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Comorbidities of child malnutrition in low- and medium-income countries:

A systematic review.

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Conflicts of interest

The authors declare that they have no competing interests.

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Registration

This review was registered on international prospective register of systematic reviews website with registration number: CRD4202118202.

ABSTRACT

The study intended to review the best evidence on prevalence, diagnosis and treatment outcomes of comorbidities associated with child malnutrition. The study design was a systematic review of quantitative studies. Critical appraisal tools were used to assess the methodological quality of the studies. Data were extracted according to the pre-determined data extraction table. Data were further analysed narratively according to the set study objectives and main concepts. Fifteen studies were eligible to include in the review. All fifteen studies reported on the prevalence of four child malnutrition associated comorbidities. Five (n=5/15) studies reported on length of hospitalization/stay, ten (n=10) studies on recovery rate and nine (n=9/15) studies on mortality rate as treatment outcomes of child malnutrition associated comorbidities. The most prevalent child malnutrition associated comorbidities were tuberculosis, pneumonia, gastroenteritis and anaemia. The treatment outcomes identified included the length of hospitalization/stay, recovery rate and mortality rate. Screening of prevalent comorbidities in children admitted with malnutrition should be standard procedure in practice. More research need to be done on the diagnosis of under-5 child malnutrition associated comorbidities.

Keywords: child malnutrition, comorbidities, diagnosis, prevalence, treatment outcomes.

What is known

- Child malnutrition (CM) is still one of the leading causes of mortality in under-5 children.
- Comorbidities contribute to high mortality in CM
- Comorbidities of CM are often missed or identified late, leading to undesirable outcomes.

What is new

- tuberculosis (TB), pneumonia, gastroenteritis and anaemia are the most common comorbidities of CM in low- and medium-income countries.
- More empirical research need to be done on diagnosis of CM associated comorbidities so as to improve early identification and treatment.

Introduction

Child malnutrition (CM) is still one of the leading causes of mortality among under-5 children. Malnutrition can be defined as nutritional deficiency developing from inadequate consumption of healthy balanced food that enables optimal health (Dipasquale *et al.*, 2020), this included severe acute malnutrition, undernutrition, stunting, underweight and being wasted. The effects of CM are devastating and exert a heavy load on low- and medium-income countries as they suffer unstable economies, lack of access to health care, political will, and social inequalities. In 2019, 144 million under-5 children globally were reported to be stunted (too short for age), and a further 47 million children were wasted (too thin for height) [1].

Most CM incidences are in the continents that host most low- and medium-income countries, such as South Asia and Sub-Saharan Africa, including South Africa [1]. Globally, South Asia contributed to half of all children who are wasted, and Sub-Saharan Africa hosts about one-quarter of wasted children [1]. In addition, a 2.2 per 1000 incidence of under-5 malnutrition in South Africa was reported for the year 2019 [2].

Comorbidity is the co-occurrence of another disease resulting from the direct impact of the primary disease [3]. The comorbidities of CM include opportunistic infections such as tuberculosis (TB), pneumonia and gastroenteritis [4]. The impact of CM associated comorbidities often leads to undesirable treatment outcomes of children admitted with malnutrition [5]. The cause of mortality in children admitted with malnutrition is often attributed to the comorbidities in CM [6].

Despite having the World Health Organisation 10-steps management of malnutrition guideline [7], the number of CM fatalities is still high in low- and medium-income countries. Timely identification and treatment of comorbidities are essential to decrease the risk for mortality [8]. However, CM comorbidities are often missed or diagnosed late despite having the guideline in place [9]. Although some countries such as Ethiopia have adopted the 10-steps guideline successfully, it is still inconclusive whether the implementation of the guideline can lead to early

detection of CM associated comorbidities, leading to a desirable prognosis [9]. Despite the successful implementation of CM treatment and preventive measures, CM associated comorbidities are still leading causes of mortality in children under-5.

Materials and Methods

Design and setting

A systematic review was employed to retrieve the best available evidence on the prevalence, diagnosis and treatment outcomes of CM associated comorbidities in under-5 children in low- and medium-income countries. The review was guided by a search protocol developed for this study.

Eligibility criteria and search strategy

A clear and focused review question was formulated based on PEOS acronym, where *population and their problem* were children under-5 with malnutrition, *exposure* was CM associated comorbidities, *outcomes* were prevalence, diagnosis, treatment outcomes and *setting* was low- and medium-income countries. A comprehensive search strategy to retrieve the best evidence on the prevalence, diagnosis, and treatment outcomes of CM associated comorbidities was developed. Studies addressing malnutrition comorbidities in children conducted in low- and medium-income countries addressing malnutrition associated comorbidities were included in the review.

The review searched for articles published in English between 2015 and 2020, in the following databases: EbscoHost (including Academic Search Premier: CAB Abstracts: CINAHL: E-journals: Health Source Premium: MasterFile Premier: MEDLINE), Pubmed: Scopus: SAE publications: Science Direct and Web of Science.

The search terms were: Child or Children or Childhood or kid or kids or paediatrics or paediatric AND malnutrition or undernutrition or undernourishment or poor diet or poor nutrition or undernutrition or stunting or wasting AND prevalence or incidence or epidemiology or frequency or occurrence AND treatment or intervention or therapy AND comorbidities or

comorbidity AND low- and medium-income countries. The search terms were comprehensive, not to limit the scope of the literature search. A search was also done to identify relevant studies that are not yet published, such as theses and dissertations on the PROQUEST database, to prevent publication bias.

The search and selection process was documented according to the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) flow diagram [10] (see figure 1). The reviewer used the Evidence for Policy and Practice information (EPPI) – reviewer 4 software [11] to manage the search and selection processes of the review.

Study selections

The phase of selecting which studies to be included in the review was done by screening the studies against the inclusion and exclusion criteria developed for the review and only completed after critical appraisal. Critical appraisal with critical appraisal tools is done to evaluate the methodological quality and rigour of studies included in the review [12]. The validity of empirical studies included in a secondary study like a meta-analysis or systematic review determines the validity of that particular secondary study [13]. Therefore, it is critical for empirical studies included in the review to be appraised.

The Critical Appraisal Skills Programme (CASP) tool was used to appraise all the cohort design studies identified. Furthermore, the John's Hopkins Nursing Evidence-Based Practice (JHNEBP) was used to appraise the studies with cross-sectional and survey designs. A summary of how each study included in the review was critically appraised is provided in Table 1.

Data collection process.

The data collection process in this review comprised data extraction. Data extraction is a process whereby data elements deemed to be relevant in answering the review question are extracted from the included studies and presented in a single format [14]. The data extraction table consisted of five columns which had: author, year, country & title (column 1); main findings (column 2) and findings relevant to the study (column 3). In column 3, the findings pertinent to

the study were categorized according to the three objectives of the study: prevalence, diagnosis, and treatment outcomes. Table 2 provides in-depth data extracted from the included studies.

Risk of bias in individual studies

The risk of bias in individual studies was assessed independently by two reviewers. Furthermore the use of the PRISMA flow diagram provided transparency of the review process. The use of validated critical appraisal tools ensured that only studies of good methodological quality are included in the review.

Synthesis of results

Synthesis of results in this review refers to combining and summarizing the findings of each study included in the review [15]. The review had three objectives, according to which the data were synthesized. The review's first objective was to review the best available evidence on the prevalence of comorbidities associated with CM in low- and medium-income countries.

Therefore, all CM associated comorbidities identified in the included studies were grouped according to the human body systems they affect. For the second objective about the best available evidence on the diagnosis of comorbidities associated with CM in low- and medium-income countries, no studies were found. For the last objective on the best available evidence on treatment outcomes of CM associated comorbidities in low- and medium-income countries, the findings of the included studies were grouped under the headings of the length of hospitalization/stay, mortality and recovery.

Publication bias

In order to prevent publication bias, manual search of unpublished literature was done during the initial search of the review.

Dissemination

The findings of this review will be published in a peer-reviewed journal according to PRISMA checklist. (See Table, supplemental digital content 2).

Ethics statement

This study received ethical approval from North-West University with ethical number: NWU-00314-20-A1.

Results

The review retrieved a total number of 20 001 studies that were subjected to screening against the inclusion and exclusion criteria. The articles deemed to address the review question were subjected to critical appraisal, leaving the review with n=15 studies eligible to be included. Some of the n=15 studies included in the review addressed more than one of the review's objectives, whilst others only addressed one objective. The fifteen (n=15) included articles came from low- and medium-income countries (Ethiopia (n=9/15), Uganda (n=1/15), Somalia (n=1/15), South Africa (n=1/15), Nigeria (n=1/15), combined Burkina Faso and Mozambique (n=1/15) and multiple low- and medium-income countries (n=1/15) as presented in Table 3. The results of this review are discussed according to the prevalence, diagnosis and treatment outcomes.

Prevalence

Data extracted from studies reporting on the *prevalence* of CM comorbidities were grouped according to human body systems affected, namely the respiratory system (included TB and pneumonia), the gastrointestinal tract system (included gastroenteritis) and the haematology system (included anaemia).

The respiratory system

The respiratory system comprises the lungs and surrounding structures such as the trachea and bronchioles. The comorbidities identified from the selected articles which affected the abovementioned structures in children with malnutrition included TB and pneumonia:

TB

Five studies included in the review reported TB as a comorbidity in children with malnutrition. Four of these studies [16-19] were cohort studies, while one study [20] was a cross-sectional study. All were conducted in Ethiopia.

In a retrospective cohort study [16] with a systematically selected sample of 423 under-5 children with malnutrition, 5.7% had TB as common comorbidity. These findings further concurred with the results of one of the included cohort studies [17], with a randomly selected sample of 1690 children (under-5) with malnutrition, of which 8.22% also had TB.

Furthermore, in a retrospective cohort study [18] with a randomly selected sample of 420 under-5 children with malnutrition, 22% had TB as common comorbidity. The prevalence of TB as a comorbidity in CM was also found in a cohort study [19], with a randomly selected sample of 440, of which 15.9% had TB as comorbidity. In addition, the findings above were supported by a cross-sectional study done in Ethiopia [20], where TB was reported as a comorbidity in CM in 15.8% of the sample.

Pneumonia

A total of eight studies reported on pneumonia as a comorbidity of CM [9, 16, 18-23]. Out of these, five were cohort studies [16, 18, 19, 21, 22], two were survey studies [9, 23], and one was a cross-sectional study [20].

One of the included retrospective cohort studies reported 41.5% of the sample having pneumonia as a comorbidity of CM [18]. The results concurred with the findings of a cohort study done in Ethiopia [19], where 20.6% of the randomly selected sample size of 416 children under-5 with malnutrition had pneumonia as comorbidity. In addition, pneumonia was identified as a comorbidity of CM in a cohort study done in Ethiopia where 27% of under-5 children with CM had pneumonia [21]. Pneumonia is also indicated as one of the most prevalent comorbidities in the findings of several other studies ranging between 25.2% and 54.8% of the under-5 children admitted with malnutrition [9, 16, 20, 22, 23].

Gastrointestinal tract system

The gastrointestinal system comprises of the stomach and surrounding structures such as the small and large intestines, appendix and the rectum. The comorbidities identified from selected studies, which affected the abovementioned structures in children with malnutrition are discussed.

Gastroenteritis

The findings of eleven of the studies included in the review revealed gastroenteritis as one of the most prevalent comorbidities of CM. Eight of the identified studies were cohort studies [16-18, 21, 22, 24-26], five of which were conducted in Ethiopia [16-18, 21, 22], and the remaining three studies conducted in South Africa, Nigeria and Uganda respectively [24, 25, 26]. The remaining three studies were surveys conducted in Ethiopia [9, 23] and Somalia [27].

The findings of a retrospective cohort study from Ethiopia indicated gastroenteritis as one of the most prevalent comorbidities of CM, with 46.7% of the sample having gastroenteritis as CM comorbidity [18]. The findings were further supported by another cohort study done in Ethiopia, where gastroenteritis was reported as one of the most prevalent comorbidities of CM, with 34.02% of the sample having gastroenteritis [17]. In another cohort study [26], gastroenteritis was also found to be a common comorbidity of CM, with 43% of the sample having gastroenteritis. The findings concurred with multiple studies [9, 16, 21-25, 28], where the prevalence of gastroenteritis in under-5 children admitted with malnutrition ranged from 11% and 57.6%.

Haematology system

The haematology system comprises of the blood and blood products or cells therefore, the comorbidities identified from the selected studies which affected the abovementioned structures in children with malnutrition are discussed.

Anaemia

Six of the articles identified by this review revealed anaemia as one of the most prevalent comorbidities of CM. Three of the identified articles were cohort studies [16, 18, 21] and two articles were cross-sectional studies [20, 28]. One study of the six identified studies was a survey [29].

Two of the three cohort studies randomly selected their sample [18, 21], whilst the remaining study [16] purposively selected its sample. Furthermore, the two cross-sectional studies [20, 28] and the single survey [29] also purposively selected their samples.

A retrospective cohort study [18], with a sample of 420 under-5 children with CM, reported anaemia as comorbidity at 74.5% of the sample having a haemoglobin level ranging between 7.0 g/dl and 10.9 g/dl. A similar pattern of results was also identified in another cohort study [16], where 48.7% of the sample had anaemia. Furthermore, anaemia was also revealed as a comorbidity of CM in a cohort study [21], where 12.5% of the sample had anaemia. The findings of the cohort studies mentioned above concurred with the results of several other studies [18, 28, 29], where anaemia was a common comorbidity ranging between 41.6% and 61.8% of the under-5 children with CM.

Diagnosis

Despite the review identifying adequate studies reporting on the prevalence and treatment outcomes of comorbidities of CM, no study reporting on the diagnosis of CM comorbidities based on the set inclusion criteria could be found with the search strategy. Consequently, there seems to be a dearth of studies on the diagnosis of CM associated comorbidities.

Treatment outcomes

Data extracted from the studies reporting on treatment outcomes of CM associated comorbidities were grouped according to the following headings: length of hospitalization/stay, recovery and mortality. The findings were further compared with the acceptable values of the Sphere project standards. The Sphere Project was initiated by a group of Non-Governmental Organizations

internationally, to set acceptable standards in humanitarian aids across all social parameters, including CM [30]. The Sphere standard values are adopted in several studies on CM treatment outcomes in low- and medium-income countries to compare the progress made in ensuring quality care provided to under-5 children with malnutrition. The acceptable Sphere standard values for length of hospitalization/stay of under-5 children with malnutrition is less than 28 days and alarming if it is more than 42 days; the value for recovery rate is acceptable if above 75% and alarming if below 50%.

Length of hospitalization/stay

Five of the studies included in the review reported the length of hospitalization/stay in children with malnutrition. Four of those studies were cohort studies [16, 18, 19, 25] and one study was a cross-sectional study [20]. Three of the five cohort studies were conducted in Ethiopia [16, 18, 19], whilst the remaining one cohort study was conducted in Nigeria [25]. The cross-sectional study [20] was done in Ethiopia.

The retrospective cohort [18] reported an average hospitalization/stay period and recovery time in children with TB as a comorbidity of CM to be 26.1 days. Furthermore, an 18-day average length of hospitalisation/stay was reported in one of the cohort studies [19]. However, the findings cannot be solely attributed to CM associated comorbidities as there were children in the cohort who did not have CM associated comorbidities. The pattern of the findings was also identified in a cohort study done in Ethiopia where an average length of hospitalization/stay among children with malnutrition was reported to be 15 days for the entire cohort, with 13% of the sample exceeding the 28-day acceptable Sphere standard period [16]. The findings of the studies were in line with the results of one of the included studies [25], where the average length of hospitalization/stay for the sample was 27 days; however, the findings cannot be attributed to CM associated comorbidities solely as part of the sample did not have CM associated comorbidities. Furthermore, an average 17-day hospital stay was reported by a study conducted in Ethiopia respectively [20].

Recovery

Similarly, concerning the length of hospitalisation/stay, it was difficult to distinguish whether findings on recovery of children with malnutrition referred to children with malnutrition only or children with malnutrition associated comorbidities. Nonetheless, the findings of the included studies reporting on children with malnutrition and/or associated comorbidities are discussed. Ten of the included studies reported the recovery rate of children admitted with CM with or without associated comorbidities. Seven of these studies were cohort designs [16-19, 21, 22, 25], and one study was a cross-sectional design [20]. Two further studies reporting on recovery were surveys [9, 23]. Five of the cohort studies randomly selected their samples, whilst two purposively selected their samples. One survey study randomly selected its sample, whilst the other one purposively selected its sample. The cross-sectional study also purposively selected its sample.

The retrospective cohort in Ethiopia reported an overall recovery rate of 69.4% over a maximum period of 59 days [18]. The overall recovery rate was lower compared to other included studies. These findings were, however, in line with the results of one of the included studies, where the 62.13% recovery rate was reported [17]. Furthermore, in contrast to these studies, a slightly higher recovery rate (75.6%) was reported by one of the included cohort studies conducted in South Africa [24]. A recovery rate of 69.2% was also reported by one of the included cohort studies conducted in Ethiopia [19]. A cohort study done in Nigeria reported a high recovery rate of 87.1% among the included studies [26]. A similar pattern of results was also identified in a cohort study done in Ethiopia, where a recovery rate of 81.3% was reported [16]; however, those with comorbid conditions such as pneumonia were 24% less likely to recover than those who did not. A cohort study conducted in Ethiopia reported an overall recovery rate of 82% [22]. Ninety-four-point three percent (94.3%) of those with pneumonia as comorbidity recovered whilst 93.3% and 95.1% of those with anaemia and gastroenteritis as comorbidities respectively recovered [22]. A cross-sectional study included in the review reported a 77.8% recovery rate

[20], whilst the two survey studies [9, 23] have reported recovery rates of 55.9% and 75.4%, respectively. A 59.7% recovery rate was reported by a cohort study conducted in Ethiopia with a sample of 545 [21], which is disturbing and close to an alarming state according to the Sphere standard guidelines.

Mortality

Findings of studies reporting on mortality of children with malnutrition associated comorbidities were also analysed in relation to the Sphere standard guidelines. The Sphere standard guidelines indicated a death rate of below 10% as acceptable and a death rate above 15% as alarming [30]. The review found nine studies reporting on mortality, either in children with malnutrition only or children with malnutrition and associated comorbidities. Six of the identified studies were cohort designs [18, 19, 21, 22, 24, 25], one was a cross-sectional design [20], whilst two studies were survey designs [9, 23].

A mortality rate of 10.8%, which is slightly above the acceptable values stipulated by the Sphere standard guidelines, was reported by one of the included studies [18]. In another cohort study done in Nigeria, a death rate of 0.2%, which is low compared to other included studies and acceptable according to the Sphere standard guidelines, was reported [25]. In addition, the findings of one of the included cohort studies conducted in Ethiopia indicated a mortality rate of 9.3% [21], which was in line with the results of a cohort study done in Ethiopia where a mortality rate of 3.8% was reported [22]. Furthermore, a mortality rate of 5.7%, 6.7% and 4.9% for pneumonia, anaemia, and gastroenteritis as comorbidities among those with malnutrition was reported [22]. In contrast, one of the included cohort studies conducted in South Africa established a mortality rate of 24.4% [24], which is above the acceptable Sphere standard values. A mortality rate of 10.8% was reported by one of the included Cohort studies conducted in Ethiopia [19], which is slightly above the acceptable figure of below 10% stipulated by the Sphere standards. Furthermore, a mortality rate of 9.3%, which is acceptable according to the Sphere standard values, was reported from a cross-sectional study done in Ethiopia [20], whilst

the two surveys [9, 23] reported a mortality rate of 5.8% and 3.4%, respectively. More detailed discussion of the results is provided. (See text document, supplemental digital content 1, which is the discussion section of the manuscript.)

Conclusion

This review managed to determine the most prevalent CM associated comorbidities. Despite studies in the review reporting on many CM associated comorbidities, only those comorbidities reported in at least two of the included studies were selected as the most common CM comorbidities. Some of the studies included in this review reported signs of morbidity as comorbidities of CM. These signs included fever and dehydration, which cannot be regarded as comorbid conditions. Nonetheless, gastroenteritis, TB, pneumonia, and anaemia were the most prevalent comorbidities of CM reported by the review's primary studies.

Despite extensive literature reporting on CM associated comorbidities, the review could not determine the occurrence of late diagnosis of CM associated comorbidities and its effects.

Research should be conducted on the impact of late diagnosis of CM comorbidities. Further research is also needed on the treatment outcomes of specifically CM associated comorbidities.

The existing management protocols of CM can be strengthened as algorithms can be developed, whereby the identified comorbidities can be mandatorily ruled out on admission of children under-5. The algorithms could assist in the early diagnosis and treatment of CM associated comorbidities.

Availability of data and materials

- Text document, Supplemental Digital Content 1
- Table, Supplemental Digital Content 2

References

1. World Health Organization. UNICEF/WHO/The World Bank Group joint child malnutrition estimates: levels and trends in child malnutrition: key findings of the 2020 edition; 2020. Available from: <https://apps.who.int/iris/bitstream/handle/10665/331621/9789240003576-eng.pdf>. Accessed 12 Jul 2020.
2. Health Systems Trust. South African health review 2020. Durban: Health Systems Trust; 2020. Available from: <https://www.hst.org.za/publications/Pages/SAHR2020.aspx>. Accessed 11 Jul 2021.
3. Centers for Disease Control and Prevention. Arthritis. 2019. Available from: https://www.cdc.gov/arthritis/data_statistics/comorbidities.htm. Accessed 20 Dec 2020.
4. Dadhich SK, Rajpoot KS. Pattern of co-morbidities in children with severe acute malnutrition admitted in MTC at M.G. hospital Bhilwara, Rajasthan. *Int J Med Biomed Stud.* 2019;3(3):27-30.
5. Baskaran VM, Naaraayan SA, Priyadharishini D. Comorbidities in children hospitalized with severe acute malnutrition. *Indian J Child Health (Bhopal).* 2018;5(8):530-2.
6. Gupta RK, Nagori GL, Nagori P, Patidar RP. Pattern of co-morbidities in children with severe acute malnutrition admitted in MTC of a teaching hospital of South East Rajasthan. India. *J Pharm Biomed Sci.* 2015;5(5):403-7.
7. World Health Organization. Guideline: updates on the management of severe acute malnutrition in infants and children. Geneva: WHO; 2013. Available from: <https://apps.who.int/iris/rest/bitstreams/447316/retrieve>. Accessed 06 Jun 2019.
8. Garg M, Devpura K, Saini SK, Kumara S. A hospital based study on co-morbidities in children with severe acute malnutrition. *J Pediatr Res.* 2017;4(01):82-88.

9. Derseh B, Mruts K, Demie T, Gebremariam T. Co-morbidity, treatment outcomes and factors affecting the recovery rate of under -five children with severe acute malnutrition admitted in selected hospitals from Ethiopia: retrospective follow up study. *Nutr J.* 2018;17(1):article number 116.
10. Moher D, Liberati A, Tetzlaff J, Altman DG. The PRISMA Group. Preferred reporting item for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS Med.* 2009;6(7):e1000097.
11. EPPI-Reviewer Web [Internet]. [Accessed 21 Jul 2019]. Available from: <https://eppi.ioe.ac.uk/eppireviewer-web/home>.
12. Khan KS, Kunz R, Kleijnen J, Antes G. Systematic reviews to support evidence-based medicine. 2nd ed. New York: CRC Press; 2011.
13. Sgao GS, Little J, Higgins JP. Systematic reviews of genetic association studies. *PLoS Med.* 2009;6(3):e1000028.
14. Boland A, Cherry MG, Dickson R, editors. Doing a systematic review: a student's guide. London: Sage; 2002.
15. Centre for Reviews and Dissemination. Systematic reviews 2009; 2009. Available from: https://www.york.ac.uk/media/crd/Systematic_Reviews. Accessed 15 Mar 2019.
16. Adimasu M, Sebsibie G, Abebe F, Baye G, Abere K. Recovery time from severe acute malnutrition and associated factors among under-5 children in Yekatit 12 Hospital, Addis Ababa, Ethiopia: a retrospective cohort study. *Epidemiol Health.* 2020;42:e2020003.
17. Baraki AG, Akalu TY, Wolde HF, Takele WW, Mamo WN, Derseh B, Desyibelew HD, Dadi AF. Time to recovery from severe acute malnutrition and its predictors: a multicentre retrospective follow-up study in Amhara region, north-west Ethiopia. *BMJ Open.* 2020;10(2):e034583.

18. Fikrie A, Alemayehu A, Gebremedhin S. Treatment outcomes and factors affecting time-to-recovery from severe acute malnutrition in 6-59 months old children admitted to a stabilization center in Southern Ethiopia: a retrospective cohort study. *Ital J Pediatr.* 2019;45(1):1-9.
19. Wagnew F, Dejen G, Eshetie S, Alebel A, Worku W, Abajobir AA. Treatment cure rate and its predictors among children with severe acute malnutrition in northwest Ethiopia: a retrospective record review. *PloS One.* 2019;14(2):e0211628.
20. Jarso H, Workicho A, Alemseged F. Survival status and predictors of mortality in severely malnourished children admitted to Jimma University Specialized Hospital from 2010 to 2012, Jimma, Ethiopia: a retrospective longitudinal study. *BMC Pediatr.* 2015 Dec; 15(1):1-13.
21. Girum T, Kote M, Tariku B, Bekele H. Survival status and predictors of mortality among severely acute malnourished children < 5 years of age admitted to stabilization centers in Gedeo Zone: a retrospective cohort study. *Ther Clin Risk Manag.* 2017;13:101-10.
22. Guesh G, Degu G, Abay M, Beyene B, Brhane E, Brhane K. Survival status and predictors of mortality among children with severe acute malnutrition admitted to general hospitals of Tigray, North Ethiopia: a retrospective cohort study. *BMC Res Notes.* 2018; 11(1):1-7.
23. Hassen SL, Astatkie A, Mekonnen TC, Bogale GG. Survival status and its determinants among under-five children with severe acute malnutrition admitted to inpatient therapeutic feeding centers in south Wollo zone, Amhara region, Ethiopia. *J Nutr Metab.* 2019; 2019:article 2643531.
24. Muzigaba M, Puoane T, Sartorius B, Sanders D. Independent and interactive effects of HIV infection, clinical stage and other comorbidities on survival of children treated for

- severe malnutrition in rural South Africa: a retrospective multicohort study. *S Afr J Child Health*. 2017;11(1):46-53.
25. Chitekwe S, Biadgilign S, Tolla A, Myatt M. Mid-upper-arm circumference based case-detection, admission, and discharging of under five children in a large-scale community-based management of acute malnutrition program in Nigeria. *Arch Public Health*. 2018; 76(1):Article 19.
 26. Grenov B, Lanyero B, Nabukeera-Barungi N, Namusoke H, Ritz C, Friis H, Michaelsen KF, Mølgaard C. Diarrhea, dehydration, and the associated mortality in children with complicated severe acute malnutrition: a prospective cohort study in Uganda. *J Pediatr*. 2019;210:26-33.
 27. Kinyoki DK, Manda SO, Moloney GM, Odundo EO, Berkley JA, Noor AM, Kandala NB. Modelling the ecological comorbidity of acute respiratory infection, diarrhoea and stunting among children under the age of 5 years in Somalia. *Int Stat Rev*. 2017;85(1):164-76.
 28. Adeyemi RA, Zewotir T, Ramroop S. Joint spatial mapping of childhood anemia and malnutrition in sub-Saharan Africa: a cross-sectional study of small-scale geographical disparities. *Afri Health Sci*. 2019;19(3):2692-2712.
 29. Tran TD, Biggs BA, Holton S, Nguyen HT, Hanieh S, Fisher J. Co-morbid anaemia and stunting among children of pre-school age in low-and middle-income countries: a syndemic. *Public Health Nutr*. 2018;22(1):35-43.
 30. Sphere Project. Humanitarian charter and minimum standards in disaster response. Rugby, UK: The Sphere Project; 2011. Available from: <https://www.unhcr.org/uk/50b491b09.pdf>. Accessed 17 Oct 2020.
 31. Kumar R, Singh J, Joshi K, Singh HP, Bijesh S. Co-morbidities in hospitalized children with severe acute malnutrition. *Indian Pediatr*. 2014;51(2):125-7.

32. World Bank Group. World Bank open data. Washington, D.C.: World Bank Group.
Available from: <https://data.worldbank.org/>. Accessed 06 Jan 2021.
33. Chaturvedi A, Patwari AK, Soni D, Pandey S, Prost A, Gope RK, et al. Progress of children with severe acute malnutrition in the malnutrition treatment centre rehabilitation program: evidence from a prospective study in Jharkhand, India. *Nutr J.* 2018;17:article 69.

Table 1: Critical appraisal of the included studies

Cohort studies (n=10)			
Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
Adimasu <i>et al.</i> (2020) [16] Recovery time from severe acute malnutrition and associated factors among under-5 children in Yekatit 12 hospital, Addis Ababa, Ethiopia: a retrospective cohort	To determine the recovery time from severe acute malnutrition and to identify predictors of length of hospitalization/stay among under-5 children at Yekatit 12 Hospital in Addis Ababa City Administration, Ethiopia	A structured data abstraction form adapted from the Ethiopian protocol for management of Severe Acute Malnutrition Data analysis: EpiData version 4.2 SPSS	Tool used: CASP for Cohort studies A well stated research aim. An appropriate design employed to meet the aim. Reasonable sample size. The results were precise and clearly presented. Overall well-presented study CASP: 75% Decision: included in the review
Baraki <i>et al.</i> (2020) [17] Time to recovery from severe acute malnutrition and its predictors: a multicentre retrospective follow-up study in Amhara region, north-west Ethiopia	To determine the time to recovery from severe acute malnutrition and its predictors in selected public health institutions in Amhara Regional State, Ethiopia	A structured data extraction form Data analysis: Kaplan-meier survival method Log-rank test curves Parametrical survival analysis Schoenfeld residual test Stata V.14.0	Tool used: CASP Well stated objective. Large sample size. Validated data analysis tools. Well planned study CASP: 83% Decision: included in the review

Table 1: Critical appraisal of the included studies (continue)

Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
<p>Chaturvedi <i>et al.</i> (2018) [33] Progress of children with severe acute malnutrition in the malnutrition treatment centre rehabilitation program: evidence from a prospective study in Jharkhand, India</p>	<p>To describe children's outcomes for both phases of the program, determine access and utilization of post-discharge services, and measure compliance of health and nutrition practices advised by malnutrition treatment centre to inform future implementation of the malnutrition treatment centre and broader nutrition programs in India</p>	<p>Structured interviews Pre-tested data extraction form Data analysis: SPSS version 19 Anthro software</p>	<p>Tool used: CASP Well stated objective. A relatively low sample size. A significant high loss to follow rate. Appropriate research design. Overall compromised generalisability of the results. CASP: 50% Decision: excluded from the review</p>
<p>Chitekwe <i>et al.</i> (2018) [25] Mid-upper-arm circumference-based case detection, admission, and discharging of under five children in a large-scale community-based management of acute malnutrition program in Nigeria</p>	<p>To describes the experience of using mid-upper-arm circumference for screening, case-finding, referral, admission, and discharge in a large-scale community-based management of acute malnutrition program delivered through existing primary health care facilities in Nigeria</p>	<p>Data extraction database Data analysis: R language Graphics versions 3.1.0</p>	<p>Tool used: CASP Well stated aim. Appropriate study design. A sufficient sample size. Errors during data collection which were later corrected. Overall well conducted study. Applicable results CASP: 75% Decision: included</p>

Table 1: Critical appraisal of the included studies (continue)

Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
<p>Fikrie <i>et al.</i> (2019) [18] Treatment outcomes and factors affecting time-to-recovery from severe acute malnutrition in 6–59 months old children admitted to a stabilization centre in Southern Ethiopia: A retrospective cohort study</p>	<p>To assess treatment outcomes and factors affecting time-to-recovery from severe acute malnutrition in children 6–59 months admitted to a stabilizing center in Hawassa University Comprehensive Specialized Hospital (HU-CSH), Southern Ethiopia</p>	<p>Pre-tested structured questionnaire</p> <p>Data analysis: Kaplan meir curve Log rank test Cox-proportional hazards model</p>	<p>Tool used: CASP A well stated research purpose. Reasonable sample size. Appropriate research design. Precise and clearly presented results. Overall a well conducted study. CASP: 92% Decision: included</p>
<p>Girum <i>et al.</i> (2017) [21] Survival status and predictors of mortality among severely acute malnourished children <5 years of age admitted to stabilization centers in Gedeo Zone: a retrospective cohort study</p>	<p>To assess treatment outcomes and identify predictors of mortality among <5 years of age children admitted to SCs in Gedeo Zone</p>	<p>Structured checklist</p> <p>Data analysis: Epi info version 7 STATA version 11 Kaplan-meier survival curve</p>	<p>Tool used: CASP A well stated aim. Appropriate design. Reasonably adequate randomized sample size. Missing variables as the study is retrospective, leading to uncertainty of recorded data. Potential bias associated with excluded records and unknown absconders CASP: 75% Decision: included</p>

Table 1: Critical appraisal of the included studies (continue)

Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
<p>Grenov <i>et al.</i> (2019) [26] Diarrhea, Dehydration, and the associated Mortality in Children with Complicated Severe Acute Malnutrition: A Prospective Cohort Study in Uganda</p>	<p>To assess predictors of diarrhoea and dehydration and to investigate the role of diarrhoea in mortality among children with complicated severe acute malnutrition</p>	<p>Baseline questionnaire Validated stool diary</p> <p>Data analysis: EpiData v.3.1. R version 3.1.1. Wilcoxon rank-sum test</p>	<p>Tool used: CASP A relatively adequate sample. Well stated objective. Appropriate design. Results appropriate to the review. Overall, well conducted study. CASP: 83% Decision: included</p>
<p>Guesh <i>et al.</i> (2018) [22] Survival status and predictors of mortality among children with severe acute malnutrition admitted to general hospitals of Tigray, North Ethiopia: a retrospective cohort study</p>	<p>To assess survival status and predictors of mortality among children with severe acute malnutrition admitted to stabilization centers of general hospitals in Tigray region, northern Ethiopia</p>	<p>Questionnaire Epi Info 7.</p> <p>Data analysis: STATA version 11. Log rank test. Kaplan-meier survival test. Bi-variable cox regression analysis</p>	<p>Tool used: CASP Well stated aim. Reasonably adequate sample size. Validated data collection and analysis tools. Appropriate design. Missing variables as the study is retrospective, leading to uncertainty of recorded data. Potential bias associated with excluded records and unknown absconders CASP: 75% Decision: included</p>

Table 1: Critical appraisal of the included studies (continue)

Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
<p>Muzigaba <i>et al.</i> (2017) [24] Independent and interactive effects of HIV infection, clinical stage and other comorbidities on survival of children treated for severe malnutrition in rural South Africa: A retrospective multicohort study</p>	<p>To determine baseline clinical characteristics among children with severe acute malnutrition and assess whether HIV infection, disease stage, critical illness at baseline and other comorbidities independently and interactively contributed to excess mortality in this sample</p>	<p>A structured questionnaire. Data analysis: Stata/IC 13.0. Kaplan-Meier failure curves. The log-rank test. Cox proportional hazard model</p>	<p>Tool used: CASP Well defined objectives. Appropriate design. Reasonable sample size. Validated data processing tools. Results may not be generalizable beyond study setting Overall a well carried out study CASP: 83% Decision: included</p>
<p>Wagnew <i>et al.</i> (2019) [19] Treatment cure rate and its predictors among children with severe acute malnutrition in northwest Ethiopia: A retrospective record review</p>	<p>To determine treatment cure rate and its predictors among Children aged 6–59 months with severe acute malnutrition admitted to a stabilization center</p>	<p>Data extracting checklist Data analysis: Epi-info version-7. STATA/se version-14. Cox proportional hazard model. Multivariable analysis. Bivariable analysis</p>	<p>Tool used: CASP Well stated aim. Reasonable sample size. Appropriate design. Results precise and well documented. Well conducted study CASP: 92% Decision: included</p>

Table 1: Critical appraisal of the included studies (continue)

Cross-sectional studies (n=02)			
Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
Adeyemi <i>et al.</i> (2019) [28] Joint spatial mapping of childhood anaemia and malnutrition in sub-Saharan Africa: A cross-sectional study of small scale	To investigate the differences in small scale geographical variations and the underlying risk factors of child's health outcomes (anaemia, stunting and wasting) in Sub-Saharan Africa using spatial epidemiology	Survey data Data analysis: Independent univariate models. Multivariate CAR model analysis	Tool used: JHNEBP Well stated objective. Sufficient sample size. Appropriate design. Complex methodology. Precise and consistent results. Overall a well carried out study JHNEBP: 85% Level of evidence: III Decision: included
Jarso <i>et al.</i> (2015) [20] Survival status and predictors of mortality in severely malnourished children admitted to Jimma University Specialized Hospital from 2010 to 2012, Jimma, Ethiopia: a retrospective longitudinal study	To assess survival status and predictors of mortality in severely malnourished children admitted to Jimma University Specialized Hospital from September 11, 2010 to September 10, 2012	Pre-tested data extraction form Data analysis: SPSS version 20 Kaplan-Meier Cox regression	Tool used: JHNEBP Well stated aim. Appropriate design. Reasonable sample size. Results precise and applicable in the review. Overall well conducted study JHNEBP: 85% Level of evidence: III Decision: included

Table 1: Critical appraisal of the included studies (continue)

Survey studies (n=04)			
Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
Derseh <i>et al.</i> (2018) [9] Comorbidity, treatment outcomes and factors affecting the recovery rate of under-five children with severe acute malnutrition admitted in selected hospitals from Ethiopia: retrospective follow up study	To assess comorbidity, treatment outcomes and factors affecting the recovery rate of children aged 1–59 months with severe acute malnutrition admitted into therapeutic feeding centers	EpiData software version 3.1 Structured data extraction form Data analysis SPSS version 16 Shapiro-Wilk's test Sphere project reference standards Log-Rank test. Cox-proportional regression analysis	Tool used: JHNEBP Well stated aim. Appropriate design. Relatively minimum sample. Results precise and applicable in the review. Overall, fairly carried out study. JHNEBP: 75% Level of evidence: III Decision: included
Hassen <i>et al.</i> (2019) [23] Survival status and its determinants among under-five children with severe acute malnutrition admitted to inpatient therapeutic feeding centers in south Wollo zone, Amhara region, Ethiopia	To estimate the survival status and its determinants among under-five children with severe acute malnutrition admitted to inpatient therapeutic feeding centers	Epi-Info version 7.2 Data analysis: SPSS version 20	Well stated research aim. Sample representative of the population. Appropriate design. Randomised sampling. Results consistent and precise. Generally a well conducted study. JHNEBP: 85% Level of evidence: III Decision: included

Table 1: Critical appraisal of the included studies (continue)

Reference & Title	Aim/Objectives/Purpose	Data collection & Analysis	Rigour
Kinyoki <i>et al.</i> (2017) [27] Modelling the Ecological Comorbidity of Acute Respiratory Infection, Diarrhoea and Stunting among under-5 children in Somalia	To assess spatial co-occurrence of acute respiratory infections, diarrhoea and stunting among children of the age between 6 and 59 months in Somalia	Survey data Data analysis: Integrated nested laplace approximation	Tool used: JHNEBP Well stated aim. Adequate sample size. Results cannot be generalized to other populations as the prevalence of comorbidity is highly dependent on population characteristics. Overall a fairly conducted study JHNEBP: 75% Level of evidence: III Decision: included
Tran <i>et al.</i> (2018) [29] Comorbid anaemia and stunting among children of pre-school age in low- and middle-income countries: a syndemic	To determine the prevalence of comorbidity of two important global health challenges, anaemia and stunting, among children aged 6–59 months in low- and middle-income countries	Survey data Data analysis: Stata version 14	Tool used: JHNEBP Well stated objective. Appropriate design. Adequate sample size. Findings can be generalized to different countries. Findings are limited to the data of the original study. Overall a fairly conducted study JHEBP score: 75% Level of evidence: III Decision: included

Table 2: Data extraction table

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Adeyemi <i>et al.</i> (2019) [28] Joint spatial mapping of childhood anaemia and malnutrition in sub-Saharan Africa: A cross-sectional study of small scale	The risks for anaemia and malnutrition were: household poverty, morbidity, short birth interval, breastfeeding, antenatal attendance, and maternal literacy	Anaemia was the prevalent comorbidity of CM, with 61.8% of the sample size having anaemia	none	none
Adimasu <i>et al.</i> (2020) [16] Recovery time from severe acute malnutrition and associated factors among under-5 children in Yekatit 12 hospital, Addis Ababa, Ethiopia: a retrospective cohort study	The study reported a nutritional recovery rate of 81.3% and a median recovery time of 15.00 days	The following CM associated comorbidities were identified as most prevalent: TB (5.7%), pneumonia (42.3%), gastroenteritis (53.0%) and anaemia (48.7%)	none	<p>Length of hospitalization/stay: the average length of hospitalization/stay of the entire cohort was 15 days and 13% had an average length of hospitalization/stay exceeding 28 days</p> <p>Recovery rate: the recovery rate from CM and associated comorbidities was 81.3%.</p>

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Baraki <i>et al.</i> (2020) [17] Time to recovery from severe acute malnutrition and its predictors: a multicentre retrospective follow-up study in Amhara region, north-west Ethiopia	The study reported a median time to recovery from severe acute malnutrition as 16 days and predictors of to time of recovery were comorbidities and receiving of vitamin A	The CM comorbidities identified as most prevalent were TB (8.22%) and gastroenteritis (34.02%)	none	Recovery: the study reported a recovery rate of 62.13% from CM and associated comorbidities
Chitekwe <i>et al.</i> (2018) [25] Mid-upper-arm circumference-based case detection, admission, and discharging of under five children in a large-scale community-based management of acute malnutrition program in Nigeria	The average mid-upper-arm circumference was 109 mm and 37.4% of the sample had a comorbidity. Overall, the study met the SPHERE minimum standards for treatment outcomes for therapeutic feeding programs	The most prevalent comorbidity of CM was diarrhoea with 28.4% of the sample having either diarrhoea at the beginning or during the trial	none	Length of hospitalization/stay: the study reported an average length of hospitalization/stay to be 27 days Recovery rate: the recovery rate was reported to be 87.1% Mortality: mortality rate was reported to be 0.2%

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Derseh <i>et al.</i> (2018) [9]. Comorbidity, treatment outcomes and factors affecting the recovery rate of under-five children with severe acute malnutrition admitted in selected hospitals from Ethiopia: retrospective follow up study.	Comorbidities such as pneumonia had an impact on the nutritional recovery rate of the sample. The recovery rate was 55.9%, the death rate was 5.8% and the defaulter rate 16.3%.	The most prevalent comorbidities were pneumonia (54%) and gastroenteritis (41.8%)	none	Recovery: The recovery rate was 55.9%. Mortality: 5.8% was the reported mortality rate.
Fikrie <i>et al.</i> (2019) [18] Treatment outcomes and factors affecting time-to-recovery from severe acute malnutrition in 6–59 months old children admitted to a stabilization center in Southern Ethiopia: A retrospective cohort study	The study reported a death rate of 10.8%, a recovery rate of 69.4% and a defaulter rate of 7.1%. TB, therapeutic diet and special medications were associated with time of recovery	The prevalent comorbidities were: TB at 22%, pneumonia at 41.5%, diarrhoea at 46.7% and anaemia at 74.5%	none	Length of hospitalization/stay: The average hospitalization/stay was 26.1 days with TB as a comorbidity Recovery: The recovery rate was 69.4% Mortality: 10.8% was the reported mortality rate

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Girum <i>et al.</i> (2017) [21] Survival status and predictors of mortality among severely acute malnourished children <5 years of age admitted to stabilization centers in Gedeo Zone: a retrospective cohort study	The study reports a high survival rate of the sample size; however, the presence of comorbidities was one of the predictors of mortality	The following comorbidities were prevalent: pneumonia with 27%, diarrhoea with 57.6% and anaemia at 12.5% of the sample size	none	Recovery: The recovery rate was 59.7%. Mortality: The mortality rate was 9.3%
Grenov <i>et al.</i> (2019) [26]. Diarrhea, dehydration, and the associated mortality in Children with complicated severe acute malnutrition: A prospective cohort study in Uganda	The results of the study indicate the coexistence of diarrhoea, dehydration, and malnutrition. These comorbidities influenced the duration of hospitalization/stay in malnourished children. An association between diarrhoea and high mortality was determined	Diarrhoea was the prevalent comorbidity, with 43% of the sample having it as comorbidity	none	none

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Guesh <i>et al.</i> (2018) [22] Survival status and predictors of mortality among children with severe acute malnutrition admitted to general hospitals of Tigray, North Ethiopia: a retrospective cohort study	The study reported the development of comorbidity as one of the predictors of mortality among children with malnutrition	The most prevalent comorbidities were pneumonia at 44.1% and diarrhoea at 25.2% of the sample	none	Mortality: the mortality rate was 3.8%, with 5.7% for pneumonia, 6.7% for anaemia and 4.9% for diarrhoea respectively as comorbidities of CM
Hassen <i>et al.</i> (2019) [23] Survival Status and Its Determinants among Under-Five Children with Severe Acute Malnutrition Admitted to Inpatient Therapeutic Feeding Centers in South Wollo Zone, Amhara Region, Ethiopia	The study found a significant coexistence of pneumonia and diarrhoea with malnutrition. These comorbidities were strong predictors of the time to recovery in children with malnutrition	The most prevalent comorbidities identified were pneumonia and diarrhoea at 44.1% and 40.1% of the sample respectively	none	Recovery: the recovery rate was 75.4% Mortality: the mortality rate was 3.4%

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Jarso <i>et al.</i> (2015) [20]. Survival status and predictors of mortality in severely malnourished children admitted to Jimma University Specialized Hospital from 2010 to 2012, Jimma, Ethiopia: a retrospective longitudinal study	The study reported the presence of comorbidities and age below 2 years as a predictor of mortality	The reported prevalent comorbidities were TB and anaemia at 15.8% and 41.6%, respectively	none	<p>Length of hospitalisation/stay: the average length of hospitalization/stay was 17.4 days</p> <p>Recovery: the reported recovery rate was 77.8%</p> <p>Mortality: the reported mortality rate was 9.3%</p>
Kinyoki <i>et al.</i> (2017) [27]. Modelling the Ecological Comorbidity of Acute Respiratory Infection, Diarrhoea and Stunting among under-5 children in Somalia.	The study indicated a correlation between diarrhoea, acute respiratory infections, and stunting.	Gastroenteritis was the most prevalent CM comorbidity with a prevalence of 26% of the sample	none	none

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Muzigaba <i>et al.</i> (2017) [24] Independent and interactive effects of HIV infection, clinical stage and other comorbidities on survival of children treated for severe malnutrition in rural South Africa: A retrospective multicohort study	The study found a strong correlation between HIV and malnutrition. The presence of lower a respiratory tract infection and marasmus in HIV-malnutrition comorbidity increases the risk for mortality	The most prevalent CM comorbidity was diarrhoea at 11% of the sample	none	Recovery: the recovery rate was 75.6% Mortality: the mortality rate was 24.4%
Tran <i>et al.</i> (2018) [29] Comorbid anaemia and stunting among children of pre-school age in low- and middle-income countries: a syndemic	The study reports 21.9% pooled proportion of comorbid anaemia and stunting - indicative of the correlation between anaemia and stunting	Anaemia was the most prevalent comorbidity at 56.4% of the sample size	none	none

Table 2: Data extraction table (continue)

Authors, year & title	Main Findings	Findings relevant to the study		
		Prevalence	Diagnosis	Treatment outcomes
Wagnew <i>et al.</i> (2019) [19] Treatment cure rate and its predictors among children with severe acute malnutrition in northwest Ethiopia: A retrospective record review	The findings of the study found the presence of TB, dermatosis, anaemia and altered body temperature in malnourished children as predictors of treatment cure rate	The most prevalent comorbidities were pneumonia and TB	none	<p>Length of hospitalisation/stay: the average length of hospitalisation/stay was 18 days</p> <p>Recovery: the reported recovery rate was 69.2%</p> <p>Mortality: the reported mortality rate was 10.8%</p>

Table 3 Characteristics of the target countries included in the review [32]

Country and number of studies	Population (2019)	Gross domestic product (GDP) annual growth % (2019)	Stunting % (under-5)+ year of data	Wasting under-5 %+ year of data	Underweight under-5 % + year of data	Mortality under-5 per 1000 live births + year of data	Severe food insecurity in the population% + year of data
Ethiopia (n=9)	112 078 730	8.4	36.8 (2019)	7.2 (2019)	21.1 (2019)	51 (2019)	14.1 (2018)
Uganda (n=1)	44 269 594	6.8	28.9 (2016)	3.5 (2016)	10.4 (2016)	46 (2016)	20.6 (2018)
Somalia (n=1)	15 442 905	-1.5	25.3 (2009)	14.3 (2009)	22.5 (2009)	117 (2009)	No data available
South Africa (n=1)	58 558 267	0.2	21.4 (2017)	3.4 (2017)	5.5 (2017)	35 (2017)	18.0 (2016)
Nigeria (n=1)	200 963 599	2.2	31.5 (2020)	6.5 (2020)	18.4 (2020)	117 (2020)	9.1 (2018)
Burkina Faso and Mozambique combined (n=1)	20 321 378 + 30 366 036	5.7 + 2.3	23.8 (2019) + 42.3 (2015)	8.1 (2019) + 4.4 (2015)	16.4 (2019) + 15.6 (2015)	88 (2019) + 74 (2015)	13.9 (2018) + 40.7 (2018)
Low and medium income countries (n=1)	NA	NA -	NA -	NA -	NA -	NA -	NA -

