Detection of autism spectrum disorders using the questionnaire M-CHAT R/F: The importance of considering socio-cultural and language aspects

Martí C. Dominique | Aranda Waldo | Eblen-Zajjur Antonio

Abstract

Introduction: The influence of language and socio-cultural environment on the development of cortical connections is widely acknowledged, as well as the alteration of the latter in contexts of autism spectrum disorders (ASD). The present study evaluated potential differences in the detection of ASD, depending on the language and socio-cultural aspects of the population. Method: A search of publications was carried out in: PubMed, Google Scholar, and Epistemonikos from 2010 to 2020, which validated the use of the M-CHAT R/F questionnaire as screening in the early ASD detection in patients between 12 and 36 months of age, without risk factors and in any country in the world. The meta-analysis included three reviewers who evaluated eligibility and extracted the data. The heterogeneity and consistency between studies, as well as the specific differences between each one with the main validation study were evaluated, including the positivity of the phase 1 and its confirmation in the follow-up of each case.

Results: Eight articles met the inclusion criteria; these were carried out in the United States, Argentina, France, Spain, Turkey, Saudi Arabia, Albania and Korea, in their official languages, for a total of 36,842 children. Heterogeneity was low (OR<0.42) for most subsets of the meta-analysis, except for the results obtained in Korea (OR=7.64). There is an association in results between countries (excluding Korea) OR=0.196 [0.178-0.216]; p<10^-10. All studies showed significant differences in detection compared to the original validation study. Conclusion: The MCHAT R/F is a valid method for screening for suspected ASD in the general population, but it is dependent of the culture and language of the country.

Keywords: modified checklist for autism in young children, validation, MCHAT R/F, autism Spectrum Disorders

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Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in communication and social interaction in multiple contexts, including deficits in social reciprocity, nonverbal communicative behaviors used in social interaction, and skills to understand, develop, and maintain relationships. Its detection also requires the presence of restrictive or repetitive behavior patterns, interests or activities.1-12

Neurophysiological evidence emphasizes the important role of language in the organization of brain networks related not only to language but also to long-term executive control, and the adaptation derived from social diversity in the use of language.13-16

The application of techniques such as functional magnetic resonance imaging (fMRI), Magnetoencephalography (MEG) and Electroencephalography (EEG) have made it possible to detect, with various spatial and temporal resolutions, alterations in brain connectivity in patients with ASD, which are considered as potential biological markers for diagnosis.17-22

In the case of infants with ASD, in Latin America, clinical guidelines with recommendations for detection and timely intervention are available (Minsal, 2011).2,23 that propose action plans for the age group between 0 and 4 years and 11 months. The actions included in these guidelines are aimed at the early detection of ASD indicators and their opportune rehabilitation.2

In accordance with the above-mentioned, this meta-analytical study aims to determine if the MCHAT R/F questionnaire is a valid exploratory method for suspected ASD in general population, regardless of cultural aspects, and if there are significant differences in assessments according to the country or culture of origin.

Method

A literature review in PubMed, Google Scholar and Epistemonikos — from 2010 to June 2020 — was conducted, for studies that validated the use of M-CHAT R/F as a means of exploration in ASD early detection in different
countries. The search terms used were: “Modified Checklist for Autism in Toddlers”, “(MCHAT R/F) AND validation”, “screening autism”, “cross-cultural validation”. The selected type of study corresponded to clinical trials and randomized controlled trials. Articles that used the M-CHAT R/F adapted to each country as an exploratory method, regardless of language, were retrieved. Systematic reviews were excluded.

Inclusion criteria: 1) Age of the subject: between 12 and 36 months of age; 2) M-CHAT R/F questionnaire answered by parents in their homes or in primary care centers; 3) Follow-up interview only with parents of children who initially tested positive; 4) Publication date of the article: between 2010 and 2020; 5) In order to include a greater number of countries and cultures, indexation of the publication journal was not considered.

For each keyword the search engine showed a broad match list, of which 35 articles were selected for methodology and results review; in turn, 8 of these articles met the established inclusion criteria and were included in the meta-analysis. Table 1 shows exclusion causes.

Table 1. Exclusion causes of 27 of the 35 initially selected studies according to keywords

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total excluded</td>
<td>27</td>
</tr>
<tr>
<td>Control cases</td>
<td>6</td>
</tr>
<tr>
<td>High risk</td>
<td>5</td>
</tr>
<tr>
<td>Missing information</td>
<td>3</td>
</tr>
<tr>
<td>Screening comparison</td>
<td>3</td>
</tr>
<tr>
<td>Letter to the editor</td>
<td>1</td>
</tr>
<tr>
<td>Scale modification</td>
<td>1</td>
</tr>
<tr>
<td>Age &gt; 36 months</td>
<td>3</td>
</tr>
<tr>
<td>M-CHAT previous version</td>
<td>4</td>
</tr>
<tr>
<td>Racial comparison</td>
<td>1</td>
</tr>
</tbody>
</table>

Statistical analysis

Once the studies were selected, their heterogeneity and consistency were reviewed, finding that, with the exception of the case of Korea, results between countries are consistent. Statistical analysis was performed using the STATA program version 17.0.

For each country, it was quantified if a “positive” result on the first stage of the M-CHAT R/F questionnaire had an effect in an also “positive” result in the follow-up application, which suggests a high probability of ASD. A binary measure of association (odds ratio) was used, and it was calculated with a confidence interval of 95%. Additionally, variation coefficients of the various studied groups were compared using the Fligner-Kileen test.

Results

A screening validated in the USA —adapted and translated into different languages (French, Korean, Arabic, Turkish, Albanian, Spanish, etc.) and applied to its population — was compared between culturally different countries to determine if there were significant variances in the “positive” results on stage 2, which indicates a high risk of autism spectrum disorder, and if culture is an influential factor for this outcome.

In the 8 analyzed studies, the M-CHAT R/F questionnaire was administered to a total of 36,842 children, between 12 and 36 months of age and without risk factors; 3,818 of them (8.2%) tested “positive” in stage 1, which warranted follow-up, as indicated by the authors. In stage 2, 709 children (1.9% of the total) obtain a “positive” result and were examined with different evaluation scales to diagnose ASD —with the exception of the Korean cases. Approximately 0.62% of this meta-analyzed sample obtained an ASD final diagnosis.

Figure 1 shows that, apart from the study conducted in Korea, there is a significant association in the questionnaire results between the different countries, that showed average values less than 1, with an average OR of 0.196 95% CI [0.178-0.216] ; z: -3.30; p < 10^{-10} (excluding the Korean study). Regarding this OR value, a similar behavior is observed — in a narrow range, and with the lowest values — in the group of studies carried out in the United States, Spain, Turkey and Saudi Arabia. A second group of studies, including the ones performed in Argentina, France and Albania, showed higher OR values than those of the first described group (p<0.05; z=4.52). Additionally, the dispersions of the OR values evaluated through the coefficients of variation of the first group were statistically lower than those observed in the second group (p<0.05; z=2.37; Fligner-Kileen test).

In Table 2, the χ2 analysis performed on the proportions reported in the studies included in this meta-analysis, including or not the Korean study, shows statistically significant values χ²=358.4; p=10-70 and χ²= 277.7; p=10-250, respectively, and expresses the differences between the proportions found for each country and language.
Figure 1. Forest Plot of the meta-analysis of studies in different countries and languages in which the MCHAT R and R/F was applied to the general population in children aged 12 to 36 months without risk factors.

<table>
<thead>
<tr>
<th>Language (Country)</th>
<th>MCHAT-R</th>
<th>MCHAT-R/F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
<td>n</td>
</tr>
<tr>
<td>Argentina</td>
<td>18</td>
<td>420</td>
</tr>
<tr>
<td>USA</td>
<td>1155</td>
<td>16115</td>
</tr>
<tr>
<td>France</td>
<td>108</td>
<td>1250</td>
</tr>
<tr>
<td>Spain</td>
<td>158</td>
<td>6625</td>
</tr>
<tr>
<td>Turkey</td>
<td>658</td>
<td>6712</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>127</td>
<td>1078</td>
</tr>
<tr>
<td>Albania</td>
<td>253</td>
<td>2594</td>
</tr>
<tr>
<td>Meta-Analysis</td>
<td>2477</td>
<td>34794</td>
</tr>
<tr>
<td>Korea*</td>
<td>541</td>
<td>2048</td>
</tr>
</tbody>
</table>

*The study by Seung et al. 2015 in Korea was excluded after heterogeneity testing.

Table 2. Positivity proportions when applying MCHAT R/F stage 1 in each language/country and their statistical comparison with the validation study in English (USA).

<table>
<thead>
<tr>
<th>Language (Country)</th>
<th>% MCHAT</th>
<th>n</th>
<th>IC 95%</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (EEUU)</td>
<td>7.16</td>
<td>16115</td>
<td>7,08-10,2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spanish (Argentina)*</td>
<td>4.30</td>
<td>420</td>
<td>2,56-6,69</td>
<td>-2,27</td>
<td>0,02</td>
</tr>
<tr>
<td>French (France)</td>
<td>8,64</td>
<td>1250</td>
<td>7,14-10,34</td>
<td>2,03</td>
<td>0,04</td>
</tr>
<tr>
<td>Spanish (Spain)*</td>
<td>2,38</td>
<td>6625</td>
<td>2,03-2,78</td>
<td>-15,1</td>
<td>10^-50</td>
</tr>
<tr>
<td>Turkish (Turkey)</td>
<td>9,80</td>
<td>6712</td>
<td>9,10-10,54</td>
<td>8,39</td>
<td>10^-17</td>
</tr>
<tr>
<td>Arab (Saudi Arabia)</td>
<td>10,70</td>
<td>1188</td>
<td>8,99-12,59</td>
<td>4,73</td>
<td>10^-6</td>
</tr>
<tr>
<td>Albania (Albanian)</td>
<td>9,75</td>
<td>2594</td>
<td>8,64-10,96</td>
<td>5,12</td>
<td>10^-7</td>
</tr>
<tr>
<td>Korea (Korean)</td>
<td>26,4</td>
<td>2048</td>
<td>24,52-28,38</td>
<td>33,77</td>
<td>10^-200</td>
</tr>
</tbody>
</table>

*The proportions reported in the two studies carried out in Spanish-speaking countries (Spain and Argentina) showed highly significant statistical differences, with the proportion reported in Argentina being higher (z = 5.7; p = 10^-9).
Discussion

In the present meta-analytical study, the influence of language and socio-culture on ASD prevalence reports obtained by applying the MCHAT R/F in general populations aged 12 to 36 months without risk factors was evaluated. Despite extensive validation of the M-CHAT R/F scale in each of these languages and cultures,\textsuperscript{25-32} phase 1 prevalence for ASD was statistically different for each language/country. These contrasts were also found in cases from the same language, in studies reported for Spain and Argentina (Spanish), and between Romance languages, in the case of Spanish (Spain and Argentina) and French (France); which suggests little influence both of the linguistic root, in the case of Romance languages, and of the language itself, in the case of Peninsular Spanish in relation to Argentinean Spanish. These results lead us to attribute the differences reported between the meta-analyzed studies of Spanish-speaking countries, not only to the language but also to other socio-cultural factors, such as familiar, social, as well as customary, and other individual and collective behaviors, all in a comprehensive context of high impact and transcendence in cerebral cortical connectivity and execution.\textsuperscript{13,17,25-35}

The extensive application and exhaustive validation of the MCHAT R/F for each language,\textsuperscript{25-32} support the idea that the instrument is capable of detecting cases of ASD in initial examinations for subsequent confirmatory evaluation,\textsuperscript{6} however, the results of the present study suggest the existence of differences between studies associated with language and/or particular socio-cultural factors. It is very likely that other aspects are also involved in the generation of these contrasts, nevertheless, the predominance of communication and expression factors and their high association with socio-cultural features indicate its predominant role in the explanation of the differences found.

It is well known how language and society – understanding the latter as cultural integrality – shape neurodevelopment and, specifically, cortical neuronal connectivity in health\textsuperscript{13,17,23} and cognitive disorders in general,\textsuperscript{17,22,33-35} as well as in ASD.\textsuperscript{21,38} This study results reveal the impact and contribution of language and/or socio-cultural features in the different levels of exploratory detection of ASD when applying the MCHAT R/F, and highlight the need for values of reference specific to each society, culture and/or language, since these aspects, despite sharing many elements in common, differentially shape cortical connectivity.

The authors of the study carried out in Korea, which turned out to have significant differences with respect to the other studies, considered that, despite the validation of the MCHAT R/F in the Korean language,\textsuperscript{29} certain questions may not be well understood by the parents, which could be related to their own cultural dynamics; for example, when making unusual finger movements near their eyes, many answered “yes”, since such gestures are common in Korean games. Another example is the case of the Arab culture, in which it is customary to look down or simply avoid direct eye contact in first encounters or when one person is of higher rank, analogously, it is impolite to keep your eyes fixed on who is speaking or to point with a single finger.\textsuperscript{30,36}

In turn, Zachor et al.\textsuperscript{37} compared the comorbidity associated with ASD in children from the USA, Israel, South Korea and England, concluding that avoidance behaviors are probably more acceptable in South Korean children and, therefore, they are not reported as “present”; while in the US and England these behaviors are significant, although no mayor differences were reported regarding comorbidities between these countries.

It is worth mentioning the case of a cohort of 2,459 children obtained throughout North America, to which the ADOS (Autism Diagnostic Observation Schedule) test was applied,\textsuperscript{6} in order to analyze the potential bias in the variability of social and communication behaviors according to race, ethnicity or gender. This study found that unusual eye contact, use of stereotyped phrases, and immediate echolalia were higher in black children compared to white children.

According to the above-mentioned, the importance of considering the intercultural variations associated with socialization and language when making impressions and/or clinical diagnoses of developmental disorders is confirmed.

Although there is currently a growing prevalence of ASD diagnoses – largely attributable to the dissemination and application of evaluation strategies, broader diagnostic criteria and greater awareness of this condition by health professionals and families –, it is necessary, now more than ever, to understand the influence of language and/or socio-cultural factors on cortical connectivity and its impact on our evaluation and detection instruments, in order to avoid alpha and beta diagnostic errors for different societies and the patients that originate from them, and taking into account the dynamic plasticity of brain connectivity in neurodevelopment.
It should be noted that, as with most behaviorally defined disorders, the point at which normal variation converges with disorder is an arbitrary decision, and is likely to be influenced by cultural values and expectations, since this shapes behavior and the standards of what is or is not acceptable.38

We must then consider the differences that exist between each culture, socially accepted behaviors, verbal - non-verbal language, as well as the predominant game dynamics, when applying these tests. Thus, overdiagnosis will be avoided, all this in consideration of the emotional, social and legal implications it has for the child and his family.39

Concluding Remarks

• The MCHAT R/F questionnaire is a valid screening method for suspected ASD in general population, but it is dependent on cultural traits.
• The main difficulty in combining the results of a screening method validated for different languages and countries relates to the diverse nature of the participants, the culture of each one, and the parental understanding of children’s behavior (appropriate/inappropriate).
• The existence of differences among MCHAT R/F detection percentages between different countries and the original validation study carried out in the USA was determined.
• The point at which normal variation converges on disorder is an arbitrary decision and is influenced by cultural values and expectations.
• The application of the MCHAT R/F requires considering differences that exist in each culture, socially accepted behaviors, verbal - non-verbal language, and significant game dynamics.

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