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ARTICLES/ARTÍCULOS

Evolution of Autism Spectrum Disorder in Almeria: Prevalence and Incidence by Sex, Comorbidity and Municipal Distribution

Evolución del trastorno del espectro autista en Almería: prevalencia e incidencia por sexos, comorbilidad y distribución municipal

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ABSTRACT

The aim is to assess the evolution of the prevalence and incidence of Autism Spectrum Disorder (ASD) by sex from 2008–2020, as well as more common comorbidities and municipal distribution in the province of Almeria (Spain).

A longitudinal descriptive study is carried out using information from the Education Administration, calculating prevalence and cumulative incidence throughout the period, stratified by sex. For the prediction calculation, trend analysis and regression analysis are used to determine the relationship between the general population distribution and the ASD population.

In the province of Almeria (Spain), prevalence increased from 4.58‰ for men in 2008 to 15.26‰ in 2020, and from 1.49‰ for women in 2008 to 2.71‰ in 2020. There is an average annual increase in cumulative incidence of 1.09‰. By 2025, the prevalence is expected to reach 18.41‰ in men and 3.22‰ in women. The most common comorbidities are mental retardation and attention deficit and hyperactivity disorder. As regards municipal distribution, the distribution of the general population explains the distribution of children with ASD.

The conclusion drawn is that there is an increase in the prevalence of ASD in the province of Almeria with an upward trend that is expected to continue over the coming years.

KEYWORDS: autism spectrum disorder; inclusive education; prevalence; incidence; comorbidity; sex distribution.

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RESUMEN

Se pretende valorar la evolución de prevalencia e incidencia del trastorno del espectro autista (TEA) por sexo, de 2008-2020, así como comorbilidades más frecuentes y distribución municipal en la provincia de Almería (España).

Para ello se realiza un estudio descriptivo longitudinal con información de la Administración educativa, calculando prevalencia e incidencia acumulada en todo el período, estratificada por sexos. Para el cálculo de predicciones se utiliza análisis de tendencias, y análisis de regresión para conocer relación de la distribución de población general en relación con población TEA.

En la provincia de Almería (España), la prevalencia pasa del 4,58‰ para hombres en 2008 al 15,26‰ en 2020, y del 1,49‰ para mujeres en 2008 al 2,71‰ en 2020. Se observa un aumento medio anual de la incidencia acumulada del 1,09‰. Se prevé llegar a una prevalencia del 18,41‰ en hombres y del 3,22‰ en mujeres en 2025. Las comorbilidades más frecuentes son el retraso mental y el trastorno por déficit de atención e hiperactividad. En cuanto a su distribución municipal, la distribución de la población en general explica la distribución de los niños con TEA.

Se concluye con un crecimiento de la prevalencia de TEA en la provincia de Almería que se prevé siga aumentando en los próximos años.

PALABRAS CLAVE: trastorno del espectro autista; educación inclusiva; prevalencia, incidencia; comorbilidad, distribución por sexo.

1. Introduction

The conceptual and terminological evolution of autism spectrum disorder (ASD) is associated with an increase in cases, greater social awareness and improved identification strategies and provision of support services (Dallman et al., 2021).

1.1. Diagnosis of Autism Spectrum Disorder

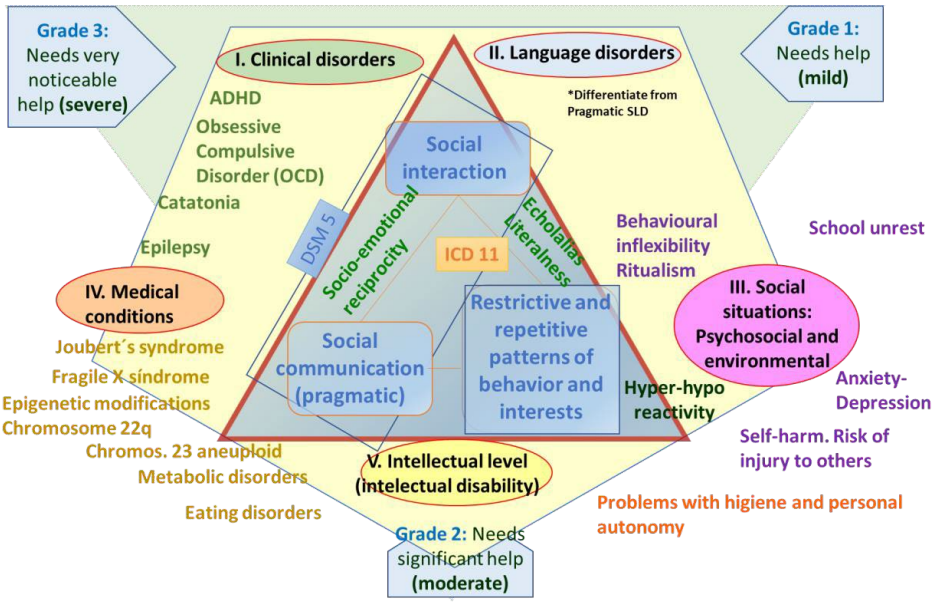
The diagnostic category of autism spectrum disorder (ASD) is reflected in the International Classification of Diseases (ICD) and in the Diagnostic and Statistical Manual of Mental Disorders (DSM), as well as in the World Health Organization (WHO, 1993) diagnostic criteria.

In the ICD-10-CM (Spanish Government, 2022) currently in force, five sub-types are included: autism disorder, Rett syndrome, childhood disintegrative disorder, Asperger's syndrome and pervasive developmental disorder-not otherwise specified.

In addition to identifying the main criteria (worsening of social communication, social interaction and restrictive and repetitive behaviours, interests or activities), autism spectrum disorder is characterised by the frequent presence of other clinical conditions, notably attention-deficit/hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD), functional language difficulties, whether there is associated mental retardation and the degree, lack of personal autonomy, worsening of behaviour (disruptive and instances of self-harming) or vulnerable social situations (WHO, 2021) (figure 1).

Figure1

Concept of Autism Spectrum Disorder (ASD)



Source: Own research.

1.2. Epidemiologic Studies of Autism Spectrum Disorder

The lack of consensus and the steady increase stand out in the numerous studies on prevalence in people with ASD (figure 2) (Sánchez-Raya et al., 2015).

Waterhouse (2008) justifies this by:

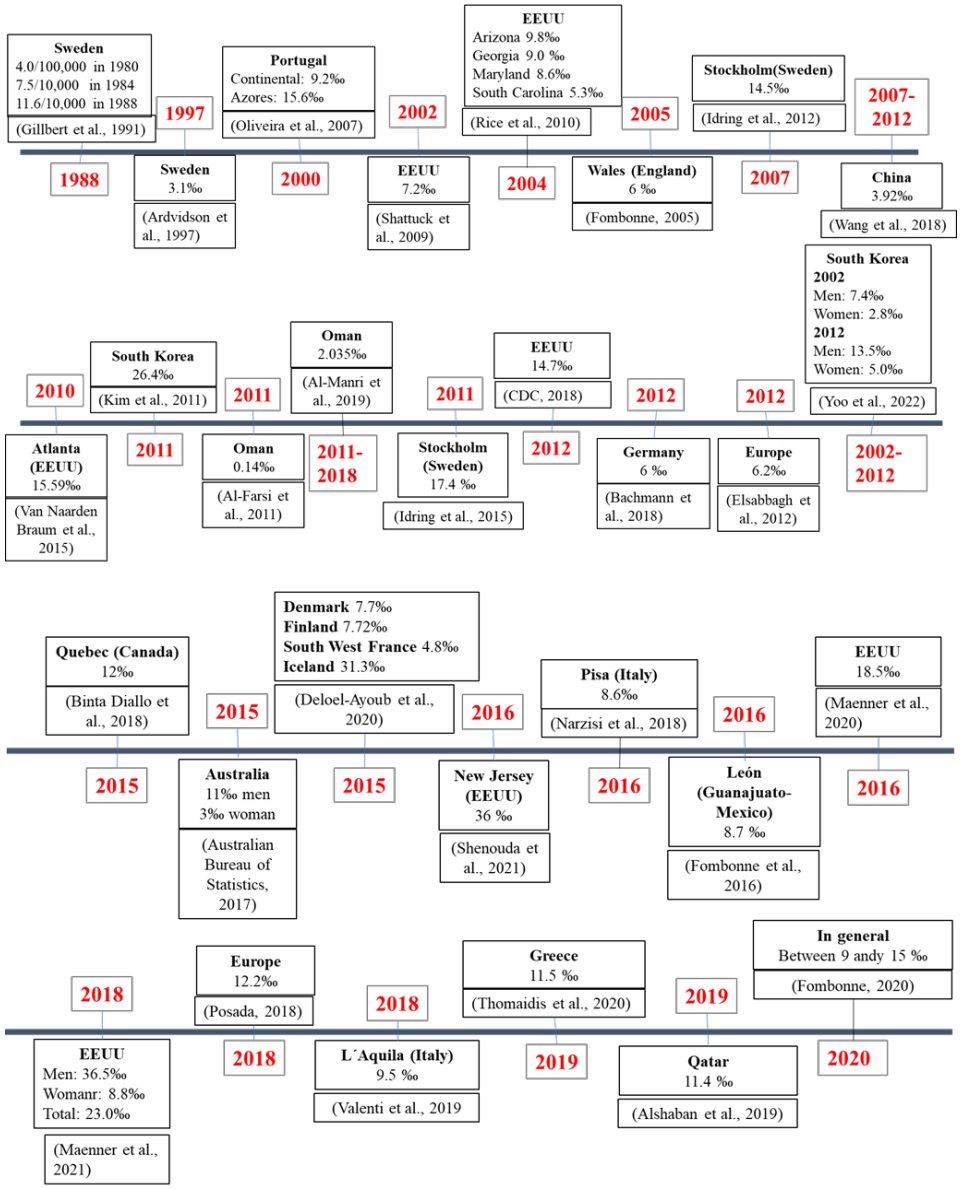
1. Changes in diagnostic criteria (Lai et al., 2013).
2. Improvement of identification and evaluation systems (Bolison et al., 2016).
3. Increase in care services for people with ASD, which may explain differences in prevalence between Bangladesh (2016), with 0.75‰ (Akhter et al., 2018), and the US (2018), with 36‰ (Maenner et al., 2021).
4. Growing awareness of the disorder (Wing and Potter, 2002).

The WHO (2019) calculates that 1 in every 160 children has ASD (6,25‰); Fombonne (2020) specifies the variations between 9–15‰.

In Spain, there are inter-regional variations and a steady increase (table 1); from 1‰ in Madrid (2001) (Belinchón, 2001), Aragon (2005) (Frontera-Sancho, 2005) or Seville (2007) (Aguilera, Moreno y Rodríguez, 2007), around 6‰ in Salamanca-Zamora (2012) (García-Primo et al., 2014), Las Palmas (2013) (Fortea-Sevilla et al.,

Figure 2

Prevalence studies of ASD outside of Spain



Source: Own research.

2013) and Guipúzcoa (2020) (Fuentes et al., 2020), up to 15.5‰ in Tarragona (2018) (Morales-Hidalgo et al., 2018) and 12.3‰ for Catalonia in general (Pérez-Crespo et al., 2019).

Table 1

Prevalence studies of autism spectrum disorders in Spain

Year	Author	Place	‰	Description
2001	Belinchón (2001)	Self-governing region of Madrid	1	People with ASD, Region of Madrid: 1,274. Extrapolated to 29 years: 1,795. Prev.1‰
2005	Frontera-Sancho (2005)	Aragon	0.92	ASD population: 155. Prev. 0.9211‰. Underdiagnosis, especially in Asperger's syndrome
2007	Aguilera et al. (2007)	Seville	1.3	ASD prevalence in compulsory education. Seville (city). Prev. 1.297‰
2008	Spanish National Statistics Institute (INE, 2021)	Andalusia, Aragon	4.9 2.2	Sample-Andalusia: 2,800. Prevalence 0.49%; Sample-Aragon: 2,300. Prevalence 0.22%.
2012	García-Primo et al. (2014)	Salamanca-Zamora	6.4	Participants: 9,524. Instrument: M-CHAT
2013	Fortea Sevilla et al. (2013)	Las Palmas	6.1	Sample: 1,796 children (18–30 months)
2014	Sánchez-Palomino and Villegas-Lirola (2014)	Almeria	2.7	School population: 99,572 pupils. Prevalence: 2.7‰. Coincidence of variations in frequency of ASD with variations in general population
2017	INE (2018)	Spain	5.7	Spanish National Health Survey (26/06/2018). Children aged 3–14. Men: 0.95% / Women: 0.16%
2017	Pérez-Crespo et al. (2019)	Catalonia	12.3	Reference population: 1,326,666 children (2–17 yrs.). ASD population: 15,466. Boy:girl ratio: 4.5:1 (12,647 boys and 2,819 girls)
2018	Morales-Hidalgo et al. (2018)	Tarragona	15.5, 3–5 years 10.0, 10–12 years	Neurodevelopmental Disorders Epidemiological Research Project (EPINED). Participants: 5,582 children. ASD results: 1.55% preschool education and 1.00% primary education
2020	Fuentes et al. (2020)	Guipúzcoa	5.9	ASDEU project. Reference population: 14,734, 7–9 years Estimated prevalence: 0.59% (95% CI; 0.48–0.73%)

Source: Own research.

1.3. Differences in Prevalence of ASD by Sex

The prevalence of ASD is higher among men than it is women. This could be justified due to underdiagnosis in girls (Wagner, 2014). This is the result of how, in *ad hoc* prevalence studies, more men than women participate (Watkins et al., 2014), the screening tools are more sensitive to identifying ASD in men (Kirkovski et al., 2013), and women with a higher intelligence quotient are not diagnosed with ASD (Parish-Morris et al., 2017). The differences between men and women oscillate between 4.34:1 (95% CI: 3.83–4.86) for Europe and 4.28:1 (95% CI: 3.76–4.79) for North America (table 2).

Table 2

ASD ratio (R) by sex in Europe and North America

	Europe. Average M:F ratio: 4.34 (95% CI: 3.83-4.86)			North America. Average M:F ratio: 4.28 (95% CI: 3.76-4.79)		
Year	Place	Reference	R	Place	Reference	R
1990	France	Fombonne et al. (1997)	1.8			
1990	South Thames (United Kingdom)	Baird et al. (2006)	3.3			
1992	Lisbon, Alentejo and Algarve (Portugal)	Oliveira et al. (2007)	2.9			
1992	Norway	Sponheim and Skjeldal (1998)	2.1			
1996				Atlanta (US)	Yeargin-Allsopp et al. (2003)	3.9
1997				Minnesota (US)	Barbaresi et al. (2005)	
1998	Iceland	Saemundsen et al. (2013)	2.7	Brick Township (New Jersey)	Bertrand et al. (2001)	2.9
1998	Staffordshire (England)	Chakrabarti and Fombonne (2001)	4.0	Montreal (Canada)	Fombonne et al. (2006)	4.9
1999	England, Wales and Scotland	Fombonne et al. (2001)	8.1			
2001	Lothian (Scotland)	Harrison et al. (2006)	7.0			
2002	Faroe Islands (Denmark)	Ellefsen et al. (2007)	5.7	US	CDC (2007)	4.2
2002	Staffordshire (England)	Chakrabarti and Fombonne (2005)	6.1	South Carolina (US)	Nicholas et al. (2008)	3.1
2003	England	Willians et al. (2008)	6.8			
2004	Denmark	Parner et al. (2011)	5.3	British Columbia (Canada)	Ouellette-Kuntz et al. (2007)	5.3
2004	Kent (United Kingdom)	Tebruegge et al. (2004)	6.1	San Francisco (US)	Windham et al. (2011)	
2004	United Kingdom	Sun et al. (2014)	3.2			
2004	United Kingdom	Totsika et al. (2011)	4.4			
2006	Denmark	Nordenbaek et al. (2014)	3.9	South Carolina S.)	Nicholas et al. (2009)	4.8
2007	Stockholm (Sweden)	Idring et al. (2012)	2.6	US	Kogan et al. (2009)	4.2
2008	Stockholm (Sweden)	Fernell and Gillbert (2010)	4.9	Montreal (Canada)	Lazoff et al. (2010)	5.5
2008	Norway	Isaksen et al. (2012)	4.1			
2009	United Kingdom	Russell et al. (2014)	5.4			
2010	Gothenburg (Sweden)	Nygren et al. (2012)	4.0	US	Baio et al. (2014)	4.6
2010	Norway	Suren et al. (2012)	4.3	Arizona and Wisconsin (US)	Christensen et al. (2019)	2.6
2010	United Kingdom	Taylor et al. (2013)	4.8			
2012	Germany	Bachann et al. (2018)	2.8			
2014	Poland	Skoniecz-na-Zydecka et al. (2017)	4.5	Colorado (US)	Christensen et al. (2019)	5.2

	Europe. Average M:F ratio: 4.34 (95% CI: 3.83-4.86)			North America. Average M:F ratio: 4.28 (95% CI: 3.76-4.79)		
Year	Place	Reference	R	Place	Reference	R
2015	Denmark	Delobel-Ayoub et al. (2020)	3.9	Canada	Ofner et al. (2018)	4.0
2015	Finland		3.3			
2015	France		5.4			
2015	Iceland		4.4			
2016	Norway	Ozerk et al. (2020)	3.6			
2018	Tarragona (Spain)	Morales-Hidalgo et al. (2018)	4.3			
2019	Catalonia (Spain)	Pérez-Crespo et al. (2019)	4.5			
2019	Italy	Valenti et al. (2019)	4.1			
2020	Greece	Thomaidis et al. (2020)	4.4			

Source: Own research.

This difference may be explained by the existence of specific risk factors in men and protective factors in women (Jacquemont et al., 2014) or by the existence of phenotypic buffering in women (Werling et al., 2016).

2. Research Design

There are relatively few studies on the prevalence and incidence of ASD in Andalusia (Aguilera et al., 2007; Sánchez-Palomino and Villegas-Lirola, 2014). This information is important for understanding the disorder and providing the associated services.

This study aims to assess the evolution of the prevalence and incidence of ASD by sex from 2008 through 2020, and analyse the most common comorbidities and distribution of ASD in the province of Almeria.

Anonymous administrative data on children aged 3–16, schooled in Almeria (Spain) between 2008–2020 (Regional Government of Andalusia Department of Education), are used.

The average annual reference population (3–16 yrs.) is 89,900 (95% CI: 85,867–93,934), with a minimum of 84,047 (2008) and a maximum of 108,692 (Regional Government of Andalusia, 2021).

The average distribution by sex, over the 13 years, is 46,191 males (95% CI: 44,125–48,257), with a minimum of 43,268 (2008) and a maximum of 55,752 (2020), and 43,709 females (95% CI: 41,738–45,680), with an average of 48.62% women in relation to the total population (95% CI: 48.53%–48.71%).

In this cohort, children diagnosed with ASD between 2008–2020 are identified and denominators are defined based on the total population of children from nursery education to compulsory secondary education (ESO) and special education. The data correspond to the month of September of each academic year.

Es un estudio descriptivo-longitudinal para el análisis de variaciones de prevalencia-incidencia en trece años (2008-2020).

It is a descriptive longitudinal study for the analysis of variations in prevalence and incidence over 13 years (2008–2020).

The analysis of comorbidities in pupils with ASD is descriptive and transversal, and is in reference to the 2019–2020 academic year.

The study variables are the diagnostic categories associated with autism spectrum disorders (ICD-10-CM) (Spanish Government, 2022), stratified by sex.

The units of measurement were the frequency or number of pupils for each diagnostic category, the prevalence or number of students with ASD in relation to the number of general pupils, and the accumulated incidence or number of new pupils with ASD in each period in relation to the risk population (Colimon, 2019).

To calculate the accumulated incidence, the risk population is defined as the pupils from the second stage of nursery education to compulsory secondary education (ESO, 3–16 years), not including those pupils diagnosed with ASD. Given the difference reported in relation to sex (Loomes et al., 2017), to avoid the bias of a single general measure, the prevalence and overall incidence stratified by sex are calculated.

The incidence is categorised based on percentiles (low: up to the 25th percentile; middle: between 25–75; and high: above the 75th percentile). Prevalence and incidence are two related measures, for which reason the sustained increase in the incidence of ASD implies an accumulative increase in prevalence (Fombonne, 2020).

To assess the association of prevalence of ASD by sex, the Pearson bivariate correlation between the evolution of the prevalence in men and women is calculated to discover the overlap between both sexes.

The calculation of the prevalence and incidence predictions for the next five years (2021–2025) is performed using the SPSS v.27 time series module, proposing for each series an analysis model according to the characteristics of the resulting mathematical function (ARIMA-additive or Holt-exponential). The benchmarks for the calculation are the prevalence and incidence of ASD by sex (dependent variables), and as the independent variable, the temporal sequence in years (2008–2020).

For the 2019–2020 academic year, a co-occurrence analysis (comorbidities) is carried out to discover the most common special educational needs in pupils with ASD.

UCINET software is used (Borgatti et al., 2002), plotting the relationships between each of the special educational needs under study.

The distribution of pupils with ASD in the province is calculated using the count for each municipality and is represented using the QGIS 3.22 application (QGIS.org, 2022). To find out whether the distribution of the overall population (independent variable) explains the distribution of the population with ASD (dependent variable), a regression analysis is carried out using STATGRAPHICS 19.

3. Results

3.1. Prevalence

If, in 2008, a total of 150 pupils aged between 3 and 16 years had ASD, this figure will rise to 726 in 2020. The prevalence has increased from 3.09‰ (95% CI: 2.52–3.66) in 2008 to 8.10‰ (95% CI: 6.97–9.22) in 2020 (table 3). This difference is especially relevant in the case of males, where the prevalence increases from 4.58‰ (95% CI: 3.62–5.55) in 2008 to 13.18‰ (95% CI: 11.79–14.56) in 2020, having reached 15.26‰ (95% CI: 13.67–16.85) in 2019; that is, one in every 65 males aged between 6 and 12 years had some type of ASD. The prevalence in both sexes only decreased in 2020 (-1.22‰) and in 2013, the prevalence in women decreased (-0.07‰).

The average percentage growth per year for prevalence and incidence is 8.33% for both sexes.

The evolution of the prevalence in men and women presents a high degree of association, obtaining a Pearson bivariate correlation of 0.964 (95% CI: 0.872–0.989); in other words, the prevalence varies proportionally for both sexes.

The average risk factor by sex or prevalence ratio in men (numerator) and prevalence in women (denominator) is 4.09 (95% CI: 3.61–4.56) for the period from 2008 to 2020. The standard deviation is 0.78, indicating a high degree of stability over the thirteen years, with a minimum of 3.07 in 2008 and a maximum of 5.16 in 2019. The risk of presenting ASD between 6 and 12 years of age is 4.09 times greater in men than in women. This difference is especially relevant in the group identified with Asperger's syndrome, with a risk factor of 10.37 (95% CI: 6.40–14.34), whereby the possibility of presenting Asperger's syndrome is 10.37 times higher in men than in women.

3.2. Incidence

In the series, a continued increase was recorded, with an average annual incidence of 1.09‰ (95% CI: 0.61–1.57). As for males, the average annual incidence is 1.73‰ (95% CI: 0.89–2.57), and for females, 0.42‰ (0.27–0.56).

The lowest incidences are recorded in the years 2009, 2011, 2012, 2013 and 2020, and the highest incidences in 2015, 2017, 2018 and 2019 (table 4).

There is a dip between 2011 and 2013, a plateau between 2015 and 2017, and a significant increase in 2014, 2015 and, particularly, in 2018 and 2019, with a decrease in 2020 (figure 3), coinciding with the pandemic and lockdown in the second and third quarters of 2019 due to COVID-19.

Table 3

Prevalence and accumulated incidence of ASD by sex (2008-2020)

Year	Freq. ASD 3-16 yrs.	Prevalence ‰			Accumulated incidence ‰		
		M	F	M+F	M	F	M+F
2008	150	4.58 (3.62–5.55)	1.49 (0.92–2.05)	3.09 (2.52–3.66)			
2009	166	4.92 (3.92–5.92)	1.50 (0.94–2.07)	3.25 (2.67–3.83)	0.35 (0.17–0.52)	0.00 (0.00–0.00)	0.19 (0.10–0.28)
2010	227	5.67 (4.61–6.74)	1.76 (1.15–2.36)	3.77 (3.15–4.39)	1.18 (0.85–1.50)	0.42 (0.22–0.61)	0.81 (0.62–1.00)
2011	250	5.82 (4.74–6.89)	1.84 (1.22–2.46)	3.87 (3.24–4.50)	0.50 (0.29–0.71)	0.10 (0.00–0.19)	0.30 (0.19–0.42)
2012	240	6.26 (5.15–7.37)	1.85 (1.24–2.46)	4.09 (3.45–4.73)	0.27 (0.12–0.43)	0.07 (-0.01–0.15)	0.14 (0.06–0.22)
2013	260	6.85 (5.69–8.01)	1.78 (1.18–2.38)	4.35 (3.69–5.01)	0.47 (0.27–0.68)	0.21 (0.07–0.35)	0.35 (0.22–0.47)
2014	302	8.18 (6.93–9.42)	1.93 (1.32–2.55)	5.09 (4.39–5.79)	1.09 (0.78–1.39)	0.26 (0.11–0.41)	0.68 (0.51–0.85)
2015	370	9.48 (8.20–10.75)	1.97 (1.36–2.57)	5.84 (5.12–6.56)	1.49 (1.14–1.84)	0.43 (0.24–0.63)	0.98 (0.77–1.18)
2016	414	10.03 (8.73–11.34)	2.07 (1.46–2.68)	6.16 (5.42–6.89)	1.25 (0.93–1.57)	0.34 (0.15–0.48)	0.80 (0.61–0.98)
2017	477	11.24 (9.87–12.61)	2.33 (1.69–2.98)	6.91 (6.14–7.69)	1.45 (1.11–1.79)	0.56 (0.32–0.75)	1.01 (0.80–1.21)
2018	542	12.71 (11.25–14.16)	2.86 (2.14–3.58)	7.93 (7.10–8.76)	1.81 (1.43–2.19)	0.31 (0.15–0.47)	1.08 (0.87–1.29)
2019	692	15.26 (13.67–16.85)	2.96 (2.23–3.69)	9.32 (8.42–10.22)	3.29 (2.78–3.80)	0.59 (0.36–0.81)	1.97 (1.69–2.26)
2020	726	13.18, (11.79–14.56)	2.71 (2.05–3.36)	8.10 (6.97–9.22)	0.58 (0.38–0.78)	0.13 (0.03–0.23)	0.32 (0.21–0.42)

Source: Own research.

Table 4

Association of incidence by degree in relation to sex

	Incidence M ‰			Incidence F ‰			Incidence M+F ‰		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2009	0.35			0.00			0.19		
2010		1.18				0.42		0.81	
2011	0.50			0.10			0.30		
2012	0.27			0.07			0.14		
2013	0.47				0.21		0.35		
2014		1.09			0.24			0.68	
2015			1.49			0.43			0.98
2016		1.25			0.34			0.80	
2017			1.45			0.56			1.01
2018			1.81		0.31				1.08
2019			3.29			0.59			1.97
2020	0.58			0.13			0.32		

Source: Own research.

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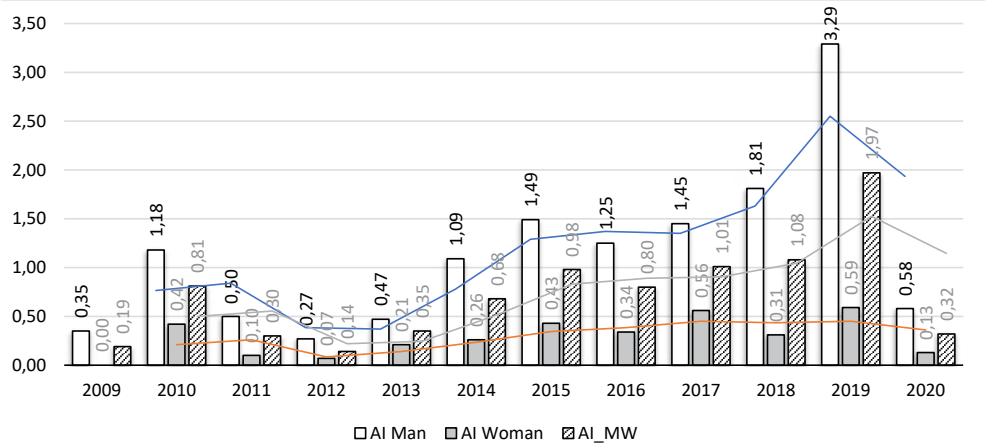
Figure 3

Incidence of ASD by sex (2009-2020)



Source: Own research.

The increase in the incidence values is 4.12 times greater in men than in women.

The average percentage has led to an average increase of 8.33% (95% CI: 4.52–12.15%), with a standard deviation of 6%. Values peaked in 2019, with a percentage increase of 23.96% for men and 17.25% for women, while minimum values were recorded in 2012, with 1.97% for men and 2.05% for women. In terms of percentage, in relation to the accumulated annual incidence, the detection of men and women was very similar.

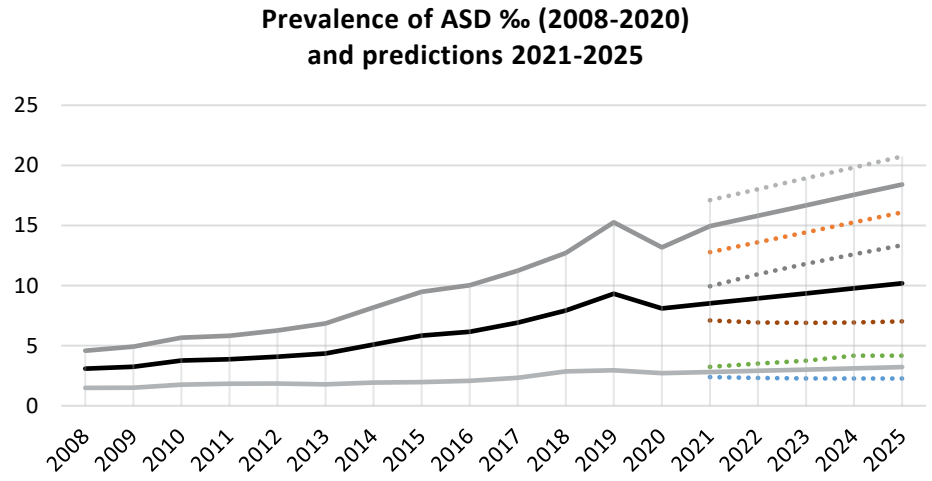
3.3. Prevalence and Incidence Predictions

Prevalence and incidence, and their evolution, are closely related (figures 4 and 5).

The predictions for the next five years imply a sustained increase that would see the population of pupils with ASD aged between 3–16 years reach 1,049 subjects in 2025 (CI 95%: 833–1.264), with a global prevalence of 10.19‰ (95% CI: 7.02–13.36), which in the case of males would reach 18.41‰ (95% CI: 16.09–20.74) (table 5).

Figure 4

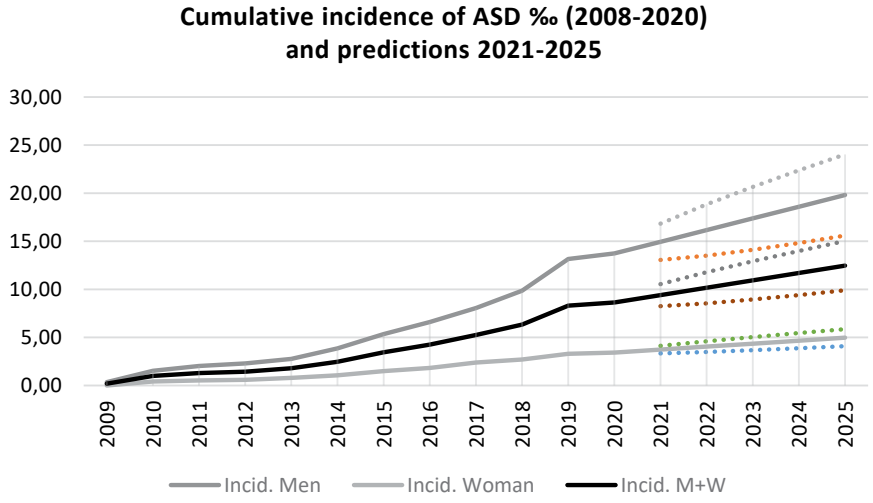
Evolution of prevalence, 2008-2025



Source: Own research.

Figure 5

Evolution of incidence, 2008-2025



Source: Own research.

Table 5

ASD predictions, 2021-2025 (95% CI)

Year	Prevalence ‰			Expected freq. ASD 6-12 yrs.	Expected freq. ASD 3-16 yrs.
	M	F	M+F		
2021	14.94 (12.78–17.11)	2.81 (2.39–3.24)	8.52 (7.10–9.94)	461 (362–570)	791 (694–887)
2022	15.81 (13.61–18.02)	2.91 (2.31–3.51)	8.94 (6.93–10.94)	496 (378–631)	855 (718–991)
2023	16.68 (14.43–18.93)	3.01 (2.28–3.75)	9.35 (6.90–11.81)	533 (396–690)	920 (753–1,087)
2024	17.55 (15.26–19.83)	3.12 (2.27–4.17)	9.77 (6.93–12.61)	571 (417–748)	984 (791–1,177)
2025	18.41 (16.09–20.74)	3.22 (2.27–4.17)	10.19 (7.02–13.36)	610 (439–808)	1049 (833–1,264)

Source: Own research.

The prediction for 2025 is that one in every 54 males and one in every 310 girls, aged between 6 and 12 years, will have some type of ASD.

3.4. Comorbidity

For the comorbidity analysis, the reference group was the population of pupils at school who have special educational needs (SEN) associated with autism spectrum disorder (ASD) in the province of Almeria in the year 2019. Of a total of 692 pupils, 211 have autism (30.5%); 135 have Asperger's syndrome (19.5%); 343 have pervasive developmental disorder-not otherwise specified (49.5%); 2 have Rett syndrome (0.3%); and 1 has childhood disintegrative disorder (0.15%).

- Autism: of the total number of pupils with autism-associated SEN (211), 38 also have other needs (18%), of which 23 show intellectual disability (severe-moderate). That is, 11% of pupils with autism-type ASD also have severe or moderate intellectual disability.

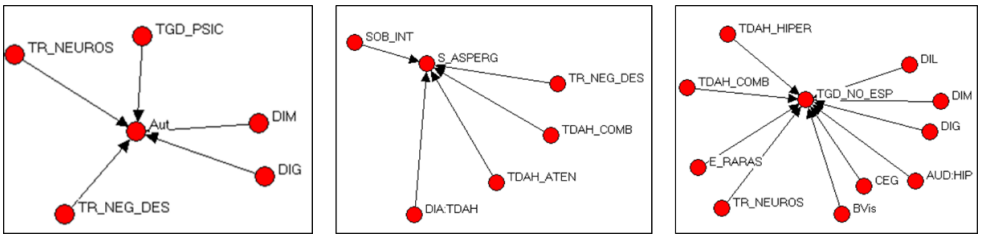
- Asperger's syndrome (AS): of the total number of pupils with AS-associated SEN (135), 30 have other associated needs (22%), of which 17 have attention-deficit/hyperactivity disorder (ADHD), and 3, oppositional defiant disorder. Notably, 12.4% of pupils with Asperger's syndrome have ADHD comorbidity.

- Pervasive developmental disorder-not otherwise specified (PDD-NOS): of the total number of pupils with PDD-NOS-associated SEN (343), 51 have other associated needs (15%), of which 22 are associated with intellectual disability, 15 with ADHD, and 2 with oppositional defiant disorder. It must be highlighted that, in the case of pupils with pervasive developmental disorder-not otherwise specified, 6.4% have intellectual disability, and 4.49% have attention-deficit/hyperactivity disorder.

- Rett syndrome and childhood disintegrative disorder: the total number of pupils with these needs is very low; 2 in the case of Rett syndrome, and 1 in the case of childhood disintegrative disorder.

Figure 6

Comorbidities of autism spectrum disorder



Source: Own research.

17.3% of pupils with ASD-associated SEN have comorbidities that increase their difficulties (Mannion and Leader, 2013). The most common comorbidities are behavioural aspects, largely associated with attention-deficit/hyperactivity disorders (Rico-Moreno and Tárraga-Mínguez, 2016) (figure 6).

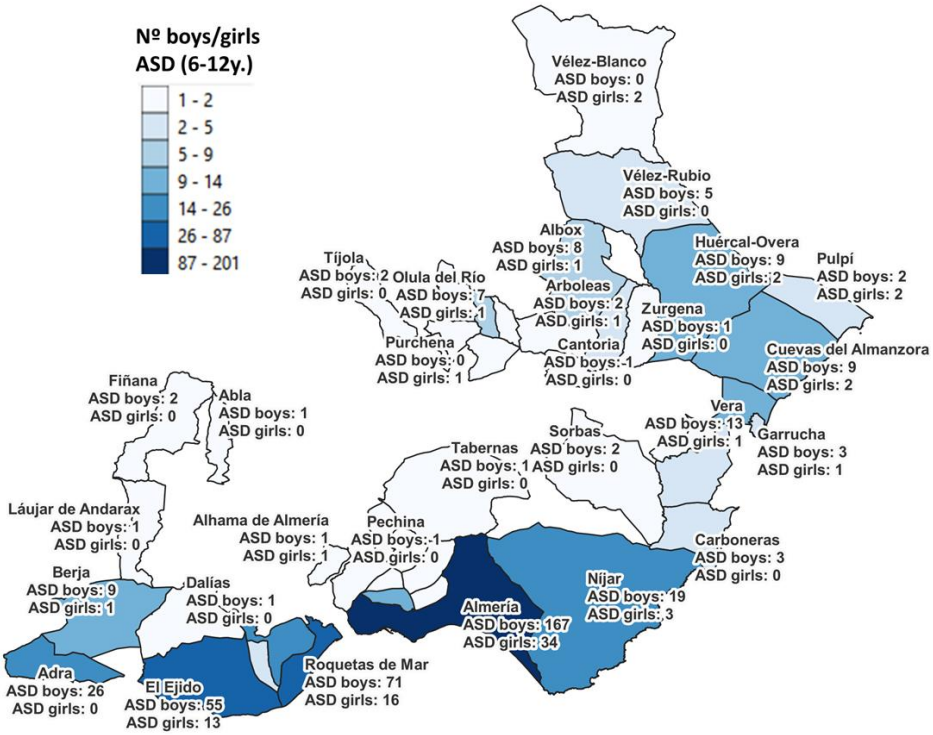
Likewise, it is also important to underline the relevance of ASD comborbidity with intellectual disability on different degrees and the significant correlation with education modalities (Sánchez-Palomino and Villegas-Lirola, 2014).

3.5. Distribution

Distribution in the province of Almeria is not homogeneous. As was to be expected, there is a higher concentration of pupils with ASD in the main population centres. This is especially true in the municipal centres of Almeria (256 aged 3 to 16 years, of which 201 are between 6–12), Roquetas de Mar (122 aged 3 to 16 years, of which 87 are between 6–12), El Ejido (91 aged 3 to 16 years, of which 68 are between 6–12) and Vícar (20 aged 3 to 16 years, of which 18 are between 6–12) in the Poniente Almeriense region, and to a lesser extent in the Levante Almeriense region: Níjar (27 aged 3 to 16 years, of which 22 are between 6–12), Vera (18 aged 6 to 12 years, of which 14 are between 6–12), Cuevas del Almanzora (11 aged 6 to 12 years), Garrucha (4 aged 6 to 12 years), Huércal Overa (15 aged 3 to 16 years, of which 11 are between 6–12), Olula del Río (15 aged 3 to 16 years, of which 8 are between 6–12), Pulpí (6 aged 3 to 16, of which 4 are between 6–12) and Los Vélez (10 aged 3 to 16, of which 7 are between 6–12) (figure 7).

Figure 7

Distribution of the number of boys/girls with ASD in Almeria (2020)



Source: Own research.

A double-square-root regression analysis is carried out, finding that the equation that relates the ASD population distribution (dependent variable) to the overall population distribution (independent variable) in the municipalities of the province of Almeria is:

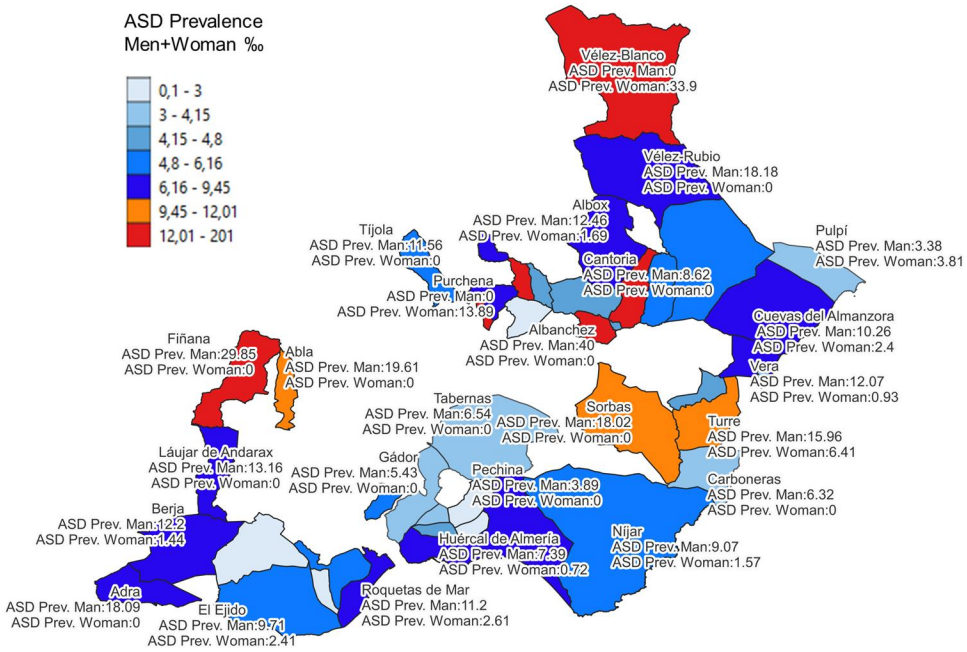
$$Total\ ASD_{M+W} = \sqrt{745402 * 10^{-10} * (Total\ M + W)^2 - 222.275}\ .$$

The p value (0.00) in the ANOVA table is less than 0.05, and therefore there is a statistically significant relationship between the distribution of the ASD population and the overall population with a 95% confidence index. The R^2 statistic indicates that the adjusted model explains 97.6% of the variability in the distribution of children with ASD aged between 6 and 12 years, with a correlation coefficient between both variables of 0.988, indicating a strong relationship without collinearity attributable to the serial organisation of the residuals (values predicted by the model less the observed values), finding a ***p*** value from the Durbin-Watson test of 0.597 (greater than 0.05).

On balance, the distribution of the provincial prevalence is representative of the distribution of municipal prevalence (figure 8).

Figure 8

Distribution of the municipal prevalence of ASD in Almeria (2020)



Source: Own research.

4. Discussion

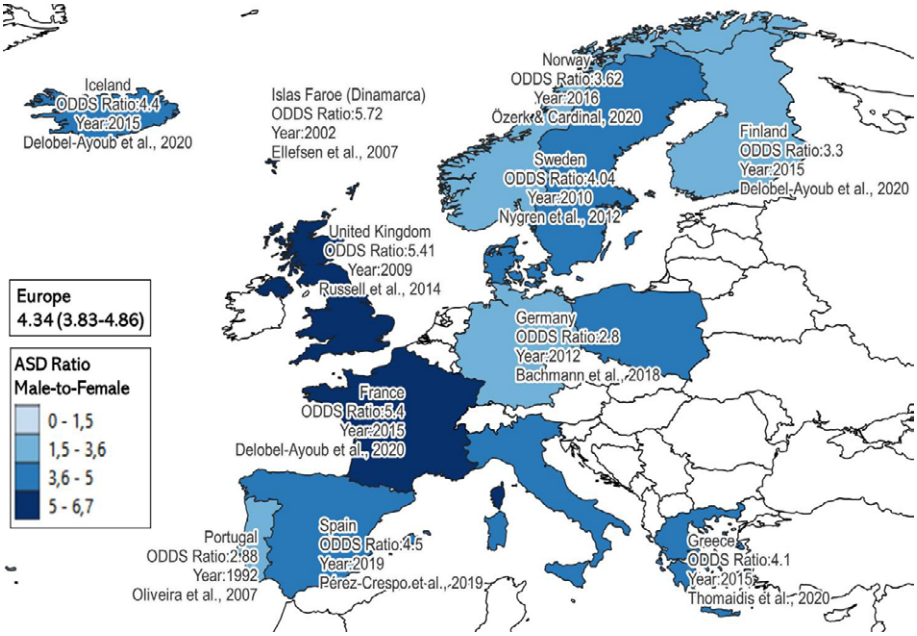
4.1. Prevalence

There was an average percentage increase of 8.33%, whereby prevalences of ASD in 2008 of 4.58‰ in men and 1.49‰ in women have increased to 15.26‰ and 2.71‰ in 2019, respectively. The only decrease in the prevalence calculated for both sexes in the entire period from 2008 through 2020 occurs in the year 2020.

The differences in prevalence between the sexes are highly significant; the average risk of having ASD (odds ratio of prevalence by sex) (Fombonne et al., 2021) is 4.09 times greater for men than it is for women (95% CI: 3.61–4.56) in line with the expectations in the studies undertaken in Europe (figure 9). In the case of the typology of Asperger's syndrome, this figure reaches 10.37 (95% CI: 6.40–14.34).

Figura 9

Map of male-to-female ASD ratio in Europe



Source: Own research.

It is a stable index throughout the entire series, with a standard deviation (δ) of 0.78 and an average (μ) of 409, which implies a coefficient of variation (δ/μ) of 0.19 (less than 0.5). The difference in prevalence between sexes in the province of Almeria cannot be said to be attributable to an underdiagnosis of ASD in women.

4.2. Incidence

Similar to the findings in terms of prevalence, the incidence also shows a continued increase with an average annual incidence of 1.09‰ throughout the period 2009–2020. There are periods in which the identification of pupils with ASD is lower (between 2009 and 2013, as well as in 2020), and periods in which it is higher (2015–2019). There is a sustained plateau between 2015 and 2017, and an increase in 2018 and 2019.

Entrance in the cohort has followed the pattern found in the prevalence ratio between sexes, with an increase that is 4.12 times greater in men than in women, although proportionally, the increase has been very similar in men and women.

4.3. Prevalence and Incidence Forecasts

The expectation is that we will continue to see a sustained increase in the number of pupils who will present ASD in the next five years, which would mean that in

2025 there would be a prevalence in men of 18.41‰ (95% CI: 16.09–20.74) and 3.22‰ in women (95% CI: 2.27–4.17), implying that a population of 1,049 boys and girls aged between 3 and 16 years will present ASD (95% CI: 833–1,264). In other words, if one in every 65 children had ASD in 2019, this will be one in every 54 in 2025.

4.4. Comorbidity

The analysis of the comorbidities of pupils with ASD shows that both intellectual disability and attention-deficit/hyperactivity disorder are frequently associated, and therefore the difficulties faced when accessing the curriculum multiply (Flannery et al., 2020). In pupils with autism, 11% have severe or moderate intellectual disability. 12.4% of pupils with Asperger's syndrome present ADHD. Of those pupils categorised as PDD-NOS, 6.4% also have intellectual disability and 4.49% have ADHD.

4.5. Distribution

There is a concentration in certain municipalities and areas in the province of children with ASD, which implies the need to continue increasing specific resources aimed at the pupils in these areas, without forgetting those that do not live in said areas.

Environmental causes associated with the geographical distribution of ASD in the province of Almeria cannot be inferred given that the distribution of boys and girls with ASD is explained by the distribution of the overall population.

5. Conclusions

There is a steady increase in the prevalence of autism spectrum disorder in the province of Almeria from 4.58‰ in men in 2008 to 15.26‰ in 2020, and to a lesser extent for women, from 1.49‰ in 2008 to 2.71‰ in 2019. The prevalence ratio by sex is seen to remain constant over time. The incidence implies an average annual continued increase of 1.09% from 2008 to 2020. It is expected that this increase will continue in the coming years, reaching 18.41‰, in the case of men, in 2025 (95% CI: 16.09–20.74).

The comorbidities identified in pupils with ASD in the province of Almeria are in line with those described by Hossain et al. (2020) and Guerrera et al. (2019).

In terms of the distribution in the municipalities in the province of Almeria, it must be highlighted that the overall population distribution explains the ASD population distribution in the province, and that the provincial prevalence is representative of the municipal prevalence.

Predicting the evolution of the population with ASD and knowing its distribution in the province of Almeria is relevant for proposing future studies aimed at the formation of a network of centres that offer special attention for these pupils in the province, in order to give an appropriate educational response not only to pupils in

specific education centres, but also to those in ordinary education, oriented both at catering for their personal characteristics (age, gender, personal image, etc.) and their personal learning style (Tamarit-Cuadrado, 2006).

It follows that there is the need to anticipate sufficient personal resources and suitable physical spaces, and to give special relevance in the training of teachers to generalise educational measures and strategies that encourage the normalisation of the attention paid to pupils with special educational needs associated with ASD (Navarro- Montaño y Hernández-de-la-Torre, 2017).

The main limitation of this study lies in its retrospective and merely descriptive nature. There is no random verification of the cases of ASD nor the possibility of assessing underdiagnosis. The instruments used in the diagnosis and its results are unknown. This is particularly evident in the analysis of comorbidities, which recommends the initiation of a recategorisation based on the DSM-5 criteria (APA, 2014) and the ICD 11.

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