ABSTRACT

Objectives This review aimed to provide an overview of the prevalence of undernutrition in children under 5 years old in refugee camps according to the different indicators. In addition, we aimed to evaluate the quality and quantity of relevant epidemiological data available.

Design We used a systematic review of prevalence study design to achieve the above aims. We sought eligible observational studies through database searching of OVID Medline, CABS Global Health, Scopus and PubMed; citation chasing; and grey literature searching.

Setting The setting of interest was refugee camps across the globe.

Participants Participants in the studies included in the review were children under 5 years old.

Primary and secondary outcome measures Outcome measures of interest were the prevalence of wasting, global acute malnutrition, stunting and underweight.

Results The review included 33 cross-sectional studies in 86 sites and a total of 36750 participants. Overall, the quality of the studies was moderate to high, but some reports lacked clarity around data collection or outcome definitions. The results showed a wide variation in prevalence estimates across the different indicators and between different refugee camps. The median prevalence estimates of global acute malnutrition based on weight-for-height z-score, stunting and underweight were 7.1%, 23.8% and 16.7%, respectively. Using weight-for-height z-score identified a higher prevalence of acute malnutrition than using mid-upper arm circumference in the majority of studies.

Conclusions Acute malnutrition remains a public health problem in many refugee camps, but chronic malnutrition has a high prevalence in more locations. Research and policy must, therefore, focus not only on nutrition but also on the wider determinants of both acute and chronic undernutrition. The difference in prevalence of global acute malnutrition depending on the measure used has implications for screening and diagnosis.

INTRODUCTION

Undernutrition is a form of malnutrition where a person’s dietary intake of energy is insufficient to meet their physiological needs. Undernutrition is the result of a complex interplay of social, environmental and biological factors including poverty, inappropriate nutrition and care practices, inadequate health services, and infections and illnesses. People living in precarious situations, such as those who are displaced from their homes, are some of the most vulnerable to the impact of malnutrition. In addition, these populations may face a triple burden of malnutrition where undernutrition, micronutrient deficiencies and overnutrition may coexist at individual, household or population levels.

The United Nations High Commissioner for Refugees (UNHCR) defines refugees as ‘all persons outside their country of origin for reasons of feared persecution, conflict, generalised violence or other circumstances that have seriously disturbed public order and who, as a result, require international protection’. (UNHCR, P3) According to the UNHCR, there were 27.1 million people worldwide officially recognised as refugees at the end of 2021. Refugee camps are collections of temporary homes for refugees where the UNHCR, host governments or non-governmental organisations often support the immediate needs of the people living there.
Undernutrition is harmful to health at any age, but children under 5 years old are at particular risk with nearly half of global deaths in this age group related to undernutrition. In addition, the prevalence of acute malnutrition in children under 5 years is used in emergency situations as a proxy indicator for the nutritional status of the wider population. Both acute and chronic malnutrition in infants and young children increase the risk of death from infectious diseases and have been associated with poor mental health, developmental and psychosocial outcomes later in life. Acute malnutrition is considered an emergency given the immediate threat to life that it poses; children with SAM have a 5–20 times higher risk of death than children without acute malnutrition. Due to these short-term and long-term effects, reducing the prevalence of malnutrition is recognised as a global priority in both the United Nations' Sustainable Development Goals and WHO’s 2025 Global Nutrition Targets.

To the best of our knowledge, there are no recent systematic reviews of the prevalence of undernutrition in refugee camps. This review will explore the prevalence of undernutrition in children under 5 years old living in refugee camps across the world, comparing the various indicators of undernutrition. The aim of the review is to provide an understanding of the variability in the burden of undernutrition in different refugee camps in order to guide public health policies. A further aim of the review is to evaluate the quality and quantity of data available in the public domain as is relevant for policy-making, funding decisions and the transparency of governmental and non-governmental organisations working with refugees.

### METHODS

We conducted this systematic review of prevalence following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (see online supplemental appendix 1) and methodological guidance on systematic reviews of epidemiological studies from the Joanna Briggs Institute (JBI).
Eligibility criteria

We used the mnemonic condition, context, population to guide the creation of eligibility criteria (see online supplemental appendix 2 for full eligibility criteria). In order to be included, a study needed to include data on the prevalence of at least one measure of undernutrition where some or all participants were children under 5 years old living in a refugee camp. Included studies were required to present primary data from an observational study with the full text published in English either in the public domain or accessible via institutional access. We included only studies published after 2015 in order to recognize the potential contributions and impact of the introduction of the Sustainable Development Goals to the research. While we cannot be certain that studies published after 2015 do take into account the agreed targets for development, we suggest that there is a greater likelihood that they are appropriately considered, and research prior to 2015 may, therefore, differ contextually to those papers published after this date. Studies were excluded if the data for the population of interest was inseparable from other groups. We excluded intervention studies since the participants might not be representative of the general population of children in refugee camps.

Literature search

We conducted comprehensive searching of OVID Medline, CAB Global Health, Scopus and PubMed databases on 12 May 2022 (see online supplemental appendix 3 for full search strategy). Manual backward citation chasing was conducted for all studies included in the review. Forward citation chasing was conducted using the Scopus database citation indexing, or Web of Science if the paper was not available on Scopus, on 11 July 2022. Extensive grey literature searching was conducted on 12 July 2022, which included searching the websites of UNHCR, United Nations Children’s Fund, Action Against Hunger, Relief Web, World Food Programme, ACAPS, The Border Consortium, Global Nutrition Cluster and United Nations Relief and Works Agency for Palestine Refugees in the Near East (see online supplemental appendix 4). If more than one nutrition survey was available for the same location within the eligible time period, only the most recent survey was included.

Data evaluation

After searching, we exported the results to Mendeley Reference Manager to screen titles and abstracts, followed by eligibility assessment of full texts. AS conducted all screening and eligibility assessment and DC independently screened a 10% sample of papers at each stage and disagreements on eligibility were discussed. For included studies, we manually extracted data using a data extraction sheet adapted from an earlier systematic review of prevalence data (see online supplemental appendix 5). The data extraction sheet included the 9-point critical appraisal checklist developed by the JBI, which provides an indication of quality and risk of bias.

The checklist produced a score from 0 to 9 with 1 point awarded for each question where the answer was ‘yes’ and 0 points awarded for each question where the answer was ‘no’, ‘unclear’ or ‘not applicable’. Although no validated cut-off points exist, a score of 9 indicates high quality and a score of 0 indicates low quality or greater risk of bias.

Data items

Variables of interest in the studies included country, camp or camps, age and sex distribution of participants, outcomes reported, outcome definitions used, sample size, type of study, sampling method, response rate and methods of data collection (see online supplemental appendix 5).

Outcomes

The outcomes of interest to this review are commonly used in nutrition surveys and are defined in line with UNHCR Standardised Expanded Nutrition Survey (SENS) recommendations (see table 1). Most of these outcomes are defined by comparing a child’s anthropometric measurements to the 2006 WHO growth standards which were produced by taking measurements from a large, international cohort of children with optimal conditions for growth. While there is some debate on the matter, the general understanding is that all children have similar potential for growth if given the right conditions and therefore, it is reasonable to use these standards to determine whether a child is malnourished. Comparing a child’s measurements to the median for the same sex and/or age gives a z-score which indicates the number of SDs away from the median. For this review, we were interested in the estimated prevalence for each indicator.

Data synthesis

We synthesised the results narratively and in tabular form to summarise and compare prevalence estimates. For quantitative analysis, we produced box-and-whisker diagrams and forest plots to show the distribution of prevalence estimates for the different indicators and refugee camps. We also compared the prevalence of wasting and stunting in refugee camps in the review to prevalence thresholds for level of public health significance used by UNHCR (see table 2).
Meta-analysis to obtain pooled estimates was not appropriate (in line with guidance from Munn et al) given that the prevalence of undernutrition is highly variable depending on context including factors such as food security, healthcare resources, carer mental health and access to clean water and sanitation.2 15

Patient and public involvement
None.

RESULTS
Study selection
Database searching retrieved a total of 98 records. After removing duplicates, we screened the title and abstract of 46 records and then conducted eligibility assessment of the full texts of 12. Eight of these reports met the eligibility criteria and were included in the review. Citation chasing found a further two reports which were included. Grey literature searching retrieved 30 reports of which 23 met eligibility criteria. In total, 33 reports were included in the review.24–56 Figure 1 shows the search process using the PRISMA flow diagram template.16

Study characteristics
These 33 studies included data from 86 individual or grouped refugee camps across 18 countries (see online supplemental appendix 6 for further details of included studies). There were a total of 36 750 participants included in the review. Thirteen of the camps were featured in multiple studies meaning there is a possibility some participants were involved in more than one study. However, this number is likely to be small because there are few studies concerned and they were conducted in different years. All the studies used a cross-sectional design to produce prevalence estimates for one or more of the outcomes of interest to our review. With the exception of four studies, all participants were aged between 6 and 59 months.

Quality of included studies
The JBI critical appraisal checklist scores give an indication of the level of quality of the studies included in the review. Twenty-five of the 33 studies had a score of 8 or higher which is likely to reflect a high quality of evidence. Many of the studies that scored 8 lost a point for not reporting a response rate which meant we could not assess the risk of selection bias resulting from non-response. Seven studies had a JBI score between 5 and 7, potentially suggesting a medium level of quality, many due to a lack of clarity around the outcome definitions and data collection methods. This means we could not assess the risk of misclassification bias or the consistency and appropriateness of data collection methods. One study was of poor quality with a score of 2, suggesting a higher risk of bias, due to a lack of clarity in several areas including the number of participants in the study.44 These scores suggest that, overall, the studies were of moderate to high quality, so we can have a good degree of confidence in the evidence that they provide.

Prevalence of undernutrition in children in refugee camps
Table 3 presents summary statistics from the included studies. Figure 2 shows the distribution of prevalence.
estimates to allow comparison between the different indicators of undernutrition. Figures 3–10 show forest plots of estimated prevalence for each indicator in each refugee camp, organised by country, to allow comparison across different locations. The completed data extraction forms and full results tables are available on request.

The prevalence of GAM based on WHZ was lowest in Dzaleka, Malawi at 1.0% (0.4–2.9)\(^25\) and highest in Nguenyyiel, Ethiopia at 29.5% (25.8–33.5)\(^25\) (see figure 3). The prevalence of SAM based on WHZ was also highest in Nguenyyiel, Ethiopia at 8.0% (6.0–10.6),\(^25\) while several sites had a prevalence of SAM of 0.0%\(^26\) 29 30 34–36 42 43 46 (see figure 4). In contrast, the prevalence of GAM based on MUAC was lowest in Mugombwa, Rwanda at 0.0% (0.0–0.0)\(^29\) and highest in Berhale, Ethiopia at 13.8%\(^30\) (see figure 5). The prevalence of SAM based on MUAC was also highest in Berhale at 4.9%\(^39\) and, again, multiple sites demonstrated a prevalence of SAM by MUAC of 0.0%\(^24\) 29 30 34 36 40 42 43 45 (see figure 6). The prevalence of stunting ranged from 2.4% (1.3–4.4) in Pugnido II, Ethiopia\(^25\) to 53.9% (48.7–59.0) in PTP, Liberia\(^36\) (see figure 7). The prevalence of severe stunting ranged from 0.3% (0.0–2.0) in Za’atri, Jordan\(^15\) to 24.4% (20.3–28.9) in Hilaweyn, Ethiopia\(^40\) (see figure 8). The prevalence of underweight ranged from 2.1% in Drama, Greece\(^47\) to 40.5% (35.7–45.5) in Buramino, Ethiopia\(^40\) (see figure 9). Of the few studies that reported wasting rather than GAM, the prevalence of wasting based on WHZ ranged from

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Summary statistics—prevalence of undernutrition in children under 5 years old in refugee camps (%)</th>
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</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Median</td>
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<tr>
<td>GAM by WHZ</td>
<td>7.1</td>
</tr>
<tr>
<td>SAM by WHZ</td>
<td>0.8</td>
</tr>
<tr>
<td>GAM by MUAC</td>
<td>3.2</td>
</tr>
<tr>
<td>SAM by MUAC</td>
<td>0.5</td>
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<tr>
<td>Stunting</td>
<td>23.8</td>
</tr>
<tr>
<td>Severe stunting</td>
<td>5.2</td>
</tr>
<tr>
<td>Underweight</td>
<td>16.7</td>
</tr>
<tr>
<td>Wasting</td>
<td>5.9</td>
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</tbody>
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*Calculations excluded estimated prevalence of wasting in Gado-Badzere\(^29\) due to the sample not being representative of the general population of children in the refugee camp.

GAM, global acute malnutrition; MUAC, mid-upper arm circumference; SAM, severe acute malnutrition; WHZ, weight-for-height z-score.
Figure 3  Prevalence of GAM by WHZ by refugee camp (95% CI). GAM, global acute malnutrition; WHZ, weight-for-height z-score.
Figure 4  Prevalence of SAM by WHZ by refugee camp (95% CI). SAM, severe acute malnutrition; WHZ, weight-for-height z-score.
Figure 5  Prevalence of GAM by MUAC by refugee camp (95% CI). GAM, global acute malnutrition; MUAC, mid-upper arm circumference.
Figure 6  Prevalence of SAM by MUAC by refugee camp (95% CI). MUAC, mid-upper arm circumference; SAM, severe acute malnutrition.
Figure 7  Prevalence of stunting by refugee camp (95% CI).
Figure 8  Prevalence of severe stunting by refugee camp (95% CI).
Figure 9  
Prevalence of underweight by refugee camp (95% CI).
2.1% in nine camps on the Thailand-Myanmar border\textsuperscript{55} to 36.1% in Gado-Badzere, Cameroon\textsuperscript{54} (see figure 10). However, the participants included in the study in Gado-Badzere were all patients at the medical centre who presented with fever. Since these children were acutely unwell and possibly more like to be acutely undernourished they may not represent the general population of children under 5 years old in the camp so this estimate should be treated with caution. None of the studies included in the review reported the prevalence of wasting defined by MUAC.

Table 4 compares the proportion of refugee camps with very low to very high prevalence of wasting or GAM and stunting using the thresholds used by UNHCR and shown above in table 2.\textsuperscript{25} Of the 88 estimates of prevalence of wasting or GAM by WHZ, 37.5% were of low or very low significance, 26.1% were of medium significance and 36.3% were of high or very high significance. Of the 91 estimates of prevalence of stunting, 9.9% were of low or very low public health significance, 24.2% were of medium significance and 66.0% were of high or very high significance.

**DISCUSSION**

The aim of this review was to explore the prevalence of undernutrition in children under 5 years old in refugee camps across the globe, comparing different camps and different indicators as well as evaluating the quality and quantity of evidence available. We found a large quantity of recent data on the prevalence of undernutrition in refugee camps, including 33 reports which covered 86 sites and included 36,750 children. Overall, the studies were of good quality, with most studies reporting valid and consistent methods of defining and measuring the outcomes of interest.

The results of this review show that there is great variation in the prevalence of various indicators of undernutrition among children under 5 years old in refugee camps within and across different countries. A greater proportion of camps had a high or very high prevalence of stunting than the proportion which had a high or very high level of wasting (66.0% compared with 36.3%). This suggests that although acute malnutrition is still a significant problem in several camps, chronic malnutrition may be of greater public health concern within many refugee camps. Given the immediate increased risk of mortality that acute malnutrition carries, providing adequate nutrition, ensuring good healthcare provision and reducing the risk of infectious diseases should continue to be a priority in refugee camps.\textsuperscript{2} Given the high prevalence combined with the long-term impacts on health, well-being and economic productivity, reducing stunting in children in refugee camps also deserves greater attention.\textsuperscript{2,12,13} Stunting is the result of a multitude of biological, social and environmental factors and is thought to often begin in utero.\textsuperscript{49} In this way, we recognise that a high prevalence of stunting may be present in children arriving at refugee camps which cannot be overcome by interventions within the camp. Nevertheless, it is necessary to consider what can be done to allow for catch up growth and to prevent further stunting. In addition, this highlights the importance of health and nutrition interventions for pregnant women to reduce the prevalence of stunting in children born in refugee camps.\textsuperscript{1}

Further, the degree of variability of level of prevalence of...
undernutrition across the different camps suggests that the conditions and services available in the camp as well as the wider context within both host country and the country of origin may all come together to influence the level of undernutrition.²⁴

While both MUAC and WHZ can be used, they tend to capture different cases of acute malnutrition, and therefore, it is recommended to use both rather than relying on one over the other.⁵⁷ However, in emergency situations, screening for acute malnutrition is often conducted using MUAC tapes which are inexpensive and easy for carers and healthcare workers to use.² Many of the studies in the review reported the prevalence of GAM based on both WHZ and MUAC and showed a disparity in the prevalence based on these two definitions. The median prevalence of GAM by WHZ was 7.1% compared with 3.2% for GAM by MUAC. Our findings, therefore, support previous evidence that MUAC and WHZ do not capture the same cases of acute malnutrition and perhaps suggests that consideration should be given to how these cases are diagnosed in practice to ensure that children receive timely treatment.⁵⁷

When comparing the prevalence of any indicators of undernutrition, the methodology used by different studies is important to ensure that the outcomes were defined and measured in the same way and that populations were sampled appropriately. Nineteen of the 33 studies in this review used the UNHCR SENS methodology.¹⁹ Using this standardised methodology enabled easier comparison across different studies because the sampling, data collection, outcome definitions and reporting were similar. Five of the remaining studies were not clear in reporting the data collection methods or outcome definitions which makes it more difficult to compare results across different studies as well as increasing the risk of bias. The vast majority of studies included in our review used z-scores based on the WHO reference data to define stunting and acute malnutrition. This standardisation allows for better comparison of data across studies, regions and time.

In addition to anthropometric indicators included in this review, SENS surveys assess various other indicators related to child and maternal nutrition and health. This standard and comprehensive methodology enables policy-makers and researchers to have a better understanding of the nutrition status in a refugee camp than some of the more limited methodologies in the studies included. UNHCR has produced an interactive resource showing SENS results from a large number of refugee camps.³⁸ While this resource provides a useful overview, the details included are limited so deeper exploration or analysis is not possible. In addition, we found these SENS reports only through grey literature searching and as such were not as easy to find as reports published on research databases. Some further SENS reports were not publicly available or were not published in English. To aid policy-makers and researchers, it would be beneficial for the SENS website to include more details or links to the full reports for all of the data included.

Strengths
Among the strengths of this review are the large quantity and overall quality of data. By including 36750 participants over 86 sites, we were able to provide a comprehensive overview of the prevalence of undernutrition in children in refugee camps. In addition, reporting on several different indicators of undernutrition allowed for comparison between acute and chronic malnutrition as well as different ways of determining acute malnutrition in particular.

Limitations
There are several limitations to our review. First, there is a risk of publication bias especially given that we excluded reports published in any language other than English. There is also a chance that the refugee camps in which surveys or studies have been conducted and published differ to those for which there are no data available, therefore, we cannot be certain that this review captures the full spectrum of undernutrition prevalence. Second, while every effort was made to make the searching as extensive as possible, we recognise that the strategy used was not exhaustive and other relevant literature may, therefore, be missing from the review. We mitigated some of the risk of missing literature through consultation with expert stakeholders. Our paper aimed to reflect the potential impact of the Sustainable Development Goals by including only studies published after their introduction in 2015. It is possible that some of the studies were conducted before this date, and therefore, do not reflect any changes after this time. However, of the papers included in our review, only two were conducted prior to 2015.

Given that all studies in the review were conducted in refugee camps, there are certain contextual issues that may have limited the quality of evidence in each study. As noted by some of the studies, the precarious nature refugees find themselves in and previous negative experiences with researchers or authorities sometimes posed a limitation to their willingness to participate and may have contributed to selection bias. Some studies reported a lack of accurate age documentation for a significant proportion of participants,³⁰ ³¹ which may also have been the case in further studies. Since defining underweight and stunting rely on age (in terms of WAZ and HAZ, respectively), this presents a risk of non-differential misclassification bias and means that these prevalence estimates may be inaccurate.

Recommendations
Our review has demonstrated significant variability in the burden of acute and chronic undernutrition for children living in refugee camps. Further research is needed to understand why this variability exists and to build on existing understanding of the factors which place children in refugee camps at higher risk of malnutrition. For example, it would be to analyse the impact of contextual factors such as food security within refugee camp and host country, feeding practices, availability of healthcare services and how long the camp has been established. Research into both the determinants of undernutrition in children in refugee camps and their lived experience would improve understanding and help to
identify areas to target for interventions such as diet quality and variety, practices of caregiving and frequency of infectious illnesses.\(^3\) For further research, a review of the prevalence of other forms of malnutrition including micronutrient deficiencies and overweight is needed to better understand the burden of malnutrition in refugee camps. In addition, it would be beneficial to understand the prevalence of concurrent forms of malnutrition at both population and individual levels as this is relevant to intervention planning to ensure that all relevant forms of malnutrition are targeted.

In terms of policy, the evidence from this review suggests that in addition to continuing and in some areas increasing nutrition support to prevent and treat acute malnutrition, more actions are needed to address the wider determinants of chronic malnutrition and reduce the long-term consequences for refugee populations. These actions might include improving access to safe drinking water and sanitation, housing conditions and health services.\(^3,9\) Recognising the need for such action also requires further research to identify the most effective interventions to prevent long-term effects of undernutrition specifically in the context of refugee camps. Conducting this review demonstrated some of the benefits of using a standardised methodology for conducting and reporting nutrition surveys and therefore would support continuing the trend towards using SENS across refugee camps.

CONCLUSION

Our review showed a wide variation in the prevalence of undernutrition in children under 5 years old across different refugee camps and between different indicators. Based on thresholds used by UNHCR, there was a significant number of camps with a high prevalence of acute malnutrition and even more with a high prevalence of stunting. There was a notable difference between the prevalence of GAM based on WHZ and MUAC which has implications for screening. These findings suggest a need to increase efforts to prevent both acute and chronic malnutrition within refugee camps so that the children living there are given the best opportunity to thrive.

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