ISSN: 2347-467X, Vol. 06, No. (3) 2018, Pg. 734-741

Current Research in Nutrition and Food Science

Journal Website: www.foodandnutritionjournal.org

The Efficacy of the Gluten-Free Casein-Free Diet for Moroccan Autistic Children

AFAF HAFID* and AHMED OMAR TOUHAMI AHAMI

Ibn Tofail University, faculty of science, department of biology, laboratory of biology and health, unit of clinic and cognitive neurosciences and health, bp 190, Kenitra, Morocco.

Abstract

The aims of this study are to verify the efficiency of gluten-free casein-free diet for children with autism spectrum disorder and to evaluate its impact on their nutritional profiles.

30 children with autism spectrum disorder, between 6 and 12 years old, had been identified for the study. An analysis of biological matrixes was performed to detect the level of urinary peptides and essential elements. A gluten-free casein-free diet was administered for children with high urinary peptides level during one year, quarterly followed-up. The scale of autism was assessed by the “Childhood Autism Rating Scale” questionnaire.

The findings, before the gluten-free casein-free diet, show that 20 children had high levels of urinary peptides and unnatural essential elements concentrations.

At the end of the sixth diet month, the results show a large decrease in essential elements concentrations for the majority of children. After identifying these deficiencies, the diet was modified and fortified in a way that made it a supervised diet. We could, then, decrease the urinary peptides level for 40% of children, improve essential elements concentrations for 30% and decrease the autism severity for 30% of them. Our study has shown that only autistic children that present both very high urinary peptide and gastrointestinal problems respond positively to a gluten-free casein-free diet. This type of died should not therefore be systematic administered to all autistic children. On the other hand, the elimination diets run risk of having deficiencies which makes the supervision of a specialist required.

Article History

Received: 26 July 2018
Accepted: 26 September 2018

Keywords

Autism Spectrum Disorder;
Casein-free;
Casomorphin;
Gliadomorphin;
Gluten-free;
Restrictive diet

CONTACT Afaf Hafid afaf.hafid88@gmail.com Ibn Tofail University, faculty of science, department of biology, laboratory of biology and health, unit of clinic and cognitive neurosciences and health, bp 190, Kenitra, Morocco.

Doi: doi.org/10.12944/CRNFSJ.6.3.15

Introduction

Autism Spectrum Disorder (ASD) affects cerebral functions.[1] It's a challenging disorder that pushes the parents to follow the long diagnosis process, to accept the particularity of their children and to start the most promising interventions as earlier as they can.

One of the approaches that have aroused the interest of many parents, and more recently of some researchers, is the gluten-free and casein-free diet.[2,3,4,5] Some authors hypothesized that the elimination of gluten and casein from the diet of children with ASD could lead to an improvement in their behavior.[6,7,8] Their proposed diet called gluten-free and casein-free, is based on the theory of opioid excess.[9] Other researchers have argued, however, that the gluten-free diet gave no evidence of its efficacy and it entails risks of nutritional deficiencies for children.[10]

In Morocco, to our knowledge, no study of the effect of nutrition on children with ASD has been published so far and the limited studies done on this subject worldwide yielded contradictory results. In order to contribute to understanding of this problem, we propose to carry out an experimental survey which aims to verify the effectiveness of a gluten-free casein-free diet on children with ASD and to evaluate the impact of this diet on their nutritional profiles.

Material and Methods

Ethical Clearance

This study was approved by the Internal Ethics Committee of Faculty of Science; Kenitra, Morocco.

Sampling Method

This study was conducted in the child psychiatry department of the ERRAZI University Hospital in Salé, Morocco. The ERRAZI Hospital is a public Institution and its child psychiatry department deals with children suffering from neurobehavioral deficiencies. Our study is based on a sample of 30 children that are 6 to 12 years old and were diagnosed with ASD. The consent of the parents has been obtained beforehand, and all children included in the study were declared in good physical health and did not need any medical therapy during the period of the study.

Methods

The state of ASD was assessed by the Childhood Autism Rating Scale (CARS), the psychological test was administered by the attending physician and the psychomotor therapist, The CARS consists of 14 domains assessing behaviors associated with ASD, with a 15th domain rating general impressions of ASD. Each domain is scored on a scale ranging from one to four; higher scores are associated with a higher level of impairment. Total scores can range from a low of 15 to a high of 60; scores below 30 indicate that the individual is in the non-autistic range, scores between 30 and 36.5 indicate mild to moderate autism, and scores from 37 to 60 indicate severe autism.[11]

An analysis of the biological matrixes (blood, urine) was carried out at the beginning of the study, after 6 months and after 12 months. It includes analysis of the following: Urinary peptides (namely casomorphin which comes from milk and its derivatives, and gliadomorphin which comes from products rich in gluten) and essential elements (iron, calcium, zinc and magnesium).

The raw concentrations of essential elements were measured in (µg / g). Creatinine is determined by the use of high performance chromatography.

A gluten-free casein-free diet was then prescribed only for children with high urinary peptide levels (20 out of 30) for a period of one year with a quarterly follow-up. The diet giving was under the supervision of a specialist physician and a nutritionist.

Results

Analyzes of peptide before the gluten-free casein-free diet revealed that only 10 subjects presented normal levels of casomorphin and gliadomorphin; respectively less than 0.56 (P/C ratio) and 0.58 (P/C ratio). This means that 20 children out of 30 have elevated urinary peptide levels, i.e. 66% of the study population.

The results of one year of gluten-free casein-free diet shows that although, there has been a very remarkable decrease in casomorphin and gliadomorphin concentrations for the whole sample only 8 children presented values exactly in the norms(figure1).

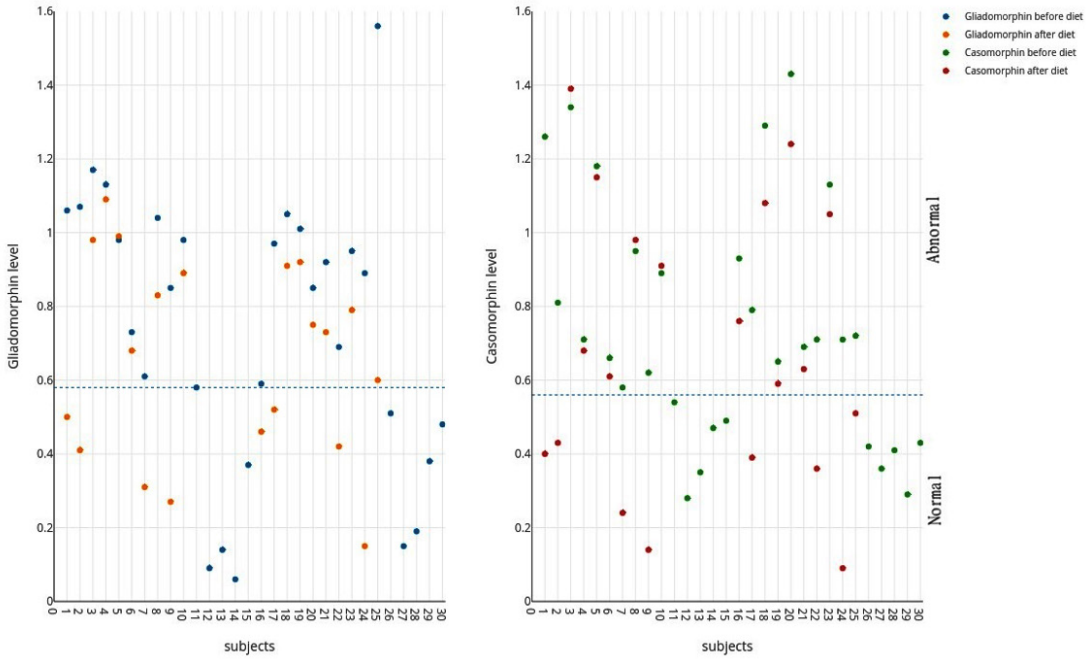

Fig.1 Urinary Peptides Levels Before and After the Diet
Relative P/C Ratio Reports (Peptides (mg/ml) / Creatinin (mg/ml))

Table 1 shows the quarterly results of analyzes of essential elements performed before and during the 12-month gluten-free casein diet.

Before the Diet

The majority of children of the sample present an abnormal level of essential elements: 8 of them have a calcium deficiency with values below 350 µg/g, 8 have a low magnesium level which is less than 35 µg/g, 10 have a hemoglobin level of less than 70 µg/g and for zinc 4 children have values below the norm which is less than 130 µg/g.

After Six Months of Diet

The results indicate a large decrease in essential elements concentrations for the majority of children: the number of children presenting a deficiency increased from 8 to 12 for calcium, from 8 to 10 for magnesium, fromc 10 to 16 for iron and 4 to 6 for zinc. After identifying these deficiencies, the diet was modified and fortified in a way that made it a supervised diet that meets both the expectations of our study (gluten-free casein diet) and the nutritional needs of each child.

After 6 months of the supervised diet, and with a regular follow-up every 3 months, we note that there is a remarkable improvement on the nutritional status of our sample: 9 out of 12 children no longer suffer from calcium deficiency, 6 out of 10 do not have a deficiency in magnesium any more, 12 out of 16 are no longer anemic and the fortified diet has corrected the problem of Zinc for 4 in 6 children.

Table 2 presents the results that the CARS test revealed before, during and after our diet. The scores after 3 months of the diet were not satisfactory enough, yet a decrease was remarkable from the 6th month of the monitored diet in almost the entire sample. At the end of the 12th month, the decrease was more significant in 12 subjects (Subject: 1; 3; 5; 8; 13; 15; 18 and 20).

Discussion

As stated above, our study was conducted on a group of children with ASD in order to verify the efficacy of the casein-free gluten-free diet in children with ASD and to evaluate the impact of this diet on their nutritional profiles.

Table 1: Quarterly Monitoring Of Raw Essential Elements Before And After Administration Of Gluten-Free Casein Diets (µg / G)

	Before The Diet				After Six Months Of Diet				After Six Months Of Monitored Diet			
E.E*	Calcium	Magnesium	Iron	Zinc	Calcium	Magnesium	Iron	Zinc	Calcium	Magnesium	Iron	Zinc
R*	350-1000	35-120	70-175	130-220	350-1000	35-120	70-175	130-220	350-1000	35-120	70-175	130-220
S*1	287	19	65	103	225	21	52	89	336	26	85	125
S2	645	91	70	221	304	88	61	220	919	121	104	241
S3	798	86	63	121	765	59	51	107	1060	76	61	131
S4	293	28	57	97	264	27	49	57	568	34	89	73
S5	495	58	97	102	189	47	95	275	854	98	156	267
S6	259	102	103	298	385	95	64	197	786	106	132	301
S7	589	31	56	206	289	28	49	187	653	66	65	243
S8	743	65	136	157	385	33	119	201	950	103	136	160
S9	234	135	89	206	198	120	61	160	495	165	120	201
S10	1132	21	53	287	812	17	59	250	1630	78	74	289
S11	168	16	71	160	131	18	62	153	204	36	95	168
S12	546	45	59	135	265	39	49	123	367	45	103	142
S13	958	22	61	158	756	14	56	140	846	21	90	149
S14	256	68	36	196	195	51	31	190	351	52	54	217
S15	1002	95	99	201	824	96	69	212	856	102	86	216
S16	638	30	126	138	497	24	105	109	528	41	121	142
S17	94	35	41	141	90	31	35	139	124	52	101	147
S18	745	83	145	186	627	80	116	185	702	82	115	202
S19	101	11	39	130	89	12	33	118	350	28	60	138
20	425	107	86	154	232	101	68	141	395	132	83	151

*E.E= Essential elements *R= Reference range *S= Subject

Table 2: CARS Scale Scores Before, during and After Gluten-Free Casein-Free Diet

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Before the diet	54	35	48	34	41	35	33	51	37	34	57	49	52	39	42	58	50	45	39	49
After 3 month of diet	53	36	47	35	41	34	34	50	37	33	56	48	50	38	41	58	50	43	38	45
After 6 month of diet	46	34	40	34	37	33	33	45	36	33	56	48	41	38	38	57	49	44	39	43
After 12 month of diet	40	35	35	34	35	34	33	41	37	34	56	49	34	39	31	58	51	35	38	38

-Scores between 30 and 36.5: mild to moderate autism
-Scores from 37 to 60 indicate severe autism

Before presenting the results of this study and discussing them in light of these previous works, we propose to describe the problems that this study encountered. These problems are linked to the fact that Morocco is a country that follows a Mediterranean diet where wheat and dairy products are kings, and where the prices of substitute products existing in the market (gluten-free bread, gluten-free pasta, soy milk …) are relatively expensive and very difficult to cook with. The non-vigilance of parents or caregivers and especially the difficulty of forcing a child with ASD to abandon his eating habits farther complicate the task of administering a gluten-free and casein-free diet.

Before the onset of the diet, urine peptide analyzes of the subjects indicate that 20 out of 30 children had high levels of casomorphin and gliadomorphin in their urines (figure 1), i.e. 66% of our sample. This is in accordance with previous works that reported abnormally high concentrations of casomorphin and gliadomorphin in urines of children with ASD.[12,13,14] In fact, casomorphin and gliadomorphin are very toxic substances that come from the incomplete digestion of a milk protein (casein); and a cereal protein (gluten) and children with ASD tend to mis-assimilate casein and gluten. During digestion, these proteins release peptides opioids that reach the brain in a form similar to that of morphine, thus causing similar behavioral problems in these children such as isolation, and unusual distress.[15]

Blood Analysis before starting the diet indicates that the majority of children have a deficiency in Calcium, Magnesium and Iron (table 1). This is in agreement with previous studies about children with ASD's nutrition that show low levels of vitamins D and calcium[16] and with other ones that show poor absorption of proteins, and vitamin B12 and iron deficiencies.[17,18]

Research has shown that children with ASD suffer from several deficiencies that result from several factors, such as restricted diets, very limited food selection, or aversion to a certain food or texture.[19,20] In order to explain the very low concentrations of essential elements observed the children of our study, we conducted an oral survey with their parents

who reported that, indeed their children were very selective in their eating habits.

After 6 months of a gluten-free and casein-free restrictive diet, essential elements analyze showed a remarkable aggravation of the deficiency in calcium, magnesium and iron in the majority of children (Table 1). After 6 months the restrictive diet, 8 children (out of 20 e.g. 40%) showed a mild behavioral improvement (Table 2).

After 12 months, this improvement became significant for these 8 children. Of the 12 children that did not show an improvement in both periods, 4 continued to show elevated urinary peptides which strongly suggests that they were not following the prescribed dietary change (figure 1).

Our results are corroborated by previous works done on groups of autistic children, who have followed the gluten-free casein-free diet for 2 years, and which report many behavioral improvements; especially in the interest that these children manifest towards other persons, in their non-verbal communication and in their creativity and anxiety.[21,22] However, other studies suggested that these diets have no efficacy and are not recommended and that the simultaneous exclusion of two major food groups from the diet could have an adverse effect on the health of children with ASD.[23,24] This is in line with the aggravation of the essential elements deficiency that we noticed in our sample after 6 months of the diet.

However, in our case, we could correct for all children the aggravation of the deficiency in essential elements that was observed during the first 6 month of the casein-free gluten-free diet by enriching this diet by minerals, vitamins, and omega 6 and 3 fatty acids. After 6 months of this fortified casein-free gluten-free diet we observed an improvement in the behavior of 8 children (Table 2) and a correction of essential elements deficiency for all the children (Table 1).

Parents of the 4 children that showed an improvement in their behavior after taking a gluten-free casein-free diet during 12 months have reported the presence of bloating and stomach aches in these children before taking the diet. In our opinion, this may be related to gluten intolerance or casein intolerance or both. Research has shown some children with ASD suffer from gastric disorders related to allergies to gluten or to lactose.[25] It is also known that pain can cause behavioral problems. So if a child with ASD is allergic to gluten, he may have behavioral problems or deficits of attention or concentration. In this case the gluten-free diet will eliminate the suffering and consequently improve the behavior of the child. We can thus conclude that only children with gluten intolerance or casein intolerance or both respond positively to a gluten-free casein-free diet.

As stated above there are two schools of taught in the relationship between the gluten-free casein-free diet and ASD. The first school suggest that the administration of this type of diet to autistic children has indeed resulted in a remarkable improvement in their behavior [21, 22] and the second school think that this type of diet has no efficacy at all and is not recommended because it has an adverse effect on the health of children owing to the Essential elements deficiency that it causes.[23,24]

Our results partially corroborate both schools. As discussed above, these results showed that the gluten-free casein-free diet can indeed causes a deficiency in essential elements but it also can result in a remarkable improvement of the behavior of some autistic children. Since a nutritional correction for this deficiency is possible, we can have the positive aspects of both sides by administering a gluten-free casein-free diet that is enriched for the deficient essential elements.

Conclusion

Our study has shown that only autistic children that present both very high urinary peptides and gastrointestinal problems respond positively to a gluten-free casein-free diet. This type of died should not therefore be systematic administered to all autistic children. It should be reserved for children showing both of these symptoms. Intolerance analyzes should thus be considered mandatory before selecting patient to whom a gluten-free casein-free diet can be administered. The introduction of a restrictive diet always involves a risk

of nutritional deficiency and thus a risk for the growth of the child. However, if such a diet is a must, the potential nutritional consequences require careful monitoring of the surveyed children by qualified physicians and nutritionists.

Acknowledgements

Special thanks to the child psychiatry department of the ERRAZI University Hospital in Salé, Morocco and target population's parents.

References

1. International Statistical Classification of Diseases and Health Problems: 10th revision: 2008 edition. France: World Health Organization (WHO); 2009. p. 234.
2. EVANS C., DUNSTAN H. R., ROTHKIRCH T., ROBERTS T. K., REICHELT K. L., COSFORD R. et al. Altered amino acid excretion in children with autism. *Nutritional neuroscience.* 2008;11:9-17.
3. GOËB J. L., MOUREN M. C. Place psychotropic treatments in autism of the child and adolescent. Medico-Psychological Annals, Psychiatric Review: Elsevier. 2005;791-801
4. REICHEIT K. L., EKREM J., SCOTT. 11. Gluten, milk proteins and autism:Dietary intervention effects on behavior and peptide secretion. *Journal of Applied Nutrition.* 1990;42:1-11.
5. WHITE J. F. Minireview: Intestinal pathophysiology in autism,Experimental Biological Medicine. 2003;228:639-649.
6. CERMAK S., CURTIN C., BANDINI L. Food selectivity and sensory sensitivity in children with autism spectrum disorders. *Journal of the Academy of Nutrition and Dietetics.* 2010;110:238-246.
7. ELDER J. H., SHANKAR M., SHUSTER J., THERIAQUE D., BURNS S., SHERRILL L. The gluten-free, casein-free diet in autism: results of a preliminary double-blind clinical trial. *Journal of autism and developmental disorders.* 2006:413-20.
8. RIMLAND B, BAKER SM. Brief report: Alternative approaches to the development of effective treatments for autism. *Journal of autism and developmental disorders*. 1996; 26 : 237-41.
9. WHITELEY P., SHATTOCK P. Biochemical aspects in autism spectrum disorders: updating the opioid-excess theory and presenting new opportunities for biomedical intervention. *Expert opinion on Therapeutic Targets.* 2002;6:175-83.
9. MILLWARD C., FERRITER M., CALVER S. J., CONNELL-JONES G. G. Gluten- and casein-free diets for autistic spectrum disorder. The Cochrane. *Database of Systematic Reviews.* 2009;2:1-11.
10. SCHOPLER E., REICHLER R., ROCHEN RENNER B. The childhood autism rating scale. Los Angeles, CA: *Western Psychological Services.* 1988;40(7):787–799.
11. CADE R. J., PRIVETTE R. M., FREGLY M., ROWLAND N., SUN Z., ZELE V.,WAGEMAKER H., EDELSTEIN C. *Autism and schizophrenia: Intestinal disorders*. Nutritional Neuroscience. 1999;2:57-72.
12. ISRANGKUN P., NEWMAN H. A., PATEL S. T., DURUIBE V. A., ABOU-ISSA H. Potential biochemical markers for infantile autism. *Neuro chem Pathol.* 1986;5:51-70.
13. SOKOLOV O., KOST N., ANDREEVA O., KORNEEVA E., MESHAVKIN V., TARAKANOVA Y. et al. Autistic children display elevated urine levels of bovine casomorphin-7 immuno reactivity. *Peptides.* 2014;56:68-71.
14. TCHOBROUTSKY G., GUY-GRAND B. Nutrition, métabolismes et diététique: Flammarion Médecine Sciences. 1979;90-103.
15. BANDINI L. G., ANDERSON S. E., CURTIN C., CERMAK S., EVANS E. W., SCAMPINI R., MASLIN M. et al. Food selectivity in children with autism spectrum disorders and typically developing children. *Journal of Pediatrics.* 2010;157:259-264.
16. BUIE T., CAMPBELL D. B., FUCHS G. J., 3RD, FURUTA G. T., LEVY J., VANDEWATER J., WHITAKER A. H. E. et., al Evaluation, diagnosis, and treatment of gastrointestinal disorders in individuals with ASD s: a consensus report. 2010;125(1):1-18.

17. ZIMMER M. H., HART L. C., MANNING-COURTNEY P., MURRAY D. S., BING N. M., SUMMER S. Food variety as a predictor of nutritional status among children with autism. *J Autism Dev Disord.* 2012;42:549-556.
18. MARI-BAUSET S., ZAZPE I., MARI-SANCHIS A., LLOPIS-GONZALEZ A., MORALES-SUAREZVARELA M. Food selectivity in autism spectrum disorders: *A systematic review Journal of Child Neurology.* 2014; 29: 1554-1561
19. NADON G., FELDMAN D., GISEL E., DUNN W. Association of Sensory Processing and Eating Problems in Children with Autism Spectrum Disorders Autism Research and Treatment. 2011;31: 1-10.
20. BLACK C., KAYE J. A., JICK H. Relation of childhood gastrointestinal disorders to autism: Nested case-control study using data rom the UK General practice research database. *British Medical Journal.* 2002;325:419-421.
21. SHATTOCK P., KENNEDY A., ROWELL F., BERNEY T. Role of neuropeptides in autism and their relationship with classical neurotransmitters. *Brain Dysfunction*. 1990;3:328-345.
22. EVANS C., DUNSTAN H. R., ROTHKIRCH T., ROBERTS T. K, REICHELT K. L., COSFORD R. et al. Altered amino acid excretion in children with autism. *Nutritional neuroscience.* 2008;11:9-17.
23. WILLIAMS K. J., WRAY J. J., WHEELER D. M. Intravenous secretin for autism spectrum disorder. The Cochrane Library. 2005;2:CD003495.
24. WHITE J. F. Minireview: Intestinal pathophysiology in autism, Experimental Biological Medecine. 2003;228:639-649.