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SOCIAL DETERMINANTS OF HEALTH AND THE STATUS OF CHILD LEARNING

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ABSTRACT

This study reviews factors that may determine risks in neurodevelopment and child development, with potential cause or aggravation of Difficulties (ADp) and Specific Learning Disorders (TAp), particularly evidenced at the beginning of the school phase. The research was structured by tracking articles, theses and dissertations published from 2011 onwards in the indexes: SciELO and Google Scholar. In addition, the data were complemented with information from scientific and physical books, Google Books and institutional websites. The integrative review adopts a descriptive qualitative approach, content analysis, eligibility by reading techniques, semantic categorization by word-theme, in addition to instruments of methodological quality and risk of bias. This review allows for the synthesis and exploration of evidence on the Social Determinants of Health (SDH) that impact the status of children's learning. The results highlight that unfavorable socio-environmental conditions, economic, sociodemographic, hereditary, genetic, biological, psychosocial factors and environmental exposures are significantly associated with impairments in the development and learning of children. These factors affect cognitive functions such as memory, attention, cognitive flexibility, and planning, which are essential

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for the development of children's learning. It was observed the need for studies that focus on specific contexts where children are in vulnerable phases of cognitive development. Special attention should be paid to factors such as social and community networks, as well as exposure to environmental pollutants and contaminants. In addition, the development of public and private educational and health interventions is recommended.

Keywords: Child Development. Learning Difficulties and Disorders. Social Determinants of Health (SDH). Cognitive and Executive Functions.

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INTRODUCTION

Healthy child development is a complex process, influenced by a wide range of biological, social, economic, and environmental factors. The conditions in which a child grows up can profoundly affect their ability to learn, impacting essential cognitive and executive functions such as memory, attention, and inhibitory control. In this context, the investigation of Social Determinants of Health (SDH) becomes essential, especially due to their potential influences on learning difficulties and disorders that frequently emerge in the school environment.

Recent studies indicate that children in unfavorable contexts may have significant deficits in these areas, which reinforces the importance of early interventions and effective public policies to mitigate such effects. Thus, this article is an integrative review of the literature on risk factors for child cognitive development and explores the association between SDH and child learning status in order to qualitatively analyze studies focused on the theme, scrutinizing impacts, relationships, associations, gaps and suggestions in favor of full child development.

METHODOLOGY

This study is characterized as an integrative literature review with a qualitative approach and descriptive purposes. The methodological procedures follow Bardin's (2016) Content Analysis in phases of Pre-analysis, Material Exploration and Treatment of Results: Inference and Interpretation.

The instruments used were checklist adaptation and *PRISMA flowchart*[6]; Protocol for methodological quality and risk of bias, *Critical Appraisal Checklist for Studies Reporting Prevalence Data – JBI,*[7] traffic light layout and plot summary from the *Rovis platform*[8].

PRE-ANALYSIS

In the initial process of the study, a floating reading was carried out, which helped in the definition of the main elements for delimiting the hypotheses, formulating the objectives

[6] *Analyses Preferred Reporting Items for Systematic Reviews and Meta-Analyses* Developed *by the Universities of Ottawa*/Canada, and *Oxford*/UK, to improve transparency and rigor in systematic reviews.
[7] Critical Evaluation Checklist for Studies Reporting Prevalence Data from the *Manual for Evidence Synthesis in Joanna Briggs Institute* .
[8] The *Robvis* tool was developed by the ROBIS group, with authors from the University of Bristol (UK), University of Ottawa (Canada) and Maastricht University (Netherlands). It is *online* and free, one of its characteristics is etiological analysis in the health area.

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and defining the *research corpus*. Thus resulting in structural, analytical guidelines and eligibility criteria and the *PRISMA* checklist[9]. As shown in chart 1.

Chart 1 – *Checklist* of the Review Verification Method

Section/topic	Item do *checklist*		*Check*
	n.	Identification	
Title	1	Identified in the title as a systematic review.	✓
Structured summary	2	Structured abstract including: *framework*, objective, eligibility criteria, summary of methods, results, limitations, conclusions and main findings.	✓
Introduction			Section 1
Rational	3	The justification for the review is described in the context of what is already known.	✓
Objectives	4	An explicit statement was made about the issue addressed with the comparisons, results, and study design.	✓
Methods			Section 2
Protocol and registration	5	A review protocol with an electronic address was indicated: *Google Sholar* – https://scholar.google.com/ , *Scielo* – https://www.scielo.br/; *Google Books:* https://books.google.com.br/	✓
Criteria eligibility	6	Specified the characteristics of the study as well as the eligibility criteria in the study methodology with the justification.	✓
Sources of information	7	Sources of search information described.	✓
Quest	8	Presented the electronic search strategy for the database, including the limits used, so that it can be repeated.	✓
Selection of Studies	9	The process of selecting studies (screened and excluded) was presented.	✓
Process Data collection	10	Described the method of extracting data from the articles and downloading the full articles.	✓
Risk of bias of each study	11	Described the methods used to assess risk in each study (by study).	✓
Measures of Summarization	12	Defined the main measures for summarizing the results (limited to the database, period analyzed and descriptors used)	✓
Analysis additional	13	Described the methods of additional analysis (analysis of subgroups of themes results of the identified studies)	✓ ⊘
Results			Section 3 and 4
Selection of Studies	14	The numbers of the studies screened, evaluated for eligibility and included in the review, exclusion reasons at each stage were presented.	✓
Study characteristics	15	For each study, the characteristics for data extraction are presented with the presentation of citations. (Objectives and conclusions)	✓
Risk of bias in each study	16	Data on risk of bias in each study (flowchart) were presented.	✓
Study results Individual	17	Presented for each study: summary with objectives, results and conclusions (benefits or risk if applicable).	✓
Risk of bias between studies	18	Results of the risk of bias assessment between studies	✓
Analysis additional	19	The results of the additional analyses (authors, institutions, study citations) were presented.	✓
Discussion			Section 3 and 4

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Summary of the evidence	20	Summarized the main results, their relevance and contributions.	
Limitations	21	Limitations at the level of studies and contributions were discussed.	
Conclusions	22	The general interpretation of the results in the context of other evidence and implications for future research was presented.	
Financing			
Caption	served on another non-applicable item		

Source: Prepared by the authors Adapted by the authors from PRISMA4, 2024.

Therefore, the eligibility criteria have been established to ensure the relevance and quality of the included studies, organised into inclusion and exclusion criteria which are illustrated in Table 2:

Table 2 – Study eligibility criteria.

item	Inclusion Criteria	Exclusion Criteria
(i.)	Studies in Portuguese and/or English	Records in other languages. Results with duplicates, re-edits.
(ii.)	Articles, dissertations and/or theses with free and unrestricted access.	Other styles of textual studies; Restricted access. Results with duplicates, re-edits.
(iii.)	Studies indexed in: *Scielo; Google Scholar.**	Studies of other indexers; Results with duplicates, re-edits. *
(iv.)	Studies from 2011*	Pre-2011*
(v.)	Free instructional materials: books, guides, booklets, manuals and/or reports with the concepts necessary for the study.	Other instructional materials; Restricted access; Results with duplicates, re-edits.
(vi.)	Instructional from physical material, *Google Books* and unrestricted institutional websites with national and international coverage/institutional and/or conceptual relevance	Lack relevance and scope
(vii.)	Presence of theme words: equal/synonym/semantic *	Absence of theme words: equal/synonym/semantic*
(viii.)	Direction of registration: corresponds to the study question*	Does not match the study question*
(ix.)	Targets: JBI ≥ 3 sim; Overrral Robvis = low (baixo viés)*	Viés: JBI < 3 "Sim" *Overrral Robvis = high* (alto viés) *
*Applies only to item (ii)		

Source: Prepared by the authors, 2024.

Open and unrestricted access prioritizes the transparency and accessibility of sources, ensuring that the selected studies are available and are reproducible and verifiable on two multidisciplinary platforms with broad common access. The selection of studies was limited to publications from 2011 onwards, taking as reference the important report of the National Commission on Social Determinants of Health (CNDSS), presented at the Conference on SDH, held in 2011 in Brazil.

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Materials in item (v.) are conceptually based and were selected based on their comprehensiveness and relevance, especially in the light of Jean Piaget's cognitivist theory, ensuring that the studies contribute significantly to the review in an objective and concise way. To increase the reliability of the selected data, additional evaluation methods were adopted:

In the eligibility of item (ii), thematic content analysis by direction and theme word was applied, according to Bardi (2016). This guiding assumption ensures that studies are evaluated based on their direction and thematic relevance, according to the central question of the research.

The JBI Tool for assessing methodological quality and risk of bias, in item (ii), was used because it makes it possible to identify potential methodological biases in the selected studies. Thus, the exclusion criteria were defined in order to minimize noise in the research. These include: studies with restricted access or irrelevant textual formats, publications prior to 2011, materials without significant relevance or scope, and studies that do not directly align with the research question.

EXPLOITATION OF THE MATERIAL

This section describes the process of exploring the selected material, focusing on the categorization and content analysis of the included studies. To ensure completeness and representativeness (items i to vi), search descriptors were defined in the *SciELO and Google* indexers, using combinations of terms related to SDH and Learning Status, such as the following descriptors:

SciELO: ('Learning Disabilities' OR 'Specific Learning Disorders' OR 'neurodevelopment' OR 'child development') AND ('Social Determinants' OR 'health' OR 'socioeconomic status')

Google Sholar: ('Learning Disabilities' OR 'Specific Learning Disorders' OR 'neurodevelopmental' OR 'child development') AND ('Social Determinants').

Thus, based on eligibility criteria (i) to (vii), the categorization presented a structure organized in three levels by theme word of semantic categories: initial category, intermediate category and final category or thematic axis.

Chart 3 illustrates this categorization, it starts from broad statements, are intermediated with other intermediaries among themselves and ends in final groups that encompass the others.

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Chart 3 – Semantic categorization of the registration units: theme words.

Categorias iniciais		Categorias intermediárias		Categoria final: eixo-temáticos
1	Ambiente de trabalho	Aa	Condições socioeconômicas, culturais, ambientais gerais.	A Determinantes Sociais de Saúde (DSS)
2	Desemprego			
3	Educação	Ab	Redes sociais e comunitárias.	
4	Produção agrícola e dos alimentos			
5	Desemprego	Ac	Estilo de vida dos indivíduos.	
6	Agua e esgoto			
7	Serviços sociais e de saúde	Ad	Idade, hereditariedade, gênero e sexo do indivíduo.	
8	Habitação			
9	Sensório-motor 0 a 2 anos/ Pré-operatório 2 a 7 anos/ Operatório concreto 8 a 12 anos/ Operatório formal a partir dos 12 anos.	Ba	Neurodesenvolvimento.	B Desenvolvimento Infantil (DIn.)
10	desenvolvimento do sistema nervoso e habilidades: cognitivas, psicossociais psicomotoras e sensoriais.			
11	Neuroplasticidade, capacidade adaptativa de adquirir, modificar ou estimular conhecimentos, habilidades, comportamentos e valores através de experiências, estudo, ensino ou prática.	Bb	Aprendizagem.	
12	Problemas no desenvolvimento neurológico, saúde física, predisposições herdadas.	Ca	Influências biológicos genéticas e hereditárias.	C Dificuldade de Aprendizagem (DAp.)
13	pobreza, instabilidade familiar, desnutrição, estilo de vida.			
	exposição à ecossistemas, toxidade, aspectos educacionais e pedagógicos falta de estímulos precoce.	Cb	Causas ambientais, sociais, econômicos e mentais.	
14	Linguagem, funções executivas, raciocínio, resolução de Problemas, habilidades visuo-espaciais, tomada de decisão e velocidade de processamento.	Cc	Dificuldades cognitivas.	
15	Dificuldades ecadêmicas e escolares: leitura, grafia e ortografia, atenção, cálculo, raciocínio, organização e planejamento e interações sociais.			
16	Transtornos do neurodesenvolvimento que envolvem dificuldades específicas em habilidades acadêmicas (CID. 116A03).	Da	Causas neurobiológicos, Genéticos e hereditários.	D Transtornos Específicos de Aprendizagem (TEAp.)
17	Mutações e variações genéticas e conexões neuronais.			
18	Infecções e doenças na primeira infância.			
19	Condições de Saúde Materna.			
20	Atraso no desenvolvimento cognitivo ou falta de estímulo cognitivo, educacional.	Db	Fatores ambientais e exposição.	
21	Exposição e contaminção de poluentes e toxinas.			
22	Experiências adversas e estressoras na primeira infância.			
23	Condições de saúde e estilo de vida, desnutrição.			
24	Disfunções na Decodificação e Processamento de Linguagem (Dislexia CID.11 6A03.0).	Dc	Disfunções cognitivas.	
25	Disfunções nas Habilidades Numéricas e de Cálculo (Discalculia CID.11 6A03.2).			
26	Disfunção na codificação fonológica, escrita e organização textual ((Disortografia e/ou Disgrafia CID.11 6A03.1).			
27	Disfunções nas Funções Executivas (Controle Inibitório, memória de trabalho, flexibilidade cognitiva CID.11 6A03.Y).			
28	Disfunções na memória e atenção (CID.11 6A03.Y ou 6A03.).			

Source: Prepared by the authors, 2024.

The intermediate categories formed the fundamental indicators as registration units in the content analysis, as their semantic essence and contextual connectivity allowed the identification of patterns and relationships regarding the presence and direction of thematic association between the reviewed texts.

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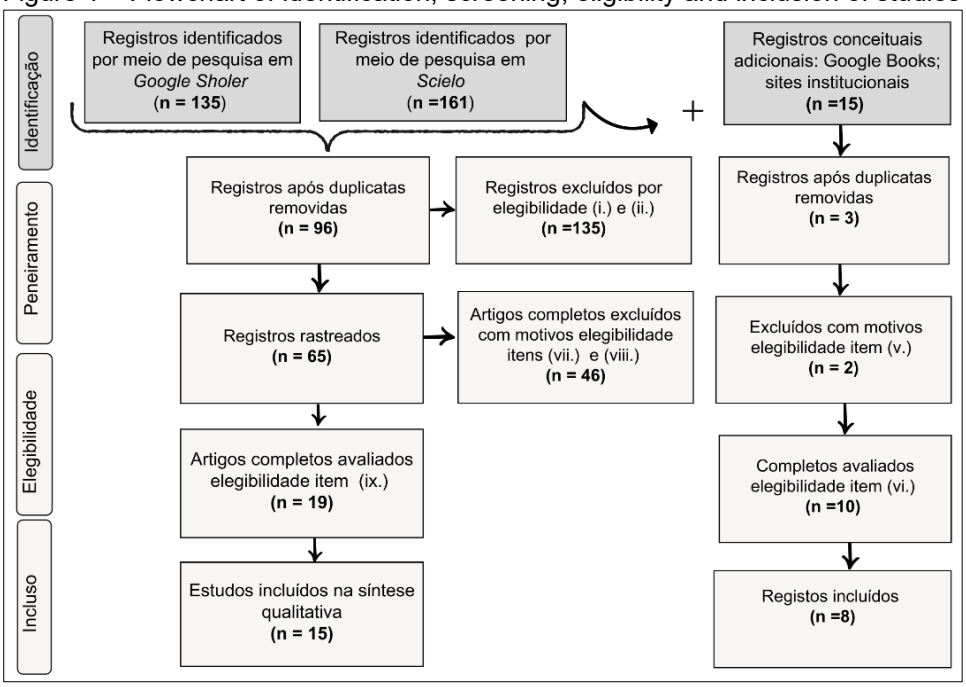
Presence and direction were conducted by classifying the responses of the studies into variables: positive "Present with association"; "Absent, but with possible semantic association"; negative "Absent, without Association"; and ambiguous "Present, but without association". The axes, on the other hand, helped in the synthesis and organization of the results, since the use of categorical layers allowed a guided analysis in the understanding of the associations between the Social Determinants of Health and child learning.

DEVELOPMENT AND DISCUSSION: TREATMENT OF RESULTS, INFERENCE AND INTERPRETATION

The process of tracking the records identified in *Google Scholar, SciELO* and contents of physical books, institutional materials and *Google Books* were illustrated in an adaptation of the PRISMA flowchart (figure 1), in three phases: initial identification, sifting, eligibility and inclusion of the tracked studies.

Figure 1 – Flowchart of identification, screening, eligibility and inclusion of studies



Source: Prepared by the Authors from PRISMA, 2024.

As can be seen, based on the pre-established criteria, 296 (two hundred and ninety-six) records were identified in the indexers: *Google Scholar* (135) and *Scielo* (161).

After the removal of 96 (ninety-six) duplicate records, 200 (two hundred) records were sent to the eligibility phase. Among these, 135 (one hundred and thirty-five) records were excluded based on eligibility criteria (i) and (ii). After this screening, 65 records

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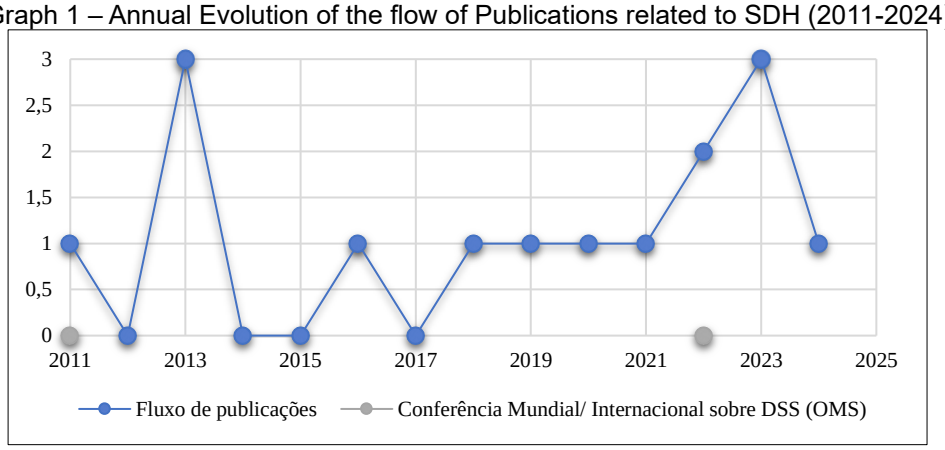
remained, which were organized into an analysis matrix. At this stage, 46 (forty-six) records were excluded because they did not meet eligibility criteria (vii) and (viii), resulting in 19 records that were checked for item (ix) using the JBI tool to assess the risk of bias. Finally, 4 records were excluded due to risk of bias, and 15 records were included in the final qualitative synthesis.

A curiosity was also observed among these studies (Graph 1). In the time frame, there was a greater number of studies published in 2013 and 2023, with at least three studies published in each. It is not possible to specify the reasons, however it is interesting to report that in 2011 there was the World Conference of SDH in Brazil, two years later there was the first peak of studies in 2013 and in 2021.

Graph 1 – Annual Evolution of the flow of Publications related to SDH (2011-2024)



Source: prepared by the authors, 2024.

It was also possible to note that among the fifteen studies, the majority, eight of them occurred between 2016 and 2024, with a decrease in 2017 and a return of the upward flow between 2018 and 2024. There was a peak period in 2013 and a continuous rise in 2017, five years after the CNDSS.

In addition to the records found in the academic indexers, conceptual materials from books and institutional websites were included . Initially, 15 (fifteen) records of this type were identified, of which 3 (three) duplicates were removed. Then, 2 (two) records were excluded by eligibility criterion (v), and 3 more were excluded based on criterion (vi). At the end of this screening, 8 (eight) records of institutional books and instructional materials were considered eligible.

In view of the importance of establishing a specific understanding of each concept included, the organization of the analysis of the results was in the following sequence: (a)

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Summarized conceptual basis (b) Filing and summarization of the studies. (d) Qualitative analysis. They were extracted from nationally and internationally recognized sources in different aspects that make up the thematic axes A, B, C, and D. The concepts extracted from books and institutional instructional materials are presented in detail in chart 4 below:

Chart 4 – Summarization of the results of books and instructional and institutional materials

Registro/ título	Procedência	Abrangência relevância	Eixo-temático	Conceito extraído
1. **APA (2014)** "Manual diagnóstico e estatístico de transtornos mentais: DSM-5"	*American Psychiatric Association* (APA)	Manual mundial	TEAp.	**Transtornos de neurodesenvolvimento:** são condições que afetam o desenvolvimento do cérebro e do sistema nervoso. **Transtornos específicos da Aprendizagem**: transtornos do neurodesenvolvimento que afetam o processo de aprendizagem. Causas, genéticas, neurobiológicas e ambientais
2. **Altafim *et al* (2021)** "O Cuidado Integral e a Parentalidade Positiva na Primeira Infância"	*United Nations Children's Fund* (UNICEF)	Internacional. Referencial adotado pelo fundo das Nações Unidas para Criança	DSS	**Modelo *Nurturing Care* de Atenção e Cuidado Integral às crianças**, modelo adotado pela UNICEF, dominios integrais: saúde adequada, alimentação balanceada, segurança e proteção, cuidados sensíveis e oportunidades de aprendizado.
3. **Hacon; Carvalho (2017)** "Domínios cognitivos e intervenção"	Fundação Oswaldo Cruz (Fiocruz) / Universidade Federal da Bahia (UFBA)	Nacional. Cartilha orientativa para profissionais da Educação e Psicologia	DIn.	**Funções cognitivas:** responsáveis diretas no desempenho escolar dos indivíduos. **Funções Executivas**: conjunto de habilidades essenciais para direcionar o comportamento em direção a metas e objetivos.
4. **Papalia; Feldman (2013)** "Desenvolvimento Humano"	Edição traduzida Pontifica Universidade de São Paulo (PUC)	Internacional. Livro referência bibliográfica básica nas áreas de Educação e Psicologia.	DIn.	**Desenvolvimento infantil** é um processo contínuo de aquisição e aprimoramento de habilidades e capacidades, que ocorre a partir do nascimento.**Neurodesenvolvimento:** desenvolvimento do sistema nervoso, abrangendo habilidades psicomotoras, sensoriais, psicossociais, cognitivas e executivas. **Neuroplasticidade**: capacidade do cérebro de se adaptar e remodelar, mais latente na infância.
5. **CNDSS (2008)** "As Causas Sociais das Iniqüidades em Saúde no Brasil. "	Fiocruz	Internacional Relatório CNDSS	DSS	As desigualdades em saúde são significativamente influenciadas por fatores sociais, econômicos, culturais e ambientais.
6. Conferência mundial sobre Determinantes Sociais da saúde. (2011)	Comissão Nacional Determinantes Sociais da Saúde (CNDSS)	Internacional Relatório CNDSS	DSS	**Modelo de *Dahlgren e Whitehead* de Determinantes Sociais da Saúde (DSS):** Modelo teórico que organiza os determinantes sociais que influenciam a saúde das populações. Condições socioeconômicas, culturais, ambientais, políticas e mudanças demográficas. Idade, hereditariedade, gener e sexo do indivíduo.
7. Piaget (1975) e (1992) "A equilibração das estruturas cognitivas." "A formação do símbolo na criança: imitação, jogo e sonho"	*Google Books*	Internacional. Livros físicos do teórico responsável pela teoria de etapas do desenvolvimento infantil	DIn.	**Desenvolvimento Cognitivo**: Piaget chama de "estágios" de desenvolvimento cognitivo, os estágios que representam as fases pelas quais a criança desenvolve seu entendimento do mundo.**Aprendizagem:** uma mudança duradoura no comportamento baseada na experiência ou adaptação ao ambiente.
8. **Fonseca (2016)** "Dificuldade de aprendizagem: Abordagem neuropsicopedagógica"	Plataforma Vetor testes e escalas psicométricas	Internacional, autor responsável pela criação de escalas e testes validados	DAp.	**Dificuldade de aprendizagem:** defasagem abrangetes e inesperadas que afetam a aprendizagem, simbólica ou verbal, não simbólico e não verbal. Causas ambientais, sociais, cognitivas, emocionais, ambientais, metodológicas e limitações neurológicas.

Source: prepared by the authors, 2024.

Regarding axes A and B, Altafim *et al.* (2021) brings the *Nurturing Care* Model (figure 2), a UNICEF reference that emphasizes the creation of a safe environment in child development, including domains of health, safety, protection, nutrition, and early learning.

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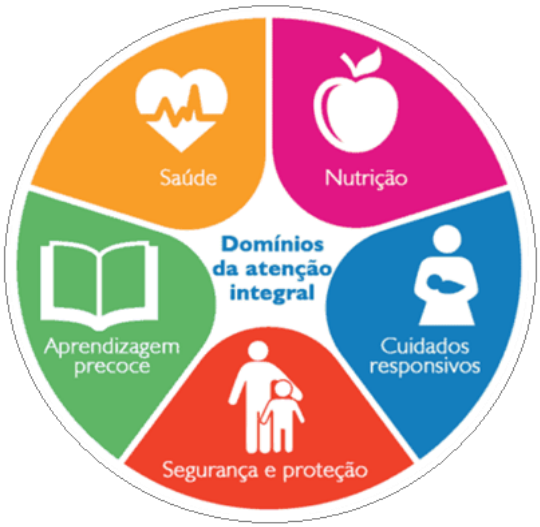
Figure 2 – *Nurturing Care Model:* domains of Comprehensive Care necessary for child development.



Fonte: Altafim *et al* (UNICEF), 2018.

In this context, the CNDSS (2008) and Pellegrini Filho (2011) through their reports demonstrate the factors of impact on health, axis A, the SDH (figure 3) from the perspective of the *Dahlgren and Whitehead model* adopted by the WHO and national health commissions around the world.

Figure 3 – Social Determinants of Health: *Dahlgren and Whitehead model*.

Source: Fiocruz, 2011.

The reports present the model that organizes the SDH, evidencing macrofields that determine the health of a population, this includes homogeneous/heterogeneous and vulnerable audiences, in the latter are children. These fields are: general social, cultural, economic, and environmental conditions, living and working conditions, social and community networks, lifestyle of individuals, age, sex, and hereditary factors. That is, factors that, aligned with the domains of the *Nurturing Care* Model, can directly interfere in the integral development of a child. Knowing this, it is important to connect to the B axis

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(DIn.) alluding to Piaget (1975; 1992), through the theory of child development stages. The theorist describes this process in different stages of learning and interaction with the environment:

Sensorimotor Stage (0 to 2 years), children explore the world through their senses and motor actions. Preoperative Stage (2 to 7 years), children develop the ability to use symbols and language, but still think in a self-centered and concrete way. Stage of Concrete Operations (7 to 12 years), children begin to develop the ability to think logically about concrete objects, understanding concepts such as conservation and reversibility. Stage of Formal Operations (from 12 years old), there is a transition from late childhood to early adolescence, where individuals develop abstract thinking, the ability to reason about hypothetical situations and to make complex plans.

In summary, the phases of Piaget's cognitive development demonstrate that the needs for support and care evolve throughout childhood and adolescence. During these stages of development, windows of positive susceptibilities conducive to learning stand out, described by Papalia; Feldman (2013) as neurodevelopment and neuroplasticity:

Neurodevelopment involves the formation, growth, and specialization of nerve cells (neurons) and the connections between them (synapses). This process is influenced by both genetic factors and experiences and environmental factors, which shape the functioning and structure of the brain, including motor, cognitive, emotional and social functions.

Neuroplasticity is the brain's ability to adapt and reorganize its networks in response to new experiences, or environmental changes. Also called brain plasticity, this characteristic allows the nervous system to modify and restructure itself throughout life, forming new synaptic connections or strengthening existing ones, which is fundamental for learning. It is especially active during the first few years of life, when the brain is developing rapidly.

These two central areas are for understanding how the human brain develops and adapts. Thus, neurodevelopment provides a structural basis for cognitive functions, while neuroplasticity ensures that the brain remains flexible and adaptable, supporting the enhancement of executive functions.

In the meantime, Hacon; Carvalho (2017) explain about cognitive and executive skills. Cognitive functions include the basic mental processes that allow us to understand,

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perceive, process, and remember information, which is the basis for brain function. The main cognitive functions are:

Attention: sustained and selective attention; Perception: interpretation and organization of sensory information (visual, auditory, tactile, palatal) that we receive from the environment; Memory: short-term, long-term, and working; Language: listening comprehension, vocabulary and verbal expression. Information Processing: understanding, analyzing, and processing information; Reasoning and Logic: abstract, concrete, making inferences, making decisions and solving problems.

Executive functions, on the other hand, are advanced mental processes that regulate behavior and help organize and control actions toward specific goals. They depend on basic cognitive functions. Key executive functions include:

Inhibitory Control: suppressing impulses and resisting distractions, allowing self-control and concentration on a task. Cognitive Flexibility: Ability to change strategy or adapt to new situations. Planning and Organization: the ability to set goals and organize necessary steps and resources. Working Memory: in addition to being a cognitive function, working memory is also an executive function, essential for complex tasks; Decision Making: ability to evaluate different options and choose the most appropriate one. Monitoring and Self-Assessment: Ability to review and evaluate one's own performance, adjusting actions as needed to ensure that the objective is achieved.

Cognitive and executive functions play central roles in the ability to learn, adapt, and apply knowledge in different contexts. However, when there are *deficits* or limitations in any of these areas, the child may present learning challenges, such as problems focusing, retaining information, organizing tasks, and maintaining flexibility in the face of change.

Fonseca (2016) expands this view by detailing Learning Disabilities (DAp.). They are caused by multifactorial factors, including punctual and contextual deficits not only in cognitive aspects, but also emotional and environmental factors. This perspective highlights the complexity of learning challenges

The DSM-5 manual (APA, 2014) complements this understanding, with the involvement of dysfunctional neurological circumstances of cognitive and executive abilities, classifying them as Specific Learning Disorders (ASD) within the scope of Neurodevelopmental Disorders.

As described in the DSM-5, these are neurobiological, genetic, and hereditary divergences that affect specific academic abilities and interfere with educational

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achievement and learning ability. They are persistent, more visible from the beginning of school life and classified in the ICD-11 TEAp. as:

Difficulty in Reading (ICD-11 6A03.0), dyslexia, is characterized by difficulties in reading words, slowness and imprecision in decoding, and problems in understanding the meaning of what is read.

Difficulty in Written Expression (ICD-11 6A03.1), dysorthography and dysgraphia, is a condition in which the individual has persistent difficulties in organizing thoughts in writing, which can manifest as problems with spelling, grammar, textual coherence and correct use of punctuation.

Difficulty in Mathematics (ICD-11 6A03.2), dyscalculia, refers to difficulties in mathematical skills such as calculations, comprehension of numerical concepts, mathematical reasoning, and arithmetic operations.

Executive Function Dysfunctions (ICD-11 6A03. Y) is characterized by difficulties in executive functions, such as inhibitory control, planning, organization, and cognitive flexibility. Difficulties managing time, organizing tasks, and switching between activities. And Attention Dysfunctions (ICD-11 6A03. Z), includes significant difficulties in maintaining attention on academic tasks, with frequent distraction and lack of concentration.

These disorders require additional care to avoid worsening complications, considering in addition to neurobiological, genetic and hereditary causes, factors such as ecosystem and environmental, psychosocial and socioeconomic exposures can aggravate the situation and intensify the challenges faced by these individuals. Therefore, the interconnected analysis of the concepts and thematic models provided a basic understanding of the relationship between SDH, DIn., DAp. and TEAp.

Based on this foundation, the next stage involved the analysis of the quality and risk of bias of the studies of articles, dissertations and theses. For the analysis of methodological quality and/or risk of bias (ii), *the JBI Checklist* [10] was used. The questions are the indicators and can be answered through four variables: *Yes*, *No*, *Unclear*, *Not Applicab*. It adopts an *overall appraisal* (general judgment) in three variables: *include*, *exclude*, and *seek furher info*. In addition, it provides for the exclusion of studies whose *overall appraisal* is of "Low" methodological quality. In the case of this review, it was established as "Low" when the study obtained equal to or less than three "Yes" answers.

[10] *Checklist for Studies Reporting Prevalence Data* Critical appraisal checklist for studies reporting prevalence data: the tool has nine critical appraisal questions for each sample.

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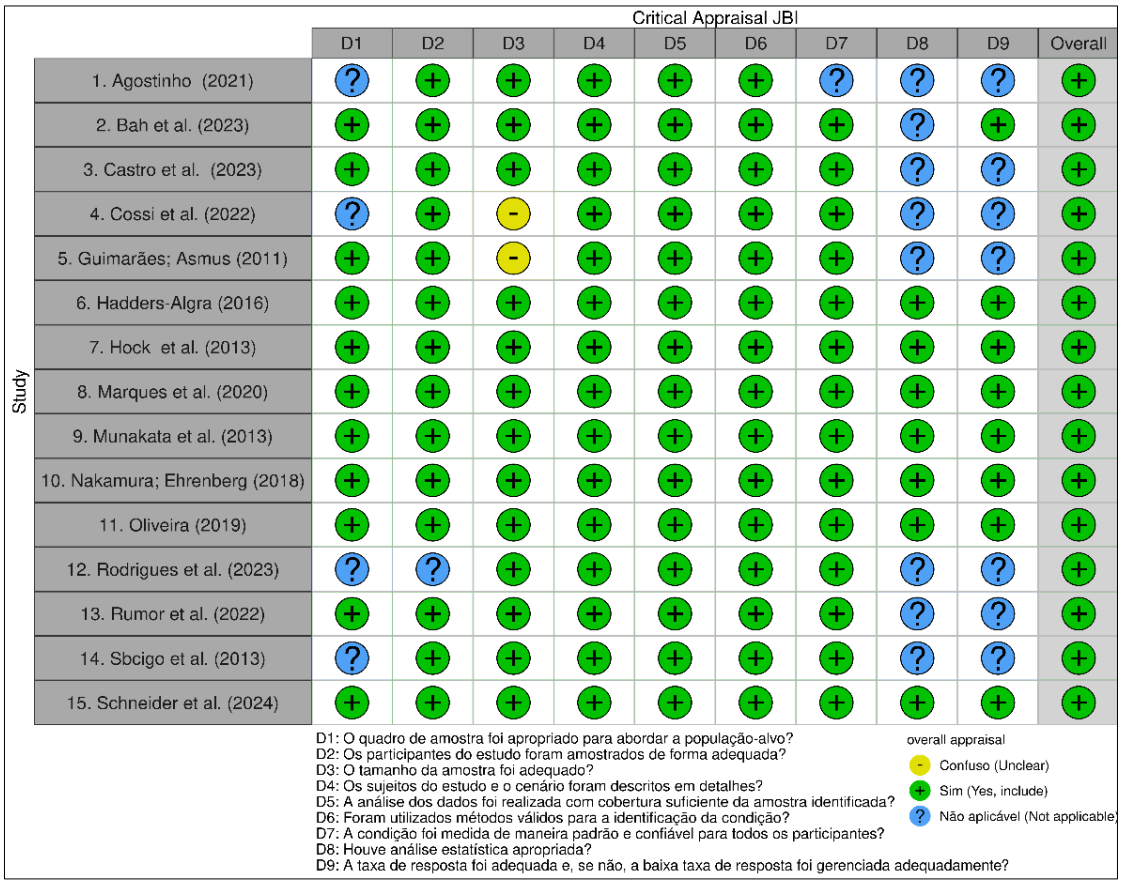
We also explain that the studies with *search furher info* were reevaluated and assigned the final result "inclusion or exclusion", so *only the 15 (fifteen) records* included are presented in Rovis graphs.

Rovis considers essential aspects in the assessment, relevance, review process, and judgment of bias: (a) Whether the methods of the review were designed to reduce the risk of bias; (b) Whether the research question of the review is properly defined and in the direction of the objectives of this *overview.* From now on, *Robvis,* through the graph "traffic light direction", allows a view of the judgments (variables) at the domain level (indicators), thus, in figure 4 we first present item (a) regarding the risk of bias of the included studies.

Figure 4 – Evaluation of the quality risk of bias, JBI in a Robvis traffic light layout



Source: Prepared by the authors on https://mcguinlu.shinyapps.io/robvis/, 2024.

The traffic light direction in Figure 4 illustrates the evaluation of 15 studies in relation to nine domains (D1 to D9) of the *Critical Appraisal* JBI. As mentioned earlier, each domain was classified on variables such as 'Yes' (*Ye/ Include*: green +), 'Confusing' (*Unclear*: yellow -) or 'Not applicable*'* (Not applicable: blue?). It was possible to observe regarding the domains and variables:

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- D1 – Received 'Yes' in most studies. However, some studies (Agostinho (2021), Cossi *et al.* (2022), Rodrigues *et al.* (2023), and Sbciog *et al.* (2013)) were classified as 'Not applicable', suggesting that the sampling criterion was not relevant or clear for these surveys.
- D2 – Almost all studies (except Sbciog *et al.* (2013), where it did not apply). This indicates that studies in general carried out an appropriate selection of individuals.
- D3 - Most studies obtained a 'Yes' result in this domain, but Cossi *et al.* (2022) and Guimarães; Asmus (2011) were classified as 'Confusing'. It suggests that there may be uncertainty in the description of the sample size in some cases.
- D4 - All studies were rated 'Yes', indicating that there was a detailed description of the participants and the context in which the studies were conducted.
- D5 - All studies met this domain, showing that the data analysis was carried out with sufficient coverage of the identified sample.
- D6 - This domain was met by all studies, which suggests a rigorous and standardized approach in the evaluation of the conditions studied.
- D7 - In the cases where it was evaluated, most studies were successful in meeting the domain, with some cases marked as not applicable due to the nature of the measurements performed.
- D8 - Most studies met this criterion. This indicates that statistical analysis, when necessary, was performed appropriately and consistently.
- D9 - In general, the studies have taken into account this domain. Where applicable, studies have demonstrated an appropriate response rate.

The *Overall appraisal* of the traffic light indicates that most studies met the established methodological criteria. Consistency in domains such as the description of the subjects (D4) and the validation of the methods (D6) shows a high methodological rigor in most cases.

Therefore, *Robvis* also generates plot summary graphs in weighted bars, which show the distribution of judgments assigned within each domain, allowing the evaluation of patterns and trends.

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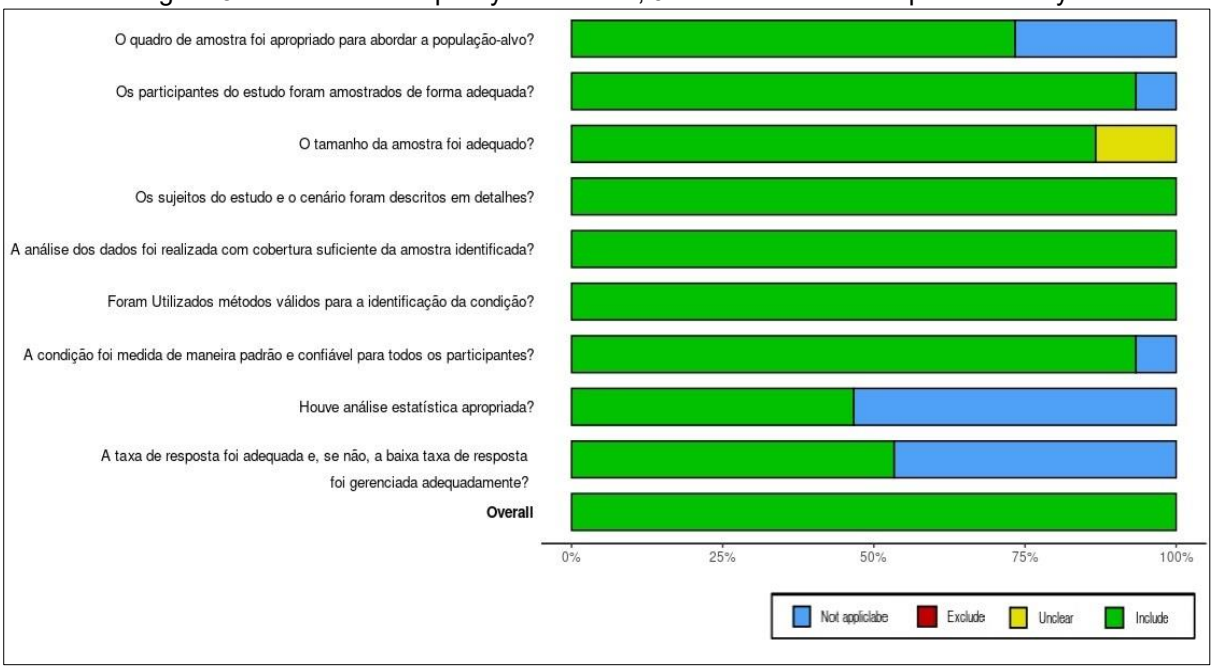
Figure 5 – Evaluation of quality risk of bias, JBI domains in Rovis plot summary.



Source: Prepared by the authors in https://mcguinlu.shinyapps.io/robvis/, 2024.

Figure 5 shows a plot summary graph from evaluation D1 to D9. Each criterion was classified as '*Include*', 'Unclear, and 'Not *appliclabe*: blue). Most studies demonstrated good methodological quality, between 75% and 100% in five domains (D2, D4, D5, D6, D7).

Especially in criteria such as the description of the subjects (D4), the coverage of data analysis (D5) and the use of valid methods to identify the condition (D6) with 100% included. Three criteria (D1, D8, D9) were marked with more than 10% 'Not applicable', which is expected in evaluations that encompass several methodological approaches, not specifically statistical and this was weighted, since they obtained more than three yeses.

The *overall appraisal* showed low risk of bias. Knowing this, it was possible to summarize the objectives, methodologies and results of the studies tracked, which were illustrated in tables 5a and 5b of the subsequent page.

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Figure 5a – Filing and summarization of the studies included in the qualitative synthesis

n.	tipo	Autor	indexador Idioma	Objetivo	metodologia	Resultado
1	diss.	Agostinho (2021)	*Google Sholar* port.	Explorar as bases conceituais para contrapor as interpretações das dificuldades de aprendizagem de forma biologizante e individualizante.	Revisão narrativa qualitativa das teoria Histórico-Cultural de Escogidas de Lev Vygotsky.	As dificuldades de aprendizagem não são exclusivamente atribuíveis a características biológicas, mas também no contexto social, histórico e educacional em que ocorre.
2	art.	Bah *et al.* (2023)	*Scielo* inglês	Desenvolver um modelo conceitual para examinar efeitos de metais pesados no desenvolvimento infantil através de características sociais e biológicas das crianças desde o período gestacional até os dois primeiros anos de vida.	Revisão narrativa qualitativa do modelo bioecológico de Bronfenbrenner, 69 estudos entre 1977 a 2022 no rasil, Estados Unidos, Itália, México e Holanda.	Uso do Modelo conceitual *Bronfenbrenner* na investigação da toxidade neurodesenvolvimental ilustra fatores ecológicos, sociais e biológicos, incluindo o impacto de determinantes sociais de saúde (DSH), como gênero, raça e classe social, além de conceitos como estresse alostático e incorporação.
3	art.	Castro *et al.* (2023)	*Scielo* inglês	Analisar como experiências adversas na infância, como a pobreza, a violência e a negligência, impactam o desenvolvimento de habilidades cognitivas essenciais.	Revisão Bibliográfica qualitativa, 31 artigos a partir de 1980 áreas: medicina, psicologia cognitiva e educação, em inglês português, no Google Sholar .	Experiências adversas na infância, têm efeitos significativos e duradouros sobre o desenvolvimento cognitivo e emocional das crianças.
4	art.	Cossi *et al.* (2022)	*Google Sholar* port.	Identificar a relação entre vulnerabilidades sociais, particularmente os determinantes sociais de saúde, e o desenvolvimento de deficiências de aprendizagem em crianças e adolescentes.	Revisão integrativa da literatura qualitativa, Biblioteca Virtual em Saúde (BVS) e Periódicos CAPES, 11 artigos, 2017 a 2021 em sete línguas.	Indica associação entre fatores de vulnerabilidade social e o desenvolvimento de deficiências de aprendizagem em crianças.
5	art.	Guimarães Asmus (2011)	*Google Sholar* port.	Examinar a vulnerabilidade suscetibilidade das crianças em relação à exposição ambientais. devido às suas características fisiológicas e comportamentais.	Estado da arte sobre estudos clínicos de susceptibilidade a exposição ambiental em crianças em 30 estudos até até 2010.	Crianças têm janelas de suscetibilidade à agentes ambientais durante seu desenvolvimento, chamadas. Os períodos pré-concepcionais pré-natais e pós-natal são igualmente sensíveis, podem levar a doenças cronicas, e neurodegenerativas.
6	art.	Hadders-Algra (2016)	*Scielo inglês*	Investigar os determinantes sociais e biológicos que influenciam o crescimento e o desenvolvimento de crianças em sociedades menos favorecidas	Pesquisa de campo, 92com idades entre 24 e 36 meses, rede municipal de educação infantil do Vale do Jequitinhonha em 2011. análise multivariada: crescimento infantil, peso ao nascer, número de consultas pré-natais e DSS.	O desenvolvimento infantil em sociedades menos favorecidas é fortemente influenciado tanto por fatores sociais quanto biológicos, Influências ambientais e cuidados pós-natais.
7	art.	Hock *et al.* (2013)	*Google Sholar* port.	Investigar a relação entre o status socioeconômico (SES) das crianças e suas funções executivas (FE)o desempenho escolar e a saúde.	Estudo transversal, longitudinal, qualitativo, dados dos projetos *Study of Early Childcare do NICHD* e *Family Life Project, A* valiações comportamentais e eletrofisiológicas (ERPs), Inventário *HOME*, até 2013, na Carolina do Norte e Pensilvânia, EUA.	Análise de variáveis como controle inibitório e memória de trabalho, levando em consideração fatores ambientais e familiares. Fatores ambientais, como stress, estimulação cognitiva no lar, ambiente e nutrição pré-natal, variam com entre crianças com maior e menor SES apresentando disparidades nas funções executivas

Source: prepared by the authors, 2024.

As can be seen, Agostinho (2021), Hock et al. (2013), and Marques et al. (2020) explore the influence of socioeconomic status (SES) on children's learning. Above all, these studies show that children from families with low SES face greater learning difficulties, in part due to lack of access to cognitive stimulation, economic poverty, school support, and basic resources. Hock et al. (2013) also show that children with lower SES have deficiencies in inhibitory control and working memory, essential components of executive functions (EFs) that are closely linked to school performance. Analysis of these

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studies suggests that financial support and education policies for low-SES families could mitigate these disparities in learning. In continuity, the studies in table 5b below also deal with this theme, as well as others:

Figure 5b – Filing and summarization of the studies included in the qualitative synthesis

n	tipo	Autor	indexador Idioma	Objetivo	metodologia	Resultado
8	art.	Marques *et al.* (2020)	*Google Sholar* port.	Discutir os impactos da gestão ambiental na saúde e desenvolvimento infantil, com foco em comunidades ribeirinhas e urbanas na região amazônica	Pesquisa empírica de abordagem quanti-qualitativa, com 217 crianças, de 0 a 5 anos, provenientes de áreas urbanas e ribeirinhas próximas ao Rio Jamari, no estado de Rondônia, BR. Questionário socieconômico estruturado e estatísticas descritivas e comparativas.	As crianças da região do Rio Jamari estão expostas a uma série de vulnerabilidades ambientais e socioeconômicas que afetam diretamente sua saúde e desenvolvimento. 41% renda menor que 1 salário. Desnutrição moderada a grave: 7%. Risco de desnutrição: 13%.Concentrações de mercúrio acima de 6 µg/g: 16,6%
9	art.	Munakata *et al.* (2013)	*Google Sholar* Inglês.	Explorar o desenvolvimento das funções executivas (FEs) em crianças e como esses processos cognitivos fundamentais influenciam o comportamento e o desempenho futuro em áreas como educação, saúde e condições socioeconômicas.	Pesquisa Teórica e Experimental, quali-quantitativa, crianças de idades entre 3 a 12 anos, longitudinal todo ano de 2013 *University of Colorado at Boulder*, Estado do Colorado, EUA. Modelos de regressão e análises de variância (ANOVA) de testes psicométricos das FEs., influências genéticas ambientais e cotexto socieconômico.	Crianças de baixo status socioeconômico apresentaram até 30% menos desempenho em testes de FEs, especialmente em controle inibitório e memória de trabalho, em comparação com crianças de famílias de maior renda. Essas diferenças têm implicações no desempenho escolar e nas habilidades sociais.
10	art.	Nakamura *et al.* (2018)	*Scielo* inglês	Explorar a análise sociológica dos problemas de saúde mental na infância.	Análise documental quanti-qualitativo,de 275 prontuários de crianças pacientes entre 5 a 11 anos em dois serviços de saúde mental infantil (CMHS), nordeste de Paris, França.	Meninos (71%) entre 6 e 11 anos, apresentaram problemas de comportamento e dificuldades cognitivas. Meninas 28,7% 5 a 11 anos mais frequentemente associadas a problemas afetivos e emocionais.
11	art.	Oliveira (2019)	*Scielo* port.	Analisar o desenvolvimento infantil em diferentes grupos sociais	Estudo transversal, quantitativo de fevereiro a abril de 2013, com 348 crianças em unidades básicas de saúde (UBS) de Itupeva, SP, Brasil. Ficha de Acompanhamento do Desenvolvimento, Índice de Reprodução Social, com análise univariada regressão Logística Múltipla.	29% das crianças dos grupos sociais menos favorecidos não alcançaram o esperado para a idade, até 2,6 vezes mais chances de atraso em marcos de desenvolvimento infantil.
12	art.	Rodrigues *et al.* (2023)	Google Sholar port.	Esclarecer as diferenças entre TEAp e DAp, considerando a influência de fatores externos, como ambiente socioeconômico e escolar.	Revisão sitêmica de literatura de 26 artigos publicados no sistema *Redalyc* em agosto de 2022.	Há poucos estudos que relacionam fatores biológicos e externos nas DAp. Embora os TEAp tenham origem neurobiológica, condições externas podem agravar ou atenuar essas dificuldades.
13	art.	Rumor *et al.* (2022)	Scielo inglês	Compreender a relação entre DSS e a aprendizagem de crianças da rede pública de ensino, a partir da perspectiva de profissionais da saúde e da educação.	Pesquisa ação-participante, qualitativa com 27 profissionais de saúde e 18 de educação de Florianópolis/SC, em novembro de 2020 e março de 2021. Itinerário de pesquisa de Paulo Freire, entrevistas individuais e círculos de cultura.	Condições de vida precárias, hábitos pouco saudáveis e relações frágeis impactam negativamente a aprendizagem.
14	art.	Sbcigo *et al.* (2013)	*Scielo* port.	Explorar a relação entre status socioeconômico (SES) e desenvolvimento cerebral	Revisão sitemática, qualitativa 19 artigo com técnicas de EEG (eletroencefalograma) e fMRI (imagem por ressonância magnética funcional) entre 2000 e 2011, no ISI Web of Knowledge, Scopus e PsycINFO, da América do Norte, América do Sul e Reino Unido, além de países da Ásia, Europa e África.	O NSE é um fator relevante no desenvolvimento da FE, em 17 dos 19 estudos, o NSE afetou o desempenho em FE, crianças e adolescentes do NSE mais altos apresentaram melhor desempenho em comparação as de NSE mais baixos.
15	art.	Schneider *et al.* (2024)	*Google Sholar* inglês	Investigar como os mecanismos sociodemográficos, status socioeconômico (SES) que impactam o desenvolvimento cerebral das crianças	Revisão sistemática, quali-quantitativa, análise de variância (ANOVA) de ressonância magnética funcional (FMRI) e eletroencefalografia de segurança (rsEEG) e SES, de 236 artigos que envolvem 212 crianças e adolescentes com idade entre 6 e 16 anos de países ociedentais.	A situação socioeconômica (SES) influencia o desenvolvimento cerebral. A educação da mãe afeta a qualidade e quantidade do insumo linguístico, que impacta a linguagem. A renda familiar impacta no controle inibitório e na memória de trabalho.

Source: prepared by the authors, 2024.

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As explained earlier, executive functions (EFs) are fundamental for academic success, this is also highlighted in Munakata's studies *et al.* (2013) and Schneider et al. (2024). Also, according to these authors, children with low SES have deficits in EFs, especially in skills such as inhibitory control and working memory, which are directly linked to academic performance and learning capacity. Schneider et al. emphasize that socioeconomic status influences brain development, suggesting that cognitive support and stimulation in disadvantaged environments to compensate for the limitations imposed by SDH.

Guimarães; Asmus (2011) and Marques *et al.* (2020) demonstrate that risk environments, such as exposure to pollutants, contaminants, and unhealthy conditions, affect children's learning and development. The work of Guimarães; Asmus (2011) identifies critical periods in which children are more vulnerable to environmental agents, with impacts that can result in learning difficulties and cognitive impairment. Henceforth, Marques *et al.* (2020) show that children exposed to high levels of mercury and poverty in the Amazon have an increased risk of cognitive and health problems, both of which limit academic development. These studies reinforce the need for environmental protection and pollutant control in vulnerable areas.

Castro *et al.* (2023) e Nakamura *et al.* (2018) highlight the relationship between adverse experiences, such as poverty and neglect, and the development of learning disorders and emotional problems. Adverse experiences, according to Castro *et al.*, cause lasting impacts on cognitive and emotional development, limiting children's ability to learn. Nakamura *et al.* (2018) also notes that behavioral and emotional problems are common among children in vulnerable situations, emphasizing that social and emotional support are important to prevent or mitigate learning difficulties resulting from childhood trauma.

Rodrigues *et al.* (2023) and Rumor *et al.* (2022) examine how external factors, such as the socioeconomic and school environment, aggravate or attenuate learning disorders. Rodrigues *et al.* (2023) notes that despite the neurobiological origins of certain disorders, such as aASD, social and economic conditions play an important role, often exacerbating the barriers already existing in this neurodivergent condition. Rumour *et al.* (2022) reinforces that precarious living conditions and lack of family support are associated with compromised learning, indicating that improvements in the social environment and school support are essential for these children to face the challenges arising from their condition.

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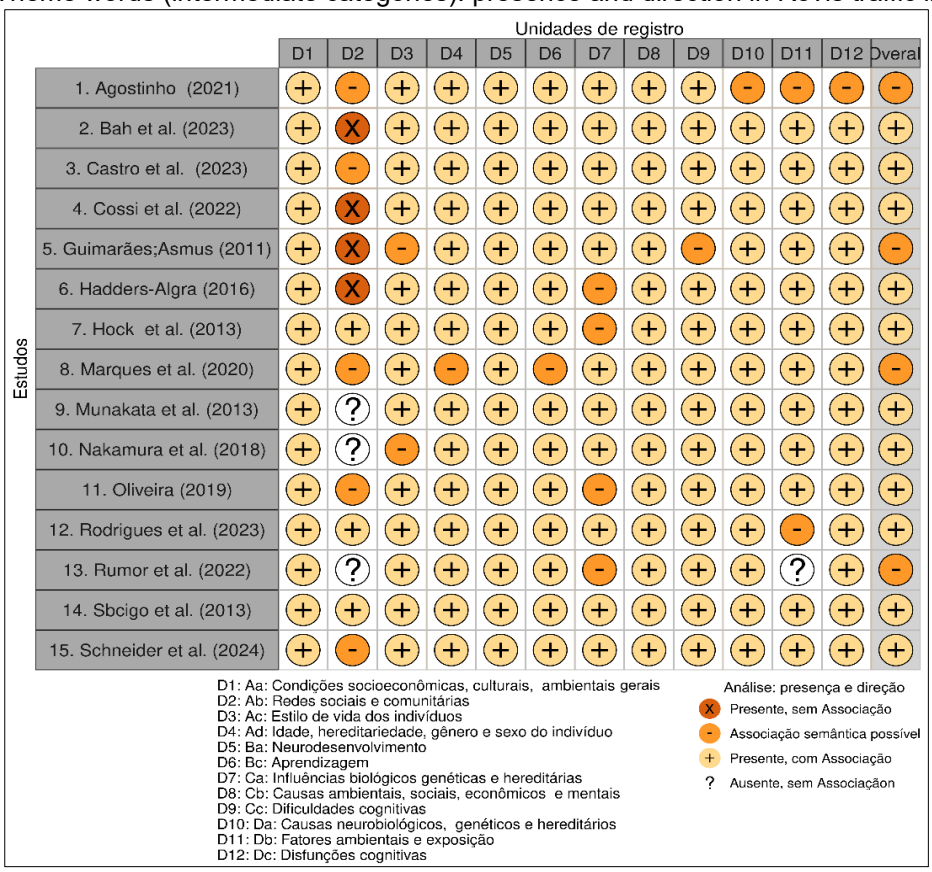
The analysis of the studies indicates that the Social Determinants of Health exert a significant impact on the *status* of child learning, influencing from cognitive development to the incidence of aggravation of learning difficulties and disorders.

To better illustrate the qualitative perception, we then used the analysis based on item (b) Robvis, "If the research question of the review is properly defined and in the direction of the objectives of the study, *overview"*, also using the traffic light and plot graphics. As already explained, the variables for each study were: positive "Present with association"; "Absent, but with possible semantic association"; negative "Absent, without Association"; and ambiguous "Present, but without association". The domains (indicators) were the categories of registration units of the intermediate categories (D1 to D12). As illustrated in figure 6 below:

Figure 6 – Theme words (intermediate categories): presence and direction in Rovis traffic light layout .



Source: Prepared and adapted by the authors in: https://mcguinlu.shinyapps.io/robvis/, 2024.

The traffic light shows that most studies obtained the classification 'Present and with Association' in most of the registration units, especially in the criteria related to socioeconomic conditions, etc. (D1:Aa), neurodevelopment (D5:Ba) and environmental

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causes, etc. (D8:Cb). However, criteria D2:Ab and D7:Ca show more than three variations, D3:Ac and D11:Db two variations, and D4:Ad, D6:Bc, and D10:Da at least one variation. For a better detail, we scrutinize each of the domains:

- D1: Aa – General Socioeconomic, Cultural and Environmental Conditions: all studies marked this criterion as 'Present and with Association', indicating that D1 was widely addressed.
- D2: Ab – Social and Community Networks: This criterion presents some classifications 'Absent and without Association'. This indicates that the focus on social networks may have been secondary in these studies. The others, for the most part, met the criterion as 'Present and with Association'.
- D3: Ac – Lifestyle of Individuals: eleven of the studies address this criterion appropriately and one with 'Possible semantic association' indicate that lifestyle was mentioned in the direction of this article.
- D4: Ad – Age, Heredity, Gender and Sex of the Individual: as in the previous item, most studies considered this criterion as 'Present and with Association', showing associative consistency in the approach to demographic and hereditary factors.
- D5: Ba – Neurodevelopment: All studies met this criterion, indicating that neurodevelopment was a topic addressed with direct association in all cases.
- D6: Bb – Learning: This criterion was widely met, with all studies indicating a direct association between the factors studied and the learning process.
- D7: Ca – Genetic and Hereditary Biological Influences: Most studies were classified as 'Present and with Association', suggesting that biological and genetic influences were addressed with direct association.
- D8: Cb - Environmental, Social, Economic and Mental Causes: All studies met this criterion with direct association, which suggests that environmental, social, economic and mental causes are relevant factors in the analysis of the studies.
- D9: Cc - Cognitive Difficulties: The criterion was largely met, with a minority of studies marked as 'Present but No Association', which indicates that, although cognitive difficulties are mentioned, there is not always a direct association with the main factors of each study.
- D10: Da – Neurobiological, Genetic and Hereditary Causes: This criterion was addressed with direct association by most studies, showing an appreciation of neurobiological and genetic causes in the analyses performed.

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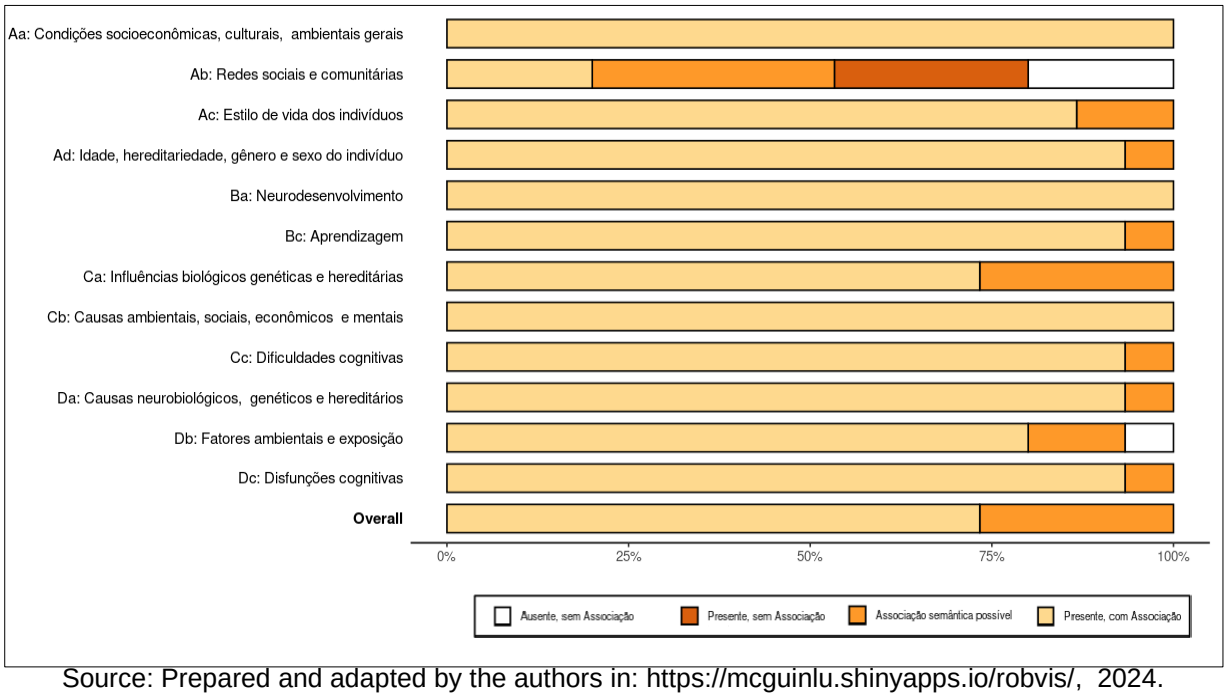
- D11: Db – Environmental Factors and Exposure: Most studies have recognized environmental factors and exposure as important elements, but there have been exceptions.
- D12: CD – Cognitive Dysfunctions: The studies have broadly addressed this criterion, with most indicating a direct association between the factors studied here.

The plot summary (figure 7) also presents this relevance of compliance with the criteria, with 75% to 100% of the registration units being marked as 'Present and with Association'. However, some units show variations, with classifications in 'Possible semantic association' and even in 'Absent and no Association'. The Ab domain presented only 25% to 50% of 'Present and with Association' and 'Possible semantic association'.

Figure 7 – Theme word (intermediate categories), presence and direction, plot summary, Rovis platform.



Source: Prepared and adapted by the authors in: https://mcguinlu.shinyapps.io/robvis/, 2024.

Although the studies reviewed show a degree of methodological consistency and significant associations, some observations were identified:

Standardization of Approaches to Social Networks and Lifestyle: In some studies, criteria such as 'Social and Community Networks' and 'Lifestyle' were rated as 'Possible semantic association' or even 'Absent and no association'. This variation indicates that these factors could be addressed in a more standardized and in-depth manner.

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Detailed analysis of Environmental Factors and Exposure: Although widely recognized, the criterion 'Environmental Factors and Exposure' could be explored in a more segmented way in studies, enabling an understanding of the associations with other factors and their specific effects.

Clarity in the Justification of Sample Size: Some studies presented the sample size criterion as 'Confusing', indicating a lack of clarity or justification in the choice of sample size.

Limited Analysis of Genetic and Hereditary Factors: Although some studies have addressed genetic factors, their analysis has been limited in certain cases. A more detailed investigation into how hereditary factors influence development and learning could enrich future research.

Some practices are possible to be carried out within the state system itself.

Grants and Incentives: Creation of direct financial support programs for low-income families, with collateral benefits for education and child health. These grants could include food stamps, subsidies for school transportation, and support for educational materials, which are essential for academic development in vulnerable contexts.

Work and Income Programs: Implementation of employment incentive policies for parents of school-age children, promotes financial stability that directly impacts the home environment and reduces financial stress that affects children's mental health and school performance.

Training in Health and Education: Offering workshops and courses for parents and caregivers on preventive health practices, child development and school support techniques. Awareness of the impacts of environmental and socioeconomic factors on learning can empower families to seek healthier and more enriching environments.

Community Support Networks: Encourages the strengthening of social and community networks, including the development of support centers that connect parents, schools, and health services. These centers can offer psychological counseling, support for specific learning needs, and nutritional support.

Individualized School Support: In schools, they implement school support programs with personalized plans for children facing learning difficulties. This includes mentoring programs, extracurricular activities focused on executive functions, and inclusive practices that value emotional and social development.

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Safe and Healthy Educational Environments: Environmental inspection and control policies in school environments, especially in regions vulnerable to contaminants. This type of policy helps to ensure that schools are safe places that are free of environmental risks that could impact neurocognitive development.

Pollutant Regulation: Implementation of more specific regulations for the emission of pollutants in areas near schools and residential neighborhoods. These policies include continuous monitoring of air quality and restrictions on the use of hazardous chemicals in residential and school settings.

Sanitation and Access to Clean Water Programs: In underserved regions, policies that ensure access to clean water and basic sanitation systems have a direct impact on child health and development. This includes the installation of water filtration systems and campaigns for the proper maintenance of these systems.

Overall, the reviewed studies provide a solid basis for subsequent analysis and revision, especially in the areas of neurocognitive development and cognitive difficulties and dysfunctions, which have been consistently addressed at the expense of the Social Determinants of Health.

FINAL CONSIDERATIONS

It is possible to consider that the studies analyzed present a significant interassociation in relation to criteria such as general socioeconomic, cultural and environmental conditions (axis A), age, heredity and sex of the individual (axis A), neurodevelopment (axis B), learning (axis B), biological influences (axis B, C and D), cognitive difficulties and dysfunctions (axes C and D).

There are variations observed in criteria such as social networks (axis A), lifestyle (axis A), genetic and hereditary factors, environmental factors, and exposure (axes B, C, and D) probably reflect circumstances for a better associative approach. Suggestions and gaps identified indicate that there is room for improvement in future studies.

The results suggest further studies in contexts where there are children in susceptible windows of cognitive development and neurodevelopment to these circumstances. In particular, those involving social and community networks, heredity and genetics, exposure to pollutants and environmental contaminants. As well as the need for public and private interventions in education and health. In addition to guidance on prevention habits, thus aiming at a healthy environment conducive to the full development

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of the child from the perspective of the *Nutring Care* (UNICEF) model of integral domains of child care.

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