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Biopsychosocial factors associated with undernutrition in children under 5 years of age: a review of the state of the art

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Abstract

Introduction: The least developed countries exhibit significantly higher levels of stunting in children under 5 years of age, as well as anemia in women aged 15 to 49 years. In 2022, stunting affected 22,3 % of children under 5 years of age worldwide. **Objective:** to update the knowledge and state of the art of biopsychosocial factors associated with undernutrition of children under 5 years of age. **Methodology:** Scientific articles in Spanish and English, describing the factors associated with undernutrition were searched in the Medline, Embase, and ScienceDirect databases. **Results:** A total of 81 studies were selected of which 80,25 % were cross-sectional observational studies. Food insecurity is a factor affecting the health of children. Improving maternal education has a positive impact on the nutrition of children under five years of age. **Discussion:** Children suffering from undernutrition become lethargic and passive, and are deprived of the stimulation necessary for their proper mental and social development. **Conclusion:** Understanding the multicausality of undernutrition in children under 5 years of age is necessary to improve human capital in communities.

Keywords

Child Nutrition Disorders; Health Education; Infant Mortality; Child Health services; Public Health; Malnutrition; Child Health.

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Factores biopsicosociales asociados a la desnutrición en menores de 5 años: revisión del estado del arte

Resumen

Introducción: los países menos desarrollados presentan niveles significativamente más altos de retraso en el crecimiento en niños menores de cinco años y anemia en mujeres de 15 a 49 años; en 2022, el retraso en el crecimiento afectó al 22,3 % de los niños menores de cinco años en todo el mundo. **Objetivo: a**ctualizar el conocimiento y el estado del arte de los factores biopsicosociales asociados con la desnutrición en menores de cinco años. **Metodología:** se buscaron artículos científicos en español e inglés que describieran los factores asociados con la desnutrición en las bases de datos Medline, Embase y ScienceDirect. **Resultados:** se seleccionaron un total de 81 estudios, de los cuales el 80,25 % eran estudios observacionales transversales. La inseguridad alimentaria es un factor que afecta la salud infantil. Mejorar la educación materna tiene efectos positivos en la nutrición de los menores de cinco años. **Discusión: l**os niños que sufren de desnutrición se vuelven letárgicos y pasivos, y se les priva de la estimulación necesaria para su adecuado desarrollo mental y social. **Conclusión: e**ntender la multicausalidad de la desnutrición en niños menores de cinco años es necesario para mejorar el capital humano en las comunidades.

Palabras clave

Trastornos de la Nutrición del Niño; Educación en Salud; Mortalidad Infantil; Servicios de Salud Infantil; Salud Pública; Desnutrición; Salud Infantil.

Fatores biopsicossociais associados à desnutrição em crianças menores de 5 anos: revisão do estado da arte

Resumo

Introdução: Os países menos desenvolvidos apresentam níveis significativamente mais altos de atraso no crescimento em crianças menores de cinco anos e anemia em mulheres de 15 a 49 anos; em 2022, o atraso no crescimento afetou 22,3% das crianças menores de cinco anos em todo o mundo. Objetivo: Atualizar o conhecimento e o estado da arte dos fatores biopsicossociais associados à desnutrição em menores de cinco anos. **Metodologia:** Foram buscados artigos científicos em espanhol e inglês que descrevessem os fatores associados à desnutrição nas bases de dados Medline, Embase e ScienceDirect. **Resultados:** Foram selecionados um total de 81 estudos, dos quais 80,25% eram estudos observacionais transversais. A insegurança alimentar é um fator que afeta a saúde infantil. Melhorar a educação materna tem efeitos positivos na nutrição dos menores de cinco anos. **Discussão:** As crianças que sofrem de desnutrição tornam-se letárgicas e passivas, sendo privadas da estimulação necessária para o seu adequado desenvolvimento mental e social. **Conclusão:** Compreender a multicausalidade da desnutrição em crianças menores de cinco anos é necessário para melhorar o capital humano nas comunidades.

Palavras chave

Transtornos da nutrição infantil, educação em saúde, mortalidade infantil, serviços de saúde, saúde pública.

Introduction

By definition, malnutrition means "imperfect nutrition" and can include overweight, obesity and undernourishment. The latter condition is of great importance among children under 5 years of age, causing 48 deaths per 1000 live births worldwide annually, 82 in developing countries, and 6 in developed countries. Globally, it is the cause of more than 50% of child deaths (1–4). Optimal nutrition practices for mothers, infants, and young children are crucial for ensuring maternal health, improving child survival, and supporting the growth and development of children (5)

Since 1997, the World Bank priority has been to "work with countries to reduce poverty, improve health and nutrition, and protect people from the impoverishing effects of disease and high fertility", an example followed by the World Health Organization (WHO) in prioritizing the reduction of disease burden among the poorest in the world (6).

It is important to know the factors that facilitate the appearance of undernutrition in children under 5 years of age, since the effectiveness of public health actions will depend on the proper establishment of priorities, sufficient budgetary allocation and the recognition that the causes are not the same in all communities (7). The objective of this study is to update the state of the art regarding the biopsychosocial factors associated with undernutrition in children under 5 years of age.

Epidemiology

Child undernutrition is the main public health problem in developing countries. By 2012 there were 165.8 million children under 5 years of age with chronic undernutrition, 99 million with general undernutrition and 51 million with acute undernutrition (4,8) with the highest prevalence in Southeast Asia, particularly in India, Bangladesh, and Pakistan (9,10). In 2018, the prevalence of acute undernutrition was 7.3% and chronic undernutrition was diagnosed in 148.9 million children, which represented a decrease of 10.1%, compared to 2012. This was insufficient to halve chronic undernutrition by 2030. Said reduction should have been 20% over a similar period: the least developed countries have significantly higher levels of stunting in children under five years of age and anemia in women aged 15 to 49. By 2022, stunting affected 22,3% of children under five years of age worldwide (11).

Annually, 5.9 million children under 5 years of age die worldwide, 40% to 60% due to undernutrition related diseases such as gastrointestinal infections, pneumonia, malaria and measles (12,13), a substantially lower figure compared to the 12 million preventable deaths that occurred in the 1990s (14). Underweight amog children under 5 years of age have a 20-fold higher risk of death and account for 20% of deaths in all population groups (3,15).

In the field of food security, the Food and Agriculture Organization of the United Nations (FAO) demonstrated that, in 2018, declining export prices of primary commodities in 27 out of 33 low- and middle-income countries led to an acute food crisis, resulting in 807 million undernourished people and 154 million children under the age of 5 with chronic undernutrition. Of these, 381 million and 73 million respectively were in countries highly dependent on primary commodities (11).

Methodology

A search of scientific articles in Spanish and English was conducted in the Medline, Embase, Redalyc and ScienceDirect databases, using the following search equations: "child nutrition AND Public Health", "child malnutrition AND Risk Factors" and "desnutrición infantil AND Factor de Riesgo". In addition, a manual search was carried out by selecting articles of interest from the bibliography of the selected studies from the databases. Full articles were read and analyzed, taking into account the following inclusion criteria: description of risk factors associated with undernutrition in children under five years of age, selection of articles from a database and by manual search specifying the type of study and place of completion. Articles that did not meet the above criteria and were in a language other than Spanish and English were excluded. The descriptive analysis of the frequency of the studies included was carried out using the R 4.0.2 version software. Finally, a qualitative analysis of the articles was performed to construct the state of the art of psychosocial factors associated with undernutrition in children under 5 years of age.

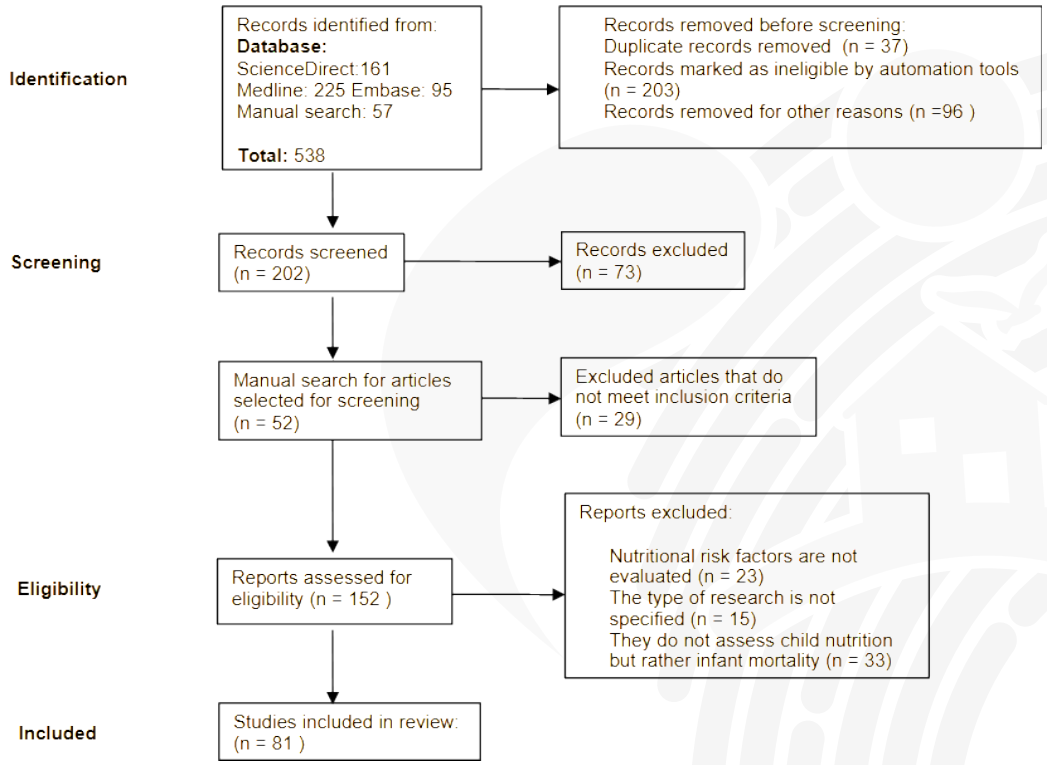
Ethics approval and consent to participate
Not applicable

Results

The search was carried out in the databases, reading the titles and abstracts for the initial selection. Subsequently, the reading of full texts of 35 studies in Embase, 48 in ScienceDirect, 57 in Medline, 10 articles in Redalyc and 52 found by manual search

was carried out, obtaining a final sample for the construction of the review article of 81 studies as follows: 12 studies from Embase, 15 from ScienceDirect, 36 from Medline and 18 studies found by manual search. The bibliographical search yielded results from the years 1982 to 2024. See Flowchart 1.

Flowchart 1. Identification of studies through databases



Source: Adapted PRISMA 2020 format. Data from the author's own review.

Table 1 below shows the proportion of the types of studies included in the review, which made it possible to for update the state of the art on biopsychosocial factors associated with undernutrition in children under 5 years old.

Table 1. Proportion of the type of studies included in the review.

Type of study	Number	%
Cross-sectional observational study	65	80,25
Review studies	6	7,41
Randomized controlled trial	3	3,7
Cases and controls	3	3,7
Ethnographic studies	2	2,47
Systematic review	1,23	1
Econometric analysis	1,23	1
Total	**81**	**100**

Source: Compiled by author

The studies were conducted in Asia (34.57%), Africa (33.30%), Latin America (9.88%), North America (7.41%), Oceania (2.47%), Europe (1.23%) and 11.11% of the studies were categorized as pertaining to developing countries. In total, 49.38% of the studies were conducted by countries with a high or very high Human Development Index (HDI) on populations in countries with a medium or low HDI, while 40.74% of the studies were conducted by countries with a medium or low HDI on their own populations.

The biopsychosocial factors associated with undernutrition in children under 5 years of age are described below, understanding the need for their study from a multi-causal perspective. The factor that has the greatest weight in undernutrition morbimortality depends on biological, cultural, social, and economic circumstances, so each community has different associated causes. Poverty, food insecurity, and illiteracy have been described as the three pillars of malnutrition (12).

• Social and food insecurity related factors

State action is essential to improve the quality of life of the poorest and meet their basic needs. Unfortunately, in developing countries, part of this responsibility has been delegated to humanitarian and charitable institutions (16). Lack of food at home is a public health problem and demonstrates the lack of food sovereignty of the state (17-19)**.**

FAO identifies four essential dimensions in food security: availability, economic and physical access, and use and stability of food, defining it as follows:

> "When all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and preferences for a healthy and active life" (17).

Food insecurity is a risk factor for the maintenance of children health, associated with inadequate nutrient intake, depression in adolescence, poor interpersonal relationships, weak self-control, and school difficulties (20). Betebo et al., 2017 showed that 89.7%, 90.7% and 76% of children with general, chronic, and acute undernutrition, respectively, were in households with food insecurity (2).

Another risk factor is the economic dependence of the countries on primary products. FAO showed that in the majority of countries (52 out of 65) that had experienced an increase in the level of undernourishment. This was due to the economic slowdown between 2011 and 2017 of nations highly-dependent on the export and import of primary products, as well as those dependent on oil exports. An increase of 1% in dependence on exports of primary products increases undernourishment by 2.2% annually and by 8% if food imports increase (11).

• Family socio-economic factors

The level of economic income allows indicators such as the degree of autonomy of women, access to health services, presence of infectious diseases and infant mortality (21–23) to be visualized. A 10% increase in household per capita expenditure reduces the likelihood of a child dying by 0.97%, compared to another household with lower per capita expenditure (24). Macro-economic growth is an indicator that shows whether the health conditions and nutritional status of children have improved, mainly among the poorest groups, by improving access to health services and food security (25).

Other research has shown indeterminate associations between economic growth and adequate nutritional status. Subrmanyam et al., 2011 identified a connection between economic growth and general undernutrition with an Odds Ratio (OR) of 1.01, and a Confidence Interval (CI) of 95%, 0.98 - 1.04. The connection with chronic undernutrition was an OR of 1.02, and a CI of 95%, 0.99 - 1.05, and with acute undernutrition, the connection was an OR of 0.99, and a CI of 95%, 0.96 – 1.02 (25). Vollmer et al., 2014 also described a weak connection between macroeconomic growth and a reduction in chronic, acute, and general undernutrition (26). Sinha et al., 2017 describe the paradox of India: the increase in economic growth and the increase in child undernutrition (21).

• Factors related to the mother

These are the most studied factors and the scientific literature is abundant, as the care and education of children, together with domestic work, are usually the responsibility of women, from whom men generally distance themselves and, therefore, their influence on the nutritional care of children is limited (27).

It has been shown that young marriage and early pregnancy result in general and chronic undernutrition and repeated gastrointestinal infections in the children of these mothers (13,28). The factors that most influence this problem are the low level of education of the mothers, living in a rural area, poor access to health services, and fewer pre- and post-natal controls. Borkotoky & Unisa, 2015 showed that the average number of children of uneducated mothers is 5.5, compared to 2.5 for educated mothers (29).

The increase in maternal schooling improves nutritional status and reduces morbility and mortality in children under 5 years of age, with a statistical weight even greater than access to health services. For each year of maternal schooling, infant mortality decreases by 1.9%, as a result of the transformation of traditionalist and fatalistic attitudes towards disease and acceptance of modern medical treatment (24,30,31).

Caldwell & McDonald, 1982, indicated that the children of mothers with primary school education had a mortality rate 20% to 50% lower than the children of illiterate mothers and it was 30% to 60% and 60% to 90% lower for the children of mothers who had a secondary and higher education, respectively (32). Maternal education counteracts the negative effects of a lack of drinking water and hygiene in the community (24). Low levels of schooling lead to poor eating practices, such as low consumption of breast milk or its early interruption and increased use of substitutes (33-37).

Other authors have reported that the effect of maternal education decreases if the economic status of the family improves and it has been indicated that it has a positive influence only on households with minimal but sufficient resources to meet food needs and with access to public services (38). Melesse 2021, has shown that, since maternal education is a significant factor for nutritional outcomes, nutritional knowledge has an independent effect on child nutrition, and that this knowledge is often acquired outside the classroom (39).

Formal education improves women's self-esteem, decreases domestic violence and prevents states of depression and anxiety. It also increases their confidence to enforce their decisions within the home, strengthens their ability to communicate their health needs, participates in public policy-making on nutrition, implement effective medical treatments and have greater access to family planning methods. It has been shown that educated women without decision-making power do not make adequate use of oral rehydration therapies when their children have diarrhea, increasing the morbidity and mortality in this population (40-43).

The autonomy of women includes the ability to decide on family finances and expenses, social outings and travel that allow for cultural exchange and improve knowledge regarding child care and feeding. Maternal autonomy increases the likelihood that a child receives quality complementary feeding from 6 to 12 months of age (44). Shroff et al., 2009 showed that children had a lower risk of chronic undernutrition if their mothers had a high level of financial autonomy, obtaining an OR of 0.731, with a CI of 95%, 0.546 - 0.981 and an OR of 0.593, and a CI of 95%, 0.376 - 0.933 if they additionally had the freedom to choose when to go to the supermarket (41).

Finally, it has been shown that a duration of more than two years of breastfeeding is associated with chronic and general undernutrition (13) and the risk of intrauterine growth retardation and infant stunting increases with low maternal stature (47,48).

• Factors related to the father

Paternal education has been described as a secondary factor with low impact on nutrition and infant mortality (32). Alderman & Headey, 2017 suggest that this is true in developing countries (38). Gupta et al., 2020 and Jeong et al., 2024 refute this conclusion, arguing that it is a protective factor against undernutrition in children under 5 years of age, particularly in developing countries, for two reasons: first, because men attain a higher level of education, and second, because it has been demonstrated that involving fathers in nutrition interventions can yield benefits and improve early child development outcomes beyond what a nutritional intervention alone can achieve (47,48).

The scientific literature indicates that paternal education is important for compliance of vaccination schedules and the decision to go to health centers when children are ill, and maternal education influences the maintenance of adequate hygiene guidelines, modifying health behaviors and the learning of healthy eating habits (36).

- **Socio-cultural factors**

The procurement, preparation, consumption and distribution of food is part of social and cultural constructions, influenced by trade, politics communication and knowledge exchanges within the family and community. This is how poor social relations lead to poor eating habits and malnutrition (16). Understanding food through its traditions, uses, and symbolism in specific contexts enables the successful implementation of health and nutrition policies in highly vulnerable communities, particularly in situations of humanitarian crises, such as droughts and conflicts (49,50).

- **Factors related to the mental health of the mother or caregiver**

Nutrition is linked to both good physical and mental health, and malnutrition has been associated with depression. Globally, 4.4% of mothers of malnourished children were found to have common mental disorders (CMDs). Studies from several countries have shown that the prevalence of CMDs is higher among mothers of undernourished children compared to those with children of normal nutritional status (51).

In the caregiver field, it has been mentioned that suffering from some type of mental illness increases the probability of child undernutritionion. Depression in the mother increases inadequate breastfeeding practices and has been associated with low infant growth rate (52,53).

Nguyen et al., 2014 demonstrated the low consistency between chronic undernutrition and poor mental health in mothers, with an OR of 1.21, and a CI of 95%, 1.03 – 1.41 and an OR of 1.27 and a CI of 95%, 1.01 – 1.61 for general undernutrition, but showed a higher risk of their children suffering from infectious diseases such as acute diarrheal diseases in the two weeks prior to the study, OR of 2.11 and CI of 95%, 1.61 – 2.76, and Acute Respiratory Infection (ARI), OR of 2.05 and a CI of 95%, 1.61 – 2.62, both diseases associated with undernutrition (52).

Currently, mental health interventions for mothers are considered as a strategy to address child undernutrition (54). Wachs, 2009 described that, in animal models, a diet rich in saturated fatty acids induces hyperinsulinemia, systemic immune response and depression, reiterating that poorly nourished mothers generate weak emotional bonds with their children, increasing the risk of childhood undernutrition (55). Stevens et al., 2018 showed that the exposure of a pregnant mother to malnutrition in the second trimester of pregnancy produces neurological deficits in the newborn, along with personality disorders and schizophrenia in adulthood (56).

Finally, restriction, insistence, pressure to eat, and blackmail are harmful behaviors for infant feeding . These practices contribute to an increase in carbohydrate intake and a decrease in protein-based food (37).

- **Factors arising from acute or chronic disease**

Chronic undernutrition has been linked to poor socioeconomic conditions, inadequate health care practices and recurrent diseases. Acute undernutrition has been linked to infectious pathologies and is a predictor of imminent death in childhood. It is associated with a severe lack of weight gain due to acute pathology and recent food shortages (57-60). Betebo et al., 2017 showed that infants with acute diarrheal diseases in the two weeks prior to the study had 2.5 and 2.28 times greater risk of general and acute undernutrition, respectively (2). General undernutrition reflects a negative synergy between inadequate food intake and the recurrence of infectious diseases (61).

- **Environmental factors and factors related to access to health services.**

Household location and the socioeconomic status of the family are related to access to public and health services, the coverage of vaccination schemes and adequate hygiene habits, social factors which are generally met in urban areas with a high socioeconomic status (13-21). Each year of schooling of the mother increases by 4% the probability of using preventive health services during the first year of the child's life (62), as well as prenatal checkups, improving the chances of hospital delivery (63). Continuous improvement in the quality of communication and transport networks is important, especially in rural and mountainous areas where there are greater difficulties in accessing health centers (64).

Discussion

Analysis of the physical and cognitive consequences of undernutrition in children under five and the role of maternal education in child nutrition.

Understanding the biopsychosocial factors of undernutrition in the first years of life allows for a more rational analysis of the associated pathologies and their consequences on health as well as the impacts they have on the communities they inhabit. Updating the state of the art of the factors described should allow for the transformation or creation of health policies that have greater positive impacts on the child population for their proper physical and cognitive development.

Intrauterine growth retardation and chronic undernutrition in the first two years of life cause irreversible physical disorders and cognitive impairments manifested in poor academic performance, short stature, lower economic incomes and low productive capacity, affecting the well-being of a nation by decreasing its competitiveness compared to other countries with better human capital (7,10,21,45,65,66). Undernutrition in children under five years of age affects normal development maintaining a poor peripheral lymphocyte count that increases the probability of infectious pathologies and deaths in early childhood and has been associated with an increased risk of both chronic and mental illness in adulthood (4,12,14,67–69).

Low birth weight (LBW) has been linked to increased plasma glucose and an higher insulin concentration due to a lack of sensitivity to this hormone and pancreatic damage, which will result in type 2 diabetes and insulin resistance. LBW is also associated with high blood pressure and a high risk of cardiovascular disease. Victora et al., 2008, reported that the Relative Risk (RR) of coronary heart disease is 3.63 times higher in men who weighed less than 2.5 kg at birth compared to those weighing more than 4 kg (45). Furthermore, LBW has been associated with increased carotid intima-media thickness, decreased arterial distensibility and damage to endothelial function (70). Schizophrenia has been correlated with young adults with a medical history of maternal-fetal undernutrition. Depression and anxiety have been associated with states of undernutrition in the first three years of life (21,45).

Children with undernutrition, become lethargic and passive and will be deprived of the stimulation necessary for their proper mental and social development, exacerbated by a weak response of the mother to interact with the child, decreasing their cultural learning (21,45,71,72), while developing pathologies with cellular consequences due to micronutrient deficiency such as vitamin A, iron and zinc. It has been reported that anemia caused by iron deficiency produces serious biopsychosocial impacts that lead to the repetition of cycles of poverty, illiteracy and violence (4,21,33,45,57,71–74).

Knowing the factors associated with undernutrition and their interrelations is fundamental for the proper approach of public health policies and to achieve the best human capital of a country (71,75). For example, breastfeeding reduces by 13% mortality in children under 5 years of age and 20% decrease of deaths in newborns from diseases such as acute diarrhea, ARI and neonatal sepsis (76), something that involves a good breastfeeding technique and the autonomy of women, adequate economic income, maternal and paternal education, absence of physical and mental pathologies, the prevention of domestic violence, adequate hygiene guidelines, etc. (77,78).

An important result of this study is the responsibility that has been attributed to non-formal education in the understanding of nutritional and health aspects, and to formal education in increasing general knowledge, access to better jobs and a better economic income (79,80). Other research has shown that formal education improves nutritional care and knowledge, giving less value to informal educational processes (24).

It is interesting to note tthe importance given to the role of maternal education in the nutritional care of infants. Knowledge acquired in schools increases the ability of women to understand public health messages transmitted in the media. Knowing how to read and having good levels of reading comprehension allow mothers to better follow medical instructions and improve their interaction with health institutions (24,63). Health literacy is of great value, as it facilitates the process of obtaining and understanding information to make appropriate decisions about the health-disease process (81).

Conclusions

Understanding the multicausality of undernutrition before age of 5 is necessary to improve the human capital in societies and an appropriate approach to public health policies to enhance the physical and cognitive capacities of the children of a nation, which will influence the increase in academic and labor competitiveness, improving the chances of a country to increase its economic, cultural and social development.

The mother has a fundamental role in the health care of infants. Characteristics such as schooling and health literacy, the autonomy of women and mental health, are fundamental factors for adequate nutrition in children. It is necessary to update the state of the art on maternal education and child nutrition and to propose research aimed at studying this association through a systematic review, with or without a meta-analysis, that approaches a consensus and establishes the route by which education is effective in preventing undernutrition in childhood.

Competing interests
The author declares no conflict of interest.

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Data availability.
Data used in this manuscript are publicly available, and can be found in the Medline, Embase and ScienceDirect databases.

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