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ORIGINAL ARTICLE

Prevalence estimation of Autism Spectrum disorders in chilean urban population

Estimación de la prevalencia de trastorno del Espectro Autista en población urbana chilena

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What do we know about the subject matter of this study?

The prevalence of Autism Spectrum Disorder has been increasing. Monitoring this condition is important to determine and implement the necessary resources for the therapeutic approach of these patients in each community. The Chilean prevalence of Autism Spectrum Disorder is unknown.

What does this study contribute to what is already known?

To approximate the prevalence of Autism Spectrum Disorder in a sample of children aged 18-30 months in two urban communities of the Metropolitan Region, Chile. A prevalence of 1 in 51 children was obtained, with a male-to-female distribution of 4:1.

Abstract

The prevalence of Autism Spectrum Disorder has increased, varying between 0.5 and 1% around the world. The prevalence of ASD in Chile is unknown. **Objective:** To estimate the prevalence of ASD in two urban communes of Santiago, Chile. **Subjects and Method:** Cross-sectional epidemiological study. 272 children aged between 18-30 months who attended well-child visits at two Family Health Centers in two urban communes of Santiago participated. Consecutive sampling was used and children who were already being monitored by neurology were excluded. Screening was performed using the Modified Checklist for Autism in Toddlers (M-CHAT). Those children with altered M-CHAT were evaluated by a pediatric neurologist at the San Borja Arriarán Clinical Hospital and diagnosed

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with ASD according to clinical criteria. The Autism Diagnostic Observation Schedule - Second Version (ADOS-2) was used as a diagnostic complement. The prevalence of ASD was estimated with a 95% confidence interval. **Results:** 44 children had altered M-CHAT; 5 of them were clinically diagnosed with ASD. A 1.95% prevalence of ASD (95% CI 0.81-4.63) was obtained, with a sex distribution of 4 boys per 1 girl. **Conclusions:** This study is the first estimate of ASD prevalence in two communes of Santiago, Chile. A high prevalence of this condition was observed, which highlights the need for obtaining resources for an early multidisciplinary approach for these patients.

Introduction

Autism Spectrum Disorders (ASD) are a group of clinical disorders that include persistent deficits in communication and social interaction in various contexts, as well as restrictive and repetitive patterns of behavior, interests, or activities, causing significant clinical impairment in social, occupational, or other areas important for normal functioning[1]. The prevalence of ASD has been steadily increasing over the last 30 years[2], currently fluctuating between 0.5 and 1% worldwide[3-5].

According to the Centers for Disease Control and Prevention (CDC) in 2014, the prevalence in the United States was as high as 1 in 59 children aged 8 years[3]. The causes of this increased prevalence are controversial and are still under study. They have been attributed to the heterogeneity of the patients included in the samples, the lack of standardized methodology for epidemiological studies in ASD, and a real increase due to environmental factors that have been difficult to identify[2,6].

The importance of monitoring this condition has become a public health priority in many countries[2]. This information provides valuable benefits, serving as a registry of existing services and helping to assess the needs and priorities of each community[4]. Obtaining a local prevalence of ASD could help to determine the true deficit of therapeutic resources for these patients and to achieve their implementation. Prevalence studies of ASD have been conducted in Venezuela, Brazil, and Argentina, but their methodologies have been controversial[2] and the Chilean prevalence is currently unknown.

The objective of this study was to estimate the ASD prevalence in children aged 18-30 months in urban primary health care centers.

Subjects and Method

Descriptive cross-sectional study.

Participants

The study population consisted of boys and girls between 18 and 30 months of age who were treated in the public health system, residents of the Estación Central and Santiago Centro communes of the Metropolitan Region, Chile, and part of the population evaluated in the Child Neuropsychiatry Service of the *Hospital Clínico San Borja Arriarán* (HCSBA).

The sample size calculation was performed using the formula for finite populations considering a 0.5 prevalence[7], the population size for this age range according to the 2012 Census (corresponding to 8,366 children)[8], 90% confidence level, and 5% precision. The sample size to be evaluated was 264 children.

Consecutive sampling was performed. Inclusion criteria were 1) children attending for well-child check-up or non-neurological morbidity consultation at the Family Health Centers (CESFAM) of Chuchunco (Estación Central) and CESFAM N°1 Ramón Corbalán Melgarejo (Santiago Centro) and 2) aged between 18 and 30 months. According to the databases of the participating CESFAMs, they mainly treat families of low and middle socioeconomic levels, which are mostly users of the National Health Fund (FONASA).

Data from the 2012 Census was used, as it was the only one available at the beginning of the study.

On the other hand, children who were already being monitored at the Child Neuropsychiatry Service of the HCSBA were excluded because they had been evaluated using procedures different from those proposed in this research. The sample was collected between August 2016 and August 2018.

Measures

Modified Checklist for Autism in Toddlers (M-CHAT)[9]. This is a screening test for the detection of ASD in children. We used the Spanish version of the questionnaire, which has 23 items with a dichotomous response format (1 = *no*, 0 = *yes*). We considered as an altered result those who answered *no* to 3 or more items or who answered *no* to 2 or more critical items (items 2, 7, 9, 13, 14, and 15).

Autism Diagnostic Observation Schedule, second edition (ADOS-2)[10,11]. Standardized, semi-structured observational assessment for ASD symptoms, composed of 5 modules that are applied according to the

chronological age and language level of the child. In this study, the Spanish version of the instrument was used, and the first two modules (T and 1) were administered as a complement to the clinical evaluation, as this instrument is considered the gold standard for research purposes[12].

Autism Spectrum Disorder

Children who met the clinical diagnostic criteria by the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) were diagnosed with ASD, according to the evaluation of a pediatric neurologist of the Child Neuropsychiatry Service of the HCSBA.

Procedure

The study was approved by the Ethics Committee of the Central Metropolitan Health Service. Nurses and general practitioners, pediatricians, and pediatric neurologists, previously trained, surveyed with M-CHAT[9] caregivers of children who met the inclusion criteria and asked for informed consent. Children with altered M-CHAT were referred for evaluation by a pediatric neurologist to the Neurodevelopmental Disorders polyclinic at the HCSBA. ADOS-2 was applied by professionals trained in the instrument, as a complement to the clinical diagnosis. The children were subsequently admitted for monitoring and management by a multidisciplinary team at the same health care center.

Statistical analysis

The prevalence with a 95% confidence interval (95%CI) of children who were diagnosed with ASD was estimated. Given that there were participants with altered M-CHAT who could not be clinically evaluated, a sensitivity analysis was performed[13], which aims to examine the results under certain assumptions, as an approximation to the evaluation of the systematic error, which in the study could be given by the loss of follow-up of these participants. For this purpose, data from participants who did not complete the clinical evaluation were considered under three assumptions: 1) all cases had ASD, 2) all cases did not have ASD, and 3) cases were distributed with the same proportion of ASD-positive cases as those who were clinically evaluated. For each assumption, the prevalence and 95%CI were estimated.

Results

Figure 1 shows the flow chart of the participant evaluation process. The M-CHAT was administered to 300 children who attended a well-child check-up or morbidity consultation. Of these, 20 were excluded due to lack of data, and 8 refused to participate in the study. A total of 272 children were included, 146 were boys (53.7%) and 126 were girls (46.3%). The mean age of the participants was 22.2 months (SD 3.7 months).

Of the whole sample, 44 (16%) participants had altered M-CHAT, who were referred to the HCSBA child neuropsychiatry service for clinical evaluation by a pediatric neurologist. 28 of them were evaluated and the remaining 16 patients missed follow-up and did not complete clinical evaluation by the specialist (did not attend the appointment or failed to be contacted).

Of the 28 children evaluated, 5 were clinically diagnosed as ASD, 14 were healthy, and 9 had other diagnoses (3 developmental hyperactivity, 3 specific language impairment, 2 sensory processing disorder, and 1 anxiety disorder).

Of the 5 children clinically diagnosed with ASD, 4 were evaluated with ADOS-2, and 1 missed follow-up. Regarding the application of ADOS-2, 3 children were evaluated with module T, and all were considered within the range of moderate to severe concern, and 1 child was assessed with module 1, who was considered as moderate ASD, thus supporting the clinical diagnosis. As mentioned, only 4 of the 5 children underwent the ADOS-2 test. Considering that the diagnosis of ASD is clinical, all 5 patients were diagnosed with this condition. Finally, of the patients diagnosed with ASD, 4 were boys and 1 was a girl.

Table 1 shows the prevalence obtained in the sample and under the assumptions of the sensitivity analysis. The prevalence of ASD in the final sample (n = 256) was 1.95% (95%CI 0.81-4.63). The percentage of children with ASD among those with altered M-CHAT who were clinically evaluated was 17.9%. According to this percentage, data from the 16 cases that missed follow-up were used for assumption 3 of the sensitivity analysis, i.e., 3 cases were considered as having ASD and 13 as not having ASD. The sensitivity analysis shows that, except for assumption 1 which is the least likely since the 16 cases that missed follow-up are considered as ASD, the prevalence under certain assumptions would not be statistically different from the estimated prevalence, since the confidence intervals overlap.

Discussion

The ASD prevalence obtained in the sample was 1.96% (95%CI 0.81-4.63), that is, 1 in 51 children, with a male-to-female distribution of 4:1. This prevalence is similar to the highest reported worldwide, with a predominance in the male sex, which is in line with what has been reported in the literature[3]. The high prevalence obtained in this study, although similar to that reported by the Center for Disease Control (CDC),

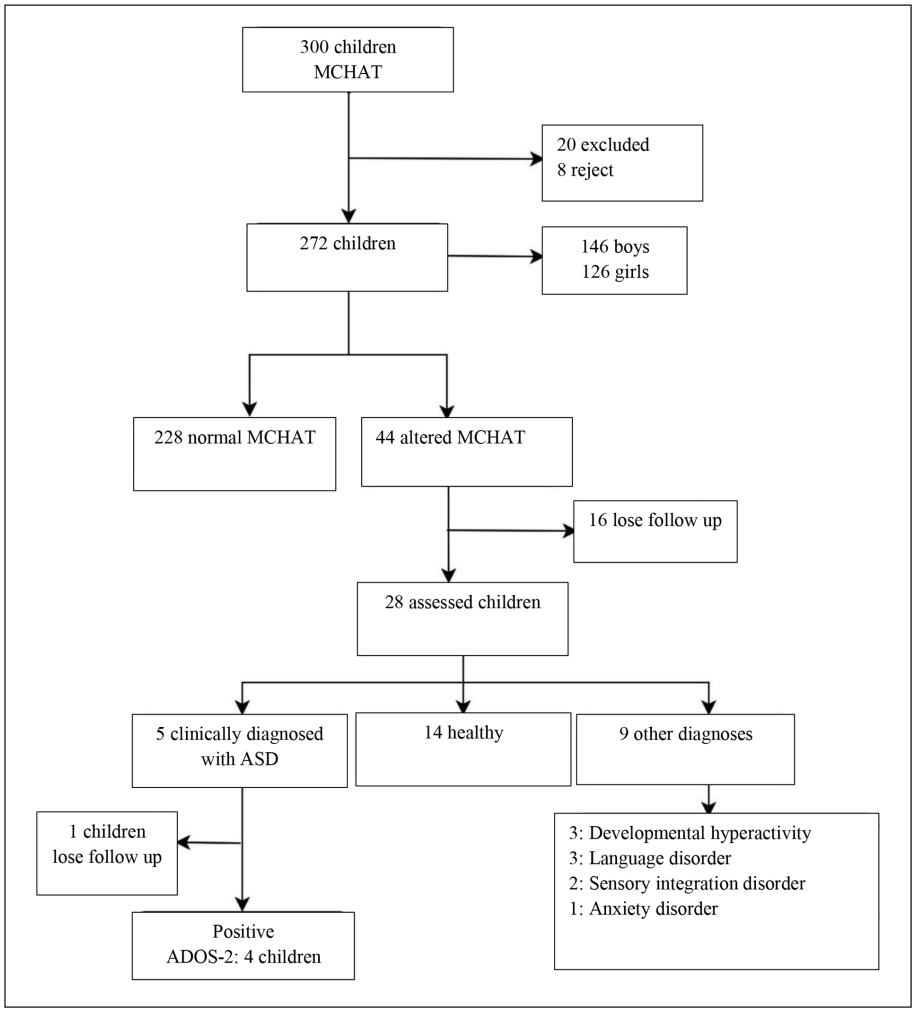

Figure 1. Flow chart of the patient evaluation proces.

may be due to the age of the children since at a younger age not all children persist with symptoms, but only 85 to 90% of them; unlike what happens with the diagnosis of ASD at an older age, which is more stable. On the other hand, no data were recorded on environmental factors such as the age of both parents, pregnancy pathology, prematurity, among others, which increase the prevalence of ASD and could explain the prevalence obtained[14,15].

Regarding prevalence estimation, differences in prevalence between studies are complex to assess and it is difficult to determine whether the discrepancies observed are due to method factors or true differences in population parameters[16]. The limitations of the lack of a standardized method for conducting epidemiological studies include the age range of the participants, different sample sizes, diagnostic criteria used, among others[2]. Regarding screening instruments, most of them are based on the clinical history provided by parents[5].

The CDC has conducted three types of data collection: parent surveys on ASD diagnosis throughout the child's life, clinical experts who review the medical and

Table 1. Prevalence of Autism Spectrum Disorder (ASD) and sensitivity analysis

		Prevalence	CI 95%
Total sample with complete information	(n = 256)	1.95	0.81 - 4.63
Assumption 1: 16 cases missed with ASD	(n = 272)	7.72	5.07 - 11.58
Assumption 2: 16 cases missed without ASD	(n = 272)	1.84	0.76 - 4.36
Assumption 3: 16 cases missed with same proportion of ASD of evaluated cases (3 with ASD out of 16)	(n = 272)	2.94	1.47 - 5.79

educational records of patients, and surveys answered by parents reporting on the current diagnosis of ASD. This methodology has multiple limitations such as recall bias and lack of patient follow-up.

The prevalence figures reported by the CDC are among the highest, ranging from 1.47 to 2.2% depending on the methodology used[3]. Thus, some studies use instruments to identify cases, focusing on children previously diagnosed with ASD or some other neurodevelopmental disorder. This approach does not allow investigators to detect patients without a previously identified condition resulting in unknown and probably imperfect sensitivity. In contrast, in this study, the evaluation was performed in a neurologically healthy population.

The prevalence of ASD has been extensively studied in developing countries, in contrast to the rest of the world where there is limited availability of these data. There are estimates in Mexico and some South American countries. A study conducted in Guanajuato determined a 0.87% prevalence of ASD in 8-year-old children[2]; another study in Venezuela reported a 0.17% of prevalence of ASD in children aged 3-9 years[17]; while another study in Argentina showed a prevalence of 1.3%, which is difficult to interpret given its methodology[18]. In Brazil, in a sample of 1,470 children aged 7 to 12 years, there was a preliminary estimate of 0.27% in the district of Atibaia[19].

A study carried out in the Canary Islands, Spain[20], with a methodology similar to that used in this study, obtained 0.61% of prevalence. False positives were ruled out through a follow-up telephone call, which corroborated the initial responses. In the Spanish study, the results were analyzed by age group, showing the highest number of false positives in the youngest children.

One of the main implications of this research is that estimating the local prevalence of ASD could help to make decisions on public policies in health and education, allowing to guide the planning and distribution of resources in these areas, which favor a multidisciplinary approach to children with ASD. The high prevalence found indicates that ASD could be considered a public health problem.

There are prevalence studies that try to identify ASD children in the school context[2]. In this study, the recruitment was carried out in the primary health care, since schooling at the age of the children included in this study is not mandatory in Chile. Within the diagnostic flowchart, health check-ups in primary health care are a good entry point, considering the coverage they have in our country[21]. We chose a sample of the Chilean public health system because it covers most of the population (around 80% of children under 10 years of age), providing good coverage of health check-ups[22].

One of the main limitations of the study is that, in addition to the age and sex of the patients, no other sociodemographic or medical data were recorded. We did not consider patients with previous pathology or their characteristics, which could have contributed to a lower prevalence obtained, something we consider to be a limitation of our study. In addition, we used the Spanish versions of the two instruments, because, at the time of the study, the adaptations to the Chilean population were not available. Subsequently, the Chilean adaptation of the M-CHAT R/F (Revised with Follow-up) was published[12], so it would be important to include this version of the instrument in future studies on ASD in this age range.

Another limitation is the loss of follow-up of 16 cases. Their loss could have affected the prevalence estimation since they are cases that had a positive screening test (M-CHAT). Therefore, to evaluate the possible impact of this loss of cases, a sensitivity analysis was performed by considering the missing data of these cases under certain assumptions. According to this analysis, the results showed no significant differences between the prevalence with the 16 cases considered under certain assumptions and without them, except for the first scenario, which is the least probable one since the 16 cases were considered as ASD.

On the other hand, another possible limitation is that a clinical evaluation of participants with negative M-CHAT was not performed to look for false negatives. In this work, a cross-sectional design was used, so participants were not followed up. We recommend for future research to use longitudinal designs to explore the persistence of ASD symptoms.

The strengths lie in the fact that the M-CHAT screening test was administered by trained personnel, in addition to that a clinical diagnosis was made by a pediatric neurologist, subspecialist in Neurodevelopmental Disorders. Also, ADOS-2 was administered by trained personnel to support the clinical diagnosis, which is the instrument considered the gold standard in research[12]. The results of this test were concordant with the clinical diagnoses.

Conclusions

The prevalence of ASD obtained in the sample was 1.96% (95%CI 0.81-4.63), that is, 1 in 51 children, with a male-to-female distribution of 4:1.

This study provides evidence that in an urban area of Chile there would be a high prevalence of this condition, as occurs throughout the world, making it a health problem, with the consequent need to make public policy decisions in education and health for the study and multidisciplinary approach to these patients and thus address the needs of Chilean children with ASD.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

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References

1. Diagnostic and Statistical Manual of Mental Disorders: DSM-5. 5th ed., American Psychiatric Association, 2013.
2. Fombonne E, Marcin C, Manero AC et al. Prevalence of Autism Spectrum Disorders in Guanajuato, Mexico: The Leon survey. J Autism Dev Disord. 2016;46(5):1669-85.
3. Zablotsky B, Black LI, Maenner MJ, et al. Estimated prevalence of autism and other developmental disabilities following questionnaire changes in the 2014 national health interview survey. Natl Health Stat Report. 2015;(87):1-20.
4. Elsabbagh M, Divan G, Koh YJ et al. Global Prevalence of Autism and Other Pervasive Developmental Disorders. Autism Res. 2012;5(3):160-79.
5. Davidovitch M, Hemo B, Manning-Courtney P, et al. Prevalence and incidence of autism spectrum disorder in an Israeli population. J Autism Dev Disord. 2013;43(4):785-93.
6. Weintraub K. The prevalence puzzle: Autism counts. Nature. 2011;479(7371):22-4.
7. Daniel WW, Cross CL. Estimation. En: Daniel WW, Cross CL. Biostatistics: a foundation for analysis in the health sciences (10th edition). USA: Wiley, 2013;161-213.
8. INE: XVIII Censo nacional de población y VII de vivienda 2012.
9. Canal-Bedia R, García-Primo P, Martín-Cilleros MV et al. Modified checklist for autism in toddlers: Cross-cultural adaptation and validation in Spain. J Autism Dev Disord. 2011;41(10):1342-51.
10. Lord C, Rutter M, DiLavore PC, et al. PARTE I: Módulos 1 a 4 En: ADOS-2. Escala de Observación para el Diagnóstico del Autismo. Madrid: TEA Ediciones 2015;11-204.
11. Lord C, Luyster RJ, Gotham K, et al. PARTE II: Módulo T. En: ADOS-2. Escala de Observación para el Diagnóstico del Autismo. Madrid: TEA Ediciones 2015;213-353.
12. Coelho-Medeiros ME, Bronstein J, Aedo K, et al. Validación del M-CHAT-R/F como instrumento de tamizaje para detección precoz en niños con trastorno del espectro autista. Rev Chil Pediatr. 2019;90(5):492-9.
13. Szklo M, Nieto F J. Epidemiologic issues in the interface with public health policy. En: Szklo M, Nieto F J. Epidemiology: beyond the basics (4th edition). Burlington, MA: Jones & Bartlett Publishers 2018:437-78.
14. Baumer N, Spence SJ. Evaluation and Management of the Child With Autism Spectrum Disorder. Continuum (Minneap Minn) 2018;24(1):248-75.
15. Germain B, Eppinger MA, Mostofsky SH, et al. Recent Advances in Understanding and Managing Autism Spectrum Disorders. J Child Neurol. 2015;30(14):1887-1920.
16. Fombonne E. Editorial: The rising prevalence of autism. J Child Psychol Psychiatry Allied Discip. 2018;59(7):717-20.
17. Montiel-Nava C, Peña JA. Epidemiological findings of pervasive developmental disorders in a Venezuelan study. Autism. 2008;12(2):191-202.
18. Lejarraga H, Menéndez AM, Menzano E et al. Screening for developmental problems at primary care level: A field programme in San Isidro, Argentina. Paediatr Perinat Epidemiol. 2008;22(2):180-87.
19. Paula CS, Ribeiro SH, Fombonne E, et al. Brief report: Prevalence of pervasive developmental disorder in Brazil: A pilot study. J Autism Dev Disord. 2011:41(12);1738-42.
20. Fortea MS, Escandell MO, Castro JJ. Estimación de la prevalencia de los trastornos del espectro autista en Canarias. An Pediatr (Barc). 2013;79(6):352-59.
21. Ministerio de salud. Programa nacional de salud de la infancia con enfoque integral. Santiago, 2013. [Acceso: 20 Agosto 2020]. Disponible en: https://www.minsal.cl/portal/url/item/e2323d12579b8c79e0400101650124b6.pdf
22. Ministerio de Desarrollo Social y Familia. Encuesta de Caracterización Socioeconómica Nacional (CASEN) Santiago, 2011.
23. McPheeters M, Weitlauf A, Verhorn A et al. Screening for autism Spectrum Disorder in Young Children: A Systematic Evidence Review for the U.S. Preventive

Services Task Force 2016;13-05185-E(129):202.
24. Pasco G. The value of early intervention for children with autism. Paediatr Child Health. 2018;28(8):364-7.
25. García R, Irarrázabal M, Moyano A et al. Encuesta latinoamericana sobre las necesidades de los cuidadores de personas con trastornos del espectro autista. Libro de resúmenes. Rev Chil Psiquiatr Neurol Infanc Adolesc. 2016;27(3):57-8.
26. Prevalence of autism spectrum disorder among children aged 8 years - autism and developmental disabilities monitoring network, 11 sites, United States, 2010. MMWR Surveill Summ. 2014;63(2):1-21.
27. Johnson CP, Myers SM, Lipkin PH et al. Identification and evaluation of children with autism spectrum disorders. Pediatrics 2007;120(5):1183-215.
28. Robins DL, Fein D, Barton ML, et al. The Modified Checklist for Autism in Toddlers: An Initial Study Investigating the Early Detection of Autism and Pervasive Developmental Disorders. J Autism Dev Disord. 2001;31(2):131-44.
29. Robins DL. Screening for autism spectrum disorders in primary care settings. Autism. 2008;12(5):537-56.
30. Chlebowski C, Robins DL, Barton ML, et al. Large-scale use of the modified checklist for autism in low-risk toddlers. Pediatrics 2013;131(4).
31. Zwaigenbaum L, Bauman ML, Fein D et al. Early screening of autism spectrum disorder: Recommendations for practice and research. Pediatrics 2015;136:S41-SS59.
32. Øien RA, Candpsych SS, Volkmar FR et al. Clinical features of children with autism who passed 18-month screening. Pediatrics 2018;141(6):e20173596.