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Review Article
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Artículo de Revisión

Immunization and geographic contexts: a review of factors contributing to low vaccination

Imunização e contextos geográficos: revisão sobre fatores de baixa cobertura vacinal

Inmunización y contextos geográficos: revisión de los factores que contribuyen a la baja cobertura de vacunación

Gilberto Leão Fragoso[I]; *Luiz Sérgio Silva*[I]

[I]*Universidade Federal de Minas Gerais. Belo Horizonte, MG, Brazil*

ABSTRACT

Objective: to identify factors that influence vaccination coverage in different geographic contexts. **Methods:** an integrative literature review was conducted using the BVS, PubMed, and CAPES databases, including documents published between 2022 and 2024. **Results:** the findings were grouped into three areas: (1) demographic and socioeconomic factors (low income, education, gender, ethnicity, religion); (2) caregivers' knowledge and attitudes (gaps in understanding, mistrust); (3) barriers to access (distance, schedules, lack of guidance). Most studies were cross-sectional, focusing on the United States, China, and Ethiopia, with low representation from Latin America. **Conclusion:** the interconnections among these factors require holistic approaches and public policies to improve vaccination coverage. Nursing is strategically important for health education, combating misinformation, and strengthening ties with the community. The methodological and geographical limitations of this review underscore the need for longitudinal, qualitative, multicenter research, particularly in underrepresented regions, to support more effective and equitable interventions.

Descriptors: Vaccination; Vaccination Coverage; Vaccination Hesitancy; Barriers to Access of Health Services.

RESUMO

Objetivo: identificar fatores que influenciam a cobertura vacinal em diferentes contextos geográficos. **Métodos:** revisão integrativa da literatura nas bases BVS, PubMed e CAPES incluindo documentos de (2022 a 2024. **Resultados:** os achados foram agrupados em três áreas: (1) fatores demográficos e socioeconômicos (baixa renda, escolaridade, gênero, etnia, religião); (2) conhecimentos e atitudes dos cuidadores (lacunas na compreensão, desconfiança); (3) barreiras de acesso (distância, horários, falta de orientação). A maioria dos estudos foi transversal, concentrando-se nos Estados Unidos, China e Etiópia, com baixa representação da América Latina. **Conclusão:** a interconexão entre os fatores exige abordagens holísticas e políticas públicas direcionadas para melhorar a cobertura vacinal. A enfermagem emerge como estratégica para educação em saúde, combate à desinformação e fortalecimento do vínculo com a comunidade. As limitações metodológicas e geográficas desta revisão ressaltam a necessidade de pesquisas longitudinais, qualitativas e multicêntricas, especialmente em regiões sub-representadas, para subsidiar intervenções mais eficazes e equitativas.

Descritores: Vacinação; Cobertura Vacinal; Hesitação Vacinal; Barreiras ao Acesso aos Cuidados de Saúde.

RESUMEN

Objetivo: identificar los factores que influyen en la cobertura de vacunación en diferentes contextos geográficos. **Métodos:** revisión integradora de la bibliografía en las bases de datos BVS, PubMed y CAPES, incluyendo documentos publicados entre 2022 y 2024. **Resultados:** los resultados se agruparon en tres áreas: (1) factores demográficos y socioeconómicos (bajos ingresos, educación, género, etnia, religión); (2) conocimientos y actitudes de los cuidadores (lagunas en la comprensión, desconfianza); (3) barreras de acceso (distancia, horarios, falta de orientación). La mayoría de los estudios fueron transversales y se centraron en Estados Unidos, China y Etiopía, con una escasa representación de América Latina. **Conclusión:** la interconexión entre estos factores requiere enfoques holísticos y políticas públicas orientadas a mejorar la cobertura vacunal. La enfermería se perfila como estratégica para la educación sanitaria, la lucha contra la desinformación y el fortalecimiento de los vínculos con la comunidad. Las limitaciones metodológicas y geográficas de esta revisión ponen de relieve la necesidad de realizar investigaciones longitudinales, cualitativas y multicéntricas, especialmente en regiones infrarrepresentadas, para respaldar intervenciones más eficaces y equitativas.

Descriptores: Vacunación; Cobertura de Vacunación; Vacilación a la Vacunación; Barreras de Acceso a los Servicios de Salud.

INTRODUCTION

Vaccination, which began in the 18th century, remains one of the most effective public health interventions in preventing infectious diseases[1,2]. To achieve better vaccination coverage, it is crucial that health services are close to the community, which can be facilitated by the implementation of Primary Health Care as a guiding framework for healthcare practices[3].

However, there have been declines in vaccination coverage rates in several countries, posing a threat to public health and raising the possibility of outbreaks of preventable diseases, the reappearance of diseases that had already been eradicated, increased morbidity and mortality, and substantial economic costs[2]. The complexity of this scenario lies in

Corresponding author: Gilberto Leão Fragoso. E-mail: leaofragoso@gmail.com
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the multiplicity of factors that influence vaccination coverage, which vary significantly between different geographic and socioeconomic contexts[4].

In some contexts, such as Brazil, which has a universal healthcare system covering the entire national territory[5], there has been a decline in vaccination rates, with low maternal education being identified as a key factor associated with children not being vaccinated[6].

Although there have been reviews of the factors influencing vaccine uptake, specific aspects related to the impact of demographic and socioeconomic factors, caregivers' knowledge and attitudes, and barriers to accessing health services remain critical issues that require systematization and comparative analysis across contexts. Given the need to deepen our understanding of these issues, we ask: Which factors have been most relevant in causing the decline in vaccination coverage in different geographical contexts? To address this question and elucidate the complexity of this phenomenon, a literature review was conducted to identify and systematize the factors influencing the immunization process across regions, with the aim of clarifying the nuances that shape vaccination adherence even in settings with broad availability of health services.

Understanding these determinants is essential to guide strategies capable of reversing this scenario. In this context, nursing plays a central and multifaceted role: In addition to being the main provider of immunization actions—including vaccination, active search, monitoring of vulnerable groups, and health education—it is also responsible for organizing the work process in primary care, analyzing indicators, territorial planning, and coordination with managers and communities.

The integration of these care, management, and educational functions places nursing at the strategic center of efforts to reduce inequalities, strengthen public confidence in vaccines, and ensure the effectiveness of immunization programs.

Thus, this study aimed to identify and analyze factors associated with low vaccination coverage across diverse geographical contexts, drawing on recent scientific literature (2022 to 2024) to inform decision-making and improve nursing care and management practices.

METHOD

This study consists of an integrative literature review, conducted in accordance with the PRISMA 2020 recommendations. The study was conducted by a team of three researchers. Two reviewers independently performed all stages of data selection and extraction, and any discrepancies were resolved by consensus and, when necessary, with the participation of a third researcher.

The search was conducted between April 18 and 22, 2024, in the Virtual Health Library (VHL), PubMed, and the CAPES Portal databases (Cochrane, Scopus, Web of Science, and Embase). Controlled and uncontrolled descriptors were combined using Boolean operators (Figures 1 and 2).

Database	Descriptors and Boolean operators used in the search
Virtual Health Library	("Cobertura Vacinal" OR "Vaccination Coverage" OR "Cobertura de Vacunación" OR "Couverture vaccinale" OR "Taxa de Vacinação" OR "Hesitação Vacinal" OR "Vaccination Hesitancy" OR "Vacilación a la Vacunación" OR "Réticence à l'égard de la vaccination" OR "Recusa de Vacinação" OR "Vaccination Refusal" OR "Negativa a la Vacunación" OR "Refus de la vaccination" OR "Movimento contra Vacinação" OR "Anti-Vaccination Movement" OR "Movimiento Anti-Vacunación" OR "Mouvement anti-vaccination") AND ("Fatores Culturais" OR "Cultural Factors" OR "Factores Culturales" OR "Facteurs Culturels" OR "Fatores Econômicos" OR "Economic Factors" OR "Factores Económicos" OR "Facteurs économiques" OR "Fatores Sociais" OR "Social Factors" OR "Factores Sociales" OR "Facteurs sociaux" OR "Fatores Sociodemográficos" OR "Sociodemographic Factors" OR "Factores Sociodemográficos" OR "Facteurs sociodémographiques" OR "Fatores Socioeconômicos" OR "Socioeconomic Factors" OR "Factores Socioeconómicos" OR "Facteurs socioéconomiques") AND (db:("LILACS" OR "IBECS" OR "BDENF" OR "PAHOIRIS" OR "PREPRINT-MEDRXIV" OR "BBO" OR "WPRIM" OR "BINACIS" OR "SES-SP" OR "WHOLIS" OR "colecionaSUS" OR "AIM" OR "PAHO" OR "RSDM" OR "MedCarib" OR "campusvirtualsp_brasil")
PUBMED	("Vaccination Coverage" OR "Vaccination Hesitancy" OR "Vaccination Refusal" OR "Anti-Vaccination Movement") AND ("Cultural Factors" OR "Economic Factors" OR "Social Factors" OR "Sociodemographic Factors" OR "Socioeconomic Factors")

Figure 1: Descriptors and Boolean operators used in search on Virtual Health Library and PUBMED databases. Belo Horizonte, MG, Brazil, 2024.

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COCHRANE CAPES	("Vaccination Coverage" OR "Vaccination Hesitancy" OR "Vaccination Refusal" OR "Anti-Vaccination Movement") AND ("Cultural Factors" OR "Economic Factors" OR "Social Factors" OR "Sociodemographic Factors" OR "Socioeconomic Factors")
SCOPUS CAPES	("Vaccination Coverage" OR "Vaccination Hesitancy" OR "Vaccination Refusal" OR "Anti-Vaccination Movement") AND ("Cultural Factors" OR "Economic Factors" OR "Social Factors" OR "Sociodemographic Factors" OR "Socioeconomic Factors")
WEB OF SCIENCE CAPES	("Vaccination Coverage" OR "Vaccination Hesitancy" OR "Vaccination Refusal" OR "Anti-Vaccination Movement") AND ("Cultural Factors" OR "Economic Factors" OR "Social Factors" OR "Sociodemographic Factors" OR "Socioeconomic Factors")
EMBASE CAPES	('vaccination coverage') AND ('cultural factor' OR 'economic aspect' OR 'social aspect')

Figure 2: Descriptors and Boolean operators used in search on COCHRANE, Scopus, Web of Science and Embase databases. Belo Horizonte, MG, Brazil, 2024.

Original articles published between 2022 and 2024 were included, covering studies that addressed factors associated with low vaccination coverage, vaccine hesitancy, or barriers to access, and that were available in full in any language. Reviews, editorials, letters, government documents, and duplicate texts were excluded, as well as studies that exclusively addressed COVID-19 or that did not address the researched topic or lacked an abstract or full text availability.

Data from the selected studies were extracted using a standardized form that included information on the author, year, country, study type, main findings, and identified factors. Data analysis was performed using a descriptive synthesis, grouping the results by thematic similarity to identify the main factors influencing vaccination coverage. Absolute and relative frequencies were calculated to characterize the studies. For comparison, countries were categorized according to the World Bank's income classification, defined by Gross National Income (GNI) per capita. The detailed classification for the current fiscal year is provided in the publication "World Bank Country and Lending Groups – Fiscal Year [2023]", available on the World Bank official website at https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

RESULTS

The initial search resulted in 2,013 records. After removing duplicates, 1,537 studies remained. A total of 1,316 were excluded after reading the titles, and 109 after reading the abstracts. In the end, 112 articles were read in full and included in the qualitative synthesis (Figure 3).

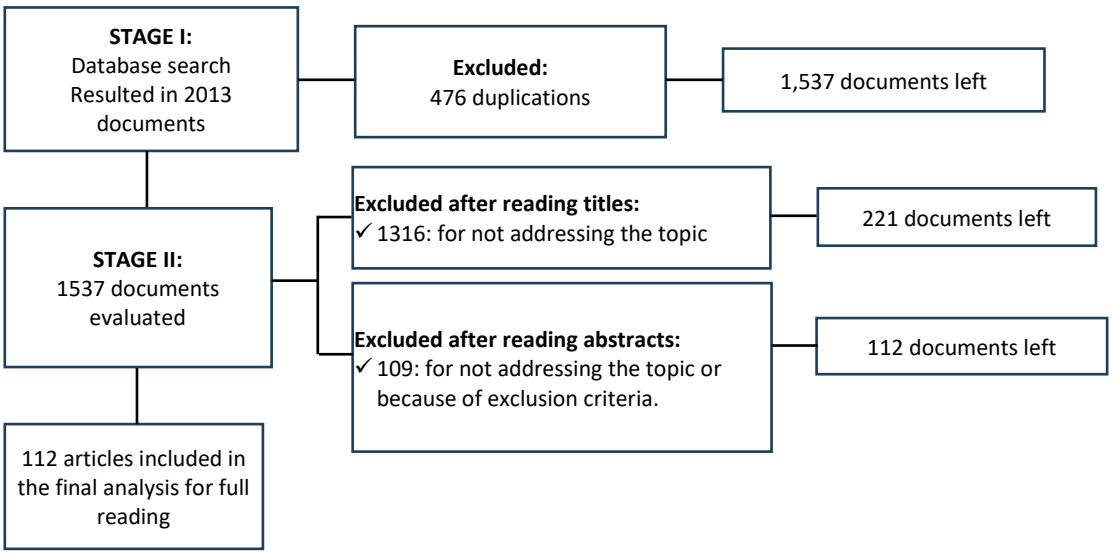

Figure 3: Flowchart of the document selection process steps. Belo Horizonte, MG, Brazil, 2024.

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After selecting the studies, 112 articles published between 2022 and 2024 were included in the analysis, with characteristics presented in Table 1.

Table 1: Distribution of publications according to population, vaccines, origin, study type, and topics covered. Belo Horizonte, MG, Brazil, 2024.

Variables	n	f (%)
Study population		
Children and adolescents[1-19,23,24,35,40,42-44,53,60,-64,67,68,70,74,77-0,87,88,92,95,108,111,114,118-122]	53	47.32
Caregivers [20,21,24-27,35,36,41,52,58,68,81-84,94,99,107,110,113,115]	22	19.64
Adults[27,51,97,100,102,103,105,117]	8	7.14
Pregnant women[28,29,45,50,51,57,69,87]	8	7.14
Healthcare professionals[45,50,84-87,89,101,106,109]	9	8.03
Elderly people[22,30,31,45,90]	5	4.46
Other populations[a] [32-34,37,48,49,51,55,77,101,103,123-125]	14	12.50
Vaccines covered in the study		
Pentavalent (pertussis, tetanus, diphtheria, hepatitis B)[8,9,14,17,23,29,35,40,50,51,53,60,61,64,67,70,85,88,95,103,106,108,113-116,124]	28	25.00
Influenza[21,27-29,32,33,41,45-47,49,50,54,57,69,87,90,91,97-103,105,109,122,123]	26	23.21
Measles[1,16,17,21,44,63,68,85,95,103,107,108,115,117,120]	15	13.39
Pneumococcal[7,23,31,32,70,91,97-99,103,108,116]	11	9.82
Polio[12,23,28,53,60,70,95,108,111,117]	10	8.93
BCG (Bacillus Calmette-Guérin)[11,17,23,35,44,53,95,111,117]	9	8.04
HPV (Human Papillomavirus)[24,37,74,81,87,98,100,117,121]	9	8.04
Other immunizers[b] [1,10,11,13,15,19,22,23,24,30,34,37,42,43,46,48,52,57,58,62,67,77-85,89,91-94,97,98,100,103,110-113,117,119,121,125]	48	42.85
Origin/country		
United States of America[24,27,30,36,55,69,74,87,89,100,103,105,121,122]	15	13.39
China[41,47,47,48,88,90,97,99,110,118]	10	8.93
Ethiopia[7,12,42-44,62,67,78,94,108]	10	8.93
India[11,13,15,20,22,79,80,95,96]	9	8.04
Brazil[1,23,25,29,85,93,109,117]	8	7.14
Other nations[c] [8-10,14,16-19,21,26,28,31-35.37.40.45.49-52.53-54.56-58,60-64,67,68,70,77,81-84,87,91,92,98,101,102,104,107,108,111,113-115,117,119,120,123,124]	57	50.89
Study type		
Cross-cutting[7,8,10-16,18,19,23-26,27,2,30,32-35,36,37,40-42,47,49-54,56-58,60-63,67-69,74,77,79-81,83,85-90,92,94-97,99-101,103,105-109,111-112,114-117,118-119,121-124]	82	73.21
Qualitative[21,48,81,82,84,93,98,104]	8	7.14
Cohort[1,22,28,31,70,125]	6	5.36
Ecological[9,55,64,67,113]	5	4.46
Case-control[43,78]	2	1.79
Other[d] [20,102,110,117]	4	3.57
Demographic and socioeconomic issues[1,7-13,14-19,20-22,23-27,28-37,40-42,44,46-49,51-53,55-58,60-64,67-70,74,78,82,83,84,91-94,98-101,103-108,110,115,121-122,124,125]	80	71.42
Knowledge and attitudes: individual or caregiver factors[1,9,13,17,21,25,28,29,31,33,35,37,42-44,47-49,52,57,58,61,62,67-69,77-103,106-110,104,117,125]	63	56.25
Access to health services[1,7,8,10-13,17,19,21,24,28,29,31,42,43,45,47,51-53,57,62,64,67,68,79-81,83-87,90,91,93,98-100,101-103,107,108-120,125]	59	52.67

Notes: [a]other populations: included university students, people with chronic diseases, and the general population; [b]other immunizers: covered Herpes Zoster, Mumps, Triple Bacterial, and Rotavirus vaccines; [c]other nations: included countries with 1, 2, or 3 studies; [d]other (study types): mixed, intervention, randomized.

Most of the studies, totaling almost 80%, employed a cross-sectional design. This type of study is useful for analyzing the prevalence of conditions or behaviors at a given moment, but does not allow causal relationships to be established[123]. Next, there were studies that used qualitative methods, which accounted for 7.14% of the research and are essential for understanding perceptions and behaviors related to vaccination[123]. Cohort studies (5.36%), which provide valuable information on the incidence and determinants of vaccine adherence over time[123], were also identified and, finally, ecological studies, with 4.46%. The latter helps to identify trends and patterns in population groups[123].

Among the main vaccines investigated, the pentavalent vaccine was the most prevalent, accounting for 22.32% of studies, followed by the influenza vaccine, which accounted for 19.64%. The emphasis on the former reflects the importance given by the academic community to an immunobiological agent capable of preventing

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multiple serious childhood diseases, while the latter prevents influenza, known for its high transmissibility and potential to cause seasonal epidemics affecting all population groups. Other frequently investigated vaccines include measles (13.39%), a highly contagious disease, and pneumococcal (9.82%), essential for preventing serious infections such as pneumonia. Polio (8.93%), still a concern in some regions, and both BCG and HPV, each with 8.04%, were also significant focuses, reflecting efforts to control tuberculosis and prevent cervical cancer, respectively.

In terms of scientific output by country, the United States (US) published just over 13% of studies, standing out as a leader in research on factors associated with low vaccine uptake. China and Ethiopia, with 8.93% each, reflect the growing scientific output of these countries in public health. India, with 8.04%, and Brazil, in fifth place with 7.14%, demonstrate important contributions to immunization research, particularly in the context of middle-income countries facing challenges related to vaccine-preventable communicable diseases.

Regarding geospatial distribution, a concentration of study publications was observed in certain regions of the world. In contrast, findings were more dispersed, with fewer publications identified across several regions of Africa, Asia, Oceania, and Europe. The search identified studies from only three Latin American countries (Brazil, Costa Rica, and Peru), showing an underrepresentation of the region.

The factors influencing the immunization process and contributing to the decline in vaccination rates were organized into specific thematic categories. Demographic and socioeconomic determinants emerged as the main theme, followed by knowledge and attitudes, with a focus on individual or caregiver factors, and, finally, items related to access to health services.

To better visualize and compare the presence of these factors across socioeconomic contexts, Figures 4 and 5 were developed, categorizing the causes of declining vaccination coverage by the countries explicitly mentioned in the reviewed studies.

Table 2: Factors identified in national and international studies as related to low vaccination coverage in various geographic and income contexts. Belo Horizonte, MG, Brazil, 2024.

Cause Category	Cause Subcategory	Presence in Medium-/High-Income Contexts (Country/reference of studies)[e]	Presence in Low-/Middle-Income Contexts (Country/reference of studies)
Demographic and Socioeconomic Issues	Low income/unemployment	Gabon[18]; Brazil[23,25,29]; USA[24,30,36]; Australia[28,33]; Japan[31]	Ethiopia[7,12]; Somaliland (Somalia)[8]; Sub-Saharan Africa[10,19]; India[11,13,15,20,22]; Pakistan[14]; Burkina Faso[16]; Kenya[17]; Sierra Leone[21]; Indonesia[34]; Nigeria[35]; Bangladesh[37]
	Low schooling	Brazil[25]; Turkey[26]; USA[30,55]; China[46-48]; Greece[50]; Peru[53]; Norway[54]; Japan[56]	Ethiopia [7,12,19,42-44]; Kenya[17]; Benin[10]; Afghanistan[45]; Bangladesh[37]; India[11,13,15]; Indonesia[34]; Hungary[49]; Myanmar[51]; Iran[52]
	High schooling	China[41,48;]	Nigeria[40]; Costa Rica[57]
	Gender (lower male participation)	Hungary[44]; Norway[54]; USA[30]; Japan[31]; Italy[58]	Ethiopia[42]
	Large families/young mothers	Brazil[25]; Australia[28] ; China[48]; Greece[50]; Peru[53]	India[11]; Myanmar [51]; Ethiopia [62]; Gana[63]; Sierra Leone[64]
	Ethnicity/religion	USA[24,30,33,36,55,69]; Brazil[25]; China[48]; Serbia[68]; Antigua and Barbuda[66]	Somaliland[8]; India[11,20]; Sierra Leone[64]; Ethiopia[67]; Gambia[70]
	Location (rural/urban -with different challenges in each context)	USA[55,74]	Ethiopia[7]; Benin[10]; Indonesia[34]; Hungary[44], India[11]; Sub-Saharan Africa[19]; Nigeria[40]; Gana[63]

Notes: [e]For comparative analysis purposes, countries were classified by income level according to World Bank criteria. (World Bank, 2023). As a result, China was considered an upper-middle-income country.

Figure 4: Factors identified in national and international studies associated to Demographic and socioeconomic issues as related to low vaccination coverage in various geographic and income contexts. Belo Horizonte, MG, Brazil, 2024.

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Cause Category	Cause Subcategory	Presence in Medium-/High-Income Contexts (Country/reference of studies)[e]	Presence in Low-/Middle-Income Contexts (Country/reference of studies)
Knowledge and Attitudes	Lack of knowledge about vaccines/diseases	Brazil[29,85]; China[48]; Japan[56]; Antigua and Barbuda[66]; Serbia[68]; France[77]; South Africa[81]; Thailand[82]	Somaliland [8]; Kenya[17]; Sierra Leone[21]; Nigeria[35]; Ethiopia[42-43,62,67,78]; Afghanistan[45]; India[79,80]; Cameroon[83]; Malawi[84]; Pakistan[86]
	Distrust in vaccine safety/side effects/previous illness/risks outweighing benefits	Brazil[25,85,93,109]; China[46,48,88,90,97]; Antigua and Barbuda[67]; Serbia[68]; USA[69,89]; France[77]; Thailand[82]; Japan[91]; Spain[92]	Sierra Leone[21]; Iran[52]; India[80,87,96,110]; Pakistan[86]; Ethiopia[94]
	Vaccine hesitancy (postponement, forgetfulness, complacency)	Italy[58]; Antigua and Barbuda[66]; South Africa[81,101]; USA[89,100]; Australia[98]; China[99]	India[13,79]; Burkina Faso[16]; Sierra Leone[21]; Iran[52]
	Unawareness of the age for vaccination or vaccination status	China[99];	Ethiopia[67,108]; Cameroon[83]
	Individual issues (smoking, alcoholism, sedentary lifestyle, chronic diseases, lack of time)	Australia[28,33]; China[47]; Italy[58]; Japan[91]; Spain[92]; Brazil[93]; Canada[102]; USA[103,105]	Malawi[84]; Uganda[104]; Somalia[107]; Sudan[107]
Access to Health Services	Deficit in pre/postnatal care/home birth	Brazil[1,29]; Australia[28]; Peru[53]; Norway[54]; USA[55]; Japan[56]; Italy[58]; Germany[60]	Ethiopia[7,42-43,62,67,78,108]; Sub-Saharan Africa[10]; India[11,13,19]; Myanmar[51]; Costa Rica[57]; Gana[63]; Sierra Leone[64]; Indonesia[112]; Senegal[113]; Nigeria[114]; Gana[115]
	Lack of continuous professional monitoring and scarcity of home visits	Japan[31]; China[47]; Peru[53]; Canada[102]; USA[103]; Brazil[109,116]	-
	Lack of adequate guidance from a professional	Brazil[29,93]; Japan[31]; Serbia[68]; Australia[98]; USA[100]; Slovenia[117]	Costa Rica[57]; India[87]
	Geographic distance to health facilities	Brazil[85]; China[90,118]	Somaliland (Somalia)[8]; Ethiopia[12,43]; Sierra Leone[64]; Liberia[64]; Guinea[64]; Malawi[84]; Uganda[104]; Senegal[113]; Papua New Guinea[119]; Malawi[120]
	Incompatibility of health facility operating hours	China[90,118]	Ethiopia[12]; Sierra Leone[21]; Afghanistan[45]; Cameroon[83]; Senegal[113]; Malawi[121]
	Lack of vaccine availability: lack of free access/cost/lack of vaccination facilities	South Africa[81]; Japan[91]; China[99]; USA[121,122]; Spain[123]	Ethiopia[12,108]; Uganda[104]; Somalia[106]; Vietnam[124], Indonesia[125]

Notes: [e]For comparative analysis purposes, countries were classified by income level according to World Bank criteria. (World Bank, 2023). As a result, China was considered an upper-middle-income country.

Figure 5: Factors identified in national and international studies as associated to Knowledge and attitudes, and Access to health services, related to low vaccination coverage in various geographic and income contexts. Belo Horizonte, MG, Brazil, 2024.

DISCUSSION

The findings of this review highlight the predominance of cross-sectional studies, reflecting an approach focused on capturing snapshots of vaccination-related conditions and challenges in different global contexts. The concentration of research on vaccines such as the pentavalent and influenza vaccines indicates a priority in investigating immunobiologicals that are critical to public health. The uneven geographical distribution of publications highlights a significant gap in vulnerable regions, such as Latin America and parts of Africa and Asia.

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Furthermore, low vaccination rates result from a complex interplay of structural and behavioral factors, including socioeconomic and demographic conditions, caregiver knowledge gaps, and barriers to accessing health services. This problem manifests across various geographical contexts, regardless of income levels, indicating that vaccination coverage is influenced by a range of factors operating at different levels, from socioeconomic and demographic characteristics to individual attitudes and access to health services, thereby requiring integrated interventions adapted to local contexts. The discussion is presented below according to the identified thematic categories.

Demographic and socioeconomic issues

Belonging to lower social strata has been identified in most studies as a factor reducing adherence to vaccination, regardless of the countries where the studies were conducted. This finding was found in both low- and middle-income countries as well as in those with medium- to high-income levels[7-34]. Caregiver unemployment was also identified as an important factor associated with low vaccination rates[14,18,29,35-37].

A study conducted in Ethiopia, based on a demographic survey, found that the probability of receiving all doses of the pneumococcal conjugate vaccine increased with the family wealth index[7]. Similarly, but in a different socioeconomic context, another study in the United States concluded that the lower the income level, the lower the chance of receiving the influenza vaccine[27]. It has been suggested that access to various forms of media, often available to families with greater purchasing power, facilitates awareness of essential vaccines, thereby increasing the likelihood of immunization[38].

On the other hand, unlike traditional media, social networks allow individuals to quickly create and share content worldwide without editorial oversight, thereby enabling the spread of misinformation. Users can select content according to their preferences, which can lead to ideological isolation. This raises public health concerns, especially due to anti-vaccination messages disseminated on these platforms, which can lead to vaccine hesitancy and undermine public confidence in the development of future vaccines for new pathogens[39].

Conversely, one study found that in rural Nigeria, residents with better financial conditions had lower first-dose immunization rates for the diphtheria, tetanus, and pertussis vaccines. The same study added that improvements in educational and income levels among the urban population also worsened vaccination rates among Nigerians. Similarly, research in China found that, although vaccine efficacy was the most important factor for respondents, parents with higher education and income were less likely to adhere to immunization[41].

Factors linked to low levels of education among caregivers were identified as negative influences. Regardless of the countries of origin of the studies, low levels of education were associated with poor vaccination adherence in both low-income countries, such as Ethiopia[7,12,19,42-44], Kenya[17] and Benin[10], as well as in middle-income countries such as Pakistan[45], Bangladesh[37], India[11,13,15], Indonesia[34] and in middle- and high-income countries such as China[47-48], Brazil[25], Hungary[49], Turkey[26], Greece[50], Myanmar[51], Iran[52], and Peru[53], in addition to high-income countries such as Norway[54], USA[30,55], and Japan[56]. On the other hand, four studies reported a relationship between high levels of education and low vaccination coverage in China[41,48], Nigeria[40], and Costa Rica[57]. It should be noted that the relationship between education, income, and vaccination coverage is complex and multifaceted, present in countries with different levels of socioeconomic development.

Lower adherence to immunization was more frequent among males, regardless of age, and was observed in children[42], adults[49,54], and the elderly[30,31], in addition to male caregivers[58]. This trend highlights a gender bias in adherence to vaccination practices, whereby men, across various age groups and as caregivers, show a lower propensity for immunization and self-care. This may reflect cultural attitudes, perceptions of invulnerability, or a lower priority given to preventive health among men[59].

Conversely, a hospital-based survey conducted in India assessed vaccination status by analyzing vaccination cards or contacting parents by phone. The results showed a significant association, indicating that girls were 52.7% more likely to have incomplete immunization than boys (female AOR=1.527, CI(95%)=1.296–1.938)[13].

Vaccination rates were negatively influenced by factors such as large family sizes[11,20,25,48,53,60,61] and younger mothers[11,28,50,62-64]. This is because these families may face economic, logistical, and experiential challenges that hinder adherence to vaccination schedules[61].

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Similarly, younger parents, especially mothers, may have less experience, fewer resources, or less social support, which can affect their ability to ensure that their children receive all recommended vaccinations[65].

Ethnicity and religious beliefs were also significant barriers to achieving high vaccination rates. Belonging to non-Christian religions[8,11,20,25,64], being persuasively influenced by religious practice[66,67], and attachment to religious values[68], in addition to the discomfort of discussing topics related to sex, as in the case of the HPV vaccine[24,36], were factors that contributed to low vaccination coverage. In the United States, factors such as being Hispanic[30,55,69] or Black[30,33,69], as well as belonging to ethnic minorities[48,70], were often associated with lower adherence to the vaccination process.

Religious influence can create substantial barriers by giving rise to conflicts between religious practices and public health recommendations[71,72]. Additionally, ethnic and racial issues seem to highlight systemic inequalities that go beyond economic and educational barriers, also reflecting structural discrimination and unequal access to health services[72,73].

Living in rural[7,10,34,44,74] or urban areas[11,19,40,55,63] also contributed to the decline in vaccination coverage, suggesting common barriers, such as reduced access to health services, greater distances to vaccination sites, and reduced availability of information[10]. In urban areas, despite closer proximity to health services, other factors, such as misinformation and the influence of anti-vaccine movements, may play a significant role[75].

The complexity of socioeconomic factors influences vaccine acceptance. Despite having one of the largest public health programs in the world, Brazil still faces these disparities[76].

Knowledge and attitudes: individual or caregiver factors

It should be noted that caregivers' poor understanding of immunizations was identified as a factor contributing to the decline in vaccination rates in a significant number of articles[8,17,21,29,35,42,43,48,56,62,66-68,77-85]. In addition, a lack of knowledge about diseases that can be prevented by the respective vaccines was also reported[17,45,56,68]. One study highlighted that healthcare professionals' lack of knowledge about the disease may negatively affect vaccination uptake among those responsible for referring children for this procedure[86]. Attitudes related to lack of confidence in vaccine safety were frequently mentioned[46,52,68,69,77,85,87-91]. Fear of contracting the disease targeted by vaccination or experiencing side effects was also reported as a factor that caused low adherence to immunization[21,25,45,52,69,80,87,92-94].

These factors not only compromise the effectiveness of vaccination campaigns but also expose flaws in health education. Furthermore, the lack of trust in this process reflects a broader problem of mistrust in health institutions and science[75].

Child illness was identified as a reason for caregivers failing to attend vaccination appointments[48,66,95-97]. Situations that led to vaccine hesitancy were also cited[13,16,21,52,58,61,66,79,81,89,98-101] and included delaying the procedure, caregiver forgetfulness, delays in health-seeking behavior, missed opportunities, and greater complacency.

The frequent mention of practices that lead to vaccine hesitancy demonstrates the psychosocial complexity underlying caregivers' decisions. This hesitation is often rooted in concerns about the safety, efficacy, and possible side effects of vaccines,[72] highlighting the importance of addressing these issues in an empathetic and informative manner to build trust in the vaccination process. News disseminated without adequate scientific scrutiny, especially about possible side effects, plays a key role in the lack of trust in vaccines.

Individual habits, such as smoking[28,32,47,92,102], alcoholism[32], lack of physical activity[47,103], and high body mass index[28,33], were identified as factors that negatively impacted the vaccination process. Preferences for natural methods of protection were also reported[93,104]. These negative factors for vaccination uptake suggest an interconnection between lifestyle and preventive health[75]. Therefore, the preference for natural approaches reinforces the need for educational strategies that promote a scientific understanding of immunization, using communication methods appropriate to this population.

Having chronic diseases[28,91,105] and reporting lack of time as a justification[84,95,107] were additional factors that hindered vaccination uptake. Furthermore, seeking information from unreliable sources that did not recommend immunization was also cited[58,107].

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The lack of electronic devices at home[37] and limited knowledge of the appropriate age for immunizing children[67,83,108] were cited as reasons for their limited knowledge of vaccination. Pregnant women also reported a lack of knowledge about their own vaccination status[99]. Some caregivers believed that the risks of vaccination outweighed the benefits[82,109] and perceived that the immunity conferred by vaccines would last less than a year[110].

The absence of electronic devices in the household reveals a digital divide that may limit families' access to relevant and reliable information about vaccination.

Access to health services

A considerable number of studies have pointed to the lack of maternity care as a crucial barrier. This lack includes a low number of prenatal and postnatal consultations[1,10,11,19,28,29,42,51,53-64,67,108-113] and the practice of home births[7,10,11,13,42,43,64,78,108,112,114,115]. The lack of ongoing professional support[47,102,103,117] and the scarcity of home visits by health professionals[31,53,109] were mentioned as factors that reduce adherence to the vaccination process.

These results highlight the need for improvements in perinatal care, especially in regions where vaccination adherence is compromised. The lack of prenatal and postnatal consultations, as well as the practice of home births, reflects failures in the provision of maternal and child health services. In addition, the scarcity of continuous professional monitoring and home visits underscores deficiencies in the health system that require attention.

The lack of adequate guidance from health professionals was highlighted as a significant factor that negatively impacts vaccination adherence[29,31,57,68,87,93,98,100,117]. These studies have shown that the lack of clear and consistent information about the importance of vaccines contributes to vaccine hesitancy and low vaccination coverage. It is essential that health professionals are well informed and trained to provide clear and consistent guidance to increase public confidence in vaccines.

Geographical distance to health facilities was repeatedly cited as a barrier to vaccination in countries with diverse economic conditions, including Nigeria, Ethiopia, Senegal, Uganda, Sierra Leone, Liberia, Guinea, Papua New Guinea, China, Malawi, India, and Brazil[8,12,43,64,84,85,90,104,113,118-120]. It is clear that long distances make it difficult for many families to reach vaccination sites, especially in rural areas, where transportation infrastructure is often inadequate.

The incompatibility of health facility opening hours with caregivers' needs was also cited as a significant barrier[12,21,45,83,90,113,118,121]. Healthcare facilities with restricted hours or that do not operate at times convenient for families make vaccination access difficult.

Limited vaccine availability has been identified as a serious problem affecting access. This includes both the costs of purchasing vaccines in cases where services are not free of charge[s91,106,113-122] regarding the shortage of vaccination sites and the low supply of vaccines[12,81,99,104,107,108,124,125]. Interruptions in vaccine supply can discourage families from seeking immunization, thereby reducing vaccination coverage.

An integrative review concluded that it is necessary to quantify these phenomena and to understand their effects on populations across nations, particularly in countries with universal health systems[126].

Study limitations

This review has some limitations that should be considered when interpreting the findings. First, the geographic concentration of the included studies, predominantly conducted in North America, Asia, and Africa (particularly the US, China, and Ethiopia), limits the generalization of the results to underrepresented regions, such as Latin America. Although Brazil was included, the scarcity of research from other Latin American countries or vulnerable regions, such as parts of Africa and Asia, in the selected databases may underestimate the diversity of factors in specific contexts. In addition, methodological heterogeneity among studies, including different designs (with a predominance of almost 80% of cross-sectional studies), populations, and analytical strategies, made direct comparisons difficult and may have introduced selection and publication biases, as well as prevented the establishment of causal relationships between factors and vaccination coverage.

CONCLUSION

For health managers and policymakers, the findings reinforce the importance of integrated and holistic interventions that are sensitive to the sociocultural context and capable of addressing socioeconomic inequalities and access barriers. Policies should consider the complex interconnection of demographic factors (such as income

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and education), barriers to access, and knowledge gaps, with a focus on equity and promoting universal access to vaccination.

Despite the limitations of this study, the results make important contributions to practice and the formulation of public health policies. In nursing, nurses' strategic role in health education is critical for mitigating misinformation and combating vaccine hesitancy, thereby strengthening public confidence in immunization. It is essential that nursing strategies focus on strengthening the connection between primary care teams and the population, actively reaching vulnerable groups and reducing barriers to access (such as distance and health facility operating hours) to improve work processes and expand vaccination coverage.

Finally, for the future research agenda, multicenter, longitudinal studies should be conducted in underrepresented countries, particularly in Latin America and other vulnerable regions. Such studies, employing robust methodologies, would enable more consistent comparisons across contexts and the establishment of causal relationships. Qualitative and mixed-methods investigations are also essential for deepening understanding of individual and collective barriers to immunization, including perceptions of vaccine safety and side effects, thereby supporting the development of more effective and equitable public policies. In addition, future reviews and research should include databases and literature sources that may include studies from currently underrepresented regions, thereby ensuring a more comprehensive and global view of the topic.

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Authors contributions

Conceptualization, G.L.F. and L.S.S.; methodology, G.L.F. and L.S.S.; validation, G.L.F.; formal analysis, G.L.F. and L.S.S.; investigation, G.L.F. and L.S.S.; manuscript writing, G.L.F.; review and editing, G.L.F. and L.S.S.; visualization, G.L.F. and L.S.S.; supervision, G.L.F. and L.S.S.; project administration, G.L.F. and L.S.S. All authors read and agreed with the published version of the manuscript.

Use of artificial intelligence tools

Authors declare that no artificial intelligence tools were used in the composition of the manuscript "*Immunization and geographic contexts: a review of factors contributing to low vaccination*".