



The Role of Probiotics in improvement of Gastrointestinal Symptoms among children with Autism Spectrum Disorders.

Thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سبقتناك لا تعلم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٢٢

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CONTENTS

	<i>Page</i>
List of Abbreviations.....	II
List of Tables.....	VI
List of Figures.....	IX
Introduction	1
Aim of the Work	4
Review of Literature	
▪ Chapter I: Autism spectrum disorder.....	5
▪ Chapter II: Gastrointestinal disorders in autism.....	33
▪ Chapter III: Nutrition and feeding concerns in children with autism.	56
Patients and Methods	84
Results	93
Discussion	118
Summary	133
Conclusion	136
Recommendations	137
References	138
Arabic Summary	-

List of Abbreviations

ASD	Autism spectrum disorder
ACTH	Adrenocorticotrophic hormone
ADHD	Attention Deficit Hyperactive Disorder
ALA	Alpha-linolenic acid
ANS	Autonomic nervous system
APA	American Psychiatric Association
atm	atmosphere
ATP	Adenosine triphosphate
B6	Vitamin <i>B6</i>
BBB	Blood brain barrier
BMI	Body mass index
CAM	Complementary and Alternative Medicine
Cfu/gm	Colony forming units per gram
CNS	Central nervous system
CNV	Copy number variants
CRH	Corticotropin-releasing hormone
DA receptors	<i>Dopamine receptors</i>

<i>List of Abbreviations (cont....)</i>	
DHA	Docosahexaenoic acid
DMG	Dimethylglycine
DNA	Deoxyribonucleic acid
DSM-V	Diagnostic and Statistical Manual of Mental Disorders (fifth edition)
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders (fourth edition)
e.g.	For example
ENS	Enteric nervous system
EPA	Eicosapentaenoic acid
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
GABA	Gamma-aminobutyric acid
GBA	Gut-brain axis
GFCF	Gluten-free/casein-free
GI	Gastrointestinal
GIT	Gastrointestinal tract
GSH	Glutathione
HBOT	Hyperbaric oxygen treatment

<i>List of Abbreviations (cont....)</i>	
HPA	Hypothalamic pituitary adrenal axis
HPHPA	3-hydroxyphenyl-3-hydroxypropionic acid
Ig	Immunoglobulin
IgA	Immunoglobulin A
IL1β	Interleukin-1 beta
IL-6	interleukin-6
IQ	Intelligence quotient
kg/m²	Kilogram per square meters
KNOX-2	NADPH oxidases
L-carnitine	Levocarnitine
LPS	Lipopolysaccharides
MMR	Measles Mumps Rubella vaccine
MUFAs	monounsaturated fatty acids
N	Number
n-3 PUFAs	omega-3 polyunsaturated fatty acids
NADH	Nicotinamide adenine dinucleotide dehydrogenase
NADPH	Nicotinamide adenine dinucleotide phosphate
iNOS	Nitric oxide synthase

List of Abbreviations (cont....)

NCCAM	The National Center for Complementary and Alternative Medicine
NO	Nitric oxide
OXTRs	oxytocin receptors
PCR	Polymerase chain reaction
RD	Registered dietitian
RNA	Ribonucleic acid
ROS	Reactive oxygen species
SAM	S-adenosyl methionine
SCD	Specific carbohydrate diet
SCFAs	short-chain fatty acids
SD	Standard deviation
SNV	single nucleotide variants
TJ	Tight junctions
TNFα	Tumor necrosis factor alpha
WHO	World Health Organization
Wt	Weight
Z_{BMI}	BMI z-scores for age
Z_{WH}	Weight for height z-scores

List of Tables

<i>Table</i>	<i>Title</i>	<i>Page</i>
1	Nutrition assessment components for children with autism	62
2	The Relationship between feeding problems and other behavioral characteristics in ASD children.	64
3	Autism Treatment Evaluation Checklist (ATEC)	89
4	The Gastrointestinal Severity Index (6-GSI)	92
5	Descriptive data of the study population	93
6	Demographic data of the mothers of the autistic children.	95
7	Baseline anthropometric measures and Z-scores of both groups.	97
8	The mean ATEC and 6-GSI Scores of the autistic group evaluated before probiotic supplementation.	99
9	The stool colony counts of <i>Lactobacillus</i> and <i>Bifidobacterium</i> in stool PCR of both groups before the start of the probiotic supplementation.	100
10	Collective anthropometric data and Z-scores of autistic children before and after probiotic supplementation	102

11	The stool colony counts of <i>Lactobacilli</i> and <i>Bifidobacteria</i> in autistic group before and after 3 months of the probiotics supplementation.	103
12	The ATEC Score for the autistic group before and after probiotic supplementation.	104
13	The 6-GSI scores of the autistic group before and after probiotic supplementation.	106
14	Correlations between rate of change of total ATEC scores with rate of change of 6-GSI scores after probiotic supplementation.	108
15	Correlations between rate of change of <i>Bifidobacteria</i> colony counts in relation to that of <i>Lactobacilli</i> in stool PCR after probiotic supplementation.	109
16	Correlations between rates of change of <i>Bifidobacteria</i> and <i>Lactobacillus</i> colony counts with rate of change of the total ATEC score and each of its subscales after probiotic supplementation.	110
17	Correlations between rate of change of <i>Bifidobacteria</i> and <i>Lactobacilli</i> colony counts with rate of change of each of the 6 items of the GSI score after probiotic supplementation.	111
18	Correlations between rate of change of <i>Bifidobacteria</i> and <i>Lactobacilli</i> colony counts with the rate of change of different parameters of the autistic children after probiotic supplementation.	112

19	Correlations between rates of change of the total ATEC and the 6-GSI scores after probiotics supplementation with the rates of change of different parameters.	115
20	Correlations between rate of change of the total ATEC and 6-GSI scores of the autistic children after probiotic supplementation with their age (months).	116
21	Regression analysis of the rate of change of total 6-GSI score and the associated rates of changes of different parameters of the autistic children after probiotic supplementation.	117

List of Figures

<i>Fig.</i>	<i>Title</i>	<i>Page</i>
1	DSM-5 ASD diagnostic criteria and specifiers	7
2	Endophenotype oxidative stress cycle	17
3	Mitochondrial function, features associated with mitochondrial disease and the features and consequences of mitochondrial dysfunction in ASD	21
4	Reported prevalence of gastrointestinal disorders in children with ASD	34
5	Gastrointestinal influences on symptoms of autism spectrum disorder	35
6	Schematic representation of the proposed role of non-allergic mast-cell activation in gut–blood–brain-barrier permeability and ASDs	40
7	Schematic representation of the pattern of bidirectional brain–gut–microbe interactions	41
8	The intestinal microbiome: a complex and dynamic ecosystem that establishes bi-directional interactions with the host	43
9	The Factors affecting the composition of the gut microbiota in a neonate	47
10	The gut microbiota composition in humans	50
11	Major mechanisms of action of probiotics	55

12	Antioxidant and brain overview	60
13	The gender distribution of the autistic group.	94
14	The degree of education of the mothers of the autistic children.	94
15	The residence of the mothers of the autistic children.	96
16	The socioeconomic status of the mothers of the autistic children.	96
17	Comparing the initial stool colony counts of Lactobacilli and <i>Bifidobacteria</i> in autism group with those of the control group before probiotic supplementation.	101
18	The stool colony counts of Lactobacilli and <i>Bifidobacteria</i> in autistic group before and after probiotics supplementation.	103
19	The scores of the four ATEC domains before and after probiotic supplementation.	105
20	The scores of the 6 items GSI of the autistic group before and after probiotic supplementation.	107
21	Correlation between the rate of change in 6-GSI score and the rate of change in total ATEC scores.	108
22	The correlation between the rate of change of Bifidobacteria colony counts and the rate of change of weight z scores of the autistic group after 3 months of probiotic supplementation.	113

23	The correlation between the rate of change of Lactobacilli colony counts and the rate of change of body weight of the autistic group after 3 months of probiotic supplementation.	114
24	The correlation between ages of autistic children with the degree of change of the 6-GSI score.	116

Abstract

Objective: This study was designed to evaluate the role of probiotics supplementation in improving the gastrointestinal symptoms, the general and mental health of the autistic children at the age of 5 to 9 years old.

Methods: Gastrointestinal flora were assessed by quantitative real time PCR of stool samples of 30 autistic children from 5 to 9 years old and 20 healthy control of similar age and sex. Gastrointestinal symptoms of autistic children were assessed with a modified six-item Gastrointestinal Severity Index(6-GSI)questionnaire, and autistic symptoms were assessed with the Autism Treatment Evaluation Checklist(ATEC)before and after 3 months of supplementation of autistic children with a probiotic nutritional supplement formula (each gram contains 100×10^6 colony forming units of different probiotic strains).

Results: After probiotic supplementation, the stool PCR of autistic children showed increases in the colony counts of Bifidobacteria and Lactobacilli levels, with a significant reduction in their body weight as well as significant improvements in the severity of autism (assessed by the ATEC), and gastrointestinal symptoms (assessed by the 6-GSI) compared to the baseline evaluated at the start of the study.

Conclusions: The use of probiotics seems to be helpful in reducing the severity of autism gastrointestinal symptoms and related abnormal behaviours as well as offering new possibilities for preventive and therapeutic applications in weight management.

Keywords: Autism; Probiotics; ASD; Gastrointestinal flora; Bifidobacteria.