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# A scoping review of early childhood caries, poverty and the first sustainable development goal

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## Abstract

**Background** Poverty is a well-known risk factor for poor health. This scoping review (ScR) mapped research linking early childhood caries (ECC) and poverty using the targets and indicators of the Sustainable Development Goal 1 (SDG1).

**Methods** We searched PubMed, Web of Science, and Scopus in December 2023 using search terms derived from SDG1. Studies were included if they addressed clinically assessed or reported ECC, used indicators of monetary or multidimensional poverty or both, and were published in English with no date restriction. We excluded books and studies where data of children under 6 years of age could not be extracted. We charted the publication year, study location (categorized into income levels and continents), children age, sample size, study design, measures of ECC, types and levels of poverty indicators and adjusted analysis. The publications were also classified based on how the relation between poverty and ECC was conceptualized.

**Results** In total, 193 publications were included with 3.4 million children. The studies were published from 1989 to 2023. Europe and North America produced the highest number of publications, predominantly from the UK and the US, respectively. Age-wise, 3–5-year-olds were the most studied (62.2%). Primary studies (83.9%) were the majority, primarily of cross-sectional design (69.8%). Non-primary studies (16.1%) included reviews and systematic reviews. ECC was mainly measured using the dmf indices (79.3%), while poverty indicators varied, with the most common used indicator being income (46.1%). Most studies measured poverty at family (48.7%) and individual (30.1%) levels. The greatest percentage of publications addressed poverty as an exposure or confounder (53.4%), with some studies using poverty to describe groups (11.9%) or report policies or programs addressing ECC in disadvantaged communities (11.4%). In addition, 24.1% of studies requiring adjusted analysis lacked it. Only 13% of publications aligned with SDG1 indicators and targets.

**Conclusion** The ScR highlight the need for studies to use indicators that provide a comprehensive understanding of poverty and thoroughly examine the social, political, and economic determinants and impact of ECC. More studies

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in low and middle-income countries and country-level studies may help design interventions that are setting- and economic context-relevant.

**Keywords** Material deprivation, Child, Preschool, Oral health, Low income, Income inequality, Sustainable development, Dental caries

## Introduction

The National Library of Medicine's Medical Subject Heading (MeSH) defines poverty as the situation where people have a living standard that is below that of the community because of their income level [1], thus using income to define poverty. This monetary poverty definition considers a person or a household to be poor if their standard of living is below the national poverty line which captures the ability to meet basic needs in food, shelter, clothing, and other goods obtained through purchase [2, 3].

Poverty can be classified based on how it is measured into absolute poverty referring to the percentage of the population having an income below the national or international poverty line and thus, unable to meet their basic needs [4]; and relative poverty where persons have living standards less than others in their community/ country and thus represents income inequality [5]. Income inequalities are measured by indices of inequality such as the Gini coefficient or the Lorenz curve [6]. Monetary poverty equates poverty with financial resources. On the other hand, multi-dimensional poverty uses a wider perspective of poverty [7, 8] which includes, in addition to the monetary dimension, education, basic infra structure such as water, sanitation and electricity in addition to health, nutrition and security [9].

The sustainable development goals (SDGs), established in 2015, replaced the millennial development goals (MDGs) [10]. Compared to the MDGs, the SDGs targeted all countries and not only developing countries, and addressed economic growth, social inclusion and environmental protection and not only social development [11, 12]. The first goal of the SDGs, however, remained the same as for the MDGs: to end poverty.

The SDG1 has seven targets aiming to build the resilience of the poor and those in vulnerable situations by reducing their exposure to environmental, economic, social shocks and disasters [12]. The seven targets of SDG1 define poverty in the monetary dimension as absolute poverty such as living below the international poverty lines (target 1.1) and below the national poverty lines (target 1.2) indicating extreme poverty. The targets also refer to multidimensional poverty including people in need of social protection systems (target 1.3) and people in need of basic services (target 1.4) [12]. Two targets, 1.a.2 and 1.b.1 aim to promote governmental spending to support the poor by providing essential services. A central goal in the SDGs is to end extreme poverty in all its forms everywhere by 2030.

Early childhood caries (ECC), which is the presence of any untreated, restored or extracted tooth with caries in a child below the age of 72 months [13], is linked to poverty. At country level, low and middle-income countries, which are resource-limited economies, have higher percentage of children with ECC than high income countries [14]. Monetary poverty is also associated with higher risk of ECC with higher ECC prevalence in countries with greater percentage of population living below the poverty line [15]. Also, multi-dimensional poverty is associated with high prevalence of ECC [16]. However, an ecological study suggested that not all forms of poverty are similarly linked to the risk of ECC [17].

The theory of economic, political, and social distortions suggests that poverty is linked to economic, political, and social systems, which limit the opportunities and resources to achieve well-being [18]. The SDG1 recognises the multiple dimensions of poverty, and how inequitable economic, political, and social structures impact health. The efforts to achieve the SDG1 targets may also have direct and indirect impact on shaping children's oral health and their risk of ECC [14, 19]. The eradication of poverty, institution of social protection systems, efforts to reduce the impact of disasters, increased governmental spending on essential services including health and education, and increased pro poor spending can have a positive impact on reducing the risk of ECC. On the other hand, ECC treatment and cost of care may have great financial implications on families of children with ECC. However, the pathways for this possible bidirectional relationship between ECC and poverty need to be identified.

The aim of this scoping review (ScR), therefore, was to identify research linking ECC and various types of poverty using the SDG1 targets and indicators. This ScR was guided by the question: what is the status of research on the relationship between ECC, poverty and the SDG1?

## Methods

This ScR was performed in accordance with the Joanna Briggs Institute guidelines [20] and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews guidelines (PRISMA-ScR) [21].

### Eligibility criteria

Studies were included if they addressed ECC which is caries including untreated, filled or extracted primary teeth in children younger than 6 years of age as defined by Drury et al. [22] and endorsed by the American Association of Pediatric Dentistry [13] whether assessed clinically or reported by parents. Various ECC indicators were used including the presence of ECC experience (yes/no), the presence of untreated ECC (yes/no), ECC severity measured by the number of teeth/surfaces with ECC experience or the number of teeth/surfaces with untreated ECC. The studies had to include a measure of monetary poverty, multi-dimensional poverty, or both. Studies of any design or publication date were included.

Publications not written in English and books, book chapters and book reviews were excluded. We also excluded studies where data specific to children under 6 years of age could not be extracted. Studies with indicators exclusively associated with socioeconomic status that were addressed by SDG 4 (education), SDG 15 (migrants and refugees), and SDG 11 (urban/rural differences) were excluded. Publications with no full texts were excluded.

### Information sources

Three electronic databases were searched: PubMed, Web of Science, and Scopus. The searches were conducted in March and April 2023 and updated in December 2023. The search terms for poverty were based on the terms for the SDG1 defined in Scopus [23] and adapted to the two other electronic databases. The search strategies can be seen in Appendix 1. Expert members of the Early Childhood Caries Advocacy Group (ECCAG) were also consulted for other sources that might have been missed by the search strategy.

### Selection of sources of evidence

Retrieved publications were exported to the reference management software Mendeley version 1.19.8. Duplicate publications were removed. Title and abstract screening was performed independently by two researchers (MET and DA) using the pre-defined inclusion and exclusion criteria. Full-text review of screened-in publications from the first level was then performed independently by the same two researchers. Uncertainty regarding whether publications met the inclusion criteria was resolved through consensus. The results were shared with two experts (RJS and MOF) for their review. Publications were retained when there was consensus between the experts and the reviewers. The final list of included publications was shared with members of the ECCAG for further confirmation. No external authors or institutions were contacted to identify additional sources.

### Data charting

We extracted details on publication year (grouped into decades) and study location, defined as the country in which the study was conducted. The countries were grouped by continent and by income level (low-income countries (LICs), lower middle-income countries (LMICs), upper middle-income countries (UMICs) and high-income countries (HICs)) based on the World bank 2022-23 classification [24].

We also extracted the age of children included in the study in years. The publications were grouped into studies conducted among 0-2-year-olds, 3-5-year-olds, and 0-5-year-olds. The age grouping was done following the recommendation in our previous publication based on differences in data availability, ECC prevalence and age-related determinants of risk [25]. Information on sample size was also extracted.

The design of each study was identified and classified into primary and non-primary studies. Primary studies were further classified into cross-sectional, ecological, case control, cohort, randomized clinical trial (RCT) and protocols of any of the above. Non-primary studies included reviews, systematic reviews, scoping reviews, guidelines and opinions.

We extracted information on the measures of ECC and classified them into non-clinically assessed (parent reported, years lived with disability (YLDs)) [26] and clinically assessed including the presence/absence of untreated decay or caries experience, the number of surfaces/teeth with untreated decay or caries experience whether caries was measured using the dmf index, its variants or ICDAS [27] as well as pufa for caries complications [28].

In addition, we extracted information on poverty indicators and classified the publications into those using single or multiple indicators. We identified the publications using indicators of monetary poverty (absolute or relative) and multidimensional poverty. We defined absolute poverty as the percentage of the population below national or international poverty lines [4] and relative poverty as inequalities in ECC due to socio-economic position measured by the Lorenz curve, the Gini index, or both [5, 6]. Multidimensional poverty was defined by at least two indicators of poverty exclusive of monetary poverty. Indicators of multidimensional poverty include crowding, occupation, school type, federal assistance, qualification for school meal, ownership of commodities, and food insecurity. We also assessed if poverty was measured at the individual, family, area, community, school, city and country levels by adapting the Fisher Owens conceptualization of the influences on child's oral health [29].

In addition, we adapted Locker's description of MacIntyre's method [30] to classify primary studies

according to how the relation between poverty and ECC was conceptualized. The method encompasses a view of poverty that includes economic, social, and cultural dimensions, and frames poverty within a broader historical and societal narrative, acknowledging its roots and evolution over time. This allows poverty-related actions to reach beyond the alleviation of material deprivation to the overall well-being and flourishing of individuals and communities. There were eight ways poverty could be conceptualized in relation to ECC: (1) defining a group or community of people; (2) in a causal relation with ECC (dependent variable) where poverty is an independent or a confounding variable; (3) measured by income level, and used to compare ECC among administrative units/countries in ecological studies; (4) assessing trends or changes across time in ECC based on poverty; (5) assessing a gradient of ECC or effect modification of ECC risk by levels of poverty; (6) the effect of poverty on ECC at different ages in life course studies; (7) evaluating the effect of policies or programs, including fluoridation, on ECC at different levels of poverty; and (8) ECC as independent factor and poverty as dependent or confounding factor. We also identified whether these relations were analyzed using bivariate or multivariable methods to adjust for confounders.

### Analysis

The extracted data were presented using descriptive statistics as numbers, frequencies, and sums. Excel was used for graphical presentation to generate bars/clustered bars, tree maps, and map. A word cloud was created to demonstrate study designs [31].

## Results

The initial search from the three databases yielded 3,377 potentially relevant publications. Thereafter, 614 duplicates were removed, and 2,354 publications were removed after screening the titles and abstracts, leaving 409 for full text screening. Of these, 40 publications could not be retrieved. On reading the full text of the remaining 369 publications, 176 publications did not meet the inclusion criteria and were removed leaving 193 publications to be included in this ScR. Figure 1 is a flowchart of the selection process. The details of the publications included in the ScR are in Appendix 2.

Fifteen (7.8%) papers were published in the 1990s or before, 54 (28.0%) in the 2000s, 81 (42.0%) in the 2010s and 43 (22.3%) from 2020 to December 2023 (Fig. 2). The publications increased in number since 2016, the year the SDGs came into effect, except for the year 2020 when the COVID-19 pandemic brought the world to a standstill. The average number of publications till 2015 was 5 and it doubled afterwards from 2016 to become 10.

Twenty-two publications were multi-country, while 171 publications were country-specific (Fig. 3). The greatest number of publications were from Europe (49, 25.4%), mostly the UK (31 publications), and North America (46, 23.8%), mostly the US (42 publications), followed by South America (35, 18.1%) mainly Brazil (29 publications), Asia (20, 10.4%) mainly India (5 publications) then Australia and New Zealand (12 and 4 publications) and Africa (5, 2.6%) with three publications from South Africa and one each from Nigeria and Tanzania. Of all publications from specific countries, two (1.0%) were from LICs, 11 (5.7%) from LMICs, 40 (20.7%) from UMICs and 118 (61.1%) from HICs.

Twenty (10.4%) of the publications included 0–2-year-old children, 120 (62.2%) included 3–5-year-old children, and 40 (20.7%) included 0-5-year-old children. Also, 13 (6.7%) did not specify the age of the included children and 33 (17.1%) publications did not specify the number of children in the sample. The total number of children included in the remaining 160 publications was 3,404,236 with a median of 892 children per study, a minimum of 24 children and a maximum of 995,003 children. There was a much greater number of 3–5-year-old ($n$=3,249,261) than 0–2-year-old children ($n$=21,549).

Figure 4 shows that 162 (83.9%) publications were primary studies and 31 (16.1%) were non-primary studies. Most primary studies were cross-sectional in design (113, 69.8%), and there were 23 (14.2%) cohort studies. Most of the 31 publications about non-primary studies were reviews (14, 45.2%) or systematic reviews (10, 32.3%).

Most publications (153, 79.3%) measured ECC using dmf scores and 10 (5.2%) publications used ICDAS. One recent publication used the pufa index. Six publications assessed ECC non clinically, with five relying on parent reporting, and one using YLDs. Four publications used a mixture of indices and 19 publications did not specify how ECC was measured.

Figure 5 shows the poverty indicators used in the publications. There were 113 (58.5%) publications with a single poverty indicator and 71 (36.8%) with more than one indicator, whereas 9 (4.7%) did not specify the indicators used. The most common indicator was income (89, 46.1%) followed by area-based indicators such as the Jarman deprivation index, the Townsend deprivation index and the Carstairs index of deprivation in the United Kingdom, the Socio-Economic Indexes for Areas (SEIFA) in Australia, the area deprivation index in the United States of America (37, 19.2%) and occupation (36, 18.7%). Four (2.1%) publications explicitly used indicators of multidimensional poverty. Relative poverty was measured in 8 (4.2%) publications, including four (2.1%) using the Gini coefficient. Thirteen (6.7%) publications reported the percentage of the population below the national poverty line.

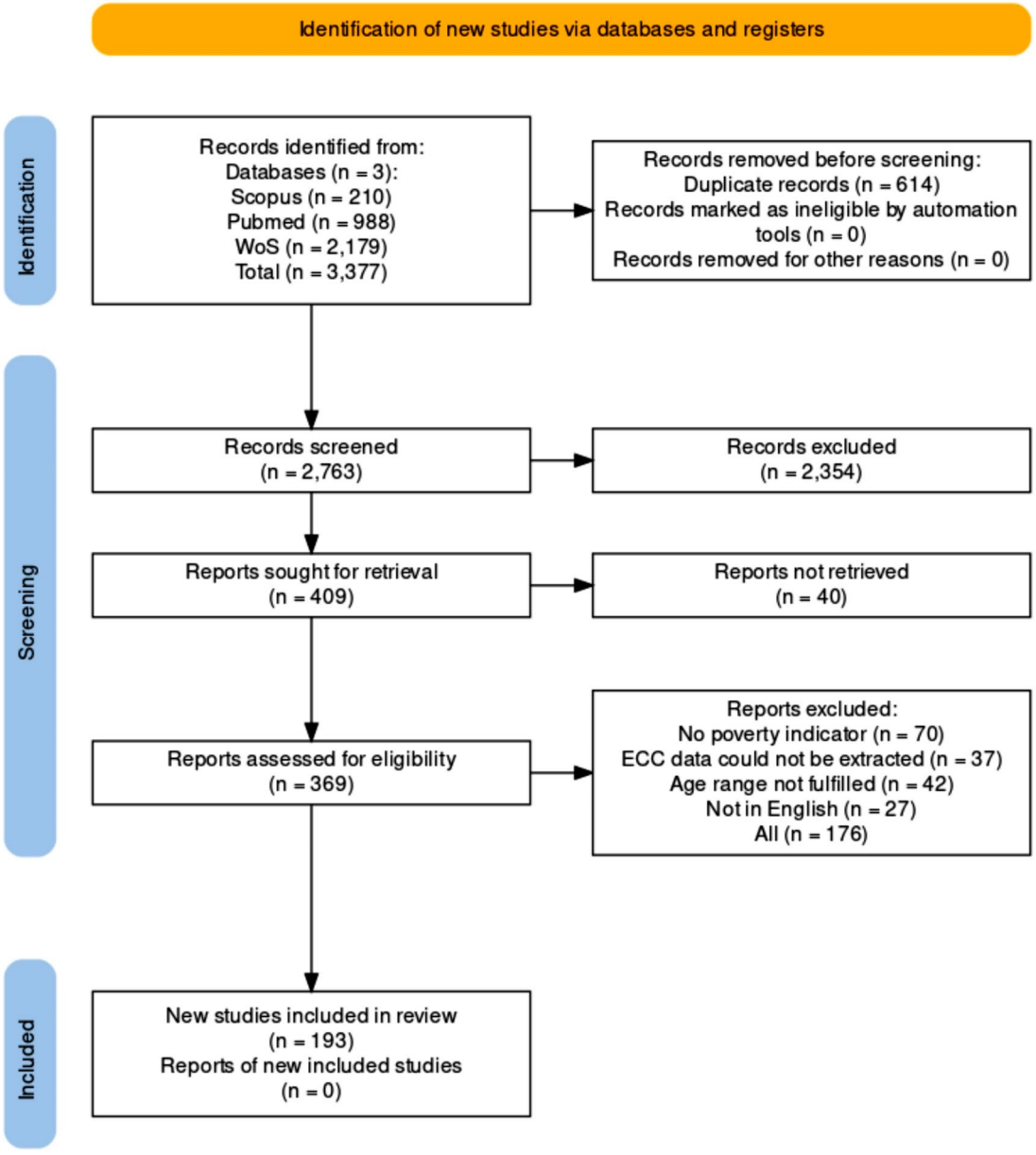


**Fig. 1** Flowchart of study selection process [32]

Most (157, 81.4%) publications used poverty indicators measured at one level and the remaining 18.6% assessed it at two ($n$=28), three ($n$=7) or four ($n$=1) levels. Poverty was measured at the family (94, 48.7%), or individual (58, 30.1%) levels followed by area (34, 17.6%) or community (31, 16.1%) levels. Some publications assessed poverty at the school level (16, 8.3%) and only a few measured it at city or country levels (2 and 3 respectively).

Figure 6 shows that more than half of the publications (103, 53.4%) addressed poverty as an exposure or confounder. Less studies used poverty as descriptor of participants (23, 11.9%), reported on policies, or programs addressing ECC in disadvantaged communities (22, 11.4%), or assessed effect modification by poverty on ECC (21, 10.9%). Five publications reported on the cost implications of ECC. Adjusted analysis was not indicated in 56 (29.0%) of the included studies. In the remaining 137, adjusted analysis was used in 104 (75.9%) while 33 (24.1%) publications that required adjusted analysis did not have this done.

In addition, 25 (13.0%) publications addressed absolute, relative or multidimensional poverty (SDG targets 1.1 to 1.4). Furthermore, from 2016 to 2023, only 11 publications addressed programs and policies on ECC in disadvantaged populations (SDG1 targets 1.a.2 and 1.b.1).

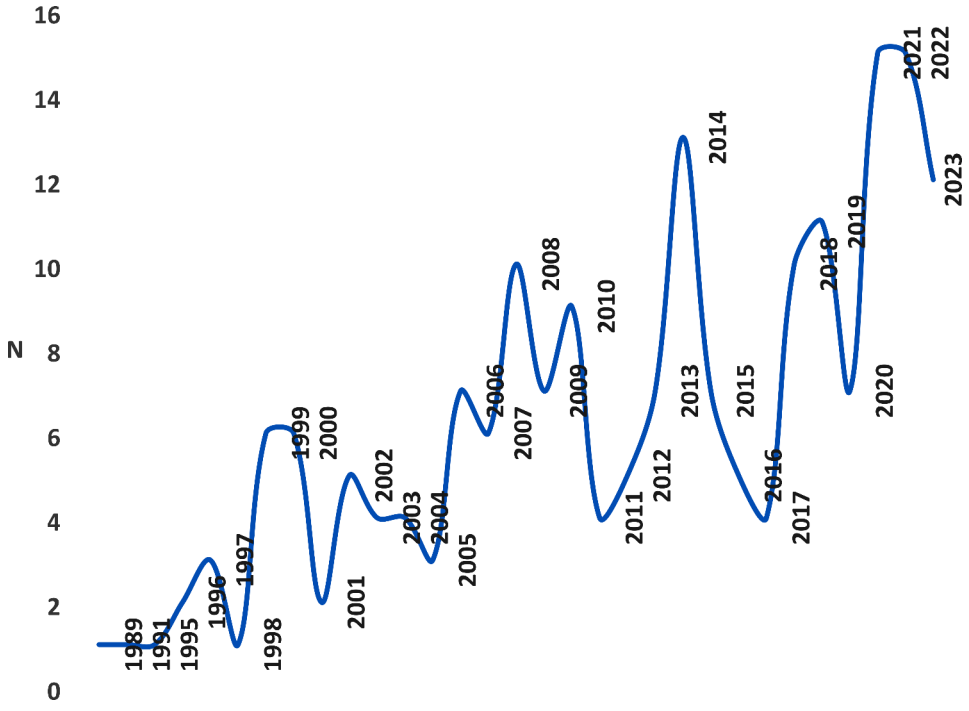


**Fig. 2** Number of publications on ECC and poverty by year

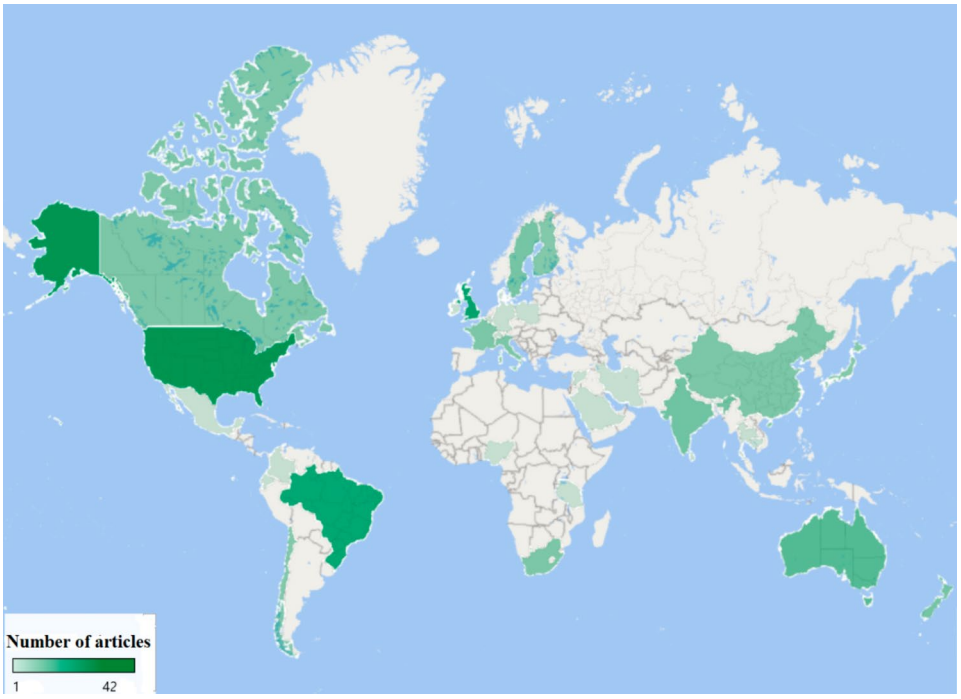


**Fig. 3** Number of publications on ECC and poverty by country (darker shade of green indicates more publications from the country)

## Discussion

This ScR showed that most studies on ECC and poverty were conducted after 2010, focused on 3–5-year-old children, used a cross-sectional design, and measured ECC clinically. Poverty was mainly assessed using single indicators, indicators of monetary poverty, or measures of poverty at the family level. Studies aligning with the SDG1, including the impact of social protection systems, access to basic services, governmental spending on essential services and pro poor public spending, were few. Most publications linked poverty to ECC as a confounder or an independent variable, some evaluated the impact of

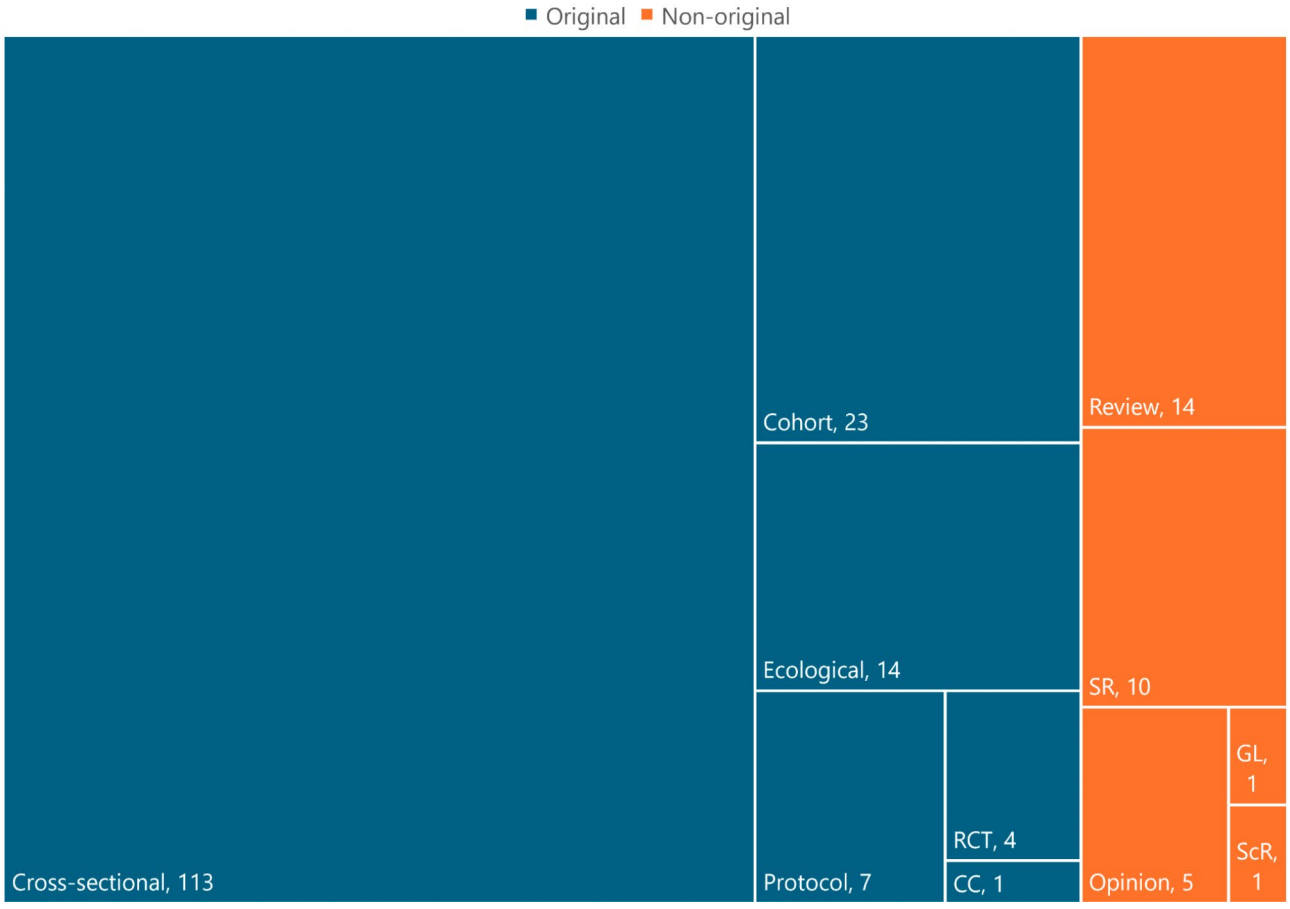


**Fig. 4** Design of studies on the association between poverty and ECC (RCT: randomized controlled trial, CC: case-control, SR: systematic review, GL: guidelines, ScR: scoping review)

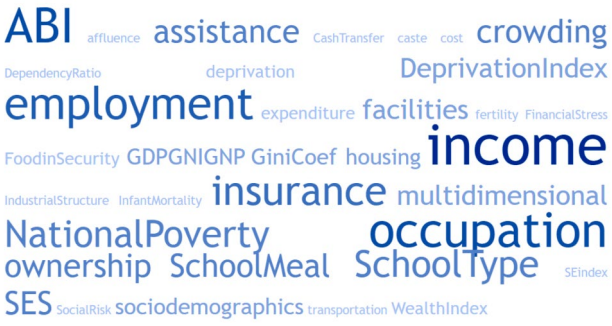


**Fig. 5** Word cloud of poverty indicators used in the publications included in the ScR (ABI: area-based index, GDP: gross domestic product, GNI: gross national income, GNP: gross national product, SES: socio economic status, SE: socio economic)

policies and programs on ECC, and few studies assessed trends or effect modification. Few studies also assessed the cost of ECC or its impact on oral and general health. Most studies were conducted in HICs and UMICs, and more than half of the studies originated from UK, US and Brazil. There was minimal evidence on the link between country-level poverty indicators and ECC.

There was a large number of publications that used multiple and diverse indicators of ECC and poverty, with different levels at which they were measured and limited use of adjusted analysis. Because of this, we could not provide a summary of the association between ECC and poverty. Therefore, we opted to present this ScR as a preliminary step to a systematic review that would allow better assessment of the quality of included studies and the impact of poverty on ECC at different units and levels.

The strengths of this study include the comprehensive review of publications in English, searching the three main electronic databases, and identifying knowledge gaps that need to be addressed to improve our understanding of the studied association. One of the limitations was the inclusion of publications in English only which may underestimate the number of identified papers. Also, we included reviews and study protocols, and it is possible that there would be some duplication because of this. However, the aim of the scoping review was to map the literature and not to extract estimates to quantify relationships like in a systematic review where estimate duplication would pose a problem. In addition, we did

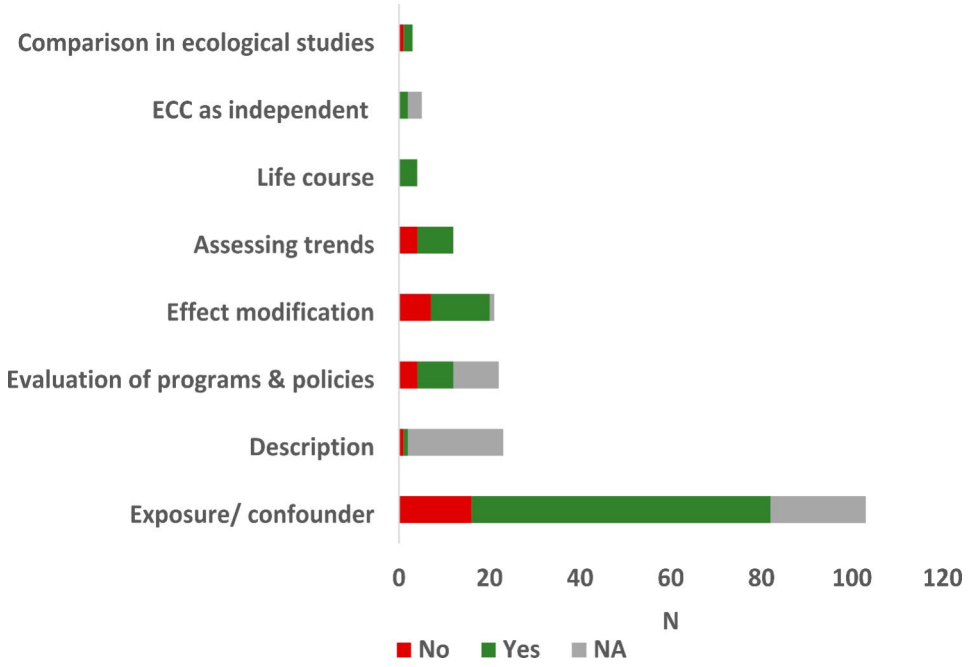


**Fig. 6** Classification of publications according to conceptualization of poverty and use of adjusted analysis (NA = use of adjusted analysis not applicable)

not include all potential databases where publications on ECC and poverty might be indexed. However, the study provides insights about the research on the link between ECC and poverty and the gaps in this area. There are several important findings.

First, this ScR aimed to align the literature on ECC and poverty with the United Nations' SDG1 targets and indicators. The dental scientific community seems to be responding to the SDGs as more research in this area has been published on average starting from 2016 than before. However, there was can be better alignment with how the SDG1 defined poverty. Thus, despite the increasing number of publications in the field, more alignment is needed to ensure that dental research supports the achievement of SDG1 in relation to ECC.

Second, the current review identified that studies from LICs or LMICs were few. This affects our full understanding of the relationship between ECC and poverty. ECC research in LICs and LMICs faces several challenges including the need to build research capacity [33, 34] and secure data sources. Few LICs and LMICs routinely collect nationally representative data on ECC [25]. The 2022 Global Oral Health Status Report [35] used advanced computational methodologies to infer disease estimates for countries where there are none based on the Global Burden of Diseases (GBD) studies. However, the GBD studies reported only on untreated caries in primary teeth regardless of age, and did not include the sequalae, such as extraction and filling [36], which are part of the ECC definition [13]. Thus, global comparisons using the GBD estimates do not adequately assess the ECC burden. However, the World Health Organization included 5-year-olds as one of the index age groups for surveys up to the 2013 edition of their oral health survey manual [37]. At the same time, data are routinely collected to monitor maternal and child health in LICs and LMICs using global health surveys such as the Demographic and Health Surveys and the Multiple Indicator Cluster Surveys [38]. If ECC indicators are incorporated into these surveys, ECC can be embedded in the surveillance systems of these countries. This may require the use of non-clinical indicators of ECC such as self-reporting which reduces the necessity for labour-intensive clinical examinations. However, research is needed to improve the accuracy of these non-clinical indicators. This approach may help address the current gap we noticed wherein only few studies used poverty indicators at country level. When data is available, it would be possible to better understand the impact of poverty on the risk of ECC in Africa and Southeast Asia where most LICs and LMICs are located, where the greatest number of people with caries live [35], and where the largest number of 0–5-year-old children are resident [39].

Third, only 10% of studies focused on 0-2-year-old children. Our previous research showed that 0-2- and 3–5-year-old children have different ECC profiles and disease determinants and hence, the need to differentiate between these two age groups [25]. In addition, 0-2-year-old children may require different, non-clinical ECC indicators due to the relative difficulty of examining children at this young age. Also, different level of measuring poverty may be needed since children at this age are

less likely to be in schools [40]. Greater focus on younger age would enable better understanding of the life course of caries at different age groups and allow the design of interventions for ECC prevention tailored to this age.

Fourth, several studies used multiple indicators to assess monetary poverty at individual, family and to a lesser extent at the community, city or country levels. There were, however, no studies focusing on polices about the impact of poverty on ECC at the sub-regional or country levels. This is a gap that limits the implementation of country specific programs. Policies aiming to control poverty can affect individuals, families, and community level experiences of ECC, and cumulatively impact country-level ECC experience than vice-versa. Future ECC-poverty research needs to align with the SDG1 and enable the promotion of poverty alleviation programs and policies that have greater potential of inducing large scale and sustained impact on populations. Greater country-focused economic development and reduced poverty are expected to reduce the burden of poor oral health including ECC [16].

Though far-reaching progress has been made to eliminate poverty in countries like China and India [41, 42], progress has been slow in South Asia and sub-Saharan Africa, where about 80% of those living in extreme poverty reside and where there is a huge burden of ECC [43, 44]. New threats brought on by climate change, conflict, food insecurity and COVID-19 mean that more work needs to be done to bring people out of poverty [44] and reduce the risk of ECC as a public health threat in deprived settings and developing countries. Socioeconomic inequalities drive higher disease burden in disadvantaged populations within and across societies, and over the life course [35]. The causes of these inequalities are often complex and related to country-specific cultural, economic, historical, social, or political factors, and reflect the inequitable distribution of resources in society including power, money, and agency among others [5, 45]. Research disentangling the complexities of cultural, economic, healthcare system and political factors at country level is needed to guide policy formulation, and to set international agendas for oral health.

Fifth, most studies used poverty as an independent factor affecting ECC, as a descriptor for participants, or a modifier for the association between ECC and other factors. More studies are needed to investigate the impact of ECC on the risk for poverty as untreated ECC can increase the risk of reduced productivity and has high management associated costs for parents [46]. Studies on the economic impact of ECC can support advocacy efforts that call for greater investment in poverty-alleviation programs controlling ECC. There is currently limited information on the cost of ECC care and the extent to which it contributes to catastrophic oral healthcare expenditure since ECC has a socioeconomic gradient and is concentrated in the most disadvantaged [47]. ECC places further stressors on already strained healthcare systems due to the increased demand for treatment under general anaesthesia. In addition, information on dental insurance that covers ECC is scarce. This information is critical to advocate for the inclusion of ECC prevention and management within universal healthcare care schemes in settings with high disease burden.

In addition, there has been recent interest in the impact of ECC on oral and general health in children and adults in later life [48–50]. This line of research sheds light on how ECC affects child growth, nutritional status and wellbeing. Such evidence helps better advocacy for ECC care and bridges the gap separating oral and general healthcare of children. In addition, it directly puts ECC on the agenda of child healthcare.

Sixth, the use of adjusted analysis to control confounders was limited in the studies in this ScR. Confounders obscure the effect of exposures on dependent variables [51] and if not controlled, produce biased estimates of the relation between ECC and poverty, threatening internal validity and leading to incorrect conclusions either over- or underestimating the effect [52]. This problem has been previously reported in dental research with differences among dental journals in the use of adjusted analysis [53]. Also, a ScR of waste in dental research [54] showed that confounding was ignored in 17% of non-randomized studies and 21% of different types of studies. Journals need to emphasize the use of adjusted analyses.

In conclusion, this ScR suggests that research on the link between poverty and ECC is growing and currently occurs in limited settings and economic contexts. More research is needed using indicators based on a more comprehensive definition of poverty, to assess the social, political and economic determinants and impact of ECC. More studies are also needed in Africa and South Asia where the burden of ECC is high and there are currently very few studies. In addition, country-level studies about poverty and ECC are also needed to support context-specific responses for ECC management.

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-024-04790-w.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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None.

**Author contributions**
MOF conceived the study. The project was managed by MET and MOF. Data curation was done by MET. Data analysis was conducted by MET and DY. MOF and MET developed the first draft of the document. MET, DA, JIV, CAF, RJS, OBA, AA, MOF read the draft manuscript, made inputs prior to the final draft and approved the final manuscript for submission.

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**Data availability**
The datasets used and/or analysed for the study are publicly accessible.

## Declarations

**Ethics approval and consent to participate**
Not applicable.

**Consent for publication**
Not applicable.

**Competing interests**
Jorma I. Virtanen, Ola B. Al-Batayneh and Arheiam Arheiam are editorial Board members with BMC Oral Health. Morenike Oluwatoyin Folayan and Maha El Tantawi are Senior Editor Board members with BMC Oral Health. All other authors declare no conflict of interest.

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