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Review Article

Reviewing Nutritional Status in Children with Severe Early Childhood Caries

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Abstract

Early Childhood Caries is a disease that is diagnosed when a child of or under 71 months of age has got his/her primary teeth with one or more caries, missing tooth surfaces or tooth surfaces with filling. Severe Early Childhood Caries (S-ECC) is the most common disease in children, affecting 60% to 90% of children worldwide. Nutritional status and S-ECC can be caused by some behavioural factors associated with poor dietary habits. Therefore, this study was aimed to determine the nutritional status of children with severe early childhood caries. This study was conducted by using a literature review method with a systematic approach and by collecting articles related to research topics on PubMed, ScienceDirect, and Google Scholar. The referenced papers which were used for the purpose of creating this study were published within the last ten years (between 2011 and 2021). The articles were selected using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). They were screened and assessed for eligibility by JBI critical appraisal tools and The Mixed Methods Appraisal Tool (MMAT). 610 studies were identified through the database search, and 16 were included in this systematic review. The studies which were included in this systematic review vary.Ten of the studies have significant results whilst six of them have non-significant results. The reason for this might be either caries being a multifactorial, varied sample population or the research methods differing in each study.

Keywords: Anthropometric, BMI, nutrition status, overweight, severe early childhood caries, underweight

Introduction

Early Childhood Caries (ECC) affects 60% to 90% of children worldwide. It could be said that it is the most common disease found in children.[1] ECC is a condition in which a child of or under 71 months of age has primary teeth with one or more tooth surfaces that are carious, missing, or filled.[2] In 1999, for the first time in history, Wynne classified ECC into three types based on the level of aetiology as follows: Type I (mild to moderate), Type II (moderate to severe), and Type III (severe). According to the American Academy of Pediatric Dentistry, in children under three years of age, caries being seen on smooth surfaces can be thought as an indication of severe early childhood caries (S-ECC). Between 3 to 5 years of age, S-ECC can be defined as the loss of one or more teeth due to caries, cavities, or fillings on the smooth surface of the anterior maxillary teeth or a deft score of 4 (at the age of 3), 5 (at the age of 4), or ≥6 (at the age of 5).[3]

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The American Academy of Pediatric Dentistry (AAPD) recognizes ECC's significant impacts on public health issues, but awareness of the impact of caries which are left untreated through a child's development and growth is still quite low.[3] Severe Early Childhood Caries (S-ECC) can affect a child's ability to talk, eat, grow, socialize, and it can also cause pain.[4] Factors that influence the occurrence of S-ECC are (1) environmental risk factors, (2) socio-cultural risk factors such as low socioeconomic status, (3) behavioural risk factors related to eating behaviour such as patterns like excessive sugar intake (4) resulting with the need of frequent dental care.[5]

Nutritional status and ECC can also be a result of behavioural risk factors associated with poor dietary habits and food choices. Wasting and stunting are associated with the risk of developing enamel defects and increased plaque accumulation.[6,7] Another study shows that caries causing pain and resulting with tooth loss can affect a child's ability to eat, can disrupt his/her sleep time, and can cause discomfort. So, nutritional status and ECC may have a two-way correlation. Assessing nutritional status by using various anthropometric measurements provides information about the growth and helps with obtaining data to evaluate conditions associated with increased risk factors for disease, such as being underweight or overweight, stunting, or wasting.[8]

Information related to the correlation between being underweight or obese and S-ECC shows varied results. Several studies have found a positive correlation between caries and obesity.[3,9] On the other hand, other studies have reported no correlation between S-ECC and BMI deficiency, weight or height of children.[10] The purpose of this study was to explore children's nutritional correlation with S-ECC by using a systematic literature review approach. Studying the correlation between nutritional status and ECC can enrich the learning of its impact on children's growth and development.

Methods

Data extraction

The article extraction system used the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) technique.[11] Paper criteria specified by constructing research questions, using the PICO framework (Population, Intervention, Comparison, and Outcome) guidance and other inclusion and exclusion criteria,[12] are as follows: (1) Population, children with ECC type III (severe); (2) intervention, without any intervention; (3) comparison, healthy children without systemic disorders; (4) outcome, knowing the nutritional status of children with type III ECC. The inclusion criteria in this study were for the articles to be published in English or Indonesian languages within the last ten years (from 2011 to 2021), and for their full text to be examining the nutritional status of children with early childhood caries type III (severe).

The article search strategy utilised PubMed, Science Direct, and Google scholar digital databases with these keywords: "early childhood caries", "severe early childhood caries", "rampant caries", "nutrition status", "overweight", "undernutrition". These keywords were then used with Booleans (AND and OR) to combine searches. Additional article searches were performed manually by looking at the list of obtained article references to pinpoint missing articles from the search database. Firstly, data on the articles which were generated from the search process within the database were extracted. Secondly, they were checked for duplication by using Mendeley Tools. Then, the articles were selected manually based on title and abstract. And lastly, they were assessed as a whole and complete text. The article data extraction included the name of the researcher, year of publication, title, country, sample, results, conclusions, and the results of the article quality assessment. From the articles obtained, only S-ECC and rampant caries cases were selected for further process.

Risk of bias assessment

The process continued by assessing the generated papers from the inclusion criteria screening process by using JBI critical appraisal tools and then by adjusting Mixed Methods Appraisal Tool (MMAT)[13] to the design study of each article so that the articles' bias level and the article quality could be determined. Based on the formulated questions in the assessment tool, the articles were assessed by using four assessment criteria, namely "yes", "no", "unclear", and "not applicable". The risk of bias was determined to be "highly biased" when the study's "yes" score reached up to 49%, "moderate bias" when the "yes" score reached between 50% to 69%, and "low bias" when the study reached more than 70%.[14]

Results

Article selection

In the early stages of the article processing, the researcher put keywords in the electronic database which, as a

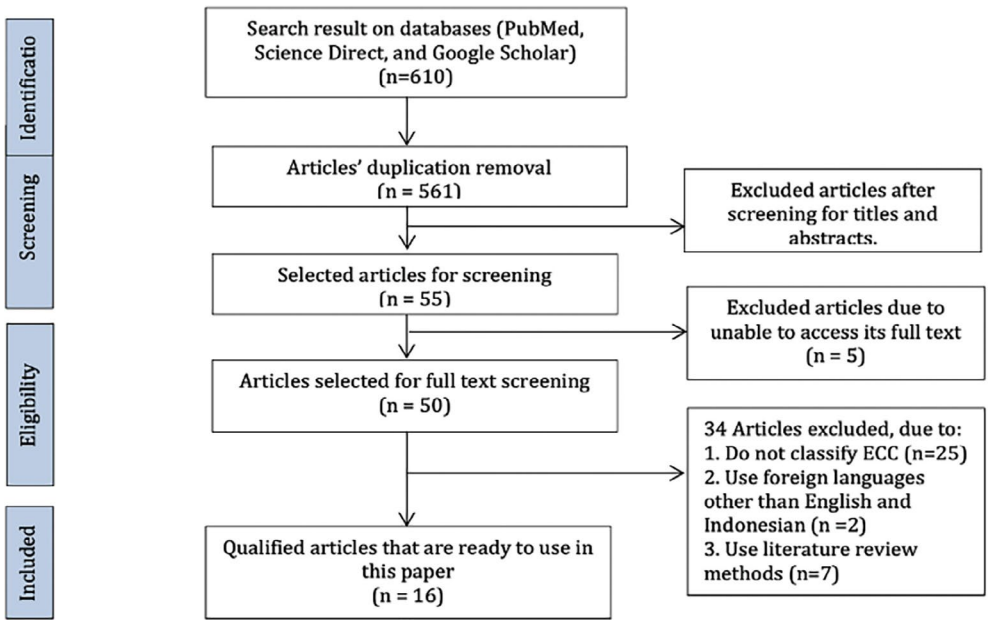

Figure 1. PRISMA systematic review

ECC: Early Childhood Caries

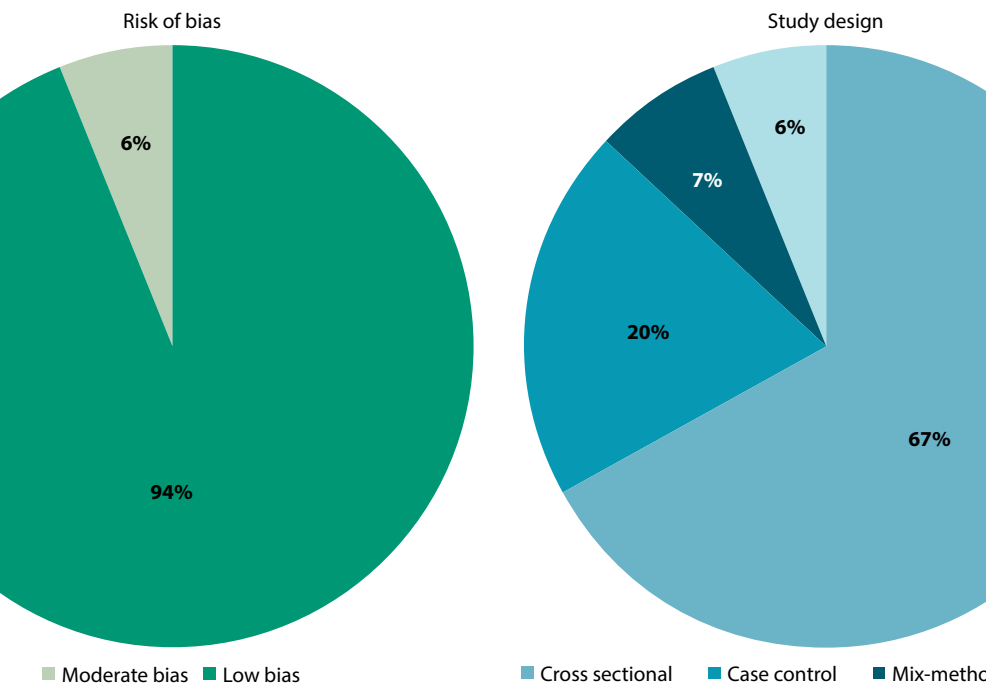

Figure 2. Articles' characteristics

result, delivered 610 articles. Then, to ensure there were no duplicate articles, 49 articles were excluded, leaving 561 eligible out of 610 articles. Furthermore, after opting out some more articles based on their titles and abstracts, and ensuring articles' text completeness, 50 complete articles were obtained in total and they were ready to be reviewed along with their entire context. Then, 34 articles out of 50 were excluded for the following reasons: Not classifying ECC and S-ECC (n=25), using foreign languages other than English or Indonesian (n=2), and using literature review methods (n=7). In the final stage, 16 articles were selected for the

Table 1. Results on risk of bias assessment using Joanna Briggs Institute (JBI) critical appraisal tool and the mixed methods appraisal tool (MMAT)

Author	Research method	Risk of bias
Tsang, Chloe, et al	Cross-sectional	Low bias
So, Marvin et	Cross-sectional	Low bias
Bhoomika, W., & Munshi, A. K	Cross-sectional	Low bias
Davidson, Katherine, et al	Cross-sectional	Low bias
Bagherian, A., & Sadeghi, M	Cross-sectional	Low bias
Wasunna, D. C	Cross-sectional	Low bias
Costa, L. R., Daher, A., & Queiroz, M. G.	Cross-sectional	Low bias
Edalat, A., et al	Cross-sectional	Moderate bias
Kennedy, Tara, et al	Cross-sectional	Low bias
Yen, C. E., & Hu, S. W.	Cross-sectional	Low bias
Hung, Ha Van, et al	Cross-sectional	Low bias
Vundavalli, Sudhakar, et al	Case-control	Low bias
Vania, Andrea, et al	Case-control	Low bias
Gaur, S., & Nayak, R.	Case-control	Low bias
Renggli, Eva Peris, et al	Cohort	Low bias
Athavale, Priyanka, et al	Mix-Method	Low bias

literature review approach. Figure 1 shows the summary process PRISMA for selecting articles used in this paper.

Study characteristics

After being reviewed, the articles chosen as resources for this study were 16 in total. The study population varied from 100 to 1407 different samples in each article. The types of research included in this study were cross-sectional research design (n=11), case-control studies (n=3), cohort research studies (n=1), and mix-method studies (n=1) as shown in the graph in Figure 2. During the bias risk assessment of each article, 15 articles with low risk of bias and 1 article with moderate risk of bias were found. Table 1 summarizes the complete results of the bias risk assessment.

Presentation of results

Since the articles showed varying results, after extracting data from the 16 chosen articles and classifying them according to their results, it was decided to divide them into two groups. The first group has ten studies with significant nutritional status results on S-ECC, and the second group has six studies with insignificant results on S-ECC. The presented results of data extraction are shown in Table 2 and Table 3.

Discussion

Significant relationship between BMI and S-ECC

Among the articles which were referenced in this study, four articles have found that compared to the other groups, children with S-ECC had significantly higher BMI scores and had a positive correlation between S-ECC scores and BMI.[3,9,15,16] Overweight is a balance disorder in which calorie consumption is more than calories burnt.[17-19] Caries and overweight can be caused by the same risk factors, including the habit of eating carbohydrates, foods with high sugar quantities, fast food, and caries foods.[20,21] The case-control study in Sakaka, Saudi Arabia, has also found a significant association between the frequency of sugar intake and S-ECC (p=0.001).[16] In a previous study, Vázquez-Nava et al[22] mentioned that children who consume fermentable carbohydrates has a 2.34 times greater risk of developing caries. In addition, children who consume more soft drinks than milk or fruit juices are 100% at risk for tooth decay as they age.[23] Streptococcus Mutans (SM) can transform carbohydrates into acids, reduce salivary flow, and make the demineralization process more dominant by raising the frequency of carbohydrate fermentation and this can cause caries to increase.[2]

Significant relationship between nutritional status and S-ECC

According to this study, severe early childhood caries were described as caries in the primary teeth of children under 71 months of age. However, the age of the children from whom the samples were taken in each study varied widely. One study reported that in children up to 2 years of age, there was no significant risk of malnutrition but children between 3 to 6 years of age had a greater chance of being underweight (AOR=1.45; 95% CI: 1.24-1.66; p=0.004) compared to the ones who did not have caries and mouth pain.[24] If left untreated, ECC can cause pain, affect sleep quality, reduce chewing and eating abilities, and a child's nutritional deficiencies can also affect his/her quality of life.[25-27] Six of the studies which were referenced in this study implied that severe caries significantly correlated with chronic or acute malnutrition, stunting, and underweight children. [24,28-32] Children with S-ECC are also three times more likely to experience mouth pain.[24] The case-control study which was performed in India and which was also included in this studyfound that among the children with S-ECC at the baseline in the control group, 46% were underweight. However, after six months of rehabilitation, there was a significant increase in Wt of children in the S-ECC group (p=0.002).[31]

Table 2. Nutritional status significantly correlates with S-ECC

No	Study (year)	Title	Country	Research method	Sample	Child growth standards guidance	Anthropometrics	Caries Index	Results	Conclusion
1.	Tsang, Chloe, et al (2019)28	Early Childhood Oral Health and Nutrition in Urban and Rural Nepal.	Nepal	Cross-sectional	836 (6 years of age)	WHO	1. Length than Age 2. Body Mass Index 3. Weight For Age	- Average dmft 4.3 - 58.2% of the children have caries. - 50.1% have 1-4 caries teeth. - 35.3% have 5 to 9 caries teeth. - 14.6% have ten or more carious teeth.	- 34.2% of the children are stunted and the amount is significantly higher in rural children. - 15% of the children are underweight, 2% of the children are wasted, and there is no significant difference between children in rural and urban areas.	Child caries severity according to dmft significantly correlated with the probability of experiencing oral pain, and chronic and acute malnutrition according to height for age (HAZ), weight for age (WAZ), and BMI for age (BAZ) scores.
2	Renggli, Eva Peris, et al (2021)29	Stunting Malnutrition Associated with Severe Tooth Decay in Cambodian Toddlers.	Cambodia	longitudinal cohort	1307 (<23.9 months of age)	WHO	Age	- Mean (SD) baseline dmft for children with caries was 5.1 (3.6). - At baseline dmft children with stunting is 2.7 (3.5) and children without stunting is 2,3 (3.6) (p=0.053). - Follow-up dmft in stunted children is 3.2 (3.9) and in non-stunted children it is 3.3 (4.1) (p=0.800).	- At baseline, 14.4% of the children had severe dental caries, 25.6% with stunted growth. - 17.6% of the children's status were changed from healthy nutritional status to low height for age during the observation period. - Children with severe caries nearly doubled the risk (OR=1.8; CI 1.0-3.0) of making the transition.	This study shows that severe tooth decay is associated with the development of stunting malnutrition.
3.	Athavale, Priyanka, et al (2020)30	Early Childhood Junk Food Consumption, Severe Dental Caries, and Undernutrition: A Mixed-Methods Study from Mumbai, India.	India	Quantitative and Qualitative	959 (6 months of age)	WHO	1. Length for age 2. Weight for age 3. Body Mass Index	-Mean dmft in children with caries <3 years (3.7±2.5). - Average dmft in children with caries >3 years (5.7±4.1). - Overall, 50% experienced ECC. -19% experienced severely deep tooth decay.	- Overall, 56% of the children were malnourished, with 42% being stunted. 36% were underweight, and 21% were wasted. - There is a moderate relationship between severe tooth decay (with deep decay, d3) and an increased likelihood of undernutrition (are: 1.10, 95% CI: 1.02–1.21). - For each additional tooth that is deeply carious, there is a 10% increased chance of stunting, underweight or wasting.	The frequency and severity of untreated ECC from infancy to six years of age and frequent mouth pain are associated with severe ECC and malnutrition.
4.	So, Marvin et al (2017)24	Early Childhood Dental Caries, Mouth Pain, and Malnutrition in the Ecuadorian Amazon Region.	USA	Cross-sectional	1407(6 months to 6 years of age)	WHO	Body mass index	- The average dmft increases with age, 0.06 dmft in children younger than one year and 11.81 dmft among children who are aged six years old. -Overall, 65.4% of the children experienced dental caries (dmft>1), and 44.7% experienced severe caries (D2 or D3).	- Malnutrition prevalence, 35.9% stunted children, 1.1% wasted, 7.4% underweight, 6.8% overweight. - In Severe caries, the frequency of oral pain may increase threefold (Adjusted Odds Ratio (AOR)=2.98; 95% Confidence Interval (CI): 2.36–3.75; p<0.001). - In children who are 0 to 2 years of age, there is no significant risk of malnutrition. - Compared to children without oral pain, children 3 to 6 years of age have a greater chance of being underweight (AOR=1.45; 95% CI: 1.24–1.66; p=0.004) and a lower chance of being overweight (AOR=0.78; 95% CI: 0.67–0.94; p=0.009).	Mouth pain that was associated with severe caries and mouth pain that interrupted sleep were predictive of poor nutritional status.

Table 2. Cont.

No	Study (year)	Title	Country	Research method	Sample	Child growth standards guidance	Anthropo-metrics	Caries Index	Results	Conclusion
5.	Gaur, S., & Nayak, R. (2011)31	Underweight in low socioe-conomic sta-tus preschool children with severe early childhood caries	India	Case con-trol	100 (3 to 6 years of age)	WHO	Body mass index	- Average defs on S-ECC is 8.92±3.21	- Initial measurements showed that 46% of the children with S-ECC had a body weight below the 3rd percentile (underweight, mean 15.49±1.87Kg) which was less than that of the control groups (mean weight of 16.34±1.46kg). - After six months, the anthropometric mean is below the 3rd percentile between the S-ECC and control groups, showing a significant increase in the Wt of the S-ECC group children (P=0.002). - There was a significant decrease in the number of children with Wt below the 3rd percentile in the S-ECC group.	Overall, in-between-group comparisons after dental rehabilitation showed that the S-ECC group no longer differed from the control group around various growth parameters.
6.	Vun-davalli, Sudhakar, et al (2019)16	Association between healthy eating index, body mass index, and early childhood caries in schoolchild-ren of Sakaka, KSA: A case–control study	India	Case-con-trol	350 (5 to 6 years of age)	CDC	Body mass index	Average dmft - underweight group 7.8±3.3 - obese group 10.8±4.09 and statistically significant (P=0.000)	- The mean dmft was significantly higher in the group of obese children compared to other groups. - A statistically significant relationship was found between the frequency of adding sugar intake to the S-ECC (P=0.001).	There is a positive correlation between BMI and ECC scores.
7.	Bhoomika, W., & Mun-shi, A. K. (2013)3	Relationship between severe early childhood caries and body mass index.	India	Cross sec-tional	100 (3 to 6 years of age)	CDC	Body mass index	The average defs in the S-ECC group is 9.22	- The mean BMI of S-ECC children was higher when compared to caries-free children, which was found to be statis-tically significant at $p<0.05$. - 45% of the children with S-ECC are underweight, 41% are normal, 4% have a risk of being overweight, and 10% are overweight. - Underweight was found in the caries-free and S-ECC group of children.	This study observed, A posi-tive correlation between BMI and S-ECC.
8.	Davidson, Katherine, et al (2016)9	Higher body mass index associated with severe early child-hood caries	Canada	Cross sec-tional	235 (<72 months of age)	CDC	Body mass index		- Overall, 34.4% of the participants were either overweight or obese. - Significantly, more children with S-ECC were classified as overweight or obese when compared to caries-free children (p=0.038). - Mean BMI scores were significantly higher than caries-free children (0.78±1.26 vs. 0.22±1.36, p=0.002). - Children with S-ECC also had a signifi-cantly higher BMI percentile (69.0%±29.2 vs 56.8%±31.7, p=0.003). - Multiple linear regression analysis revealed that BMI's z-score was signifi-cantly and independently associated with S-ECC.	Children with S-ECC in the sample had a significantly higher BMI z-score than their caries-free peers.

Table 2. Cont.

No	Study (year)	Title	Country	Research method	Sample	Child growth standards guidance	Anthropometrics	Caries Index	Results	Conclusion
9.	Vania, Andrea, et al (2011)32	Early Childhood Caries underweight or overweight, that is the question	Italy	Case control	468 (36 to 71 months of age)	CDC	Body mass index	1: non cavitated lesion (D1 level). 2: cavitated lesion (D2 level). 3: severe EEC (D3 level).	- The distribution of BMI percentiles in the ECC group were as follows: Underweight-10%; normal-55.90%; risk of obesity-22.22%; obesity-11.11%. - Children with severe caries, especially children aged 5 to 6 years, were underweight. - There were significantly more underweight children in the case group than there were in the control group.	The ECC population does not have a typical weight distribution, and the finding of being underweight in a large number of Severe ECC (S-ECC) children may be due to the chewing changes associated with mouth pain due to caries or tooth loss after hard tissue destruction.
10.	Bagherian, A., & Sadeghi, M. (2013)15	Association between dental caries and age-specific body mass index in preschool children of an Iranian population.	Iran	Cross sectional	400 (30 to 70 months of age)	NHNES	1. Body mass index 2. Weight for length	- Average and SD defs 8.37±11.2. - Underweight group defs 4.89±10.8. - Normal group defs 8.84±11.8. - Risk of overweight group defs 8.68±10.6. - Overweight group defs 10.39±10.2.	- The percentage of the sample with S-ECC was 51.2%. - Scores in the S-ECC group were 11.7% underweight, 44.4% normal-weight, 13.7% at risk of being overweight, and 30% overweight. The results were significantly different from the caries-free group (P=0.001). - Analysis showed significant statistics between BMI-for-age scores and caries-free frequency (P=0.001) and had significant direct association with children with S-ECC(P=0.001).	The findings of this study suggest that being overweight hasa connection with higher defs scores and severe early childhood caries.

Previous longitudinal studies have shown that a causal relationship exists between early malnutrition and increased caries.[33] The deficiency of protein leads to protein-energy malnutrition (PEM). By playing the role of a cariogenic environment catalyst, it becomes a host factor in the development of caries related to tooth decay such as hypoplasia.[34] Moderate malnutrition where micronutrient deficiencies, such as lack of vitamins, zinc oriron exists can also decrease the protective effect of saliva on the oral cavity and thus, can increase the formation of calculus. This situation leads to an increased risk of caries.[34-36]

Non-significant nutritional status results on S-ECC

The resources which were included in this study consist of six articles with non-significant nutritional status results on the S-ECC. These articles implied that there was no linear correlation and significant relationship between BMI and S-ECC[10,37], that obesity was not significantly associated with caries,[19,38] and that there were no significant differences of caries index between the normal and obese groups.[39] On top of these, malnutrition was also found in both groups, and there were no significant differences of nutritional status between the S-ECC and normal groups.[40] These six articles have some similarities: Having some confounding factors regarding socioeconomic status and having a small or limited number of samples. Socioeconomic factors such as maternal education or family income influence the development and prevalence of early childhood caries.[41] Costa, L. R., Daher, A., & Queiroz, M. G., whose researches were included in this study, found that lower family income was a significant determinant of the caries experience in children. Another study found that poverty was the main confounding factor in the relationship between BMI and caries.[37,38,42-44] Children from low SES are more likely to eat sweet foods, have less physical activity, are limited in consuming nutritious foods, lack awareness of the importance of exclusive breastfeeding and complementary foods for children's health and nutrition.[45,46] The level of parental education is also directly related to parental health literacy, which consists of behaving in favour of having a healthy lifestyle, maintaining oral health, and making choices for better child health.[42-44] Previous studies have also showed

Table 3. Non-significant nutritional status results on S-ECC

No	Study (year)	Title	Country	Research method	Sample	Child growth standards guidance	Anthropometrics	Caries Index	Results	Conclusion
1.	Wasunna, D. C. (2012)40	Nutritional status of children aged 3-5 years with and without severe early childhood caries in New Nyanza Provincial General Hospital, Kisumu, Kenya	Kenya	Cross sectional	196 (3 to 5 years of age)	WHO	1. Weight for age 2. Height for age 3. Weight for length	The mean dmft in S-ECC children was 7.5 (+-1.9SD).	-The results in the group of children with S-ECC were 14% underweight, 4.9% wasted, and 2.5% stunted. -There was no significant difference, but the prevalence of underweight was slightly higher in the S-ECC group (14.8%) than in the caries-free group (13.9%). - Children with S-ECC were 1.08 (95% CI=0.48-2.42) times more likely to be underweight.	Malnutrition was reported in the two groups of children. There was no statistically significant difference in the nutritional status of S-ECC and caries-free children.
2.	Costa, L. R., Daher, A., & Queiroz, M. G. (2013)38	Early childhood caries and body mass index in young children from low income families.	Brazil	Cross sectional	269 (<6 years of age)	WHO	Body mass index	Average dmft2.5±3.2 (mean±SD).	- 23.4% of the subjects were overweight or obese. - 45.0% had active ECC, and 17.1% had S-ECC. -The average body mass index (BMI) of the children was 15.9±2.2. -In the S-ECC group, 84.9% were normal, 10.9% were overweight, and 4.3% were obese, - BMI does not correlate with three categories of dental caries (P>0.05).	No significant association between dental caries and childhood obesity at six years of age was observed. However, lower family income was a significant determinant of caries experience.
3.	Edalat, A., et al (2014)10	The Relationship of Severe Early Childhood Caries and Body Mass Index in a Group of 3- to 6-year-old Children in Shiraz.	Iran	Cross sectional	202 (5 to 6 years of age)	WHO	Body mass index	Average dmft was 4.13.	- 12.5% of the children with S-ECCwere underweight, 5% had height deficiency, and 19.5% had deficiency in BMI. -There is no significant correlation between increased dmft and deficiency of height, weight, and BMI. (p=0.502).	There was no linear correlation between S-ECC and BMI, height, and weight deficiency. The resulting 55% incidence of severe early childhood caries was an additional study finding.
4.	Kennedy, Tara, et al (2020)37	The association of body mass index and severe early childhood caries in young children in Winnipeg, Manitoba: A cross-sectional study.	Canada	Cross sectional	150 (<72 months of age)	CDC	Body mass index	The median of dmfs was 40.	- More than 42% of the samples were at risk of being overweight or obese. - The results showed a positive relationship between BMIz scores and DMFS (p<0.05). However, this relationship was not significant in the adjusted regression model.	There was no significant relationship between BMI and S-ECC. Poverty was the main confounding variable. Behaviour may have played a role in disease prevention.
5.	Yen, C. E., & Hu, S. W. (2013)19	Association between dental caries and obesity in preschool children.	Taiwan	Cross sectional	329 (3 to 6 yearsof age)	Taiwan Departemen of Health	Body mass index	Average deft index was 4.52±3.93.	- The prevalence of dental caries was 73%, and 55% had severe caries. - Anthropometric status did not have a significant difference between the caries-free group, caries, and caries severity.	This study shows that obesity is not significantly associated with dental caries in preschool children.
6.	Hung, Ha Van, et al (2021)39	Early Childhood Caries in Obese Children: The Status and Associated Factors in the Suburban Areas in Hanoi, Vietnam.	Vietnam	Cross sectional	400 (30 to 70 months of age)	Barlow and experts' proposed cut-off points, Al Herbish	Body mass index	dmft index 6.84±4.92, dmfs index 9.10±7.48.	- 82.91% had ECC and 59.82% had S-ECC. -The caries index in obese children was higher than it was in normal children, but the difference was not significant (p 0.05).	There was no significant difference between the normal and obese groups. Related factors, such as consumption of soft drinks, drinking milk at night, and eating sweet marshmallows were associated with ECC in obese children with p<0.001.

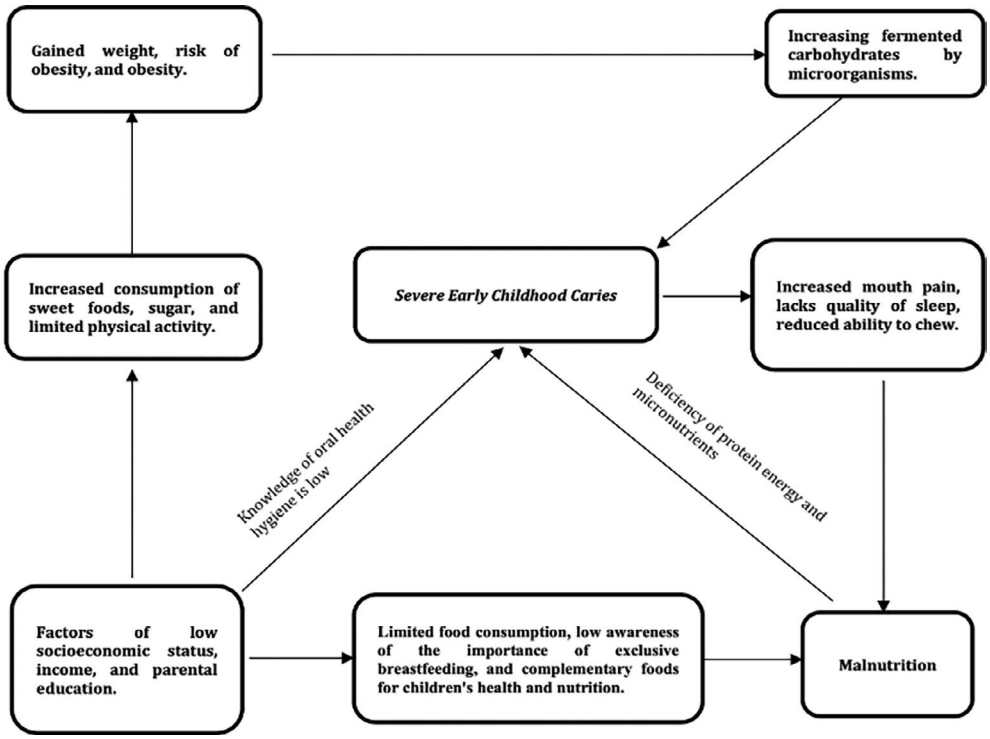

Figure 3. Relationship between nutritional status and S-ECC

S-ECC: Severe Early Childhood Caries

that not only children who come from low SES, but children with high parental income as well can have increased exposure to carbohydrates, which leads to an increased risk of dental caries.[47] Oral hygiene status, weaning, and dietary consumption habits of children were also identified as confounding factors. The children without caries showed excellent oral hygiene compared to children with S-ECC.[40] Previous studies found that plaque accumulation in primary teeth had a positive relationship with the risk of ECC and children in the caries group had a higher debris index than the caries-free group.[48,49]

This systematic review shows that there are still different results regarding the nutritional status of children with severe early childhood caries. However, these results are in line with previous systematic reviews.[4] Early childhood caries has a unique clinical picture and affects a child's development. Caries is a multifactorial disease associated with oral hygiene, bacteria, diet, fluoride intake, and socioeconomic conditions.[4] The varying results among the studies which were used for this study can be attributed to the sample size, study design, country of origin, and confounding factors influencing S-ECC. Nutritional status and S-ECC have a complex relationship illustrated in Figure 3.

Conclusion

The included studies in this systematic review vary with ten studies having significant results and six with non-significant results. The reason for this could either be that caries is a multifactorial, varied sample population or that a varied range of research method approaches were used in each study.

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Conflict of Interest: None declared.

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