reduced production of breast milk which, in turn, may lead
12
13 298 to the earlier introduction of CF. [42] Gaining weight, lesser crying and improved sleeping
14
15 299 patterns are being seen by parents as being healthier for the baby and a positive choice for
16
17 300 earlier CF. The trends of the new immigrating HIC influence these factors. [43]

18 301 Reviews have shown that insufficient knowledge, feeding attitude changes due to acculturation
19
20 302 and incorrect advice lead to practising earlier CF resulting in COO. [27,43] A similar review
21
22 303 that explored COO concerning CF was conducted in the general population without
23
24 304 stratification on EMG or HIC. [20] Although another review on CF practices focused on South
25
26 305 Asian children in HIC as an EMG, they did not report on obesity risk. Still, they identified
27
28 306 significant differences in CF practices that were obesogenic [27]. On the other hand, one earlier
29
30 307 review identified a clear association amongst the general population in developed countries
31
32 308 [44]. This means that with a combined multiple ethnicities review, there is a possibility of
33
34 309 statistically meaningful results identifying COO risk in EMG children residing in HIC. Such
35
36 310 risk poses an important need for public health interventions. Evidence suggests adherence to
37
38 311 BF and appropriate CF to improve growth and development of child [45]. Moreover, there
39
40 312 has been a disparity in bodyweight changes among children, especially among ethnic
41
42 313 minorities [46–48]. Our study will contribute to the efforts to prevent COO within EMG that
43
44 314 is often under-researched and marginalised. Furthermore, we envisage our study to enhance
45
46 315 the reduction in health disparities experienced by EMG through subsequent targeted
47
48 316 interventions.

49 317 To our knowledge, it is the first review considering an extensive analysis of COO risk in
50
51 318 multiple EMG children residing in HIC pertaining to CF practices. COO has been confirmed
52
53 319 to be higher in EMG compared to native groups. If CF practices among EMG are a contributory
54
55 320 factor in COO, our review will bring evidence for targeted interventions to prevent rather than
56
57 321 cure COO by promoting healthy weight throughout childhood years. It will also highlight the
58
59 322 scarcity of research within marginalised EMG by identifying gaps and making
60
323 recommendations for future studies in CF practices.

1
2
3 324 The review is not without limitations. First, most studies included will be observational.
4
5 325 Second, studies amongst EMG in HIC tend to be limited, with ethnic groups making up small
6
7 326 samples. Additionally, language barrier difficulties may be present in the host country.
8
9 327 Therefore, our review will likely capture a small number of studies likely to meet the inclusion
10
11 328 criteria, and heterogeneity between studies is expected to be high. Population diversity will
12
13 329 further increase heterogeneity risk. There is potential that some studies, which include EMG,
14
15 330 may be missed due to countries using varied ethnicity classifications, paired with the subjective
16
17 331 nature of ethnicity.

18 332 **Conclusion**

20
21 333 This systematic review will highlight the CF practices in the EMG regarding frequency, the
22
23 334 timing of CF and the identified factors that could have influenced CF. Such a systematic review
24
25 335 will increase awareness and guide improvement and create future policies aimed at preventing
26
27 336 COO.

28 29 337 **Authors Contribution**

30
31
32 338 MT and MK were involved in all aspects of the study, from conceptualisation, protocol
33
34 339 development, and the preliminary search strategy. LÖ developed the preliminary search
35
36 340 strategy, contributed with text for the methods part of the manuscript and will conduct the final
37
38 341 literature search and the reference management in Covidence. Further screening of literature
39
40 342 and data extraction will be carried out by MT and data validated by MK. TA revised the first
41
42 343 draft for intellectual content and will assist with drafting and revising content in the final
43
44 344 project. OMO will oversee the data extraction process and complete all aspects of the meta-
45
46 345 analysis.

47 346 **Support: Source and sponsor**

48
49
50 347 No funding declared.

51 52 348 **Competing interests**

53
54
55 349 None declared.

56 57 350 **Patient and Public involvement**

351 No involvement and therefore patient consent not required.

352 Data Statement

353 Data will be submitted as a supplementary appendix.

354 **Amendments:** In the event of minor amendments of this protocol, the changes will be updated
355 and transparent reported in the online PROSPERO registration for the review:
356 CRD42021246029

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Supplementary materials file 1: preliminary search strategy in PubMed

Source: PubMed

Search date: 2021-04-30

Search specifications: All search terms are searched in the search field "Title/Abstract" and in MeSH (when available). Filters for English language and publication year range: January 1st, 2000- April 30th, 2021 is applied

Result: 2,951 records

Preliminary search strategy:

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(((weight*[Title/Abstract] OR obesity[Title/Abstract] OR obese[Title/Abstract] OR obesities[Title/Abstract] OR "Obesity"[Mesh] OR "Body Weight"[Mesh:NoExp] OR BMI[Title/Abstract] OR "body mass index"[Title/Abstract] OR "Body Mass Index"[Mesh] OR "Overweight"[Mesh] OR overweight[Title/Abstract]) AND ("Infant Nutritional Physiological Phenomena"[Mesh] OR "Infant nutrition*[Title/Abstract] OR "infant feeding*[Title/Abstract] OR "Infant Food"[Mesh] OR "infant food*[Title/Abstract] OR "baby nutrition*[Title/Abstract] OR "baby feeding*[Title/Abstract] OR "baby food*[Title/Abstract] OR "supplementary feeding*[Title/Abstract] OR "complementary feeding*[Title/Abstract] OR "replacement feeding*[Title/Abstract] OR "Infant Formula"[Mesh] OR "infant formula*[Title/Abstract] OR "baby formula*[Title/Abstract] OR "solid food*[Title/Abstract] OR "soft food*[Title/Abstract] OR "complementary food*[Title/Abstract] OR "Breast Feeding"[Mesh] OR breastfed[Title/Abstract] OR "breast feed*[Title/Abstract] OR "breast fed" [Title/Abstract] OR "wet nursing"[Title/Abstract] OR "Feeding Behavior"[Mesh] OR "feeding behavior*[Title/Abstract] OR "feeding-related behavior*[Title/Abstract] OR "feeding related behavior*[Title/Abstract] OR "feeding pattern*[Title/Abstract] OR "feeding habit*[Title/Abstract] OR "food habit*[Title/Abstract] OR "feeding behaviour*[Title/Abstract] OR "feeding-related behaviour*[Title/Abstract] OR "feeding related behaviour*[Title/Abstract] OR "food fussiness"[Title/Abstract] OR "food prefer*[Title/Abstract] OR "Eating Behavior*[Title/Abstract] OR "Eating Habit*[Title/Abstract] OR "Dietary Habit*[Title/Abstract] OR "Diet Habit*[Title/Abstract] OR "family diet"[Title/Abstract] OR "weaning"[Title/Abstract] OR "Weaning"[Mesh] OR "Bottle Feeding"[Mesh] OR bottlefe*[Title/Abstract] OR "feeding duration*[Title/Abstract] OR "dietary varia*[Title/Abstract] OR "breast milk"[Title/Abstract] OR "Milk, Human"[Mesh] OR "human milk"[Title/Abstract] OR "Lactation"[Mesh] OR lactation[Title/Abstract] OR "liquid food*[Title/Abstract])) AND ("Infant"[Mesh] OR "Child"[Mesh] OR child*[Title/Abstract] OR infant*[Title/Abstract] OR "newborn*[Title/Abstract] OR baby[Title/Abstract] OR babies[Title/Abstract] OR "toddler*[Title/Abstract])) AND ("Minority Groups"[Mesh] OR "Ethnic Groups"[Mesh] OR "Population Groups"[Mesh] OR "Continental Population Groups"[Mesh] OR ethnic*[Title/Abstract] OR "population group*[Title/Abstract] OR nationalit*[Title/Abstract] OR "ethnic minorit*[Title/Abstract] OR "cultural group*[Title/Abstract] OR "population minorit*[Title/Abstract] OR "racial stock*[Title/Abstract] OR race[Title/Abstract] OR races[Title/Abstract] OR Black[Title/Abstract] OR Blacks[Title/Abstract] OR African*[Title/Abstract] OR "Afro-American*[Title/Abstract] OR "Afro American*[Title/Abstract] OR "American Native*[Title/Abstract] OR "Native American*[Title/Abstract] OR Indian*[Title/Abstract] OR "American Amerind*[Title/Abstract] OR "Indigenous Canadian*[Title/Abstract] OR "Canadian Native*[Title/Abstract] OR Amish[Title/Abstract] OR Arab[Title/Abstract] OR Arabs[Title/Abstract] OR Arabic[Title/Abstract] OR Palestinian*[Title/Abstract] OR Asian*[Title/Abstract] OR Hispanic*[Title/Abstract] OR Mexican*[Title/Abstract] OR "Spanish American*[Title/Abstract] OR "Puerto Rican*[Title/Abstract] OR Latinos[Title/Abstract] OR Latino[Title/Abstract] OR Latinas[Title/Abstract] OR Latina[Title/Abstract] OR Cuban*[Title/Abstract] OR Hispanic*[Title/Abstract] OR Japanese[Title/Abstract] OR Chinese [Title/Abstract] OR Vietnamese[Title/Abstract] OR Cambodian*[Title/Abstract] OR Hmong*[Title/Abstract] OR
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3 Korean*[Title/Abstract] OR Filipino*[Title/Abstract] OR Filipina*[Title/Abstract] OR "Indigenous
4 people*" [Title/Abstract] OR Alaska*[Title/Abstract] OR Inuit[Title/Abstract] OR Inuits[Title/Abstract] OR
5 Kalaallit*[Title/Abstract] OR Inupiat*[Title/Abstract] OR Aleut*[Title/Abstract] OR
6 Eskimo*[Title/Abstract] OR "first nation people*" [Title/Abstract] OR "Native People*" [Title/Abstract] OR
7 Roma[Title/Abstract] OR Romanies[Title/Abstract] OR Romani[Title/Abstract] OR Romany[Title/Abstract]
8 OR Gypsies[Title/Abstract] OR Gipsy[Title/Abstract] OR Hawaiian*[Title/Abstract] OR "Pacific
9 Islander*" [Title/Abstract] OR Maori*[Title/Abstract] OR Aboriginal[Title/Abstract] OR
10 Aborigine*[Title/Abstract] OR Jew[Title/Abstract] OR Jews[Title/Abstract] OR Jewish[Title/Abstract] OR
11 migrant*[Title/Abstract] OR Emigrant*[Title/Abstract] OR immigrant*[Title/Abstract] OR "Emigrants and
12 Immigrants" [Mesh]
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List of High-Income economies [1]

Andorra	Greece	Palau
Antigua and Barbuda	Greenland	Panama
Aruba	Guam	Poland
Australia	Hong Kong SAR, China	Portugal
Austria	Hungary	Puerto Rico
Bahamas, The	Iceland	Qatar
Bahrain	Ireland	Romania
Barbados	Isle of Man	San Marino
Belgium	Israel	Saudi Arabia
Bermuda	Italy	Seychelles
British Virgin Islands	Japan	Singapore
Brunei Darussalam	Korea, Rep.	Sint Maarten (Dutch part)
Canada	Kuwait	Slovak Republic
Cayman Islands	Latvia	Slovenia
Channel Islands	Liechtenstein	Spain
Chile	Lithuania	St. Kitts and Nevis
Croatia	Luxembourg	St. Martin (French part)

Curaçao	Macao SAR, China	Sweden
Cyprus	Malta	Switzerland
Czech Republic	Mauritius	Taiwan, China
Denmark	Monaco	Trinidad and Tobago
Estonia	Nauru	Turks and Caicos Islands
Faroe Islands	Netherlands	United Arab Emirates
Finland	New Caledonia	United Kingdom
France	New Zealand	United States
French Polynesia	Northern Mariana Islands	Uruguay
Germany	Norway	Virgin Islands (U.S.)
Gibraltar	Oman	

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- 1 World Bank Country and Lending Groups – World Bank Data Help Desk. <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups> (accessed 23 March 2021).

Reporting checklist for protocol of a systematic review and meta analysis.

Based on the PRISMA-P guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the PRISMA-Preporting guidelines, and cite them as:

Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4(1):1.

		Reporting Item	Page Number
Title			
Identification	#1a	Identify the report as a protocol of a systematic review	1-4
Update	#1b	If the protocol is for an update of a previous systematic review, identify as such	n/a
Registration			
	#2	If registered, provide the name of the registry (such as PROSPERO) and registration number	3
Authors			
Contact	#3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1

1	Contribution	#3b	Describe contributions of protocol authors and identify the guarantor of the review	12-13
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4	Amendments			
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7		#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	n/a
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14	Support			
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16	Sources	#5a	Indicate sources of financial or other support for the review	13
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18	Sponsor	#5b	Provide name for the review funder and / or sponsor	n/a
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21	Role of sponsor or funder	#5c	Describe roles of funder(s), sponsor(s), and / or institution(s), if any, in developing the protocol	n/a
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25	Introduction			
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27	Rationale	#6	Describe the rationale for the review in the context of what is already known	5-8
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31	Objectives	#7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	7
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36	Methods			
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38	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	6-7
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45	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	8-9
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52	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	16-17
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1	Study records -	#11a	Describe the mechanism(s) that will be used to manage	8-9
2	data management		records and data throughout the review	
3				
4	Study records -	#11b	State the process that will be used for selecting studies	9-11
5	selection process		(such as two independent reviewers) through each phase	
6			of the review (that is, screening, eligibility and inclusion in	
7			meta-analysis)	
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11	Study records -	#11c	Describe planned method of extracting data from reports	9-10
12	data collection		(such as piloting forms, done independently, in duplicate),	
13	process		any processes for obtaining and confirming data from	
14			investigators	
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18	Data items	#12	List and define all variables for which data will be sought	7-9
19			(such as PICO items, funding sources), any pre-planned	
20			data assumptions and simplifications	
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24	Outcomes and	#13	List and define all outcomes for which data will be sought,	10-11
25	prioritization		including prioritization of main and additional outcomes,	
26			with rationale	
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29	Risk of bias in	#14	Describe anticipated methods for assessing risk of bias of	11
30	individual studies		individual studies, including whether this will be done at the	
31			outcome or study level, or both; state how this information	
32			will be used in data synthesis	
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36	Data synthesis	#15a	Describe criteria under which study data will be	10-11
37			quantitatively synthesised	
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40	Data synthesis	#15b	If data are appropriate for quantitative synthesis, describe	10-11
41			planned summary measures, methods of handling data and	
42			methods of combining data from studies, including any	
43			planned exploration of consistency (such as I ² , Kendall's τ)	
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46	Data synthesis	#15c	Describe any proposed additional analyses (such as	10-11
47			sensitivity or subgroup analyses, meta-regression)	
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50	Data synthesis	#15d	If quantitative synthesis is not appropriate, describe the	10-11
51			type of summary planned	
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54	Meta-bias(es)	#16	Specify any planned assessment of meta-bias(es) (such as	10-11
55			publication bias across studies, selective reporting within	
56			studies)	
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1 Confidence in [#17](#) Describe how the strength of the body of evidence will be 10
2 cumulative assessed (such as GRADE)
3 evidence
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6 The PRISMA-P elaboration and explanation paper is distributed under the terms of the Creative
7 Commons Attribution License CC-BY. This checklist was completed on 24. May 2021 using
8 <https://www.goodreports.org/>, a tool made by the [EQUATOR Network](#) in collaboration with
9 [Penelope.ai](#)
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BMJ Open

Complementary feeding practices and the associated risk of childhood obesity among ethnic minority groups living in high-income countries: protocol for a systematic review and meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-053821.R2
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Primary Subject Heading:	Public health
Secondary Subject Heading:	General practice / Family practice, Nutrition and metabolism, Paediatrics
Keywords:	NUTRITION & DIETETICS, PAEDIATRICS, EPIDEMIOLOGY, PUBLIC HEALTH

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Manuscripts

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3 **1 Protocol**

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5 **3 Complementary feeding practices and the associated risk of childhood obesity among**
6 **4 ethnic minority groups living in high-income countries: protocol for a systematic review**
7 **5 and meta-analysis**

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53 26 Word Count: 3306

56 27

28 **ABSTRACT**

29 **Introduction**

30 Complementary feeding (CF) is defined as the period from when exclusive breast milk and
31 formula are no longer sufficient for meeting the infant's nutritional needs. The CF period occurs
32 from birth to 23 months of age. Though the recommended guidelines for introducing CF is
33 from around six months of age, data indicates that some infants are introduced to food earlier
34 than six months which can predispose children to obesity and overweight. Obesity in ethnic
35 minority groups (EMG) is higher than their native counterparts and often tracks into adulthood.
36 Hence, our aim was to conduct a systematic review and meta-analysis on the available literature
37 to identify the risk of childhood overweight/obesity associated with CF practices concerning
38 their timing, as well as the frequency and type of CF food introduced. We focused specifically
39 on EMG children living in high-income countries (HIC).

40 **Methods and Analysis**

41 A methodological literature search surrounding childhood obesity and overweight (COO) risk
42 associated with complementary feeding (CF) practices will be conducted in May 2021
43 following PRISMA-P guidelines. The following academic databases will be methodologically
44 searched: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library and the
45 WHO Global Index Medicus. Three independent researchers will be involved in independent
46 screening and review the included articles based on the pre-defined inclusion and exclusion
47 criteria. Where conflicts arise during the screening process, it will be resolved through
48 discourse until a consensus is reached. Information on CF practices and anthropometric
49 measurements will be extracted to ascertain the risk of childhood obesity and overweight. For
50 this study, WHO Body Mass Index (BMI) for age and sex percentiles, Centre for Disease
51 Control (CDC) classification and other recognised country-specific classifications will be
52 utilised for the outcome.

53 **Ethics and Dissemination**

54 Formal ethical approval is not needed as the results will be drawn from currently available
55 published literature. Outcomes of the review will be shared through peer-reviewed
56 publications.

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57 **Key Words:** Complementary feeding practices; infant feeding; childhood overweight;
58 childhood obesity; ethnicity; race; culture; high-income countries; ethnic minorities.

59 **PROSPERO registration number:** CRD42021246029

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56 62 **Strengths and Limitations of the study**
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- 8
9 63 ➤ First systematic review considering extensive analysis of Childhood overweight and
10 64 obesity and the risk in multiple ethnic minority group children in high-income
11 65 countries on complementary feeding practices
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13 66 ➤ Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols
14 67 (PRISMA-P) and PRISMA 2009 guidelines follow the systematic review and meta-
15 68 analysis.
16 69 ➤ Expert librarian specialising in database search strategy has developed the search
17 70 protocol.
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19 71 ➤ Our review will capture a small number of studies that are likely to meet the inclusion
20 72 criteria due to language restriction and heterogeneity between studies is expected to
21 73 be high
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23 74 ➤ In the reported effect estimates, lack of uniformity may be one of our limitations
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79 Background

80 Childhood obesity and overweight (COO) is a global health problem in high-income countries
81 (HIC), although it has also emerged as a problem in low and middle-income countries,
82 according to the World Health Organization [1]. Evidence implies that COO, feeding practices,
83 and mean nutrient disparities are associated with race and ethnicity and are often entangled
84 with income (Davis *et al.*, 2021). Due to international migration, disparities in COO should be
85 expected. International migration to HIC has continued to increase globally, with 57% of
86 migrants living in HIC, where communities have become more diverse. In 2010, the
87 International Organisation for Migration estimated the worldwide migration was estimated to
88 be 214 million people (2010) [2]. However, research on ethnicity related obesity risk in
89 childhood is considerably limited [3]. Given the increasing migration rate from poorer to HIC,
90 COO in ethnic minority groups (EMG) presents a potential public health concern, warranting
91 further research to better understand and identify contributing factors. Ethnic minority children
92 are children who are born to parents identified as ethnic minorities in HIC.

93 Complementary feeding (CF) is defined as “the process starting when breast milk is no longer
94 sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids
95 are needed, along with breast milk”[4] CF usually occurs from six to 23 months, even when
96 breastfeeding continues over two years of age [4]. CF has always been focused on providing
97 nutritious, clean, safe and adequate food to meet the nutritional requirements of infants and
98 children. CF aims to reduce malnutrition and infections, although there have been growing
99 concerns regarding its potential contribution to COO [5]. It is recommended to exclusively
100 breastfeed (EBF) for the first six months of life and continue for up to two years or beyond
101 with appropriate, adequate, and safe CF [6]. Poor CF practices and breastfeeding are
102 widespread, with just 34.8% of infants exclusively breastfed and most infants given food or
103 liquids before the recommended six months [1,7–9]. Some studies suggest that COO is less
104 common in children and adolescents who have been exclusively breastfed [4,9–12] although
105 differences are negligible in other studies or present conflicting findings [8].

106 The World Health Organisation defines exclusive breastfeeding for the first six months of
107 life to achieve appropriate growth and development [13]. The age of introduction of
108 complementary feeding varies among different European countries between 4-6 months [14],

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3 109 with studies confirming the early introduction of solid foods in Australia [15], the UK [16]
4 and the USA [17]. One of the reasons for early recommendation by healthcare professionals
5 110 could be because many of the infants are started early CF are also formula-fed (FF) [18].
6 111 Many assumptions have less scientific evidence leading to major variations in the
7 112 recommendations of CF in different HIC.
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13 114 Introducing solid foods earlier than the recommended six months has been shown to
14 115 predispose children to overweight/obesity, as highlighted in several reviews [9,19,20].
15 116 Recommendations surrounding the optimal timing of the introduction of solid are limited and
16 117 vary between countries, cultures, and food availability [21]. For instance, the UK
17 118 recommends weaning around six months alongside breastfeeding until at least one years old.
18 119 Other European countries recommend trial foods or small tastes between 4 and 6 months
19 120 [21]. Composition of diet and how parents' approach CF is closely aligned to culture and
20 121 other factors. Bangladeshi, Indian or Pakistani mothers prefer introducing sweet food earlier.
21 122 In contrast, compared to African and Caribbean origin, mothers prefer introducing savoury
22 123 food-types [22]. Recommendations for starting solid foods by different countries are often in
23 124 line with the WHO, thus making it plausible to follow the same guidance for our study.
24 125 Studies have discovered that early rapid weight gain during infancy is related to subsequent
25 126 COO risk [23,24]. The relationship between rapid weight gain and later childhood obesity
26 127 further emphasises the potential programming that occurs very early in life, resulting in COO
27 128 and associated health problems related to CF practices. A cohort study by Ardic *et al.* (2019)
28 129 found that early feeding habits might be permanent and pose a risk to later health outcomes
29 130 [25]. In line with this study, Baran (2019), Pearce (2016) and Wang (2013) also found that
30 131 breastfeeding less than six months and introducing adults' meals before 12 months were
31 132 contributory factors for the prevalence of overweight and obesity in preschool children.

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47 133 In at least two different studies, differences across EMG concerning CF practices and COO
48 134 prevalence have been identified [9,26]. The differences are embedded in social and household
49 135 contexts in either increasing or decreasing the risk of obesity. However, Kumanyika (2008) has
50 136 highlighted that available evidence can be sparse, heterogeneous and difficult to meaningfully
51 137 summarise. Two studies have explored the cultural influences of CF practices among Chinese
52 138 and South Asian children [27,28]. However, overweight/obesity risk in relation to CF practices
53 139 has not yet been collectively analysed in different EMG children. Our research will review
54 140 those 0-2 years old children who are born to parents identified as ethnic minorities in HIC.

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3 141 Furthermore, it is known that CF practices are associated with early COO, yet the extent of
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5 142 the problem is unknown for EMG children living in HIC. Considering the substantial global
6
7 143 burden of COO, it is important to understand the association between CF practices and COO,
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9 144 specifically amongst EMG children living in HIC. We propose to conduct a comprehensive
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11 145 systematic review and meta-analysis to address this research question in this protocol. Hence,
12
13 146 in our systematic review and meta-analysis, we aim to identify the risk of childhood obesity
14
15 147 during the complementary feeding period associated with CF timing, frequency, and the type
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17 148 of CF food introduced.

18 149 **Methods/Design**

20
21 150 This protocol follows the Preferred Reporting Items for Systematic Review and Meta-
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23 151 Analysis Protocols (PRISMA-P) guidelines [29] and has been informed by the Cochrane
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25 152 Handbook for Systematic Reviews of Interventions [30]. The final review will be reported
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27 153 according to the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis
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29 154 (PRISMA) statement [31]. The prospective review is registered with the PROSPERO
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31 155 (registration no. CRD42021246029). The start date for the review will be June 2021, and the
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33 156 estimated date for completion will be May 2022.

34 157 **Eligibility criteria**

36 158 **Inclusion Criteria**

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40 159 We will include randomised controlled trials, cohort studies, case-control studies and cross-
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42 160 sectional studies. We will include studies reporting direct and/or indirect effect sizes in children
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44 161 who were exposed to CF at any age from 0-24 months. All studies should estimate the
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46 162 association between the measured exposure (CF) and the outcomes (weight gain). Such
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48 163 estimates reported should be calculated or calculable. The systematic review will be conducted
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50 164 using the PICOS approach (participants, exposure, comparator, outcome(s) and type of study)
51
52 165 from which studies are identified. [30,32,33] Inclusion and exclusion criteria are listed
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54 166 according to PICOS in table 1.

55 167 **Table 1: Pre-defined inclusion and exclusion study criteria according to PICOS**

PICOS	Inclusions	Exclusions
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Participants	Ethnic minority children aged between 0-2 years; living in HIC. Ethnicity self-identified by participants including all migrants' generations.	Pre-term and low-birth-weight children; children with medical problems that can affect body weight e.g. Prader Willi Syndrome, failure to thrive, metabolic disorders, Hypothyroidism, Cushing syndrome, growth hormone deficiency etc.
Interventions	CF practices include the timing of introduction of semi-solid, solid and soft foods, meal frequency and dietary diversity.	Studies reporting exclusively on breastfeeding outcomes alone
Comparisons	Children who followed recommended CF guidelines by WHO/UNICEF or country recommendation	
Outcomes of interest	Risk of obesity and overweight as classified by BMI z -scores and BMI percentiles in the 0-24 months age group	Studies that do not include obesity or overweight
Study design	Risk of obesity and overweight as classified by BMI z -scores and BMI percentiles	Studies not published in English, Studies with no full text available

168

169 HIC = High-Income Countries; CF = Complementary Feeding; RCTs = Randomised
 170 Controlled Trials

171 The study population will be children from ethnic minority groups aged 0-2 years who reside
 172 in HIC. The study outcome will investigate the association between CF practices and the risk
 173 of COO. The outcomes will include anthropometric measurements, including BMI z-scores or
 174 BMI percentiles. The review results on CF will be evaluated using the recommended optimum
 175 CF guidelines by WHO (2008). It is recommended that exclusive breastfeeding continues until
 176 six months and up to two years and beyond. Introduction of solids, soft and other liquids, other
 177 than breast milk or formula, is recommended from six months onwards. The study's outcome
 178 (COO) will be classified according to WHO BMI for age and sex percentiles and the Centres
 179 for Disease Control and Prevention (CDC) classification and other recognised classifications.
 180 According to the CDC, overweight is defined as BMI \geq 85th and <95th percentile, while obesity

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3 181 is BMI of $\geq 95^{\text{th}}$ percentile for children < 18 years of the same age and sex [34]. These two
4
5 182 classifications have previously been compared by Gaffney *et al.* (2016), who found that one
6
7 183 standard deviation unit above the median of the WHO growth curve population approximates
8
9 184 the 85^{th} percentile [35]. BMI does not measure body fat. If available, skinfolds measurements,
10
11 185 dual energy x-ray absorptiometry (DXA), and other methods will be used.
12

13 186 **Exclusion Criteria**

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16 187 Studies that are not published in English and do not present original data will not be included.
17
18 188 Other studies that will be excluded are narrative reviews, systematic reviews and meta-
19
20 189 analyses, opinion articles, editorials, letters to the editor, published abstracts without a
21
22 190 published full-text, student dissertations/theses, and blog posts. Studies that do not include
23
24 191 anthropometric measurements in EMG children as part of the outcome before the age of two
25
26 192 years will be excluded.

27 193 **Search Strategy**

28 29 30 194 *Developing research question and search query domains*

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33 195 We will search for papers published between 2000 until search date. A systematic search of
34
35 196 the literature will be conducted in May 2021 by a specialist medical librarian (LÖ). The
36
37 197 electronic databases: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library
38
39 198 the WHO Global Index Medicus will be included and covered from 2000 to the search date.
40
41 199 No filters or limitations will be applied. A preliminary search in PubMed was carried out in
42
43 200 April 2021 to identify relevant search terms and search technical solutions (LÖ). The search
44
45 201 terms were systematically identified with the support of PubMed's MeSH, by analysing the
46
47 202 indexing of previous, relevant studies which was informed by input from the subject specialists
48
49 203 (MT and MK). A copy of the preliminary search strategy in PubMed is available in
50
51 204 Supplementary file 1. Hand screening of reference lists of the studies that meet the pre-defined
52
53 205 criteria will also be conducted.

54
55 206 Detailed search documentation for all included databases will be appended to the final review
56
57 207 to allow search reproducibility and transparent appraisal of the search strategy and results.
58
59 208 Finally, Cabell's Predatory Reports in Cabell's Scholarly Analytics will be consulted to ensure
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2
3 209 that none of the finally selected studies published in open-access journals are listed as potential
4
5 210 predatory journals.
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7

8 211 **Data Extraction and Management**

10 212 *Screening and study selection*

13 213 Covidence systematic review software by Veritas Health Innovation (2021) will be used to
14 214 automatically de-duplicate and blind screen all records identified in the database search. After
15 215 duplicated studies have been removed, unique records will be screened based on the title and/or
16 216 abstract by two independent reviewers (MT & MK). Articles that do not meet the criteria will
17 217 be excluded. Eventual disagreements will be resolved through blinded conflict resolution
18 218 through Covidence by a third reviewer (LÖ), further reducing bias risk. Similarly, full-text
19 219 review will be carried by two independent reviewers (MT & MK), resolving conflicts for
20 220 ambiguous inclusion by a third reviewer (LÖ) through Covidence. Details from the screening
21 221 and selection process, including reasons for exclusion of the omitted full-text studies, will be
22 222 documented in a PRISMA 2020 flow diagram.
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32 223 *Data Extraction*

34 224 For extraction of data, a piloted form will be used. Data will be extracted for each study that
35 225 meets the eligibility criteria by two researchers and the third researcher will resolve any
36 226 discrepancies. The following data if available will be extracted: surname of the first author,
37 227 publication year, HIC, participant's ethnicity, study design, sample size, participant's age,
38 228 breast-feeding duration, CF timing and frequency, primary outcome, anthropometric
39 229 measurements, length of follow-up and types of CF, effect size (OR/RR) and mean difference.
40 230 HIC list provided in supplementary file 2.
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48 231 The child's ethnicity will be determined by the country of birth of the parents, although
49 232 ethnicity identification by country of birth has caveats because a diversity of the country-of-
50 233 origin can differ [36]. In addition, diversity collection practices differ among Organisation for
51 234 Economic Cooperation and Development (OECD) countries. Some countries collect
52 235 indigenous identity, others race and ethnicity, and migrant statuses.
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58 236 *Output*

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3 237 The study will present a PRISMA flow diagram, including the search results and study
4 selection summary. Rated quality of the included studies will be presented in a comprehensive
5 238 table of the study characteristics. The risk of COO identified from all studies will be
6 239 summarised and synthesised to identify the overall risk in multiple EMG children residing in
7 240 HIC when the study was conducted.
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13 242 *Risk of Bias in the primary study*

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15
16 243 Two authors (MT and MK) will assess the quality of studies independently using the Newcastle
17 244 Ottawa Scale (NOS) and modified NOS for assessing quality of non-randomised studies in the
18 245 meta-analysis. The tool assesses participant selection, comparability of groups, and outcome
19 246 or exposure depending on the type of study [37]. A point is given for each item in the three
20 247 sections if the study meets the criteria. The maximum score for cross-sectional studies is ten
21 248 and nine for cohort studies. Assessment of the internal validity of primary studies is crucial in
22 249 systematic reviews to identify the risk of bias. It has been noted that, whilst the NOS quality
23 250 assessment scale is challenging and more subjective in non-randomised studies compared to
24 251 randomised controlled trials (RCTs), there is no other widely accepted tool for non-randomised
25 252 studies. [38] Grading of Recommendations Assessment, Development and Evaluation
26 253 (GRADE) quality review tool will be used for RCTs. Disagreements with grading will be
27 254 resolved through discourse and revisiting the inclusion criteria by both authors (MT and MK).
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38 255 *Analysis and Data Synthesis*

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40 256 Descriptive analysis will be performed to report on the association between COO and
41 257 breastfeeding duration, the timing of CF and frequency, and variety of feeds. Both narrative
42 258 text and table summaries will be presented.
43
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46

47 259 The results of the included studies will be synthesised using pooled estimates and pooled
48 260 odds ratios or risk ratios (RR) applying random-effects model with 95% confidence intervals
49 261 (CI) where data permits to conclude the pooled COO risk. Random-effects meta-analysis will
50 262 be limited to studies reported on pooled estimates and at least ten studies with low to
51 263 moderate heterogeneity for meaningful results. Heterogeneity will be assessed using the I^2
52 264 and visual inspection of forest plots. For dichotomous data, RR and 95% CI will be calculated
53 265 and for continuous data, mean difference (MD) and 95% CI will be used. MD will be
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3 266 converted to RR if possible. Forest plots will be used to visually present the estimated
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5 267 weighted results from different studies.
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8 268 *Bias Minimisation*

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10 269 The review will include multiple databases to ensure all studies published are included if they
11
12 270 meet our pre-defined inclusion criteria. Funnel plots, which is a plot of effect size, will be used
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14 271 to assess publication bias and estimated by Begg's or Eggers tests using the R package.
15
16 272 Assessment of the quality of primary studies by both authors using NOS and GRADE tools
17
18 273 will further minimise bias. Disagreements with grading will be resolved through discourse. We
19
20 274 will also perform sensitivity analysis for the meta-analysis and repeat to include only studies
21
22 275 deemed to be good quality. Analyses will be conducted using Stata version 16 (StataCorp) and
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24 276 completed by the team's statistician (OMO).

25 277 *Patient and public involvement*

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28 278 Patients nor public will not be involved at any stage of the study. The proposed study
29
30 279 primarily reviews published data available in the indicated electronic databases.
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33 280 **Discussion**

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36 281 Our review is unique, and to our knowledge, is the only review considering extensive analysis
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38 282 of COO risk in multiple EMG children residing in HIC about CF practices. EMG children are
39
40 283 the offspring of migrant families who live in a different country from their parent's country
41
42 284 of origin. Immigration can be diverse and varied from country to country. EMG in the USA
43
44 285 comprises a third of the population [26]. The immigrant population of Canada is 21% [2],
45
46 286 whereas the UK is 13% [39]. Although diversity is considered based on country of birth, this
47
48 287 can pose problems due to within-country diversity from the country of origin [36].

49 288 Identifying the causes of COO amongst different EMG can be complex and challenging. It
50
51 289 could be hypothesised from previous studies that there can be multiple reasons for the EMG
52
53 290 families to adopt CF prematurely. FF is more common in HIC and, in contrast to LIC, where
54
55 291 FF is expensive, parents are more likely to resort to FF and early CF in HIC. With
56
57 292 immigration comes more work responsibilities, increased stress and poor diet. Furthermore,
58
59 293 the stress has been exacerbated by the current pandemic. [40–43] This can potentially result
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3 294 in lower breastfeeding rates and reduced production of breast milk which, in turn, may lead
4
5 295 to the earlier introduction of CF. [44] Gaining weight, lesser crying and improved sleeping
6
7 296 patterns are being seen by parents as being healthier for the baby and a positive choice for
8
9 297 earlier CF. The trends of the new immigrating HIC influence these factors. [45]

10
11 298 Reviews have shown that insufficient knowledge, feeding attitude changes due to acculturation
12
13 299 and incorrect advice lead to practising earlier CF resulting in COO. [27,45] A similar review
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15 300 that explored COO concerning CF was conducted in the general population without
16
17 301 stratification on EMG or HIC. [20] Although another review on CF practices focused on South
18
19 302 Asian children in HIC as an EMG, they did not report on obesity risk. Still, they identified
20
21 303 significant differences in CF practices that were obesogenic [27]. On the other hand, one earlier
22
23 304 review identified a clear association amongst the general population in developed countries
24
25 305 [46]. This means that with a combined multiple ethnicities review, there is a possibility of
26
27 306 statistically meaningful results identifying COO risk in EMG children residing in HIC. Such
28
29 307 risk poses an important need for public health interventions. Evidence suggests adherence to
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31 308 BF and appropriate CF to improve growth and development of child [47]. Moreover, there
32
33 309 has been a disparity in bodyweight changes among children, especially among ethnic
34
35 310 minorities [42,43,48]. Our study will contribute to the efforts to prevent COO within EMG that
36
37 311 is often under-researched and marginalised. Furthermore, we envisage our study to enhance
38
39 312 the reduction in health disparities experienced by EMG through subsequent targeted
40
41 313 interventions.

42
43 314 To our knowledge, it is the first review considering an extensive analysis of COO risk in
44
45 315 multiple EMG children residing in HIC pertaining to CF practices. COO has been confirmed
46
47 316 to be higher in EMG compared to native groups. If CF practices among EMG are a contributory
48
49 317 factor in COO, our review will bring evidence for targeted interventions to prevent rather than
50
51 318 cure COO by promoting healthy weight throughout childhood years. It will also highlight the
52
53 319 scarcity of research within marginalised EMG by identifying gaps and making
54
55 320 recommendations for future studies in CF practices.

56
57 321 The review is not without limitations. First, most studies included will be observational.
58
59 322 Second, studies amongst EMG in HIC tend to be limited, with ethnic groups making up small
60
323 samples. Additionally, language barrier difficulties may be present in the host country.
324
Therefore, our review will likely capture a small number of studies likely to meet the inclusion

1
2
3 325 criteria, and heterogeneity between studies is expected to be high. Population diversity will
4
5 326 further increase heterogeneity risk. There is potential that some studies, which include EMG,
6
7 327 may be missed due to countries using varied ethnicity classifications, paired with the subjective
8
9 328 nature of ethnicity.

10 11 329 **Conclusion**

12
13
14 330 This systematic review will highlight the CF practices in the EMG regarding frequency, the
15
16 331 timing of CF and the identified factors that could have influenced CF. Such a systematic review
17
18 332 will increase awareness and guide improvement and create future policies aimed at preventing
19
20 333 COO.

21 22 334 **Authors Contribution**

23
24
25 335 MT and MK were involved in all aspects of the study, from conceptualisation, protocol
26
27 336 development, and the preliminary search strategy. LÖ developed the preliminary search
28
29 337 strategy, contributed with text for the methods part of the manuscript and will conduct the final
30
31 338 literature search and the reference management in Covidence. Further screening of literature
32
33 339 and data extraction will be carried out by MT and data validated by MK. TA revised the first
34
35 340 draft for intellectual content and will assist with drafting and revising content in the final
36
37 341 project. OMO will oversee the data extraction process and complete all aspects of the meta-
38
39 342 analysis.

40 343 **Support: Source and sponsor**

41
42
43 344 No funding declared.

44 45 345 **Competing interests**

46
47
48 346 None declared.

49 50 347 **Patient and Public involvement**

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52
53 348 No involvement and therefore patient consent not required.

54 55 349 **Data Statement**

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3 350 Data will be submitted as a supplementary appendix.
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6 351 **Amendments:** In the event of minor amendments of this protocol, the changes will be updated
7
8 352 and transparent reported in the online PROSPERO registration for the review:
9
10 353 CRD42021246029
11

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Supplementary materials file 1: preliminary search strategy in PubMed

Source: PubMed

Search date: 2021-04-30

Search specifications: All search terms are searched in the search field "Title/Abstract" and in MeSH (when available). Filters for English language and publication year range: January 1st, 2000- April 30th, 2021 is applied

Result: 2,951 records

Preliminary search strategy:

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(((weight*[Title/Abstract] OR obesity[Title/Abstract] OR obese[Title/Abstract] OR obesities[Title/Abstract] OR "Obesity"[Mesh] OR "Body Weight"[Mesh:NoExp] OR BMI[Title/Abstract] OR "body mass index"[Title/Abstract] OR "Body Mass Index"[Mesh] OR "Overweight"[Mesh] OR overweight[Title/Abstract]) AND ("Infant Nutritional Physiological Phenomena"[Mesh] OR "Infant nutrition*[Title/Abstract] OR "infant feeding*[Title/Abstract] OR "Infant Food"[Mesh] OR "infant food*[Title/Abstract] OR "baby nutrition*[Title/Abstract] OR "baby feeding*[Title/Abstract] OR "baby food*[Title/Abstract] OR "supplementary feeding*[Title/Abstract] OR "complementary feeding*[Title/Abstract] OR "replacement feeding*[Title/Abstract] OR "Infant Formula"[Mesh] OR "infant formula*[Title/Abstract] OR "baby formula*[Title/Abstract] OR "solid food*[Title/Abstract] OR "soft food*[Title/Abstract] OR "complementary food*[Title/Abstract] OR "Breast Feeding"[Mesh] OR breastfed[Title/Abstract] OR "breast feed*[Title/Abstract] OR "breast fed" [Title/Abstract] OR "wet nursing"[Title/Abstract] OR "Feeding Behavior"[Mesh] OR "feeding behavior*[Title/Abstract] OR "feeding-related behavior*[Title/Abstract] OR "feeding related behavior*[Title/Abstract] OR "feeding pattern*[Title/Abstract] OR "feeding habit*[Title/Abstract] OR "food habit*[Title/Abstract] OR "feeding behaviour*[Title/Abstract] OR "feeding-related behaviour*[Title/Abstract] OR "feeding related behaviour*[Title/Abstract] OR "food fussiness"[Title/Abstract] OR "food prefer*[Title/Abstract] OR "Eating Behavior*[Title/Abstract] OR "Eating Habit*[Title/Abstract] OR "Dietary Habit*[Title/Abstract] OR "Diet Habit*[Title/Abstract] OR "family diet"[Title/Abstract] OR "weaning"[Title/Abstract] OR "Weaning"[Mesh] OR "Bottle Feeding"[Mesh] OR bottlefe*[Title/Abstract] OR "feeding duration*[Title/Abstract] OR "dietary varia*[Title/Abstract] OR "breast milk"[Title/Abstract] OR "Milk, Human"[Mesh] OR "human milk"[Title/Abstract] OR "Lactation"[Mesh] OR lactation[Title/Abstract] OR "liquid food*[Title/Abstract])) AND ("Infant"[Mesh] OR "Child"[Mesh] OR child*[Title/Abstract] OR infant*[Title/Abstract] OR "newborn*[Title/Abstract] OR baby[Title/Abstract] OR babies[Title/Abstract] OR "toddler*[Title/Abstract])) AND ("Minority Groups"[Mesh] OR "Ethnic Groups"[Mesh] OR "Population Groups"[Mesh] OR "Continental Population Groups"[Mesh] OR ethnic*[Title/Abstract] OR "population group*[Title/Abstract] OR nationalit*[Title/Abstract] OR "ethnic minorit*[Title/Abstract] OR "cultural group*[Title/Abstract] OR "population minorit*[Title/Abstract] OR "racial stock*[Title/Abstract] OR race[Title/Abstract] OR races[Title/Abstract] OR Black[Title/Abstract] OR Blacks[Title/Abstract] OR African*[Title/Abstract] OR "Afro-American*[Title/Abstract] OR "Afro American*[Title/Abstract] OR "American Native*[Title/Abstract] OR "Native American*[Title/Abstract] OR Indian*[Title/Abstract] OR "American Amerind*[Title/Abstract] OR "Indigenous Canadian*[Title/Abstract] OR "Canadian Native*[Title/Abstract] OR Amish[Title/Abstract] OR Arab[Title/Abstract] OR Arabs[Title/Abstract] OR Arabic[Title/Abstract] OR Palestinian*[Title/Abstract] OR Asian*[Title/Abstract] OR Hispanic*[Title/Abstract] OR Mexican*[Title/Abstract] OR "Spanish American*[Title/Abstract] OR "Puerto Rican*[Title/Abstract] OR Latinos[Title/Abstract] OR Latino[Title/Abstract] OR Latinas[Title/Abstract] OR Latina[Title/Abstract] OR Cuban*[Title/Abstract] OR Hispanic*[Title/Abstract] OR Japanese[Title/Abstract] OR Chinese [Title/Abstract] OR Vietnamese[Title/Abstract] OR Cambodian*[Title/Abstract] OR Hmong*[Title/Abstract] OR
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3 Korean*[Title/Abstract] OR Filipino*[Title/Abstract] OR Filipina*[Title/Abstract] OR "Indigenous
4 people*" [Title/Abstract] OR Alaska*[Title/Abstract] OR Inuit[Title/Abstract] OR Inuits[Title/Abstract] OR
5 Kalaallit*[Title/Abstract] OR Inupiat*[Title/Abstract] OR Aleut*[Title/Abstract] OR
6 Eskimo*[Title/Abstract] OR "first nation people*" [Title/Abstract] OR "Native People*" [Title/Abstract] OR
7 Roma[Title/Abstract] OR Romanies[Title/Abstract] OR Romani[Title/Abstract] OR Romany[Title/Abstract]
8 OR Gypsies[Title/Abstract] OR Gipsy[Title/Abstract] OR Hawaiian*[Title/Abstract] OR "Pacific
9 Islander*" [Title/Abstract] OR Maori*[Title/Abstract] OR Aboriginal[Title/Abstract] OR
10 Aborigine*[Title/Abstract] OR Jew[Title/Abstract] OR Jews[Title/Abstract] OR Jewish[Title/Abstract] OR
11 migrant*[Title/Abstract] OR Emigrant*[Title/Abstract] OR immigrant*[Title/Abstract] OR "Emigrants and
12 Immigrants" [Mesh]
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For peer review only

List of High-Income economies [1]

Andorra	Greece	Palau
Antigua and Barbuda	Greenland	Panama
Aruba	Guam	Poland
Australia	Hong Kong SAR, China	Portugal
Austria	Hungary	Puerto Rico
Bahamas, The	Iceland	Qatar
Bahrain	Ireland	Romania
Barbados	Isle of Man	San Marino
Belgium	Israel	Saudi Arabia
Bermuda	Italy	Seychelles
British Virgin Islands	Japan	Singapore
Brunei Darussalam	Korea, Rep.	Sint Maarten (Dutch part)
Canada	Kuwait	Slovak Republic
Cayman Islands	Latvia	Slovenia
Channel Islands	Liechtenstein	Spain
Chile	Lithuania	St. Kitts and Nevis
Croatia	Luxembourg	St. Martin (French part)

Curaçao	Macao SAR, China	Sweden
Cyprus	Malta	Switzerland
Czech Republic	Mauritius	Taiwan, China
Denmark	Monaco	Trinidad and Tobago
Estonia	Nauru	Turks and Caicos Islands
Faroe Islands	Netherlands	United Arab Emirates
Finland	New Caledonia	United Kingdom
France	New Zealand	United States
French Polynesia	Northern Mariana Islands	Uruguay
Germany	Norway	Virgin Islands (U.S.)
Gibraltar	Oman	

References

- 1 World Bank Country and Lending Groups – World Bank Data Help Desk. <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups> (accessed 23 March 2021).

Reporting checklist for protocol of a systematic review and meta analysis.

Based on the PRISMA-P guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the PRISMA-Preorting guidelines, and cite them as:

Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4(1):1.

		Reporting Item	Page Number
Title			
Identification	#1a	Identify the report as a protocol of a systematic review	1-4
Update	#1b	If the protocol is for an update of a previous systematic review, identify as such	n/a
Registration			
	#2	If registered, provide the name of the registry (such as PROSPERO) and registration number	3
Authors			
Contact	#3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1

1	Contribution	#3b	Describe contributions of protocol authors and identify the guarantor of the review	12-13
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4	Amendments			
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7		#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	n/a
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14	Support			
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16	Sources	#5a	Indicate sources of financial or other support for the review	13
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18	Sponsor	#5b	Provide name for the review funder and / or sponsor	n/a
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21	Role of sponsor or funder	#5c	Describe roles of funder(s), sponsor(s), and / or institution(s), if any, in developing the protocol	n/a
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25	Introduction			
26				
27	Rationale	#6	Describe the rationale for the review in the context of what is already known	5-8
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31	Objectives	#7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	7
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36	Methods			
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38	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	6-7
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45	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	8-9
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52	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	16-17
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1	Study records -	#11a	Describe the mechanism(s) that will be used to manage	8-9
2	data management		records and data throughout the review	
3				
4	Study records -	#11b	State the process that will be used for selecting studies	9-11
5	selection process		(such as two independent reviewers) through each phase	
6			of the review (that is, screening, eligibility and inclusion in	
7			meta-analysis)	
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11	Study records -	#11c	Describe planned method of extracting data from reports	9-10
12	data collection		(such as piloting forms, done independently, in duplicate),	
13	process		any processes for obtaining and confirming data from	
14			investigators	
15				
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18	Data items	#12	List and define all variables for which data will be sought	7-9
19			(such as PICO items, funding sources), any pre-planned	
20			data assumptions and simplifications	
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24	Outcomes and	#13	List and define all outcomes for which data will be sought,	10-11
25	prioritization		including prioritization of main and additional outcomes,	
26			with rationale	
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29	Risk of bias in	#14	Describe anticipated methods for assessing risk of bias of	11
30	individual studies		individual studies, including whether this will be done at the	
31			outcome or study level, or both; state how this information	
32			will be used in data synthesis	
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36	Data synthesis	#15a	Describe criteria under which study data will be	10-11
37			quantitatively synthesised	
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40	Data synthesis	#15b	If data are appropriate for quantitative synthesis, describe	10-11
41			planned summary measures, methods of handling data and	
42			methods of combining data from studies, including any	
43			planned exploration of consistency (such as I ² , Kendall's τ)	
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46	Data synthesis	#15c	Describe any proposed additional analyses (such as	10-11
47			sensitivity or subgroup analyses, meta-regression)	
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50	Data synthesis	#15d	If quantitative synthesis is not appropriate, describe the	10-11
51			type of summary planned	
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54	Meta-bias(es)	#16	Specify any planned assessment of meta-bias(es) (such as	10-11
55			publication bias across studies, selective reporting within	
56			studies)	
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1 Confidence in #17 Describe how the strength of the body of evidence will be 10
2 cumulative assessed (such as GRADE)
3 evidence
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8 <https://www.goodreports.org/>, a tool made by the [EQUATOR Network](#) in collaboration with
9 [Penelope.ai](#)
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