



Anthropometric measures of Spanish children with autism spectrum disorder



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ABSTRACT

We aimed to compare body mass index (BMI) and healthy eating index (HEI) in children with autism spectrum disorder (ASD, $n = 105$) and typically developing (TD, $n = 495$) children. They were aged 6–9 years, lived in Valencia (Spain) and came from similar cultural and socio-economic backgrounds. In this case–control study, the weight, height and BMI were measured for both groups. Three-day food records were used to assess dietary intake. Although the differences between children with ASD and TD children in raw BMI ($p = 0.44$), BMI z-score ($p = 0.37$), HEI ($p = 0.43$) and total energy intake ($p = 0.86$) were not significant, children with ASD and the boys subgroup were shorter ($p = 0.01$), but not the girls subgroup, compared to TD children of the same gender. Using the controls values as a reference, the BMI distribution in children with ASD became distorted, with values below the 5th percentile (11% vs. 4%, $p = 0.03$) and above the 95th percentile (8% vs. 5%, $p = 0.04$). The gender- and age-adjusted odds ratios for being underweight in the groups of all children and boys with ASD were 3.03 and 2.39, respectively, vs. TD children. Our data suggest that routine monitoring of children with ASD should include anthropometric measurements and assessment of their dietary habits.

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1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopment disability characterised by deficits of social and emotional reciprocity, and by repetitive, restricted and stereotyped patterns of behaviour and interests (APA, 2013). The prevalence of children diagnosed with ASD has increased significantly in the last few decades in the United States and other countries (Dawson et al., 2010; Matson & Kozlowski, 2011). According to recent data (CDC, 2012), prevalence is estimated at 11.3 per 1000 people, and ASD is almost 5 times more common in boys than in girls. No statistically significant differences have been detected according to socio-economic level or between the various cultures studied (Baghdadli, 2005).

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1.1. Behaviour and physiological perspective

Behavioural problems play an important role in the food habits of children with ASD. Their eating patterns tend to be governed by food aversion/refusal or preferences for certain types of food at the expense of others. Comprehensive reviews of food selectivity in children with ASD can be found in [Cermak, Curtin, and Bandini \(2010\)](#) and [Marí-Bauset, Zazpe, Mari-Sanchis, Llopis-González, and Morales Suárez-Varela \(2013a\)](#). It is sometimes possible to identify physiological weaknesses that are the direct or indirect cause of certain behavioural and eating problems. These include impaired sensory-motor processing ([Brisson, Warreyn, Serres, Foussier, & Adrien, 2011](#); [Matson, Matson, & Beighley, 2011](#); [Ming, Brimacombe, & Wagner, 2007](#); [Overland, 2011](#); [Provost, Lopez, & Heimerl, 2007](#)), cognitive and emotional dysfunction ([Nadon, 2011](#)) and gastrointestinal disorders ([Erickson et al., 2005](#); [Goodwin, Cowen, & Goodwin, 1971](#); [Souza et al., 2012](#); [Wang, Tancredi, & Thomas, 2011](#)). It is important that such conditions are not ignored because an exclusively behavioural approach to treatment in these cases can underrate the impact of organic problems on children's feeding habits ([Hsu & Ho, 2009](#); [Twachtman-Reilly, Amaral, & Zebrowski, 2008](#)). However when there are no identifiable organic factors, food selectivity can be considered the manifestation of the restricted interests and behavioural rigidity that are characteristic of ASD ([Ibrahim, Voigt, Katusic, Weaver, & Barbaresi, 2009](#); [Ledford & Gast, 2006](#)).

Many parents have also turned to alternative treatments, which include gluten-free casein-free (GFCF) diets, among others, that are generally perceived as risk-free. Several authors have described the adoption of GFCF diets.

For instance, the [National Research Council \(2001\)](#) refers to GF/CF diets as a non-established treatment and a questionable intervention in children with ASD. Equally, comprehensive reviews of GFCF diets in children with ASD can be found in [Mulloy et al. \(2010\)](#), [Mulloy et al. \(2011\)](#) and [Marí-Bauset, Zazpe, Marí, Llopis, and Morales \(2014\)](#). As suggested in these reviews, the effectiveness of GF/CF diets has not yet been confirmed.

Both selective eating and intentional diet restriction can potentially have an impact on dietary adequacy. In turn, inadequate intake may lead to the development of chronic and degenerative conditions that tend to appear in the third or fourth decade of life (cardiovascular disease, high blood pressure, diabetes, dyslipidaemia, and osteoporosis, among others) or even earlier, as in menstrual disturbances, sleep apnoea and psychosocial disorders.

1.2. Physical status: background

Atypical feeding behaviours, adoption of GFCF diets and the peculiar lifestyle of individuals with ASD (with not only different levels of physical activity, but also idiosyncratic social skills and poor social interaction) are factors that imply risks of both excessive and insufficient intakes. This could lead to abnormal anthropometric measurements, which would reflect an imbalance between energy intake and expenditure. At the same time, such measurements are an effective, although indirect, method to assess nutritional status ([Gordon, Chumlea, & Roche, 1988](#); [Roche & Malina, 1983](#)).

Despite concerns first being voiced more than 50 years ago ([Kanner, 1943](#)) and ongoing discussion about problematic eating behaviours in ASD, several authors ([Herndon, Di Guiseppi, Johnson, Leiferman, & Reynolds, 2009](#); [Keen, 2008](#)) have stated that abnormal growth appears to be relatively rare, and no differences in body mass index (BMI) have been found between children with ASD and typically developing (TD) children. However in the largest study of nutrient intake conducted on food in children with ASD to date, [Hyman et al. \(2012\)](#) observed that more 2–5-year-olds were overweight or obese, and more 6–11-year-olds were underweight, than in the matched cohort. Other groups have also found cause for concern; for instance, [Xiong et al. \(2009\)](#) reported that children with ASD scored high height, weight and BMI values; in contrast, [Al-Farsi et al. \(2011\)](#) and [Marí-Bauset, Zazpe, Mari-Sanchis, Llopis-González, and Morales Suárez-Varela \(2013b\)](#) found higher underweight rates in children with ASD than in TD children.

Our main aim was to assess the BMI and nutritional intake of children with ASD and TD children in Spain. Based on the data available in the literature prior to the study, we hypothesised that the association among total energy intake, HEI and BMI would differ between groups.

2. Methods

We conducted a case-control study in Valencia (east Spain) to assess the anthropometric parameters and dietary intake in children with ASD and TD children. The study was carried out in the second half of 2013.

2.1. Participants

Children with ASD (cases) were recruited from special schools for children with this disorder and the mainstream elementary schools with support for the inclusive education of such children in Valencia. Overall fewer girls than boys with ASD attended these schools, which is in line with the gender imbalance in the prevalence of this disorder. Children's diagnoses of ASD were based on the Autism Diagnostic Observation Schedule-Generic (ADOS-G) ([Le Couteur, Haden, Hammad, & McConachie, 2008](#); [Lord et al., 2000](#)); the Autism Diagnostic Interview-Revised (ADI-R) ([Lord, Rutter, & Le Couteur, 1994](#)); and the clinical opinion of an experienced clinical psychologist. Disorder severity was not considered, only the diagnosis. Candidate families were sent a letter inviting them to participate. Those who responded positively were first screened for eligibility by telephone and, if eligible, were then given an appointment. Non-responders were contacted by

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