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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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ABSTRACT

Introduction Complementary feeding (CF) is defined as the period from when exclusive breast milk and formula are no longer sufficient for meeting the infant's nutritional needs. The CF period occurs from birth to 23 months of age. Though the recommended guidelines for introducing CF is from around 6 months of age, data indicates that some infants are introduced to food earlier than 6 months which can predispose children to obesity and overweight. Obesity in ethnic minority groups (EMG) is higher than their native counterparts and often tracks into adulthood. Hence, our aim was to conduct a systematic review and meta-analysis on the available literature to identify the risk of childhood overweight/obesity associated with CF practices concerning their timing, as well as the frequency and type of CF food introduced. We focused specifically on EMG children living in high-income countries.

Methods and analysis A methodological literature search surrounding childhood obesity and overweight (COO) risk associated with CF practices will be conducted in May 2021 following Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols guidelines. The following academic databases will be methodologically searched: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library and the WHO Global Index Medicus. Three independent researchers will be involved in independent screening and review the included articles based on the predefined inclusion and exclusion criteria. Where conflicts arise during the screening process, it will be resolved through discourse until a consensus is reached. Information on CF practices and anthropometric measurements will be extracted to ascertain the risk of COO. For this study, WHO body mass index for age and sex percentiles, Centers for Disease Control and Prevention classification and other recognised country-specific classifications will be utilised for the outcome.

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

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Strengths and limitations of this study

- First systematic review considering extensive analysis of childhood overweight and obesity and the risk in multiple ethnic minority group children in high-income countries on complementary feeding practices.
- Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA) and PRISMA 2009 guidelines follow the systematic review and meta-analysis.
- Expert librarian specialising in database search strategy has developed the search protocol.
- Our review will capture a small number of studies that are likely to meet the inclusion criteria due to language restriction and heterogeneity between studies is expected to be high.
- In the reported effect estimates, lack of uniformity may be one of our limitations.

BACKGROUND

Childhood obesity and overweight (COO) is a global health problem in high-income countries (HICs), although it has also emerged as a problem in low-income and middle-income countries, according to the WHO.[1] Evidence implies that COO, feeding practices, and mean nutrient disparities are associated with race and ethnicity and are often entangled with income (Davis *et al*[2]). Due to international migration, disparities in COO should be expected. International migration to HIC has continued to increase globally, with 57% of migrants living in HIC, where communities have become more diverse. In 2010, the International Organisation for Migration estimated the worldwide migration was estimated to be 214 million people (2010).[3] However, research on ethnicity related obesity risk in childhood is considerably limited.[4] Given the

increasing migration rate from poorer to HIC, COO in ethnic minority groups (EMG) presents a potential public health concern, warranting further research to better understand and identify contributing factors. Ethnic minority children are children who are born to parents identified as ethnic minorities in HIC.

Complementary feeding (CF) is defined as 'the process starting when breast milk is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed, along with breast milk'[5] CF usually occurs from 6 to 23 months, even when breast feeding continues over 2 years of age.[5] CF has always been focused on providing nutritious, clean, safe and adequate food to meet the nutritional requirements of infants and children. CF aims to reduce malnutrition and infections, although there have been growing concerns regarding its potential contribution to COO.[6] It is recommended to exclusively breastfeed (EBF) for the first 6 months of life and continue for up to 2 years or beyond with appropriate, adequate, and safe CF.[7] Poor CF practices and breastfeeding are widespread, with just 34.8% of infants exclusively breastfed and most infants given food or liquids before the recommended 6 months.[1 8–10] Some studies suggest that COO is less common in children and adolescents who have been exclusively breastfed[5 10–13] although differences are negligible in other studies or present conflicting findings.[9]

The WHO defines exclusive breastfeeding for the first 6 months of life to achieve appropriate growth and development.[14] The age of introduction of CF varies among different European countries between 4–6 months,[15] with studies confirming the early introduction of solid foods in Australia,[16] the UK[17] and the USA.[18] One of the reasons for early recommendation by healthcare professionals could be because many of the infants are started early CF are also formula-fed (FF).[19] Many assumptions have less scientific evidence leading to major variations in the recommendations of CF in different HIC.

Introducing solid foods earlier than the recommended 6 months has been shown to predispose children to overweight/obesity, as highlighted in several reviews.[10 20 21] Recommendations surrounding the optimal timing of the introduction of solid are limited and vary between countries, cultures and food availability.[22] For instance, the UK recommends weaning around 6 months alongside breastfeeding until at least 1 years old. Other European countries recommend trial foods or small tastes between 4 and 6 months.[22] Composition of diet and how parents' approach CF is closely aligned to culture and other factors. Bangladeshi, Indian or Pakistani mothers prefer introducing sweet food earlier. In contrast, compared with African and Caribbean origin, mothers prefer introducing savoury food types.[23] Recommendations for starting solid foods by different countries are often in line with the WHO, thus making it plausible to follow the same guidance for our study. Studies have discovered that early rapid weight gain during infancy is related to subsequent COO risk.[24 25] The relationship between rapid weight gain and later childhood obesity further emphasises the potential programming that occurs very early in life, resulting in COO and associated health problems related to CF practices. A cohort study by Ardic *et al* found that early feeding habits might be permanent and pose a risk to later health outcomes.[26] In line with this study, Baran (2019), Pearce (2016) and Wang (2013) also found that breastfeeding less than 6 months and introducing adults' meals before 12 months were contributory factors for the prevalence of overweight and obesity in preschool children.

In at least two different studies, differences across EMG concerning CF practices and COO prevalence have been identified.[10 27] The differences are embedded in social and household contexts in either increasing or decreasing the risk of obesity. However, Kumanyika (2008) has highlighted that available evidence can be sparse, heterogeneous and difficult to meaningfully summarise. Two studies have explored the cultural influences of CF practices among Chinese and South Asian children.[28 29] However, overweight/obesity risk in relation to CF practices has not yet been collectively analysed in different EMG children. Our research will review those 0–2 years old children who are born to parents identified as ethnic minorities in HIC.

Furthermore, it is known that CF practices are associated with early COO, yet the extent of the problem is unknown for EMG children living in HIC. Considering the substantial global burden of COO, it is important to understand the association between CF practices and COO, specifically among EMG children living in HIC. We propose to conduct a comprehensive systematic review and meta-analysis to address this research question in this protocol. Hence, in our systematic review and meta-analysis, we aim to identify the risk of childhood obesity during the CF period associated with CF timing, frequency and the type of CF food introduced.

METHODS/DESIGN

This protocol follows the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA) guidelines[30] and has been informed by the Cochrane Handbook for Systematic Reviews of Interventions.[31] The final review will be reported according to the 2020 PRISMA statement.[32] The start date for the review will be June 2021, and the estimated date for completion will be May 2022.

Eligibility criteria

Inclusion criteria

We will include randomised controlled trials (RCTs), cohort studies, case–control studies and cross-sectional studies. We will include studies reporting direct and/or indirect effect sizes in children who were exposed to CF at any age from 0 to 24 months. All studies should estimate the association between the measured exposure (CF) and the outcomes (weight gain). Such estimates reported

Table 1 Predefined inclusion and exclusion study criteria according to PICOS

PICOS	Inclusions	Exclusions
Participants	Ethnic minority children aged between 0 and 2 years; living in HIC. Ethnicity self-identified by participants including all migrants' generations.	Preterm and low birthweight children; children with medical problems that can affect body weight, for example, Prader Willi Syndrome, failure to thrive, metabolic disorders, Hypothyroidism, Cushing syndrome, growth hormone deficiency, etc.
Interventions	CF practices include the timing of introduction of semisolid, 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

BMI, body mass index; CF, complementary feeding; HIC, high-income countries; RCTs, Randomised Controlled Trials.

should be calculated or calculable. The systematic review will be conducted using the Participants, Interventions, Comparisons, Outcomes(s) (PICOS) approach and type of study from which studies are identified.[31 33 34] Inclusion and exclusion criteria are listed according to PICOS in table 1.

The study population will be children from EMGs aged 0–2 years who reside in HIC. The study outcome will investigate the association between CF practices and the risk of COO. The outcomes will include anthropometric measurements, including body mass index (BMI) z-scores or BMI percentiles. The review results on CF will be evaluated using the recommended optimum CF guidelines by WHO (2008). It is recommended that exclusive breastfeeding continues until 6 months and up to 2 years and beyond. Introduction of solids, soft and other liquids, other than breast milk or formula, is recommended from 6 months onwards. The study's outcome (COO) will be classified according to WHO BMI for age and sex percentiles and the Centers for Disease Control and Prevention (CDC) classification and other recognised classifications. According to the CDC, overweight is defined as BMI ≥85th and <95th percentile, while obesity is BMI of ≥95th percentile for children <18 years of the same age and sex.[35] These two classifications have previously been compared by Gaffney *et al*, who found that 1 SD unit above the median of the WHO growth curve population approximates the 85th percentile.[36] BMI does not measure body fat. If available, skinfolds measurements, dual energy X-ray absorptiometry and other methods will be used.

Exclusion criteria

Studies that are not published in English and do not present original data will not be included. Other studies that will be excluded are narrative reviews, systematic reviews and meta-analyses, opinion articles, editorials, letters to the editor, published abstracts without a published full-text, student dissertations/theses and blog posts. Studies that do not include anthropometric measurements in EMG children as part of the outcome before the age of 2 years will be excluded.

Search strategy

Developing research question and search query domains

We will search for papers published between 2000 until search date. A systematic search of the literature will be conducted in May 2021 by a specialist medical librarian (LÖ). The electronic databases: PubMed, EMBASE, PsycINFO, CINAHL, SCOPUS, Cochrane Library the WHO Global Index Medicus will be included and covered from 2000 to the search date. No filters or limitations will be applied. A preliminary search in PubMed was carried out in April 2021 to identify relevant search terms and search technical solutions (LÖ). The search terms were systematically identified with the support of PubMed's MeSH, by analysing the indexing of previous, relevant studies which was informed by input from the subject specialists (MT and MABK). A copy of the preliminary search strategy in PubMed is available in online supplemental file 1. Hand screening of reference lists of the studies that meet the pre-defined criteria will also be conducted.

Detailed search documentation for all included databases will be appended to the final review to allow search reproducibility and transparent appraisal of the search strategy and results. Finally, Cabell's Predatory Reports in Cabell's Scholarly Analytics will be consulted to ensure that none of the finally selected studies published in open-access journals are listed as potential predatory journals.

Data extraction and management

Screening and study selection

Covidence systematic review software by Veritas Health Innovation (2021) will be used to automatically deduplicate and blind screen all records identified in the database search. After duplicated studies have been removed, unique records will be screened based on the title and/or abstract by two independent reviewers (MT and MABK). Articles that do not meet the criteria will be excluded.

Eventual disagreements will be resolved through blinded conflict resolution through Covidence by a third reviewer (LÖ), further reducing bias risk. Similarly, full-text review will be carried by two independent reviewers (MT and MABK), resolving conflicts for ambiguous inclusion by a third reviewer (LÖ) through Covidence. Details from the screening and selection process, including reasons for exclusion of the omitted full-text studies, will be documented in a PRISMA 2020 flow diagram.

Data extraction

For extraction of data, a piloted form will be used. Data will be extracted for each study that meets the eligibility criteria by two researchers and the third researcher will resolve any discrepancies. The following data if available will be extracted: surname of the first author, publication year, HIC, participant's ethnicity, study design, sample size, participant's age, breastfeeding duration, CF timing and frequency, primary outcome, anthropometric measurements, length of follow-up and types of CF, effect size (OR/risk ratio, RR) and mean difference (MD). HIC list provided in online supplemental file 2.

The child's ethnicity will be determined by the country of birth of the parents, although ethnicity identification by country of birth has caveats because a diversity of the country-of-origin can differ.[37] In addition, diversity collection practices differ among Organisation for Economic Cooperation and Development countries. Some countries collect indigenous identity, others race and ethnicity, and migrant statuses.

Output

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

Risk of bias in the primary study

Two authors (MT and MABK) will assess the quality of studies independently using the Newcastle Ottawa Scale (NOS) and modified NOS for assessing quality of non-randomised studies in the meta-analysis. The tool assesses participant selection, comparability of groups and outcome or exposure depending on the type of study.[38] A point is given for each item in the three sections if the study meets the criteria. The maximum score for cross-sectional studies is ten and nine for cohort studies. Assessment of the internal validity of primary studies is crucial in systematic reviews to identify the risk of bias. It has been noted that, while the NOS quality assessment scale is challenging and more subjective in non-randomised studies compared with RCTs, there is no other widely accepted tool for non-randomised studies.[39] Grading of Recommendations Assessment, Development and Evaluation (GRADE) quality review tool will be used for RCTs. Disagreements with grading will be resolved through discourse and revisiting the inclusion criteria by both authors (MT and MABK).

Analysis and data synthesis

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

The results of the included studies will be synthesised using pooled estimates and pooled ORs or RR applying random effects model with 95% CIs where data permits to conclude the pooled COO risk. Random-effects meta-analysis will be limited to studies reported on pooled estimates and at least ten studies with low to moderate heterogeneity for meaningful results. Heterogeneity will be assessed using the I^2 and visual inspection of forest plots. For dichotomous data, RR and 95% CI will be calculated and for continuous data, MD and 95% CI will be used. MD will be converted to RR if possible. Forest plots will be used to visually present the estimated weighted results from different studies.

Bias minimisation

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

Patient and public involvement

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

DISCUSSION

Our review is unique, and to our knowledge, is the only review considering extensive analysis of COO risk in multiple EMG children residing in HIC about CF practices. EMG children are the offspring of migrant families who live in a different country from their parent's country of origin. Immigration can be diverse and varied from country to country. EMG in the USA comprises a third of the population.[27] The immigrant population of Canada is 21%,[3] whereas the UK is 13%.[40] Although diversity is considered based on country of birth, this can pose problems due to within-country diversity from the country of origin.[37]

Identifying the causes of COO among different EMG can be complex and challenging. It could be hypothesised from previous studies that there can be multiple reasons for the EMG families to adopt CF prematurely. FF is more common in HIC and, in contrast to Low-income countries (LIC), where FF is expensive, parents are more likely to resort to FF and early CF in HIC. With immigration comes more work responsibilities, increased stress and poor diet. Furthermore, the stress has been exacerbated by the current pandemic.[41–44] This can potentially result in lower breastfeeding rates and reduced production of breast milk which, in turn, may lead to the earlier introduction of CF.[45] Gaining weight, lesser crying and improved sleeping patterns are being seen by parents as being healthier for the baby and a positive choice for earlier CF. The trends of the new immigrating HIC influence these factors.[46]

Reviews have shown that insufficient knowledge, feeding attitude changes due to acculturation and incorrect advice lead to practising earlier CF resulting in COO.[28 46] A similar review that explored COO concerning CF was conducted in the general population without stratification on EMG or HIC.[21] Although another review on CF practices focused on South Asian children in HIC as an EMG, they did not report on obesity risk. Still, they identified significant differences in CF practices that were obesogenic.[28] On the other hand, one earlier review identified a clear association among the general population in developed countries.[47] This means that with a combined multiple ethnicities review, there is a possibility of statistically meaningful results identifying COO risk in EMG children residing in HIC. Such risk poses an important need for public health interventions. Evidence suggests adherence to BF and appropriates CF to improve growth and development of child.[48] Moreover, there has been a disparity in bodyweight changes among children, especially among ethnic minorities.[43 44 49] Our study will contribute to the efforts to prevent COO within EMG that is often under-researched and marginalised. Furthermore, we envisage our study to enhance the reduction in health disparities experienced by EMG through subsequent targeted interventions.

To our knowledge, it is the first review considering an extensive analysis of COO risk in multiple EMG children residing in HIC pertaining to CF practices. COO has been confirmed to be higher in EMG compared with native groups. If CF practices among EMG are a contributory factor in COO, our review will bring evidence for targeted interventions to prevent rather than cure COO by promoting healthy weight throughout childhood years. It will also highlight the scarcity of research within marginalised EMG by identifying gaps and making recommendations for future studies in CF practices.

The review is not without limitations. First, most studies included will be observational. Second, studies among EMG in HIC tend to be limited, with ethnic groups making up small samples. Additionally, language barrier difficulties may be present in the host country. Therefore, our review will likely capture a small number of studies likely to meet the inclusion criteria, and heterogeneity between studies is expected to be high. Population diversity will further increase heterogeneity risk. There is potential that some studies, which include EMG, may be missed due to countries using varied ethnicity classifications, paired with the subjective nature of ethnicity.

CONCLUSION

This systematic review will highlight the CF practices in the EMG regarding frequency, the timing of CF and the identified factors that could have influenced CF. Such a systematic review will increase awareness and guide improvement and create future policies aimed at preventing COO.

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Contributors MT and MABK were involved in all aspects of the study, from conceptualisation, protocol development and the preliminary search strategy. LÖ developed the preliminary search strategy, contributed with text for the methods part of the manuscript and will conduct the final literature search and the reference management in Covidence. Further screening of literature and data extraction will be carried out by MT and data validated by MABK. TA revised the first draft for intellectual content and will assist with drafting and revising content in the final project. OM will oversee the data extraction process and complete all aspects of the meta-analysis.

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