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Research Article

Autistic Children Food Habits and the Risk of Running Malnutrition in Morocco

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Abstract

Background and Objective: In Morocco, the efforts done to track autism therapy response are limited, so many autistic children's parents look for guidance from random resources. This study, therefore, helps to prepare a special guide for them. Its main objectives are evaluating the nutritional status of a sample of Moroccan autistic children with respect to that of healthy children and defining the autism spectrum disorders' impact on the eating habits and health status. **Materials and Methods:** The study involves a group of 325 autistic children and a control group of 325 healthy children. A descriptive cross-sectional survey was conducted using a mixed questionnaire. The anthropometric measures used (weight, height and age) meet the WHO standards. The blood was collected from the patients for some biological tests. Chi-square analyses were used to evaluate the statistical significance of differences between proportions of categorical data. **Results:** All statistics of autistic children are significantly higher than those of the control group ($p < 0.05$) both in types of malnutrition and in the essential elements deficits (38 against 24%, respectively). This discrepancy is explained by some autistic children nutritional habits such as food selectivity and food refusal. Concerning parents, their level of education (low, medium, high) was found to be inversely related to the malnutrition of their children (50, 37 and 13%, respectively). **Conclusion:** This study tried to demonstrate that autistic children run a higher risk of malnutrition owing to their eating habits and that there is a reversal relationship between the parents' education level and the malnutrition of their autistic children. This implies the increasing of the education's level of the parents to decrease the severity of autism.

Key words: Malnutrition, autism spectrum disorders, food habit, education level, Morocco

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The WHO defines the autism spectrum disorders (ASD) as an umbrella term that covers conditions such as autism, childhood disintegrative disorder and Asperger syndrome. Core psychological symptoms include a variable mixture of impaired capacity for reciprocal socio-communicative interaction and a restricted, stereotyped repetitive repertoire of interests and activities¹. Organic symptoms include intestinal and metabolic disorders². Numerous genetic and environmental factors can aggravate these symptoms problem and patient care is still complex, combining a psychological and dietetic approach in addition to medication when necessary³.

The number of children diagnosed with ASD has grown recently at what many call an alarming rate. The public health authorities are thus compelled to initiate or support more research of this problem in view of informing the development of policies and services to support children with ASD and their families. The Centers for Disease Control and Prevention (CDC) estimated a 15 percent increase in autism prevalence among US children from 1 in 68 to 1 in 59 between 2014 and 2018, respectively⁴. The Public Health Agency of Canada released the first national ASD prevalence estimates among children aged 5-17 years for 2018. Their report estimates that 1 in 66 Canadian children and youth have an ASD diagnosis⁵. In the Arab world, statistics are significantly lower, ranging from 1.4-29 in 10 k^{6,7}.

In Morocco, so far, there are no field based statistics and the national center for autistic children figure of nearly 340,000 ASD children (1 in 100) which is circulating, is an estimate done only by comparison with countries where statistics exist and which have a socio-economic and cultural environment similar to that of Morocco. This absence of statistics is coupled with the absence of serious ASD related scientific research in the country. ASD is thus not included in Moroccan public health policy making as a real societal problem.

Most field studies of ASD have focused essentially on the evaluation of its etiological agents and too little attention has been paid to the evaluation of autistic children's nutritional status. In fact, many ASD children parents complain from the bad nutrition habits as well as from the poor health status of their children. This complaining is supported by several previous studies that proved that ASD children are at higher risk of malnutrition than normal children⁸⁻¹⁰. In Morocco however, the average of malnutrition among all children is already quite high¹¹. In investigating this relationship between

ASD and malnutrition, it was thus necessary to first illuminate cases where malnutrition is due to either certain types of diseases or simply to poverty.

Given the absence of any serious ASD related scientific research in Morocco and to the marginal status of ASD in health policy making of the country, the main objective of the present study is to supply some real field data that would hopefully contribute to the increase the awareness of health policy makers to the real social and economic impacts of ASD. The study also aims to evaluate the impact of ASD on a child's eating habits by establishing their nutritional status and comparing it with that of healthy children. This will hopefully make a first step in the establishment of a nutritional guide for Moroccan autistic children.

METHODOLOGY

Ethical clearance and informed consent: This study was approved by the Internal Ethics Committee of the Faculty of Science, Kenitra, Morocco. The recruitment of patients is based on the following criteria: The children's parents must write a consent to have their children participate in the study, the children must be physically healthy, free of any restrictive diets and not having undergone any treatment recently and not presenting a disease or poverty related malnutrition.

Target population: The research data of this paper is based on 325 autistic children consulting at the child psychiatry department of the ERRAZI University Hospital in Salé, Morocco and on a control group of 325 healthy children, during one year, from October 31st, 2016 to November 3rd, 2017:

- **Autistic children's group:** 6-11 years old. 170 of them are girls and 155 are boys
- **Control group:** between 6 and 12 years old. 156 of them are girls and 169 are boys

Research tools: The data was collected from the patients' anthropometric measures, in keeping with the standards of the World Health Organization and the United Nations Children's Fund¹² and by means of a detailed questionnaire filled in by the parents.

Anthropometric measures and biological tests: Three parameters were taken into consideration: Weight, height and age. Accordingly, a digital scale was used to measure the weight within an accuracy of 0.1 kg, a height gauge was used

to measure the height within an accuracy of 1 mm and birth certificates were used to check the respondents' respective ages.

The blood was collected from the patients for the following biological tests: Prealbumin, vitamin D and essential elements (calcium, zinc and iron).

Questionnaire: It was divided into three main sections, the first has been devoted to general information about the respondent, the second to medical and surgical history and the last part to a quantitative and qualitative diet survey to investigate the respondents' eating habits.

Statistical treatment of the data: The data collected were entered on the Excel database, 2010 version and processed using the SPSS Statistics Software Package, version 18.0.

Chi-square analyses were used to evaluate the statistical significance of differences between proportions of categorical data and a $p < 0.05$ was used to determine statistical significance.

RESULTS

The age, weight, height and BMI of the subjects are shown in Table 1. There was no significant difference in the age and height in the autistic and control group. However, the control group was significantly ($p < 0.05$) heavier than autistic group, the average weight was 27.11 ± 6.00 and 21.26 ± 7.77 , respectively for control group and autistic group.

The difference was also significant in BMI ($p < 0.05$). The average BMI was 21.74 ± 2.23 and 15.55 ± 2.98 , respectively for control group and autistic group.

Table 2 shows the types of malnutrition in relation to BMI for both groups of children. The difference was significant in the total percentage of malnourished children ($p < 0.05$). There were 38.8% malnourished autistic children versus 24% malnourished children from the control group.

Concerning the types of malnutrition, there was no significant difference in growth retardation but the percentage of underweight and thin autistic children was significantly higher than the control group ($p < 0.05$). There were 23.38% of underweight children and 5.85% of thin children amongst autistic children versus 12% of underweight children and 3.1% of thin children amongst the control group. None of the subjects has overweight.

Figure 1 shows the percentage of children having essential elements and Prealbumin deficits. The difference between ASD and healthy children was significant for all essential elements and Prealbumin deficits ($p < 0.05$).

The autistic children group's deficits percentages were higher than those of the control group. These are respectively 27 vs. 14% for Calcium, 32 vs. 21% for Iron, 14 vs. 7% for Zinc, 19 vs. 9 for Vitamin D and 17% vs. 8 for Prealbumin.

Table 3 shows ($p < 0.05$) a significant reverse connection between the level of education of parent and the malnutrition of their children. Autistic children whose parents have low education level came first with 50% followed by medium level parents with 46% then parents with high level of education with 13%.

Table 1: Anthropometric parameters of autistic children and of the control group

Parameters	Autistic children $\pm$ standard deviation	Control group $\pm$ standard deviation	p-value*
Age (years old)	6.64 ± 0.9	7.12 ± 2.00	0.954
weight (kg)	21.26 ± 7.77	27.11 ± 6.00	0.001
height (cm)	134.78 ± 14.50	136.14 ± 13.2	0.298
BMI (kg m^{-2})	15.55 ± 2.98	21.74 ± 2.23	0.00123

*P: Significance threshold

Table 2: Distribution of the children's corpulence according to body mass index

Malnourished	Autistic children (%)	Control group (%)	p-value*	OR**
Total	38.80	24.0	0.0001	1.91
Underweight	23.38	12.6	0.0003	1.65
Growth retardation	8.92	8.3	0.1000	0.23
Thinness	5.85	3.1	0.0001	1.98

*P: Significance threshold, **OR: Odds ratio

Table 3: Distribution of the respondents and the children's percentages according to the parents' level of education

	Thinness	Underweight	Growth retardation	Total (%)	p-value
Low	10	42	10	62 (50.0)	0.004
Medium	7	25	14	46 (37.0)	
High	2	9	5	16 (12.9)	

P: Significance threshold, Low: None+primary, Medium: High school, High: Higher studies

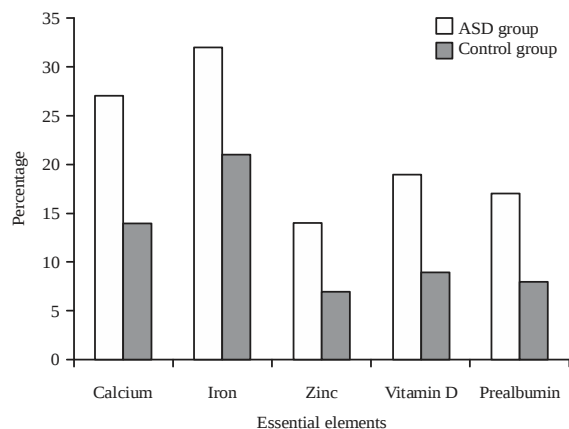


Fig. 1: Percentages of essential elements deficits

DISCUSSION

This cross-sectional study has been carried out in order to evaluate the nutritional status of children with ASD in Morocco with respect to that of healthy children. In the lack of any previous studies in this field, our data provide a baseline for comparison between Morocco and other countries.

The statistical analysis of the collected data shows that 38.15% of the autistic group presents malnutrition with respect to 24% in the normal group. The difference between these two values is significant ($p < 0.05$) indicating that malnutrition of the 325 surveyed ASD children is considerable (Table 2). In a study done by UNICEF¹³, the analysis of anthropometric parameters of healthy Moroccan children showed that 28.2% of them had malnutrition and that one third of these malnourished children had underweight. These statistics are in agreement with the findings of the present study (Table 2) and corroborates its finding that the malnutrition percentage among the autistic group is really higher than that of the normal group.

These results are also totally in line with another study done in Oman in 2011 that found an overall tendency among preschool ASD children towards being malnourished with an overall prevalence of malnutrition of 9.2%⁹. Like in the present study, the most common type of malnutrition in Oman was underweight and none of the participants showed evidence of overweight or obesity⁹. This is contrary to results of previous studies done in North America and Europe where evidence of overweight or obesity of ASD children is reported. 42.6% and 8% of ASD children were found to be obese by Ho *et al.*¹⁴ and Bolte *et al.*¹⁵, respectively. This substantial difference between developed and developing countries can be explained by the difference in socioeconomic factors and in dietary habits.

In the essential elements deficits (Fig. 1), autistic group rates are also significantly higher than control group's rates ($p < 0.05$). This is in agreement with other study done in Denver, Colorado between 2002 and 2006 showing that children with ASD had also lower percentages in Calcium Magnesium, vitamin D and Protein¹⁶.

In our survey, trying to find a connection between ASD and malnutrition, we found that diet selectivity, food refusal and novelty refusal are the most frequently mentioned dietary problems that have a direct influence on the health status of ASD children. The parents mentioned children food selection criteria such as type, texture, food smell but also packaging, color and presentation. Food refusal can cause various aversion reactions, which can be extended to all similar and new aliments. Some autistic children can refuse to taste any food that gets into contact with aversive food, which contributes to the development of a nutritional deficiency.

This is in line with previous studies that showed that autistic children run a bigger risk of developing a nutritional deficiency because of therapies, restrictive diets, abnormal food practices, limited and repetitive food consumption habits, parental beliefs regarding nutrition and medicines use¹⁷. The food restriction imposed on children by ADS results in a significant diminution of their food intake which itself results in malnutrition. This is indicated by a study that showed that autistic persons consume no more than 80% of the Recommended Daily Allowance (RDA), which makes them more likely to develop malnutrition¹⁸. Essential elements deficits are found in study done in Japan to be related to these various eating habits which result in a limited food repertoire that appears to be associated with malnutrition¹⁹.

Guidelines on how to minimize the effects the eating habits of ASD children on their health status are rare. In order to mitigate these effects in the present study, we adopted, depending on the parents' education level, the following two different strategies: (i) In the case of parents with high education level, we trained them to adopt the hierarchical desensitization steps when presenting the refused food to the child and (ii) In the case of parents with low and medium education levels, we just advised them, not to mix aliments with different colors or textures in the same meal except when they are mixed and grounded with a relative abundance of the preferred food to that the overall unified taste, shape and color is accepted by the child.

Concerning parents, we noticed that the higher their education level is the less severe is the ASD of their children ($p < 0.05$). This is explained by the fact that the education level of parents defines how aware of they can be of importance of ASD related information in improving the child health status

and how easy they can obtain such information. Parents with high education usually, when facing a problem would most likely seek advice from a psychiatrist or a nutritionist, whereas low education level parents would mostly look for information in the internet or from other ASD children parents or even from traditional religious and witchcraft sources. A study done in France in 2004 found also a reverse connection between the level of education of parents and malnutrition of their children²⁰.

CONCLUSION

This study had tried to demonstrate that there is a direct relation both between the Autism Spectrum Disorder and malnutrition and between the educational level of parents and the severity of the ASD of their children. The autistic children run a higher risk of malnutrition because of their eating habits of which the most frequent are diet selectivity, food refusal and novelty refusal.

The direct relationship between the education level of parents and the malnutrition of their autistic children implies that one very important way of decreasing the severity of autism would be the increasing of the level of awareness and education of the parents.

In the total absence of previous studies of ASD children in Morocco, the present study aims to be a first step in the establishment of a nutritional guide for Moroccan autistic children. Further studies are needed, including larger samples of autistic children over a broader age spectrum. Such a guide one finished would first be of great help to ASD parents and secondly help the public health policy makers be aware of the significant socio-economic impact of ASD and include it in the health policy of the country.

SIGNIFICANCE STATEMENT

As a Middle East and North Africa (MENA) country, basing on wheat and dairy products, where tradition and economical level push all family members to eat together and where malnutrition is already common, it's hard to accept that eating habits related to autism can run the risk of having malnutrition but this study confirmed that ASD affects directly on the health status of children whatever was the life environment. The findings will be the basis of other studies (a.e. the effectiveness of gluten-free casein-free diet in MENA countries) to prepare a special guide taking inconsideration

cultural and economic situation of Morocco and similar countries to help parents and to make recommendations to the concerned authorities to pay more attention and care to this category. Add to this, this study, can be a foundational idea of a new theory relating traditional eating habits of countries to the autism therapy response.

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