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Childhood Autism: Clinical Characteristics, Nutritional Status, and Psychosocial Features

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ABSTRACT

Introduction: **Autism spectrum disorder (ASD) is a set of neurodevelopmental disorders characterized by a deficit in social behaviors and nonverbal interactions onset in the first 3 years of life. Therefore, the present study aimed to study the clinical features, nutritional status, risk factors, and behaviors of children with autism.**

Methods: **Across section study involved a total of 100 subjects 74 (76%) male and 26 (24%) female. The ages of the children were ranging from 3-17 years old. The self-administration questionnaire containing questions on behavior, health problems, nutritional status, and risk factors was also completed. Bodyweight and height were measured to calculate the BMI percentile. Laboratory tests such as blood glucose and HbA1C, vitamin D were included. Clinical and behavioral information is also involved. All samples were analyzed through either mean ±SEM or Chi-square to determine significant differences.**

Results: **The present study shows that the majority of the children have age 7 years old, and autism increased significantly at ages between 6-10 years ($P<0.05$). In comparison to females, a male has three times more affected by autism ($P=0.000$). There were many points identified in the study including autism onset started between 1-3 years, blood groups of parents O+ significant resultant in offspring with O+ blood groups, 20% of subjects have positive family history and consanguinity for each. The behavior of autistic children shows that children like playing with electronic IPAD, dislike hearing crying, and less sleeping hours than normal people but they have similar food attitudes and consumption compared to normal counterparts. Impairment in communication was the most common sign of autism and less like hours for play. Obesity was a common nutritional disorder and food behavior has been seen toward some foods. The common health problems reported were epilepsy, respiratory diseases, constipation, and UTIs.**

Conclusion: **The present study revealed that some behaviors, risk factors, health problems, and abnormal levels of calcium, hemoglobin, and vitamin D were determined. Furthermore, increase body weight some behaviors toward certain types of foods have been identified. This study suggested that routine monitoring of children with autism should include assessment of blood groups, dietary habits, as well as anthropometric measurements.**

Keywords: Autism, behaviors, health problems, nutritional status, risk factors.

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I. Introduction

Interaction, communication, and imaginative play and being onset in the first 3 years of life [1]. The neuroimaging studies provide an important picture of the pathological changes in the brain of patients with ASD in vivo [2], [3]. The [4] has classified autism as a pervasive developmental disorder. The neuropathological and genetic bases of autism development are being studied in which autism has been found to increase by 50 to 200 times more in siblings of autistic probands than in the general population [3]. There is also an increased prevalence of milder forms of developmental difficulties related to communication and social skills in probands' relatives who do not have autism [5].

The environmental factors such as exposure to mercury, cadmium, nickel, trichloroethylene, vinyl chloride [6], MMR vaccine [3], food triggers [7], birth weight, parental history of autism [8], male gender [9] are considered a part of risk factors implicated in the development of autism.

Autism is considered a relatively rare condition. Based on the data from Centers for Disease Control and Prevention (CDC), estimates that the prevalence of autism is 1 in 88 children, occurring in all racial, ethnic, and socioeconomic groups [10]. Instead, no differences have been detected as a function of socioeconomic or cultural background [11].

Children with autism usually manifest with non-specific

symptoms such as unusual sensory perception skills and experiences, insomnia, mental retardation, emotional indifference, hyperactivity, aggression, self-injury, and hand-flapping [4], [12]. Repetitive, stereotyped behaviors are often accompanied by cognitive impairment, seizures or epilepsy, gastrointestinal complaints, disturbed sleep, and other problems [13].

For physical activities [14] found that children with autism predominantly engaged in solitary play rather than social play activities. Furthermore, [14] concluded that gender, family income, and household structure were associated with activity scores and physical barriers due to financial burden. The nutritional status of children with ASD reported that abnormally accelerated rate of growth among children and inconsistent findings on the prevalence of overweight/obesity has been noticed in comparison with typically growing children [15], [16]. Many Studies reported that Children with ASD commonly have feeding problems including food refusal, limited dietary intake, and behavior problems at mealtimes. The prevalence of autism has been raised in recent decades and is now regarded as a relatively common neurodevelopmental disorder [17], [18]. Due to the lack of significant data about autism in Libya, therefore, the present study aimed to study the risk factors, nutritional status, health problems, and behavior status of children with autism.

II. Methods

A. Study Population

A cross-sectional study was carried out from October 2018 to May 2019 in an autism center in Benghazi, the second-largest city in Libya.

The target groups in this study were the all age groups attending the Benghazi autism center. The samples of 100 subjects (26 male and 74 female) and the age of participants between 3-17 years were involved in the study. After obtaining written consent, the participants' parents were requested to fill out a questionnaire and the participants proceeded to a private area to have their height and weight measured. Although we approached a different number of subjects and the final completed questionnaires in hand were 100. Hence, our overall response rate was 99%.

B. Clinical Characteristics

Include medical history and health problems.

C. Nutritional Status

Include food intake, biochemical investigation, and anthropometrics.

D. Psychosocial Factors

Psychosocial factors investigated the characteristics that influence child behaviors, social communications, physical and mental health, and emotional changes.

E. Measurements

Weight and height were measured after completion of the questionnaires and handed in by two students. Height was measured to the nearest 0.1 cm using a standard calibrated scale attached to the balance against a wall. Weight was measured to the nearest 0.2 kg using the weighing machine. The BMI was calculated using Quetelet's formula [(weight (kg)/height² (m²)] and Children's height, weight, and BM was subsequently plotted on their CDC clinical growth charts (children ages 2– 20 years) [19]. The interpretation of BMI was based on CDC classification as follows: being obese (≥ 95th percentile), overweight (>85th and <95th percentile), normal (>5th to <85th percentiles), and underweight (<5th Percentile) [19]. The z-scores of weight-for-age (WAZ) and height-for-age (HAZ), and BMI-for-Age (BAZ) were computed and classified according to the WHO criteria: as the following Stunted with HAZ <-2, Underweight with WAZ <-2, Wasted with BAZ <-2, At the risk of overweight, overweight and obese with BAZ >1, >2, and >3, respectively [20].

F. Questionnaire

The questionnaire for this study based on 36 items is divided into four sections. It contained questions about personal information, demographic and socioeconomic characteristics, physical activity and personal habits, family history of autism, type of autism, biochemical investigations, history of the disease, health problems, behaviors, and types of food intake.

G. Dietary Intake

The dietary intake of children was assessed by using food frequency questionnaires and the analysis of dietary intake was done by using a Computerized Nutrient Analysis Program "ESHA software" (version 10.63).

H. Biochemical Tests

The laboratory tests include testing hemoglobin, Vitamin D, Calcium, and lipid profiles. Data were collected through semi-structured interviews and from the medical records of patients.

I. Ethical Statement

This study was approved by the local Ethics Committee of the Benghazi province. Informed written consent was obtained through a consent form that was given to the participants along with the questionnaire.

J. Statistical Analysis

The data from the questionnaires were entered using Excel. The data set was exported to SPSS v.18 and Epi-info for complete analysis. Statistical analysis was carried out for the complete sample which was created according to measured BMI: underweight, normal, and overweight. Mean values and standard deviation for all continuous variables: weight, height, BMI percentile, age, genders, and other variables for all groups were obtained. Frequencies for each categorical variable were calculated for each group as well. To determine the differences regarding each categorical variable in the groups, the Chi-square test was done.

III. Result

In Table I, there was a significant increase in autism among males (76% vs 24%) (P=0.000). The age of participants ranges from 3 to 17 years old with an average age was 7.7± 2 years. The peak ages of the autism shown at 7 years old (24%) followed by age of 8 years old (21%) (Table II). However,

autism has been shown to increase with age and significantly increase in age groups between 6-10 years (P=0.000) (Table III A).

The most common age of autism onset was found significantly between age 1-2 years and 2-3 years of life (P=0.01) (Table III B).

TABLE I: GENDER DISTRIBUTION OF THE PARTICIPANTS

Gender	N	N %	*P-values
Male	76	76.0%	0.000
Female	24	24.0%	
Total	100	100.0%	

*Chi-square test was performed at α <0.05.

TABLE II: AGE SPECIFIC OF THE PARTICIPANTS

Ages in years	N	N %
3	2	2.0%
4	10	10.0%
5	2	2.0%
5.5	1	1.0%
6	13	13.0%
7	24	24.0%
8	21	21.0%
9	10	10.0%
10	5	5.0%
11	3	3.0%
12	5	5.0%
13	1	1.0%
14	2	2.0%
17	1	1.0%
Total	100	100.0%

TABLE III A: AGE CATEGORIES OF THE PARTICIPANTS

Age categories		N	N %	P values
Age in years	3-5 yr.	14	14.0%	0.000
	6-10 yr.	74	74.0%	
	11-17 yr.	12	12.0%	
	Total	100	100.0%	

*Chi-square test was performed at α <0.05.

TABLE III B: AGE CATEGORIES OF AUTISM ONSET IN PARTICIPANTS

Age of autism onset	N	N %	*P-values
After birth	8	8.0%	
First-year	6	6.0%	
1-2 years	36	36.0%	0.01
2-3 years	35	35.0%	0.01
3-5 years	13	13.0%	
After 5 years	2	2.0%	
Total	100	100.0%	

*Chi-square test was performed at α <0.05.

As a part of the risk factors implicated in the development of autism, the blood groups of the parents were investigated and found that the blood group showed an independent risk factor for offspring autism, the coupling of parents with blood groups O+ result in significant offspring with autism and have blood groups +O (p<0.05) (Table IV). Furthermore, as shown in Table V, the most common kinds in the family have autism was those family with one and two children 68%, and 23% respectively. The ranking of kids with autism in the family those on 1 and 2 (28% and 27% respectively). The labor situation of the participants was found more than two-thirds normal delivery. Family history of autism and consanguinity did not show significant trends and were attributed to developing autism (20%) (Table V).

TABLE IV: BLOOD GROUPS AS RISK FACTORS FOR AUTISM

		N	N %	*P-values
Father blood groups	A+	17	17.0%	
	A-	8	8.0%	
	B+	14	14.0%	
	B-	6	6.0%	
	AB-	9	9.0%	
	AB+	2	2.0%	
	O+	38	38.0%	0.02
	O-	6	6.0%	
	Total	100	100.0%	
Mother blood groups	A+	23	23.0%	
	A-	9	9.0%	
	B+	20	20.0%	
	B-	6	6.0%	
	AB+	1	1.0%	
	AB-	2	2.0%	
	O+	35	35.0%	0.02
	O-	4	4.0%	
	Total	100	100.0%	
Participants' blood group	A+	13	13.0%	
	A-	10	10.0%	
	B+	12	12.0%	
	B-	7	7.0%	
	AB+	6	6.0%	
	AB-	5	5.0%	
	O+	40	40.0%	0.001
	O-	7	7.0%	
	Total	100	100.0%	

*Chi-square test was performed at α <0.05.

TABLE V: RELATIVE RISK FACTORS

Character		N	N %
No of the kids have autism	1	68	68.0%
	2	23	23.0%
	3	8	8.0%
	5	1	1.0%
	Total	100	100.0%
Kids rank in the family	1	28	28.0%
	2	27	27.0%
	3	18	18.0%
	4	12	12.0%
	5	7	7.0%
	6	3	3.0%
	7	4	4.0%
	Total	100	100.0%
Baby birth	Full-term	76	76.0%
	preterm	20	20.0%
	post-term	4	4.0%
	Total	100	100.0%
Family history of father and father relative of autism	Yes	16	16.0%
	No	84	84.0%
	Total	100	100.0%
Family history of mother and mother relative of autism	Yes	6	6.0%
	No	94	94.0%
	Total	100	100.0%
Marriage with relative(consanguinity)	Yes	20	20.0%
	No	80	80.0%
	Total	100	100.0%

For the behaviors and social communication, the present work revealed that the most common things the children like were electronic games (IPad) followed by watching TV (20% and 12%). In comparison to things like the children, the disliked things were 23% hearing crying, and 15% high voices (Table VI A). Also, in Table VI B, the autism is most likely determined by doctors (58%) and 25% by a

psychologist.

TABLE VIA: PARTICIPANTS' BEHAVIORS AND IDENTIFIED AUTISM IN THE CHILDREN

Behaviors and recognized of autism		N	N %
Most things the participant like	No	15	15.0%
	Play with water	5	5.0%
	Like watch TV	12	12.0%
	Song	4	4.0%
	Play with soil	9	9.0%
	Play outdoor	8	8.0%
	Reading	9	9.0%
	Writing	9	9.0%
	Electronic games (IPad)	20	20.0%
	mobile	9	9.0%
	Total	100	100.0%

TABLE VIB: PARTICIPANTS' BEHAVIORS AND IDENTIFIED OF AUTISM IN THE CHILDREN

Behavior and recognition of autism		N	N%
Most things disliked by the participants	No specific	27	27.0%
	Hearing crying	23	23.0%
	High voice	15	15.0%
	Forcing for eating	10	10.0%
	Cutting nails	9	2.0%
	Forcing to take medications	6	6.0%
	Turn off TV	10	6.0%
	Total	100	100.0%
Recognize and diagnose autism	Doctors	58	58.0%
	Through an internet	8	8.0%
	Psychologist	25	25.0%
	Family experts	6	6.0%
	Relatives	3	3.0%
	Total	100	100.0%

In Table VIIA 85% of participants slept well with a significant decrease in the average sleeping hour between 4-6 hr/day ($p<0.05$) (Table VIIA).

Autism participants were shown mostly complain of special characters include impairment of communication and combined socially communication impairments, and independent plays (24% and 20% respectively). The majority of participants performed a kind of daily physical activities including play by its games (37%) and this type of physical activities done in a short time (less than 1 hour vs 40%) (Table VIIB).

In Table VIII 50% of the participants have moderate autism while 48% suffer from mild autism by which both mild and moderate were common.

Regarding the clinical signs and complications, about 29% of the participants suffering from autism complain of epilepsy 29% and 17% of respiratory diseases, while constipation and UTI 6 and 5% respectively (Table IX).

For the determination of nutritional status, the biochemical investigation of the participants found low levels of blood hemoglobin, vitamin D, and calcium (Table X).

The participants with autism did have some food hypersensitivities against some foods, particularly milk allergy (94.7%) (Table XII).

Food intake behavior of the participants has been reported in the table (XIII A-B) and found that almost all food groups with except fish were consumed by more than 50% to 77% of participants. While the others like junk foods were consumed invariable by which foods most frequently consumed empty caloric and salted foods ($P<0.05$) and less consumption food include fatty and fast foods. Furthermore, Fatty, fast foods, tea, and coffee were not commonly liked by the participants. Beverage, soft drinks, nuts, sweets and crackers, and chips were significantly consumed ($P<0.05$).

TABLE VII A: PSYCHO-SOCIAL FEATURES OF THE PARTICIPANTS

Characters		N	N %	*P-values
Participants sleeping	Yes	85	85.0%	
	No	16	16.0%	
	Total	100	100.0%	
If yes, how long	1-3 hr.	3	3.50%	
	4-6 hr.	71	83.50%	0.000
	7-10 hr.	5	5.90%	
	11-15 hr.	5	5.90%	
	> 15 hr.	1	1.20%	
	Total	85	100.0%	

TABLE VIIB: PSYCHO-SOCIAL FEATURES OF THE PARTICIPANTS

Character	N	N %	*P-values
Participants complain of	Impairment in social interaction	10	10.0%
	Both impairment socially and communication	9	9.0%
	Socially, communication impairments and independent plays	20	20%
	Impairment in communication	24	24%
	Play alone	8	8.0%
	Sensory problems	7	7.0%
	Restricted interest and repetitive behaviors	6	6.0%
	Atypical eating problems	16	16.0%
	Total	100	100.0%
Physical activities of the participants	Do not like plays	20	20.0%
	Play footballs (lonely)	8	8.0%
	Play footballs with mates	8	8.0%
	Play with mates	15	15.0%
	Play private games	37	37.0%
	Use computer	12	12.0%
	Total	100	100.0%
How long do participants play	No	20	20%
	< 1 hr.	40	40.0%
	1-3 hr.	32	32.0%
	4-6 hr.	5	5.0%
	> 6 hr.	3	3.0%
	Total	100	100.0%

*Chi-square test was performed at $\alpha < 0.05$.

TABLE VIII: TYPE AUTISM

Types of autism		N	N %
	mild	48	48.0%
	moderate	50	50.0%
	Severe (spectrum)	2	2.0%
	Total	100	100.0%

TABLE IX: PARTICIPANTS' COMPLICATIONS AND HEALTH PROBLEMS

Complications		N	N %
Health problems	No	43	43.0%
	Epilepsy	29	29.0%
	Respiratory diseases	17	17.0%
	Constipation	6	6.0%
	Urology	5	5.0%
	Total	100	100.0%

TABLE X: SOME AVAILABLE BIOCHEMICAL TESTES

Biochemical investigation	Mean± SEM
CBC (HB)	11±1
Vitamin D	10±0.3
Calcium	8±0.2

TABLE XI: PARTICIPANTS' FOOD ALLERGY AND HYPERSENSITIVITIES

BMI percentile		N	N %
Hypersensitivity against foods	Yes	38	38.0%
	No	62	62.0%
	Total	100	100.0%
If yes	Milk	36	94.7%
	eggs	2	5.3%
	Total	38	100.0%

TABLE XII: BMI PERCENTILE FOR THE PARTICIPANTS

BMI percentile	Types of autism	N	N %	*P-values
	Underweight	9	9.0%	
	Normal	11	11.0%	
	Obese	80	70.0%	0.000
	Total	100	100.0%	

*Chi-square test was performed at α <0.05.

TABLE XIIIA: TYPE OF FOOD CONSUMED BY THE PARTICIPANTS

Types of foods		N	N %
Dairy products	Yes	71	71.0%
	No	29	29.0%
	Total	100	100.0%
Vegetables	Yes	73	73.0%
	No	27	27.0%
	Total	100	100.0%
Eggs	Yes	65	64%
	No	35	25.3%
	Total	99	100.0%
Fruits	Yes	74	74.0%
	No	26	26.0%
	Total	100	100.0%
Chicken	Yes	77	77.0%
	No	23	23.0%
	Total	100	100.0%
Red meat	Yes	65	65.0%
	No	35	35.0%
	Total	100	100.0%
Legumes	Yes	67	67.0%
	No	33	33.0%
	Total	100	100.0%
Fish	Yes	56	56.0%
	No	44	44.0%
	Total	100	100.0%
Starchy foods	Yes	77	77.0%
	No	23	23.0%
	Total	100	100.0%

TABLE XIIIB: TYPE OF FOOD CONSUMED BY THE PARTICIPANTS

		N	N %	*P-values
Cereal	Rice	49	49.0%	
	pasta	24	17.0%	
	cuscus	16	5.0%	
	No	10	1.0%	
	Total	100	100.0%	
Coffee	Yes	36	36.0%	
	No	64	64.0%	
	Total	100	100.0%	
Tea	Yes	30	23.0%	
	No	70	51.0%	
	Total	100	100.0%	
Beverages	Yes	75	75.0%	0.00
	No	25	2.0%	
	Total	100	100.0%	
Soft drinks	Yes	60	60.0%	0.00
	No	40	40.0%	
	Total	100	100.0%	
Fast foods	Yes	57	57.0%	
	No	43	43.0%	
	Total	100	100.0%	
Nuts	Yes	67	67.0%	0.00
	No	33	33.0%	
	Total	100	100.0%	
Sweets	Yes	70	60.0%	0.00
	No	30	30.0%	
	Total	100	100.0%	
Chips and crackers	Chips	67	67.0%	0.000
	Crackers	23	23.0%	
Fatty foods	No	10	10.0%	
	Total	100	100.0%	

*Chi-square test was performed at α <0.05.

IV. DISCUSSION

In the present study, the average ages of the subjects were 7.7 years. The peak of autism ages was shown at 7 years old (24%). In many studies, ages of onset of autism were found in the first year of life [1], [2] and this finding disagrees with the present study by which the age of onset was between 1-2 and 2-3 years old. In the age distribution, the age of subjects with autism significant increase at an age between 6-10 years old (*P*=0.000). Autism was significantly increased by around 3 times in males than in females (*P*=0.000) and this was consistent with the previous studies conducted by [21], [22].

Regarding the risk factors, the current work investigated many risk factors or contributing factors for develop of autism, therefore, blood groups of subjects and their parents were included in the study. Interestingly, Parents with blood groups O+ would significantly result in offspring with autism carrying blood groups O+. The study carried out by [23] found that there was no association between Parental ABO Blood Type among risk factors that have been reported as many kids and kids ranking in the family. Autism was increased among the family with one kid (68%) followed by two kids (23%). Furthermore, the kids with autism ranked in the family 1 and 2 were the predominant (28% and 27% respectively). The other risk factors that were also involved include a family history of autism and consanguinity both did not show significant trends and were attributed to developing autism (20%) (Table V).

The behavior of subjects with autism includes questions

about things like and dislike by which the most things like by the children were found electronic games (IPad) followed by watching TV (20% and 12%). In comparison to things like subjects, the things dislike were found 23% hearing crying, and 15% noise. This finding might be similar and confirmed by [24] in which auditory sensitivities are common among people with autism [24].

The current work also found that autism was diagnosed by doctors (58%) and (25%) by a psychologist. In the autism center, the subjects were classified according to a type of autism, in the present study subjects with mild to moderate autism were the most common, representing about 48-50%. Furthermore, about 29% of the subjects suffering from autism complain of epilepsy (29%) and 17% from respiratory diseases. Reference [25] and [26] have demonstrated that children with autism tend to have autism in late childhood or adolescence. Regarding sleeping hours, about 85% of subjects slept with significantly average sleeping hours between 4-6 hr/day ($p<0.05$). Sleep disturbance was found endemic among children with autism [27]. Autism subjects were shown mostly complain of special characteristics including impairment of communication and combined social communication impairments and independent plays (24% and 20% respectively). The majority of subjects performed a kind of daily physical activities include play by its games (37%) and this type of physical activity done in a short time (less than 1 hour vs 40%). These findings were shown by other forthcoming publications [28]. Children and adolescents with autism have low levels of physical fitness, which led to increased risks for health-related problems such as being overweight and obese [28].

The major problem of autistic subjects in this study was shown abnormal biochemical laboratory data including slightly low hemoglobin concertation, calcium, and server decrease in serum Vitamin D concertation. In addition, some autistic subjects have particular food allergies to milk and eggs. The body weight status of the subjects was reported, by which most of the autistic subjects were shown significantly increased body weight with which BMI of obese (P=0.000). As mentioned above [28] low levels of physical fitness among autistic subjects led to increased risks for health-related problems such as being overweight and obese [28].

The food intake behavior of the subjects has been investigated and found that almost all food groups with except fish were consumed in more than 50% to 77%. While the others like those junk foods, they were invariable which foods most frequently consumed empty caloric food and also salted foods ($P<0.05$) but not fatty and fast foods. Fatty, fast foods, tea, and coffee were not commonly liked by the subjects. Beverage, soft drinks, nuts, sweets and crackers, and chips were significantly consumed ($P<0.05$).

In sum, there were many medical conditions, abnormal nutritional status, behavior alerts, and highlighted risk factors that have been determined in autistic.

V. Conclusion

The present study revealed that autism increased significantly at an age between 6-10 years old and the first onset was identified as shown in the first 3 years of life. Furthermore, there was 3 times more autism in males than females. There were many factors determined associated with autism including blood group (O+), kids ranking in the family, and parities. Furth more, autistic children have particular behavior and attitude and complain of some chronic diseases. In addition, special behavior toward food has been reported. Increased impairment of communications and independent plays with physical activities performed in a short time. The present work found abnormally low levels of biochemical blood results and most common autistic children have heavier body weight (obese). This data altogether suggested that blood groups could play part in autism development and autistic subject do have particular behavior that differs from their normal counterpart. Its highly recommended that early diagnosis of all children especially those at high risk and health education for the parents in regard the autism disorders.

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Conflict of Interest

The authors declare no conflict of interest.

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