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Research Article

The application of the Modified Checklist for Autism in Toddlers in Primary Health Care and its importance for early screening of autism spectrum disorder

A aplicação do *Modified Checklist for Autism in Toddlers* na Atenção Primária à Saúde e sua importância para o rastreamento precoce no transtorno do espectro autista

La aplicación del Modified Checklist for Autism in Toddlers en la Atención Primaria de Salud y su importancia para el tamizaje temprano del trastorno del espectro autista

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Abstract

Introduction: Autism Spectrum Disorder (ASD) is a major public health issue, and its early detection facilitates timely interventions and better monitoring of child development. Primary Health Care (PHC) plays a strategic role in screening, and the adoption of standardized instruments, such as the Modified Checklist for Autism in Toddlers, Revised with Follow-Up (M-CHAT-R/F), is supported by Brazilian child care policies within the Unified Health System (*Sistema Único de Saúde* – SUS). **Objective:** To analyze the available evidence on the use of the M-CHAT and its versions in PHC for early screening of ASD, identifying strengths and barriers related to its implementation. **Methods:** This is an integrative literature review, conducted based on a research question structured using the PICO strategy: "What is the evidence on the use of the M-CHAT in Primary Health Care for early screening of ASD?" The search was conducted in PubMed, the Virtual Health Library (VHL/BVS), and Google Scholar. Primary studies published between 2015 and 2025, in Portuguese, English, and Spanish, that investigated the use of the M-CHAT in primary health care services or similar care settings, were included. After applying the eligibility criteria, 12 studies were selected for analysis. **Results:** The analyzed studies indicated that the M-CHAT and its versions are viable, low-cost instruments with adequate performance for early ASD screening in health services. The use of a follow-up interview proved important for reducing false-positive results, as well as conducting screenings at different stages of child development and training the professionals involved. However, barriers to its implementation were identified, such as service overload, limited knowledge among professionals regarding the instrument, and weaknesses in the integration between screening and referral processes for specialized diagnostic evaluation. **Conclusions:** The M-CHAT shows potential as a supportive tool for early ASD screening in Primary Health Care, facilitating the identification of at-risk children and timely referral for specialized evaluation. However, its implementation in the Unified Health System depends on educational strategies, the organization of work processes, and strengthening the pathways between screening, diagnosis, and intervention. The limited national scientific literature on its implementation and acceptability within the Brazilian PHC context highlights the need for further studies—especially longitudinal and intervention research—to contribute to the improvement of ASD screening strategies.

Keywords: Primary health care; Early diagnosis; Mass screening; Autism Spectrum Disorder.

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Resumo

Introdução: O Transtorno do Espectro Autista (TEA) representa um importante problema de saúde pública, e sua detecção precoce favorece intervenções oportunas e melhor acompanhamento do desenvolvimento infantil. A Atenção Primária à Saúde (APS) possui papel estratégico no rastreamento, e a adoção de instrumentos padronizados, como o *Modified Checklist for Autism in Toddlers, Revised with Follow-Up* (M-CHAT-R/F), é fortalecida pelas políticas brasileiras de atenção à infância no Sistema Único de Saúde (SUS). **Objetivo:** Analisar as evidências disponíveis sobre a aplicação do M-CHAT e suas versões na APS para o rastreamento precoce do TEA, identificando potencialidades e barreiras relacionadas à sua implementação. **Métodos:** Trata-se de uma revisão integrativa da literatura, conduzida a partir de uma questão de pesquisa estruturada com auxílio da estratégia PICO: "Quais são as evidências sobre a aplicação do M-CHAT na Atenção Primária à Saúde para o rastreamento precoce do TEA?". A busca foi realizada nas bases PubMed, Biblioteca Virtual em Saúde (BVS) e Google Acadêmico. Foram incluídos estudos primários publicados entre 2015 e 2025, nos idiomas português, inglês e espanhol, que investigaram a utilização do M-CHAT em serviços de Atenção Primária à Saúde ou contextos assistenciais semelhantes. Após a aplicação dos critérios de elegibilidade, 12 estudos foram selecionados para análise. **Resultados:** Os estudos analisados indicaram que o M-CHAT e suas versões são instrumentos viáveis, de baixo custo e com desempenho adequado para o rastreamento precoce do TEA em serviços de saúde. A aplicação da entrevista de acompanhamento demonstrou importância para a redução de resultados falso-positivos, assim como a realização de triagens em diferentes momentos do desenvolvimento infantil e a capacitação dos profissionais envolvidos. Entretanto, foram identificadas barreiras para sua implementação, como sobrecarga dos serviços, conhecimento limitado dos profissionais sobre o instrumento e fragilidades na integração entre o rastreamento e os fluxos de encaminhamento para avaliação diagnóstica especializada. **Conclusões:** O M-CHAT apresenta potencial como ferramenta de apoio ao rastreamento precoce do TEA na Atenção Primária à Saúde, favorecendo a identificação de crianças em risco e o encaminhamento oportuno para avaliação especializada. Entretanto, sua implementação no Sistema Único de Saúde depende de estratégias educativas, organização dos processos de trabalho e fortalecimento dos fluxos entre rastreamento, diagnóstico e intervenção. A limitada produção científica nacional sobre sua implementação e aceitabilidade no contexto da APS brasileira evidencia a necessidade de novos estudos, especialmente pesquisas longitudinais e de intervenção, que contribuam para o aprimoramento das estratégias de rastreamento do TEA.

Palavras-chave: Atenção primária à saúde; Diagnóstico precoce; Programas de rastreamento; Transtorno do espectro autista.

Resumen

Introducción: El Trastorno del Espectro Autista (TEA) representa un importante problema de salud pública, y su detección temprana favorece intervenciones oportunas y un mejor seguimiento del desarrollo infantil. La Atención Primaria de Salud (APS) posee un rol estratégico en el tamizaje, y la adopción de instrumentos estandarizados, como el *Modified Checklist for Autism in Toddlers, Revised with Follow-Up* (M-CHAT-R/F), se ve favorecida por las políticas brasileñas de atención a la infancia en el Sistema Único de Salud (SUS). **Objetivo:** Analizar las evidencias disponibles sobre la aplicación del M-CHAT y sus versiones en la APS para el tamizaje temprano del TEA, identificando potencialidades y barreras relacionadas con su implementación. **Métodos:** Se trata de una revisión integrativa de la literatura, realizada a partir de una pregunta de investigación estructurada con el apoyo de la estrategia PICO: "¿Cuáles son las evidencias sobre la aplicación del M-CHAT en la Atención Primaria de Salud para el tamizaje temprano del TEA?". La búsqueda se realizó en las bases de datos PubMed, Biblioteca Virtual en Salud (BVS) y Google Académico. Se incluyeron estudios primarios publicados entre 2015 y 2025, en los idiomas portugués, inglés y español, que investigaron la utilización del M-CHAT en servicios de Atención Primaria de Salud o contextos asistenciales similares. Tras la aplicación de los criterios de elegibilidad, se seleccionaron 12 estudios para el análisis. **Resultados:** Los estudios analizados indicaron que el M-CHAT y sus versiones son instrumentos viables, de bajo costo y con un desempeño adecuado para el tamizaje temprano del TEA en los servicios de salud. La aplicación de la entrevista de seguimiento resultó importante para reducir los resultados falsos positivos, al igual que la realización de tamizajes en diferentes momentos del desarrollo infantil y la capacitación de los profesionales involucrados. Sin embargo, se identificaron barreras para su implementación, como la sobrecarga de los servicios, el conocimiento limitado de los profesionales sobre el instrumento y las debilidades en la integración entre el tamizaje y los flujos de derivación para la evaluación diagnóstica especializada. **Conclusiones:** El M-CHAT presenta potencial como herramienta de apoyo al tamizaje temprano del TEA en la APS, favoreciendo la identificación de niños en riesgo y la derivación oportuna para una evaluación especializada. No obstante, su implementación en el SUS depende de estrategias educativas, la organización de los procesos de trabajo y el fortalecimiento de los flujos entre el tamizaje, el diagnóstico y la intervención. La limitada producción científica nacional sobre su implementación y aceptabilidad en el contexto de la APS brasileña evidencia la necesidad de nuevos estudios, especialmente investigaciones longitudinales y de intervención, que contribuyan al perfeccionamiento de las estrategias de tamizaje del TEA.

Palabras clave: Atención primaria de salud; Diagnóstico precoz; Tamizaje masivo; Trastorno del espectro autista.

INTRODUCTION

Autism Spectrum Disorder (ASD) is considered a neurodevelopmental disorder characterized by impairments in communication, along with repetitive and stereotyped behaviors, difficulties in social interaction, lack of joint attention, interests restricted to specific activities, and hypo- or hypersensitivity to sensory stimuli.[1,2]

ASD has a complex, multifactorial etiology involving the interaction of genetic, neurobiological, and environmental factors, which defines it as a heterogeneous condition with diverse clinical and behavioral manifestations.[2] Scientific evidence indicates that the initial manifestations of ASD emerge in the early years of childhood development. However, its clinical variability and heterogeneous early course make early identification difficult.[3]

The 2022 Demographic Census, conducted by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE), identified approximately 2.4 million people diagnosed with ASD in Brazil, corresponding to 1.2% of the national population.[4] This situation underscores the importance of early screening and diagnosis of the disorder in the healthcare process and in the comprehensive care of children. This process should be conducted primarily through clinical evaluation, based on the observation of behavioral signs and interviews with caregivers, supported by the use of validated screening tools.[1]

Thus, with the aim of ensuring the early detection of risks to children's psychological development, Law No. 13.438/17[5] was enacted, amending Article 14 of the Statute of the Child and Adolescent (*Estatuto da Criança e do Adolescente* – ECA). The law mandates the use of screening tools during pediatric care visits in the Brazilian Unified Health System (*Sistema Único de Saúde* – SUS). This measure aims to ensure appropriate interventions and the early identification of developmental disorders.[5]

Consequently, in 2022, the Ministry of Health included the *Modified Checklist for Autism in Toddlers – Revised with Follow-Up* (M-CHAT-R/F) in the third edition of the Child Health Record, with the goal of promoting early screening for ASD, particularly in Primary Health Care (PHC).[1]

The M-CHAT was developed as a standardized screening tool for children aged 16 to 30 months, designed to identify early signs suggestive of ASD through a 23-item questionnaire completed by caregivers. Subsequently, the instrument underwent revisions, resulting in the M-CHAT-R (*Revised*), a version that reduced the number of items to 20, with the aim of improving the clarity of the questions and parents' understanding, as well as simplifying the scoring process.[6,7]

The M-CHAT-R/F, published by Robins et al. in 2014, is the most recent version validated by the American Academy of Pediatrics (AAP) and is currently the most widely used format in research and clinical screening. This adaptation retained the revised structure but incorporated a second phase. Thus, one point is assigned to each item in the initial questionnaire, and on this basis, children are classified into three risk categories. Children who achieve a moderate risk score (between 3 and 7 points) should undergo a step called the follow-up interview.[7,8]

This procedure aims to minimize the occurrence of false positives by clarifying the responses provided by caregivers. A high likelihood of ASD is indicated when the initial score is 8 or higher, or when the score obtained during the follow-up stage is 2 or higher.[9]

The AAP guidelines recommend that children with a positive screening result be referred simultaneously to comprehensive diagnostic and audiological evaluation services, as well as to early intervention services.[10] Children in the low-risk category (initial score below 3) do not require a follow-up interview or additional evaluation, except when clinical monitoring indicates signs suggestive of ASD risk. In such cases, it is recommended to repeat the test at 24 months of age if the child is under two years old.[7]

In this regard, given the importance of early screening for ASD and the strategic role of PHC in this process, this study aimed to analyze the available evidence on the use of the M-CHAT instrument and its versions in PHC and to discuss its applicability and importance for screening the disorder. The choice of this topic is justified by the observation that, although there are systematic reviews addressing the use of

the M-CHAT in various contexts — such as purely psychometric studies or private and institutional settings — there is a lack of studies of this type focused on its application in the PHC setting.

METHODS

Study design

This study is an integrative literature review. This design was chosen because it allows for the synthesis and integration of different types of scientific evidence regarding the application of M-CHAT in the primary care setting, with a focus on its contribution to the early screening of ASD.

The choice of an integrative review is justified by the need to gather and critically analyze the available knowledge on the use of the M-CHAT in primary health care. Although previous reviews have addressed the instrument — particularly regarding its psychometric properties, diagnostic validity, and performance in specific populations—there has been less focus on its use in PHC settings and on the role of health professionals responsible for the screening process. Thus, this review aims to fill this gap by synthesizing the available evidence on the application of the M-CHAT in this care setting.

Accordingly, the study was conducted in accordance with the steps proposed for the preparation of integrative literature reviews,[11] including the identification of the topic and formulation of the research question; establishment of inclusion and exclusion criteria; search for and selection of studies; data extraction and organization; evaluation of the evidence; interpretation of the results; and presentation of a synthesis of the knowledge generated.

Identification of the topic and selection of the hypothesis or research question

At this stage, the guiding research question that directed the conduct of the integrative review was formulated. To structure it, the Population, Intervention, Comparison, and Outcome (PICO) strategy was adopted, a tool widely used in formulating research questions, organizing investigative elements, and designing search strategies in the scientific literature[11]. The research question structured according to the components of the PICO strategy is presented in Table 1.

Table 1. Organization of the Population, Intervention, Comparison, and Outcome (PICO) framework.

PICO Element	Definition in the review
P (Population)	Children aged 16 to 30 months who receive primary health care and undergo early screening for ASD, and/or health professionals involved in administering the M-CHAT and its versions.
I (Intervention)	Use of the M-CHAT and its versions (M-CHAT-R, M-CHAT/F, and M-CHAT-R/F) as tools for early screening of ASD.
C (Comparison)	Not applicable, as it is not compatible with the objective of this review.
O (Outcome)	Evidence related to implementation, applicability, feasibility, acceptability, diagnostic performance, early identification of ASD, and referrals for specialized evaluation in the context of primary health care.

PICO: Population, Intervention, Comparison, and Outcome; ASD: Autism Spectrum Disorder; M-CHAT: Modified Checklist for Autism in Toddlers; M-CHAT-R/F: Modified Checklist for Autism in Toddlers, Revised with Follow-Up.

Based on this strategy, the following guiding question was formulated: *"What evidence is available in the literature regarding the use of the M-CHAT and its versions for the early screening of Autism Spectrum Disorder in Primary Health Care?"*

Sampling or literature search

This stage involved conducting a systematic search of databases to select the studies included in this review. Inclusion and exclusion criteria for the selected information were defined in advance.[11]

The inclusion criteria were studies conducted in PHC or similar settings, published between 2015 and 2025, in Portuguese, English, or Spanish. We included observational studies on the use of the M-CHAT and its variations; case studies and experience reports describing the application of these instruments in health services; qualitative studies analyzing the perceptions of health professionals and family members regarding the tool; and intervention studies evaluating the effectiveness of training or implementation of the M-CHAT and its variations in PHC and similar settings. International studies from countries with primary care systems similar to Brazil's were also included.

Additionally, studies applying the M-CHAT instrument and its variations to children preferably in the 16- to 30-month age range were considered, although studies involving children slightly outside this age range were included when they contributed relevant data on early screening in PHC.

Exclusion criteria included studies unrelated to the topic, duplicate studies, systematic and integrative reviews, exclusively psychometric studies, and those that did not address early screening for ASD.

The search for articles was conducted in the National Library of Medicine (PubMed), the Virtual Health Library (VHL), and Google Scholar, the latter used to expand the identification of gray literature. The search was conducted between October 2024 and March 2025.

The search strategy was the same for all databases. Only operational adjustments to syntax and formatting were made to accommodate the specific requirements of each database, such as the use of quotation marks for compound terms and formatting adjustments to subject headings when necessary, without altering the terms or Boolean operators used.

Controlled descriptors (DeCS and MeSH) and free-text terms were used, including "Autism Spectrum Disorder," "Primary Health Care," "Screening," "Triage," and "M-CHAT," the latter of which was considered a free-text term. The subject headings were combined using the Boolean operators AND and OR, resulting in the following search strategy: ((“Transtorno do Espectro Autista” AND “M-CHAT” AND (“Triagem” OR “Rastreamento”) AND “Atenção Primária à Saúde) OR (“Autism Spectrum Disorder” AND “M-CHAT” AND (“Mass Screening” OR “Screening”) AND “Primary Health Care”)).

Two researchers independently selected the studies at all stages of the screening process. In cases of disagreement regarding study eligibility, the discrepancies were discussed between the reviewers until consensus was reached.[11]

Data extraction or categorization

After selecting the included articles, the data extracted from each study were organized and synthesized. These data were systematized in a database to facilitate the analysis and interpretation of the findings. The process of identifying, screening, assessing eligibility, and including studies was presented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram, as illustrated in Figure 1.[11]

A total of 76 articles were identified through database searches. After applying the filters, 62 articles were eligible for title and abstract screening. At this stage, 36 articles were excluded for failing to meet the eligibility criteria, and 2 were removed due to duplication, leaving 24 articles for full-text review.

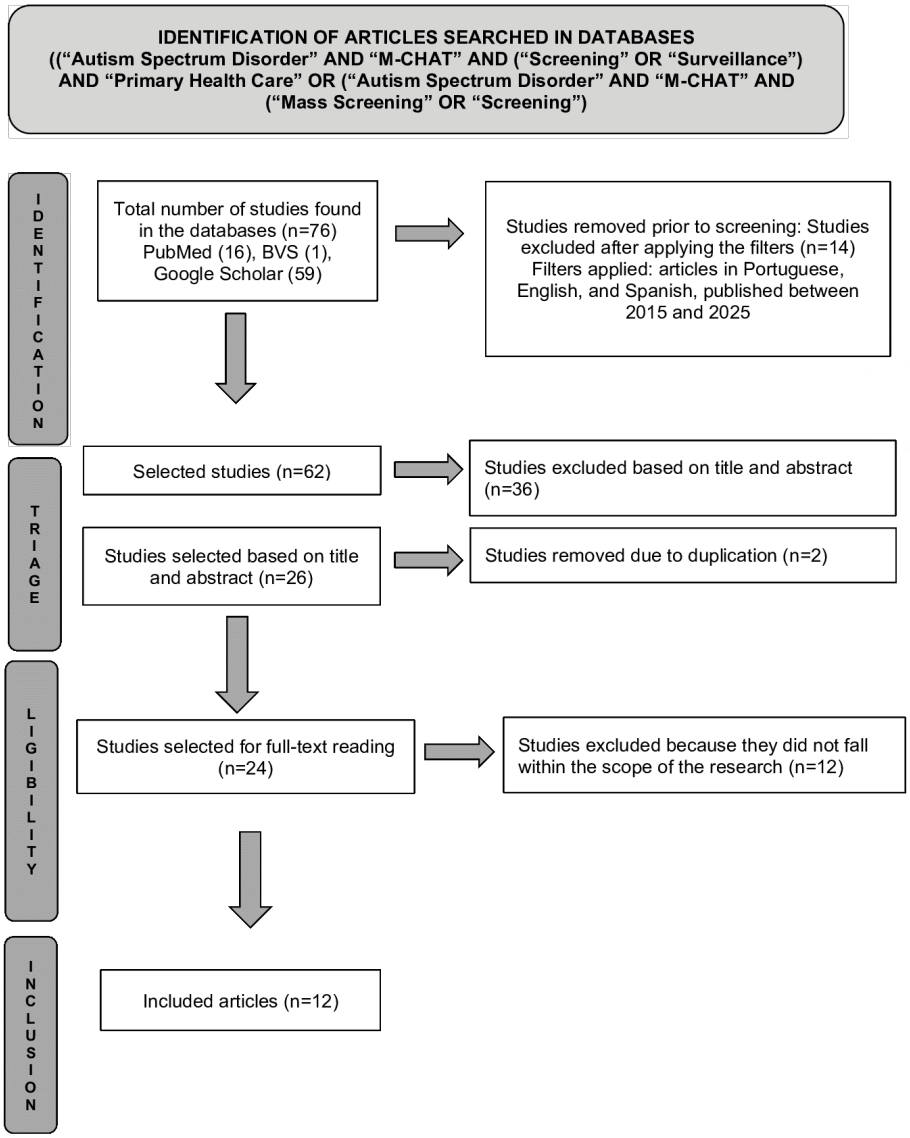


Figure 1. Methodological strategy for the selection of articles included in the PRISMA flow diagram within the context of the literature review process.

The 24 articles were evaluated in full text based on the inclusion and exclusion criteria. Of these, seven were excluded due to the study design, two because they addressed other screening tools and/or algorithms for ASD screening, two because they did not focus on early screening data, despite using the M-CHAT as a tool, and one because it focused on the influence of the COVID-19 pandemic on adherence to and frequency of M-CHAT use, which fell outside the scope of this study. Ultimately, 12 articles were included in the review.

RESULTS

Twelve studies were included in this review. Considerable heterogeneity was observed among the studies; therefore, the results were organized into analytical themes to facilitate the understanding and synthesis of the findings.

First, regarding geographic distribution, a predominance of studies from North America was identified, followed by South America, Asia, and Africa. Regarding the application settings, the studies were grouped into three categories: general primary care (50% of the studies), pediatric primary care, and other healthcare settings, including non-governmental health systems and maternal and child health services, which together accounted for the remaining 50%.

Regarding the instrument used, the studies were classified according to the version of the M-CHAT employed: original M-CHAT (6 studies), M-CHAT-R (1 study), M-CHAT/F (2 studies), and M-CHAT-R/F (3 studies), highlighting methodological variation among the studies. This heterogeneity reflects different approaches to implementing and validating the instrument in various healthcare settings.

Given that PHC provides a strategic setting for the longitudinal follow-up of children, developmental surveillance, and the early identification of findings suggestive of ASD, as described in the literature,[12–15] characterizing studies according to their different contexts of application is important for understanding the possibilities for implementing the M-CHAT in clinical practice.

Finally, the outcomes analyzed were organized into four main categories: diagnostic performance (sensitivity, specificity, and predictive value), feasibility of use, acceptability of the tool, and impact on referrals for diagnostic evaluation and early intervention.

Detailed information was summarized in Table 2 to facilitate the visualization and comparison of the included studies.

The included studies varied in terms of methodological design, healthcare context, study population, and version of the M-CHAT used, encompassing research conducted in different countries and PHC settings.

DISCUSSION

Primary Health Care as a strategic setting for the early screening of Autism Spectrum Disorder

PHC constitutes the main entry point to the Health Care Network (*Rede de Atenção à Saúde* – RAS) within SUS, playing a central role in coordinating care and linking the different levels of care. Through the longitudinal follow-up of children and their families, especially during well-child visits, PHC is uniquely positioned to monitor child development and identify early signs suggestive of ASD. In this context, the Ministry of Health recommends the use of standardized screening tools, including the M-CHAT, as a strategy to expand the early detection of at-risk children.[12–15]

The studies included in this review emphasize that the main benefit of early screening is not limited to identifying the risk for ASD, but also lies in the ability to advance the timing of diagnosis and the initiation of specialized interventions. Given the high brain plasticity characteristic of the early years of life, early recognition of neurodevelopmental abnormalities expands opportunities for intervention during a critical period for the development of cognitive, linguistic, motor, and socioemotional skills.[16,17] In this regard, Carbone et al.[18] demonstrated that children who underwent screening received a diagnosis approximately ten months earlier than those who were not screened, a finding that supports more timely access to evidence-based interventions and may contribute to better developmental outcomes.

However, the findings of this review indicate that the effectiveness of screening depends on factors that go beyond the performance of the instrument used. The combination of the M-CHAT and

Table 2. Summary of the articles included in the review.

Author and country	Study Design	Sample	Age	Context	M-CHAT version	Study Objective	Summary of Findings
Steinman et al.[8] U.S.	Intervention	46 physicians + children	18 months	Community-based primary care	M-CHAT-R/F	To determine the impact of an intervention on expanding early screening for ASD and on the self-efficacy of primary care professionals.	The study demonstrated a positive impact on the expansion of screening and on the self-efficacy of professionals, with good feasibility of the tool in its digital format. However, operational barriers and structural limitations were observed in the referral process.
Wieckowski et al.[9] USA	Prospective	7,039 children	14.2–22.4 months.	Pediatric APS	M-CHAT-R/F	To assess whether a primary care physician's clinical suspicion adds value to standardized screening in the early identification of ASD.	Children identified simultaneously by the M-CHAT-R/F and the clinician's suspicion were more likely to receive an ASD diagnosis and be referred for specialized evaluation.
Wallis et al.[10] USA	Cohort	4,486 children	16–30 months	Pediatric APS	M-CHAT/F	To identify factors associated with the M-CHAT/F follow-up interview and referrals to diagnostic, audiology, and early intervention services following a positive screening result.	M-CHAT administration rates were high, but follow-up interviews and referrals were low and influenced by sociodemographic factors, indicating inequalities in access to services.
Giaretta et al.[16] Brazil	Cross-sectional	97 nurses	—	UBS (SUS)	M-CHAT	To investigate the feasibility of implementing the M-CHAT in the SUS, nurses' knowledge of ASD, and the identification of early signs.	The use of the M-CHAT in primary care proved feasible; however, it requires professional training, adequate resources, and workflow adjustments for its effective implementation.

Continue...

Table 2. Continuation.

Author and country	Study Design	Sample	Age	Context	M-CHAT version	Study Objective	Summary of Findings
Felix et al.[17] USA	Retrospective	6,850 children	18 and 24 months	Qualified primary care center	M-CHAT-R	To assess the impact of implementing a standardized workflow with electronic screening tools on the identification of children at risk for developmental delay.	Electronic screening and training increased detection of ASD and reduced errors but presented operational barriers related to internet access and physical space.
Carbone et al.[18] USA	Retrospective	36,223 children	16–30 months	Health care system	M-CHAT	To evaluate the use of the M-CHAT, factors associated with its use, and its relationship to the subsequent diagnosis of ASD.	A positive screening result was associated with a more frequent and earlier diagnosis of ASD; however, the M-CHAT showed low sensitivity and low positive predictive value without a follow-up interview."
Carvalho et al.[19] Brazil	Cross-sectional	24 nurses and physicians	—	Primary Health Care (SUS)	M-CHAT	To assess the use of the M-CHAT in primary care and compare the local prevalence of ASD with the national prevalence.	Most primary care professionals were unfamiliar with the M-CHAT, limiting its use, but they expressed interest in training and recognized its importance for the early detection of ASD.
Oliveira[20] Brazil	Intervention	126 children	0–3 years	UBS (SUS)	M-CHAT	To identify children with ASD early in primary care following training of family health teams.	Training primary care professionals facilitated early screening for ASD, especially in resource-limited settings. The M-CHAT proved to be accessible and practical, enabling timely referrals and interventions.

Continue...

Table 2. Continuation.

Author and country	Study Design	Sample	Age	Context	M-CHAT version	Study Objective	Summary of Findings
Ambigapathy et al.[21] Malaysia	Retrospective cohort	82 children	18–36 months	Maternal and Child Health Screening Test (M-CHAT)	M-CHAT	To determine the outcomes of children who screened positive on the M-CHAT and the prevalence of ASD.	The M-CHAT performed well in the early detection of ASD; however, there was a low rate of follow-up and confirmatory diagnosis due to barriers related to parents and healthcare professionals.
Zheng et al.[22] Singapore	Observational	5,336 children	17–20 months	APS	M-CHAT-R/F	To determine the validity and feasibility of the M-CHAT-R/F for ASD screening in primary care.	The M-CHAT-R/F has demonstrated validity for ASD screening in primary care, with the potential to lower the age of diagnosis and enable earlier interventions.
Mohamed et al.[23] Egypt	Cross-sectional	5,546 children	12–34 months	APS	M-CHAT	Conduct early screening for ASD using the Arabic version of the M-CHAT.	The M-CHAT identified children who screened positive for ASD and required diagnostic evaluation. The study highlights the need to improve screening tools to reduce underdiagnosis and optimize health care resources in developing countries.
Sturner et al.[24] USA	Observational	5,071 children	18–24 months	Pediatric APS	M-CHAT/F	To evaluate the feasibility, validity, and reliability of the online-supported M-CHAT/F in primary care.	The electronically supported M-CHAT/F proved to be feasible and reliable, improving the accuracy of ASD screening. The follow-up interview reduced false positives and increased adherence to diagnostic referrals.

USA: United States of America; PHC: Primary Health Care; ASD: Autism Spectrum Disorder; M-CHAT: Modified *Checklist* for *Autism in Toddlers*, including the revised version (M-CHAT-R), the version with a follow-up interview (M-CHAT/F), and the revised version with a follow-up interview (M-CHAT-R/F); UBS: Basic Health Unit; SUS: Unified Health System.

developmental monitoring by professionals was shown to increase the likelihood of identifying children at higher risk for ASD, highlighting that screening should be understood as part of a continuous, clinical evaluation process and not as an isolated strategy.[9] Thus, clinical judgment, observation of child development, and the use of standardized instruments should work in a complementary manner during follow-up in PHC.

Another recurring aspect identified was the role of professional training as a fundamental condition for the effective implementation of screening. Brazilian studies have shown that a lack of familiarity with the M-CHAT still constitutes a major barrier to its routine use in PHC.[19,20] In contrast, educational interventions targeting healthcare teams increased knowledge about the early signs of ASD, promoted the systematic application of the screening tool, and led to the identification of more children who were later confirmed to have ASD.[20] These results suggest that continuing education represents a priority strategy for strengthening child development surveillance and improving the quality of care provided. However, the evidence from this review indicates that training alone does not guarantee the sustainable incorporation of the M-CHAT into clinical practice.

While Oliveira[20] observed a significant increase in the number of screenings following team training, Giaretta et al.[16] identified low acceptability of the tool among nursing professionals, attributed primarily to work overload and the need to reorganize the care workflow. Taken together, these findings suggest that training improves knowledge and promotes adoption of the tool, but its sustainability depends on adequate organizational conditions, so that its implementation is not perceived merely as a new administrative burden.

In addition to difficulties related to healthcare professionals, this review highlights that one of the main challenges lies not in conducting the screening itself, but in ensuring continuity of care following a positive result. Several studies reported a low rate of referrals for diagnostic evaluation and early intervention, even among children classified as being at higher risk.[10,21] Wallis et al.[10] observed that only a small proportion of children received all recommended referrals following a positive screening result, while Ambigapathy et al.[21] found that 26.8% of children with a positive M-CHAT result were not referred for specialized evaluation. The barriers identified include a lack of awareness of the early signs of ASD among professionals and caregivers, stigma associated with the disorder, and limited knowledge of referral pathways. These findings reinforce that the effectiveness of screening depends not only on identifying risk but also on the existence of an organized care network with well-defined pathways for diagnostic confirmation and the timely initiation of interventions.

In this context, the findings of this review show that the effectiveness of early ASD screening does not depend exclusively on the availability of standardized tools, but also on the integration of trained professionals, organized work processes, and care pathways that ensure continuity of care. Thus, PHC plays a strategic role in the early identification of at-risk children; however, the full impact of this strategy will only be realized when screening is integrated into a continuum of care capable of ensuring referral, diagnostic confirmation, and timely access to specialized interventions.

Potential and limitations of the M-CHAT in the early screening for Autism Spectrum Disorder

The literature recognizes the M-CHAT and its revised versions as widely used tools for the early screening of ASD, highlighting their ease of administration, low cost, and ability to be completed by caregivers — characteristics that facilitate their incorporation into primary care routines.[19,22,23] However,

the studies included in this review demonstrate that the instrument's performance is not uniform across different settings, indicating that its sensitivity, specificity, and positive predictive value vary depending on the version used, the conduct of the follow-up interview, the repetition of the screening, and the organization of the care process.

In this context, Zheng et al.[22] demonstrated high validity for the M-CHAT-R/F in primary care clinics in Singapore, reinforcing its usefulness as a screening tool when applied according to the recommended protocol. Similarly, Mohamed et al.[23] demonstrated the feasibility of using the instrument on a large scale, highlighting its accessibility, availability in different languages, and ease of administration by parents or guardians. These results suggest that the M-CHAT is a feasible tool for population-based screening programs, even in resource-limited settings.

However, the findings of Carbone et al.[18] demonstrate that the effectiveness of the M-CHAT depends on the quality of its implementation. Although screening enabled earlier diagnosis of ASD, the authors observed a high frequency of false-negative results, especially among children who underwent only a single administration of the tool. The reduction in this rate when screening was repeated at 18 and 24 months reinforces the recommendation to administer the M-CHAT at more than one point during childhood follow-up, in conjunction with longitudinal developmental monitoring, as also highlighted by Zheng et al.[22]

Another recurring finding was the influence of the method of administering the instrument on its performance. Carbone et al.[18] suggest that some of the false-negative results may be related to scoring errors in the paper-and-pencil version of the questionnaire. Similarly, Steinman et al.[8] and Felix et al.[17] demonstrated that the use of the electronic version, combined with staff training, reduced operational errors and increased the proportion of completed screenings. Automating scoring and follow-up interviews promotes greater standardization of the process, although challenges related to technological infrastructure, connectivity, workflow adaptation, and user acceptance still limit its implementation in some healthcare services.

The studies also show that the occurrence of false-positive and false-negative results is directly related to adherence to the screening protocol. While conducting only one screening may increase the likelihood of false negative results,[18] failing to conduct the follow-up interview may increase the likelihood of false-positive results and, consequently, unnecessary referrals to specialized services. In this regard, Carbone et al.[18] point out that some of the children initially classified as positive could have been reclassified after the follow-up interview, thereby reducing inappropriate referrals and optimizing the use of specialized services.

The importance of the follow-up interview was reinforced by Steinman et al.[8] and Sturner et al.,[24] who demonstrated its contribution to increasing the accuracy of screening and improving the clinical decision-making process. In addition to reducing false-positive results, this step provides a structured opportunity to educate caregivers, promoting understanding of warning signs and increasing adherence to subsequent diagnostic evaluations. Thus, the findings of this review indicate that the follow-up interview should be understood as an integral part of the M-CHAT-R/F protocol, rather than as an optional step in its application.

Taken together, the analyzed evidence demonstrates that the performance of the M-CHAT does not depend exclusively on its psychometric properties, but also on how the instrument is incorporated into clinical practice. Conducting screening at appropriate times, utilizing the follow-up interview, training professionals, and organizing care pathways are factors that directly influence its effectiveness. Thus,

the M-CHAT should be understood as a tool to support clinical judgment, whose impact on the early diagnosis of ASD depends on the integration of screening, developmental monitoring, and continuity of care in PHC.

Challenges in M-CHAT implementation and prospects for future research

Despite the growing number of studies on the M-CHAT, this review highlights that significant gaps still exist regarding its implementation in PHC, particularly in the Brazilian context. While international research focuses predominantly on evaluating the validity, feasibility, and performance of the instrument, national studies remain scarce and primarily address aspects related to implementation, healthcare professionals' knowledge, and the tool's acceptability in health services.[16,19,20] This situation limits the generation of evidence regarding its effectiveness under real-world conditions of use within SUS.

Another identified gap concerns the longitudinal follow-up of screened children. Although the M-CHAT allows for the early identification of children at risk for ASD, few studies have systematically tracked post-screening outcomes, such as diagnostic confirmation, the time to referral to specialized services, and the initiation of interventions. Consequently, evidence regarding the impact of early screening on the organization of the care pathway and on children's clinical outcomes remains limited.[10,16,24]

The studies also highlight the need for further research into factors that influence the implementation of the screening tool in clinical practice. Barriers related to professionals' knowledge, the organization of work processes, the availability of resources, integration across levels of care, and referral pathways were repeatedly identified, indicating that the incorporation of the M-CHAT depends not only on its psychometric properties but also on the structural and organizational conditions of health services.[8,10,16,19,20]

Furthermore, research is still needed to evaluate strategies for increasing the effectiveness of screening, including continuing education programs, the use of electronic versions of the instrument, improvements to referral pathways, and monitoring of adherence to diagnostic evaluations and early interventions.[8,10,20,24] Conducting multicenter studies across different healthcare settings, with longitudinal follow-up of children, may also yield more robust evidence on the performance of the M-CHAT and facilitate the generalization of findings to the Brazilian context.[16]

In this context, this review highlights that the main challenge is no longer simply to demonstrate the utility of the M-CHAT as a screening tool, but to understand how to incorporate it effectively, sustainably, and equitably into routine PHC practice. Generating evidence focused on implementation, the organization of the care pathway, and outcomes following screening represents an essential step toward strengthening early screening for ASD within SUS. Taken together, these findings reinforce that the current challenge extends beyond instrument validation to include its effective implementation in PHC, particularly within SUS.

Limitations

This review has some limitations that should be considered when interpreting the results. Although an integrative review allows for the synthesis of evidence from different methodological designs, no

formal assessment of methodological quality or risk of bias was conducted for the included studies, which limits the robustness of the inferences drawn. The heterogeneity of study designs, application contexts, and M-CHAT versions made direct comparisons between studies difficult and precluded a quantitative synthesis of the findings. Additionally, the small number of studies conducted in Brazil limits the generalizability of the results to the Brazilian context and reinforces the need for further research focused on the implementation of the M-CHAT within the SUS.

CONCLUSIONS

Based on the integrative literature review, the M-CHAT and its adapted versions were found to perform satisfactorily as tools for the early screening of ASD, demonstrating the potential to support the identification of at-risk children in different care settings. However, the findings indicate that the instrument's effectiveness is related not only to its screening properties but also to the quality of its application, including the proper conduct of the follow-up interview, the repetition of screening at recommended intervals, and coordination among different levels of health care.

In the Brazilian context, a gap was evident in the scientific literature regarding the implementation, applicability, and acceptability of the M-CHAT in PHC, especially within Basic Health Units. The studies highlight challenges related to healthcare professionals' knowledge, the incorporation of standardized instruments into routine services, and the organization of care pathways for the referral and follow-up of children identified as at risk.

Despite the findings, this review has limitations inherent to its methodological design, including the small number of studies conducted in Brazil, the heterogeneity of the contexts evaluated, and the lack of standardization in the outcomes analyzed — factors that may limit the comparability of the findings.

Therefore, further longitudinal and interventional studies are recommended to evaluate the implementation of the M-CHAT in Brazilian PHC, including investigations into professional training strategies, the organization of work processes, the integration of the care network, and the use of digital tools to support early ASD screening.

Finally, PHC represents a strategic setting for the early identification of signs related to ASD. Strengthening professional training, public policies, and care pathways is essential to facilitate the effective incorporation of screening tools, such as the M-CHAT, thereby helping to expand opportunities for timely diagnosis and intervention.

CONFLICT OF INTERESTS

Nothing to declare.

AUTHORS' CONTRIBUTIONS

IMSO: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Project administration, Writing – original draft, Writing – review & editing. MAC: Conceptualization, Formal analysis, Investigation, Methodology, Validation, Supervision, Writing – review & editing.

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