ORIGINAL ARTICLE

Evaluation of the relationship between the frequency of attention deficit, hyperactivity disorder symptoms and nutritional habits in children

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ABSTRACT

Introduction: Attention deficit and hyperactivity disorder (ADHD) is a common chronic neurodevelopment disorder characterised by inattention, hyperactivity and impulsivity at levels that are not compatible with age. ADHD is one of the high social and individual costs for the population of the country. In the present study, it was aimed to investigate the relationship between some sociodemographic characteristics, nutrition and sleep patterns, certain habits and various factors with ADHD in primary school children aged between 6 to 10 years.

Materials and Methods: In the study, a total of 600 children's parents were asked to fill in the Conners Parent Rating Scale – Short Form (CPRS-48), which consists of 48 questions. The questions in the scale are answered by the parents on a four-point Likert scale. The responses were scored as 0, 1, 2 and 3 for 'never', 'rarely', 'often' and 'always', respectively. It was accepted that the children who scored at least 18 for the behaviour problem subscale, at least five for the learning problem subscale, at least six for the aggression, hyperactivity subscale, and at least seven for the defying subscale were considered to be in the problematic category. In order to determine the eating habits of the children included in the study, their parents filled out the food consumption frequency form. Foods in the form of food consumption frequency are divided into two groups as healthy and unhealthy foods. Individuals were given scores between 0 and 6 according to the frequency of food consumption. The healthy food group and unhealthy food group scores were collected separately.

Results: Of the children included in the study, 312 (52%) were male, with a mean age of 8.24±1.30 (range: 6 10) years. The mean CPRS-48 score was 23.88±19.71. The Cronbach's Alpha value of the CPRS-48 scale, which consists of 48 questions in total, was obtained as 0.957.

The mean CPRS-48 score was significantly higher in boys (p = 0.014), in those whose mothers smoked during pregnancy (p = 0.008), those who did not receive breast feeding at birth or those who received less than 2 months (p = 0.035), those who frequently skipped meals (p < 0.001), those who do not have breakfast regularly (p = 0.002), those who spend more than four hours a day using a tablet/computer (p = 0.007), those who watch television more than 2 hours a day (p = 0.003), those who do not have regular sleep (p = 0.012), those who sleep less than 8t hours a night (p = 0.031), those who do not spend quality time with their families at least 2 days a week (p = 0.002) and those who do not have a hobby or sport that they were constantly interested in (p = 0.007).

Conclusion: The finding of the present study show that CPRS score in children is associated with some factors such as mother's habits in pregnancy, behaviours in having meals, daily habits and regular sleep. Although eating habits are a risk factor for ADHD, when the right eating habits are acquired, they can reduce the risk or symptoms of ADHD. However, more extensive and valid studies should be conducted to better explain this issue.

KEYWORDS:
Attention deficit and hyperactivity disorder, nutritional habits, child

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is the most common neurobehavioural disorder of childhood. The main components of this disorder are; developmentally inappropriate attention levels, hyperactivity and impulsivity that result in functional impairment in one or more academic, social and emotional domains.[1] ADHD usually appears in early childhood and continues to manifest throughout life. Although the aetiology of ADHD is multifactorial, it is defined as a multifactorial disorder associated with various genetic, biological, environmental and psychosocial factors. Studies show that in addition to genetic factors, environmental factors also play an active role on ADHD.[2]

It has been shown in some studies that providing nutritional supplements (such as minerals, vitamins and omega-3 fatty acids) to children with ADHD reduces the symptoms of the disease. Zinc, iron and copper deficiency, which are used as cofactors in the production of noradrenaline and dopamine, are thought to be associated with the aetiology or symptoms of ADHD.[3] It is thought that the intake of food with a high glycaemic index may be associated with careless and hyperactive behaviours, and behavioural disorders may be

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caused by additives such as preservatives and food coloring.[4] ADHD has a high impact on the way individuals participate in activities of daily living. Studies show that it has a negative effect on behaviour. Affected areas include social skills, interpersonal relationships and educational success.[5] ADHD is a life-long disorder with behavioural problems, which, when ignored, causes increased risks of committing illegal acts or substance use and side costs. Therefore, it is a disease that is also important for the society.[6]

In the present study, it was aimed to investigate the relationship between some sociodemographic characteristics, nutrition and sleep patterns, certain habits and various factors with ADHD in primary school children aged between 6 to 10 years.

MATERIALS AND METHODS

The present study was carried out on 1st, 2nd, 3rd and 4th grade primary school students aged between 6 to 10 years those who admitted to Family Medicine clinics of our tertiary care hospital between April 2022 and June 2022. Sociodemographic and clinical data form, Conners Parent Rating Scale (CPRS-48), and food consumption frequency form were answered by the parents of the students included in the study. The present study was carried out in cross-sectional type. Ethics committee approval of the study was obtained with the protocol number 2022.39.03.07 dated 29 March 2022 of Tekirdag Namik Kemal University Faculty of Medicine Scientific Research Ethics Committee. Permission was obtained from the Tekirdag Governorship Provincial Directorate of National Education to carry out the study in primary schools affiliated to the Süleymanpasa District Directorate of National Education. Permission to use the scale was obtained from Cigdem Dereboy, who made the Turkish adaptation of CPRS-48. Informed consent form and parent consent form were read to the parents of the students included in the study and their consents were obtained. The questions in the study were prepared by the researchers as a result of the literature research.

In order to determine the eating habits of the children included in the study, their parents filled out the food consumption frequency form. Foods in the form of food consumption frequency are divided into two groups as healthy and unhealthy foods. In the healthy foods group, milk and dairy products, red and white meat, legumes, fresh vegetables and fruits, homemade desserts, cakes, pastries, pastries, fruit yoghurt, ice cream and freshly squeezed fruit juice; in the unhealthy foods group, ready-made breakfast cereals and spread chocolate, sausage and bacon, beef, turkey, chicken salami and sausage, confectionery, sweets bought from the patisserie, cake, cake, pastry, ready-made dessert, cake, cake, ice cream, flavoured milk, fruit juice; pudding, fruit yogurt, chocolate, biscuits, wafers, fast food-style foods, fries, chips and crackers, milkshakes and hot chocolate, carbonated drinks. Individuals were given scores between 0 and 6 according to the frequency of food consumption. The healthy food group and unhealthy food group scores were collected separately. The questionnaire included a total of 29 questions about healthy and unhealthy foods. Each question in this group was like 'How often does your child consume this food?' The responses were 'never', 'once a month or less frequently', '2 to 3 times a month', 'once a week', '3 to 4 times a week', 'once a day' and 'several times a day', and those responses were scored between 0 and 6 according to the frequency of food consumption. Then, all scores were summed and a total score of healthy food consumption frequency and a total score of unhealthy food consumption frequency were created.

Conners Rating Scales (CRS) are among the tools frequently used to evaluate behavioural disorders. Various forms of Child Behaviour Checklist (CBL) have been developed and presented under different headings by different researchers throughout the process until today. Among these scales, CPRS-48, published in 1978, was developed by Goyette et al. Developed by In CPRS-48, there are questions related to hyperactivity, learning and behaviour problems, as well as psychosomatic problems and anxiety. It was adapted into Turkish by Dereboy et al.[7] in 2007. CPRS-48 is a Likert-type scale consisting of 48 questions. The questions in the scale are answered by the parents on a four-point Likert scale. The responses were scored as 0, 1, 2 and 3 for 'never', 'rarely', 'often' and 'always', respectively. It was accepted that the children who scored at least 18 for the behaviour problem subscale, at least 5 for the learning problem subscale, at least 6 for the aggression, hyperactivity subscale, and at least 7 for the defying subscale were considered to be in the problematic category.

Collection of socio-demographic data was done using a questionnaire.

Inclusion Criteria

Children aged between 6 to 10 years, with no known diagnosis of psychiatric, genetic or neurological diseases, those with parents volunteering to participate in the study and children living with parents were included in the study.

Exclusion Criteria

Children under the age of 6 years or over the age of 10 years, whose parent's refuse to participate in the study, those with cognitive disability in them or in their parents were not included in the study.

Statistical Analysis

Data were transferred to IBM SPSS.23 (IBM Inc., Chicago, IL, USA) program and analysed with statistical analysis. Before proceeding with the analysis, it was checked whether there was an error in the way the data was entered and whether the variables were within the expected range. Mean and standard deviation values for continuous variables, number of people (n) and percentage (%) for categorical variables are given. Shapiro Wilk's test of normality and Levene's test for homogeneity of variance were applied to continuous variables. Pearson's correlation test was used for the relationship between continuous variables. The Mann Whitney-U test was used in the analysis of two-group variables with continuous variables, and the Kruskal-Wallis H test in the analysis of three or more grouped variables. A value of $p < 0.05$ was accepted as the level of significance in all analyses.

Table I: Distribution of some variables

Variables	n	%
Total	600	100
Gender		
Male	312	52
Female	288	48
Education level of the mother		
Primary school	97	16
Secondary school	82	13.6
High school	212	35
Bachelor's or higher	210	34.7
Number of children in the family		
1	157	26
2	330	54.5
3	84	13.9
4	23	3.8
Smoking in pregnancy		
Yes	91	15
No	505	83.5
Alcohol abusement in pregnancy		
Yes	5	0.8
No	593	98
Drug use in pregnancy		
Yes	103	17
No	494	81.7
Delivery type		
Normal vaginal delivery	191	31.6
Caesarean delivery	410	67.8
Week of delivery		
Before 37th gestational week (premature)	27	4.5
In 37th week (early term)	98	16.2
Between 38th-42nd week (term)	446	73.7
After 42nd week (postterm)	25	4.1
Duration of breast feeding		
Never	10	1.7
0-2 months	67	11.1
2-6 months	143	23.6
More than 6 months	380	62.8
Skipping meal		
No	157	26.25
Sometimes	360	60.2
Yes (frequently)	81	13.55
Number of meals a day		
1	8	1.34
2	114	19.06
3	442	73.91
≥4	34	5.69
Regular breakfast		
Yes	80	13.2
No	525	86.8
Taking nutritional supplements		
Yes	77	24.14
No	242	75.86

RESULTS

Of the children included in the study, 312 (52%) were male, with a mean age of 8.24±1.30 (range: 6 to 10) years. A total of 35% of the mothers graduated from high school, and 34.7% had bachelor's degree or higher. A total of 15% of the mothers had a history of smoking in pregnancy, and 67.8% underwent caesarean delivery. A total of 4.5% of the children were born before complete term (Table I).

The mean CPRS-48 score was 23.88±19.71. The Cronbach's Alpha value of the CPRS-48 scale, which consists of 48 questions in total, was obtained as 0.957. The mean scores of subscales of CPRS-48 have been shown on Table II. According to this, 4.7% of the children had lower score than the cut-off value in Behaviour Problem Subscale, 26% had lower scores in Aggression hyperactivity subscale, 29.8% had lower scores in Learning Problem subscale, and 34.5% of the children had lower scores than the cut-off value in Defying subscale (Table II).

The mean CPRS-48 score was significantly higher in boys ($p = 0.014$), in mothers who smoked during pregnancy ($p = 0.008$), in those who did not receive breast milk at birth or those who received less than two months ($p = 0.035$), in those

Table II: Data regarding CPRS-48 subscales

CPRS-48 subscales	Mean	SD	Cut-off value	Number of children under the cut-off value	
				n	%
Total score	23.88	19.71			
Behaviour Problem subscale	4.4	6.0	18	28	4.7
Aggression, Hyperactivity subscale	4.2	2.9	5	156	26.0
Learning Problem subscale	3.0	3.0	6	179	29.8
Defying subscale	5.6	4.0	7	207	34.5

Table III: Comparison of mean CPRS-48 scores according to some variables

Variables	n	%	CPRS-48 (mean±SD)	p
General	600	100	23.88±19.71	-
Gender				0.014*
Male	312	52	26.35±21.51	
Female	288	48	21.13±17.13	
Education level of the mother				0.269
Primary school or undergraduates	97	16	26.11±21.81	
Secondary school	82	13.6	21.74±21.01	
High school	212	35	24.67±18.94	
Bachelor's / Master / Doctorate	210	34.7	23.01±19.05	
Number of children in the family				0.07
1	157	26	25.46±21.05	
2	330	54.5	22.21±17.56	
3	84	13.9	28.88±23.99	
4	23	3.8	21.22±22.47	
Smoking in pregnancy				0.008*
Yes	91	15	29.13±20.41	
No	505	83.5	22.83±19.31	
Alcohol abusement in pregnancy				0.069
Yes	5	0.8	51.4±36.18	
No	593	98	23.64±19.33	
Drug use in pregnancy				0.19
Yes	103	17	26.70±21.20	
No	494	81.7	23.23±19.22	
Delivery type				0.684
Normal vaginal delivery	191	31.6	24.89±20.6	
Caesarean delivery	410	67.8	23.33±19.14	
Week of delivery				0.397
Before 37th gestational week (premature)	27	4.5	31.67±25.60	
In 37th week (early term)	98	16.2	22.32±17.00	
Between 38th-42nd week (term)	446	73.7	23.47±19.56	
After 42nd week (postterm)	25	4.1	25.72±20.74	
Duration of breast feeding				0.035*
Never	10	1.7	33.5±18.00	
0-2 months	67	11.1	27.97±19.72	
2-6 months	143	23.6	23.80±19.27	
More than 6 months	380	62.8	22.84±19.71	
Skipping meal				<0.001*
No	157	26.25	19.48±18.43	
Sometimes	360	60.2	23.47±18.86	
Yes (frequently)	81	13.55	33.79±22.03	
Number of meals a day				0.259
1	8	1.34	29.13±21.03	
2	114	19.06	25.51±17.91	
3	442	73.91	22.87±19.10	
≥4	34	5.69	27.94±25.86	
Regular breakfast				0.002*
Yes	80	13.2	22.88±18.97	
No	525	86.8	30.41±23.09	
Taking nutritional supplements				0.176
Yes	77	24.14	24.74±14.89	
No	242	75.86	25.96±23.49	

*p < 0.05. CPRS-48: Conners Parent Rating Scale – Short Form. SD: Standard deviation.

Table IV: Comparison of mean CPRS-48 scores according to certain habits and family history variables

	n	%	CPRS-48 (mean±SD)	p
Mean daily duration of tablet/computer usage				0.007*
<1 hours	109	18.51	23.80±21.46	
1-2 hours	239	40.58	21.96±19.66	
2-3 hours	165	28.01	23.97±18.50	
>4 hours	76	12.9	29.68±19.09	
Mean daily duration of watching TV				0.003*
<1 hours	242	40.54	23.29±19.32	
1-2 hours	262	43.89	21.38±16.83	
2-3 hours	75	12.56	30.91±24.73	
>4 hours	18	3.02	38.22±28.05	
Regular sleep				0.012*
Yes	485	80.8	22.85±19.34	
No	115	19.2	28.17±20.69	
Daily mean sleep time				0.031*
<6 hours	5	0.8	31.6±22.77	
6-8 hors	132	22	28.42±22.26	
8-10 hours	425	71	22.59±18.93	
>10 hors	37	6.2	21.0±16.30	
Spending quality time with the child at least 2 days a week				0.002*
Yes	493	82.72	22.45±18.55	
No	103	17.28	30.31±23.54	
The sport or hobby that the child is constantly interested in				0.007*
Present	100	16.5	23.31±20.02	
Absent	487	80.5	27.04±18.41	
Any diagnosed disease in mother				0.158
Present	86	23.3	27.97±21.06	
Absent	285	76.8	24.99±21.38	
Any diagnosed disease in father				0.139
Present	46	9.1	28.41±22.21	
Absent	446	90.9	25.02±21.24	
Mother's psychiatric disease other than ADHD				0.06
Present	9	2.4	31.11±13.82	
Absent	366	97.6	23.77±19.77	
ADHD in mother				0.959
Present	3	0.8	21.00±12.00	
Absent	372	99.2	23.89±19.76	
Father's psychiatric disease other than ADHD				0.06
Present	8	1.4	51.00±36.33	
Absent	563	98.6	23.77±19.48	
ADHD in the family other than the parents				0.104
Present	37	10.6	21.92±17.79	
Absent	312	93.7	25.55±21.10	

*p < 0.05. CPRS-48: Conners Parent Rating Scale – Short Form. SD: Standard deviation. ADHD: Attention deficit and hyperactivity disorder.

Table V: Mean scores of healthy and unhealthy food consumption questionnaire according to some variables

	Healthy food (mean±SD)	Unhealthy food (mean±SD)
General	32.58±11.24	26.03±10.31
Education level of the mother		
Primary school	36.30±12.66	24.92±9.84
Secondary school	32.28±11.92	26.66±11.03
High school	32.15±11.24	25.66±9.91
Bachelor's or higher	31.25±9.85	26.80±10.67
p	0.001*	0.193
Number of children in the family		
1	31.82±10.76	27.52±10.45
2	32.24±11.29	25.70±10.24
3	34.37±11.26	24.83±10.27
4	30.52±11.87	26.87±10.87
p	0.291	0.151
Regular breakfast		
Yes	30.95±13.20	24.67±8.96
No	32.83±10.91	26.24±10.49
p	0.202	0.204

*p < 0.05. SD: Standard deviation.

who frequently skipped meals ($p < 0.001$) and in those who did not have breakfast regularly ($p = 0.002$) compared to the other groups (Table III).

Of the children, 12.9% spent more than 4 hours a day in front of a tablet/computer and 3% in front of the television, 485 (80.8%) had regular sleep, 493 (82.72%) spent quality time with their families at least 2 days a week (Table IV).

The mean CPRS-48 score was found in those who spend more than 4 hours a day in front of a tablet/computer ($p = 0.007$), those watch television more than two hours a day ($p = 0.003$), those do not have regular sleep ($p = 0.012$), those with mean daily sleep time less than 8 hours ($p = 0,031$). It was found to be significantly higher in those who do not spend quality time with their families at least two days a week ($p = 0.002$) and those who do not have a hobby or sport that they are constantly interested in ($p = 0.007$) compared to the other groups (Table V).
The mean of food consumption frequency (FCF) score in children was 58.52±14.95; the mean healthy FCF score was 32.58±11.24; the mean unhealthy FCF score was found to be 26.03±10.31. The mean healthy FCF score of children whose mothers' education level was primary school or undergraduates was significantly higher than those whose mothers had a higher education level ($p = 0.001$) (Table V).

A significant inverse correlation was found between the healthy FCF score and the CPRS-48 score ($p = 0.024$; $r = -0.092$). There was no significant correlation between unhealthy FCF score and CPRS-48 score ($p=0.224$; $r=0.05$).

DISCUSSION

ADHD is a common chronic neurodevelopmental disorder characterised by inattention, hyperactivity, and impulsivity at levels that are not compatible with age. ADHD is typically believed to begin in early childhood, but the diagnosis is often made at school age. Current studies in Turkey report that the prevalence of ADHD in school-age children is approximately 13%.[1,2,8]

The prevalence of ADHD was found to be more common in boys than in girls.[8] In the present study, the mean CPRS-48 score of boys was found to be significantly higher than that of girls. Our study is compatible with the literature in terms of this finding. This data showed us that we need to be more careful in terms of ADHD in boys.

A total of 91 (15%) of the mothers stated that they used cigarettes or hookahs during pregnancy. Prenatal smoking exposure has been associated with ADHD in a number of epidemiological studies. In two meta-analysis studies, it was shown that the mother's smoking during pregnancy increased the risk of ADHD in the child.[9,10] In the present study, in accordance with the literature, the mean CPRS-48 score of the children of mothers who used cigarettes or hookahs during pregnancy was found to be statistically significantly higher than the mean CPRS-48 score of the children of mothers who did not. These data we obtained indicating that smoking during pregnancy increases the risk of ADHD is very important in terms of reducing the incidence of ADHD.

Only five (0.8%) of the mothers stated that they used alcohol during pregnancy. It has been shown that there is a positive relationship between maternal alcohol use during pregnancy and ADHD symptoms in children. In a prospective Danish birth cohort study of 1628 mothers and children, no association was found between ADHD symptoms in children and alcohol use during pregnancy when mothers who abstained from alcohol were compared with mothers who consumed low to moderate levels of alcohol. In another study, when the children of mothers who did not drink alcohol were compared with the children of mothers who consumed more than eight alcohol per week, a weak correlation was found between alcohol consumption during pregnancy and ADHD in children.11 In the present study, it was observed that the mean CPRS-48 score did not show a statistically significant difference compared to alcohol use during pregnancy. The reason why we reached such a result in the present study may be that almost none of the mothers participating in the study stated that they used alcohol during pregnancy, and that did not cause a statistically significant difference.

A total of 4.5% of the children were born preterm, 73.7% were born term and 4.1% were born postterm. Cak et al[12] found that children diagnosed with ADHD had shorter week of delivery and lower birth weights. In a meta-analysis study, when the cognitive status of preterm children was evaluated, it was reported that preterm new borns showed ADHD symptoms more than twice as often as the term ones. In the present study, it was found that the mean CPRS-48 score did not show a significant difference according to the week of delivery. The statistically insignificance might be due to the low number of preterm children.

Breast milk contains nutrients that have positive effects for the development of intelligence, such as peptides and essential long-chain fatty acids (LFA). It has been reported that there is a relationship between LFA intake and intelligence development in infants. When the intelligence development of babies who are breastfed and fed with formula that does not contain LFA, it has been reported that the intelligence scores of children who are breastfed are higher.[13,14] When the literature is examined, the results of studies on the duration of breastfeeding in children and ADHD are controversial. In a study by Ptacek et al[15], children with ADHD and controls were compared when breastfeeding duration was less than 3 months, and no significant difference was found between breastfeeding rates. However, when focusing on breastfeeding durations over 6 months, the rate of breastfeeding was found to be higher in controls compared to children with ADHD in the same study. In the study by Field.[16] breastfeeding only reduced the risk of ADHD in the absence of parental psychopathology, but posed a risk for ADHD if the mother had a history of psychopathology. In a meta-analysis of four studies that revealed the difference between the duration of breastfeeding in children with ADHD and the control group without ADHD, it was shown that the duration of breastfeeding in children with ADHD was shorter than in controls.[17] In the present study, it was found that the mean CPRS-48 scores of those who were breastfed for 0 to 2 months were statistically significantly higher than those who were fed for more than 6 months. Considering that breast milk intake affects the cognitive development of children, the

result of the present study is compatible with the general literature and with this important finding, it has once again demonstrated the importance of breastfeeding.

The status of skipping meals was questioned in order to determine the food consumption habits of children. In the study conducted by Kim et al[18], no significant difference was found between the food consumption habits of the normal and ADHD groups.[18] In the present study, the mean CPRS-48 score was determined by those who skip meals frequently, those who skip meals sometimes, and those who never skip; those who skip sometimes were found to be significantly higher than those who did not skip at all. This data we obtained showed us that children's skipping meals may pose a risk for ADHD. In this respect, it is a valuable finding.

Of all the meals of the day, breakfast has the highest dietary quality, but the frequency of having breakfast has decreased in recent years, according to studies. This has the potential to negatively affect cognitive function, and past studies have shown a positive association between breakfast consumption and cognitive function. It has been proven that eating breakfast regularly is associated with better cognitive performance and academic achievement.[19] In the present study, when the mean CPRS-48 scores of those who regularly eat breakfast and those who do not, were found to be significantly lower than those who did not. This finding shows us once again that breakfast is important for children's cognitive development.

A meta-analysis of studies on children's television viewing time revealed that electronic media use is particularly associated with ADHD's attention deficit symptoms. It is thought that the use of electronic media, especially in the first years of life, may have significant negative effects on the development of the child.[20] In the present study, in accordance with the literature findings, the mean CPRS-48 score of those who spend more than 4 hours a day in front of a computer/tablet was found to be significantly higher than those who spend between 1 and 2 hours and less than 1 hour. The mean CPRS-48 score of the children who watched television for 1 to 2 hours a day on mean was found to be significantly lower than those who watched television for a mean of 2 to 3 hours. Our finding is very important as it shows that limiting screen time in children reduces the risk of ADHD.

Sleeping difficulties often coexist with ADHD. About 25 to 50% of children and adolescents with ADHD also report sleep disturbances. Despite the high comorbidity between sleep disorders and ADHD, it is unclear whether sleep disturbance is a cause, consequence or comorbid problem associated with such disorders. Studies have examined the complex situation of the relationship between sleep disorders and ADHD, and it has been stated that there is a two-way relationship between them. It has been determined that sleep-related pathologies contribute to the increase in ADHD symptoms and ADHD causes worsening of sleep.[17-21] Gruber et al[21] evaluated the effect of cumulative sleep deprivation on the neurobehavioral functioning of both healthy developing children and children with ADHD. It has been found that sleep deprivation leads to a significant decrease in performance in the continuous performance task, which is a neurobehavioral task that requires constant attention and behavioural control, which is widely used in the assessment of inattention and impulsivity in children with ADHD.[22] The mean CPRS-48 score of the children who regularly sleep at night was found to be significantly lower than those of the others, and the mean score of those who slept an mean of 6 to 8 hours a day was found to be significantly higher than that of those who slept for 8 to 10 hours. More studies are needed to clearly determine the relationship between sleep and ADHD, but our result is very important as it finds a relationship between sleep duration and ADHD risk.

In the study of DuPaul et al, it was found that the parent-child relationship was problematic in families with a child with ADHD, and the stress level was higher than normal.[23] The mean CPRS-48 score of children who spend quality time with their parents at least 2 days a week was found to be significantly lower than that of other children. This result showed us that quality time spent with parents is important in reducing the risk of ADHD.

In the study conducted by Kim et al18, there was evidence that children with ADHD were less likely to participate in physical activity and organised sports compared to those without ADHD. The mean CPRS-48 score of children who are regularly involved in sports or hobbies was found to be significantly lower than those who did not have sports or hobbies. These data showing that regular exercise and hobbies reduce the risk of ADHD in children is very important.

Studies on the relationship between family history, twinning, and ADHD have shown that genetics play a strong role in the aetiology of ADHD. In a study, the risk of developing ADHD in first-degree relatives of people with ADHD is 2 to 8 times higher than relatives of healthy people. Twin studies in many different countries have shown high heritability rates of around 71 to 90% for ADHD.[24-26] Psychiatric pathologies in the family, especially in the mother, are stated to be more common in families with ADH.[27] In the present study, it was observed that the mean CPRS-48 score of the children did not show a significant difference according to the presence of ADHD in the family members other than the parents, and the mean CPRS-48 score did not differ statistically according to the presence of a psychiatric disease other than ADHD in the parents. It can be thought that the reason for these findings in the present study was that the reporting of psychiatric illness in parents and non-parent family members was less stated because it was dependent on the parents who answered the questions.

While the majority of children in the present study did not have a nutritional supplement that they used regularly, 32 (10.03%) of them were using omega-3 and 24 (7.53%) of them were using multivitamin supplements. When the literature is examined, it has been suggested that minerals such as zinc, iron and magnesium play a role in the pathogenesis of ADHD, and therefore it is thought that the supplementation of these minerals may be beneficial in the treatment of ADHD.[28,29] Studies in humans also show that omega-3 fatty acid deficiency causes an imbalance in the

omega-3/omega-6 PUFA ratio, thus affecting neurocognitive abilities and inducing behavioural disorders including ADHD.[30] In the present study, it was found that there was no significant difference when the mean CPRS-48 scores were compared according to whether or not children took nutritional supplements. This may be due to the fact that a low number of children included in the present study were using nutritional supplements.

It has been shown that 12% of children with ADHD use complementary or alternative medicines, including dietary supplements. Concerns about the adverse effects of pharmacotherapy have spurred research on alternative treatment strategies, including the use of dietary supplements, and the role of nutrition and nutritional supplements in the aetiopathophysiology and treatment of ADHD has become central to research. For example, ADHD has been associated with a Western-style diet high in fat and refined sugars and low in omega-3 fatty acids (omega-3 PUFAs) and fibre. It has been suggested that minerals such as iron, zinc and magnesium also play a role in ADHD pathology, and it is thought that supplementation of these minerals may be beneficial in the treatment of ADHD.[28-31] A recent case-control study evaluated the possible association between dietary patterns and ADHD risk. In the study, it was shown that there is a negative relationship between the fish and white meat diet model and the risk of ADHD. It has been said that a protein diet pattern rich in minerals such as protein and zinc is also inversely related to the risk of ADHD.[30,31] Although parents report an increase in hyperactive behaviour in their children after high intakes of foods such as candy or sugary drinks, studies cannot prove a significant negative effect of sucrose.[31] In a study conducted on adolescents with a 14-year follow-up, the relationship between dietary habits and ADHD was investigated. And two major diets have been identified: 'Western' and 'Healthy'. The higher the mean score, the higher the Western diet was associated with the diagnosis of ADHD. However, the diagnosis of ADHD was not found to be related to 'healthy' eating habits. This study shows us that a Western-style diet may be one of the risk factors for ADHD.[32] In the present study, no significant relationship was found in the correlation analysis of the mean frequency of unhealthy food consumption and the mean CPRS-48 score. When the correlation analysis of the mean healthy food consumption frequency score and the mean CPRS-48 score was made, a negative very weak statistically significant relationship was observed. More detailed and large-scale studies are needed to reveal the relationship of ADHD, whose incidence is increasing and the benefits of nutritional models in reducing its symptoms, are seen with food consumption habits.

In the questionnaire, there were several questions regarding healthy and unhealthy food consumption applied to the mothers of the participants. Each question in this group was like 'How often does your child consume this food?' for each kind of food. The responses were 'never', 'never', 'once a month or less frequently', '3 to 4 times a month', 'once a week', '3 to 4 times a week', 'once a day' and 'several times a day', and those responses were scored between 0 and 6 according to the frequency of food consumption. Then we summed all scores dividing the food into healthy and unhealthy groups. In this way, we prepared a survey that can be evaluated objectively, instead of asking mothers a general and subjective question about whether their children have a healthy or unhealthy diet in general. In addition, we asked mothers a total of 29 groups of foods without commenting on whether they were healthy or unhealthy, and thus we aimed to prevent the mothers' subjective opinions about whether that food was healthy or not from affecting the survey results. Furthermore, we asked mothers about these high numbers of food groups separately and scored them separately, thus creating a very detailed mapping of the child's food consumption. Thanks to this entire methodology, we have enabled children's food habits to be compared objectively and statistically with other factors. As a result of this entire application, we could not find a significant relationship between the child's CPRS-48 score, which indicates the child's hyperactivity status, and the child's 'unhealthy' food consumption score, but we found a weak, significant but inverse relationship between the CPRS-48 score and the 'healthy' food consumption score. All these findings indicate that there may be an inverse relationship between hyperactivity and healthy food consumption in children. However, this weak significance despite our large number of participants and the statistical insignificance in the analysis with unhealthy foods show that hyperactivity does not directly affect children's consumption of healthy or unhealthy food or is not the main factor affecting this consumption. From this perspective, for example, forcing children to eat foods that are offered to them by their parents may be a restrictive factor in terms of children's ability to choose food freely. These and similar factors may have limited the direct impact of children's hyperactivity levels on healthy or unhealthy food consumption.

It is known that the knowledge level of mothers about nutrition affects the nutritional habits of children.[33] Williams et al[33] drew attention to the effect of the knowledge level of mothers with low socio-economic status on their children's eating habits. In the present study, the mean of healthy food consumption frequency of children mothers' education level was primary school or undergraduates. When the mean scores of children's unhealthy food consumption frequency were compared according to the education level of the mother, there was no significant difference. More detailed studies are needed to better elucidate this issue.

There were some limitations in the present study. Since the study was based only on a questionnaire, the data were based only on the statements of the mother or father. In addition, variables such as the number of children in the family or the educational status of the parents may have affected the observation of children. The number of participants was kept high so that these situations do not cause statistical errors.

The findings of the present study show that the level of attention deficit and hyperactivity disorder in children is higher in males, in those whose mothers smoked during pregnancy, in those who did not receive breast milk at birth or in those who received it for less than 2 months, in those with disordered eating and sleep patterns, in those who spend a lot of time in front of a tablet/computer and television and with their families. Studies showed that it was higher in those who did not spend quality time for a long time.

CONCLUSION

The finding of the present study show that CPRS score in children is associated with some factors such as mother's habits in pregnancy, behaviours in having meals, daily habits and regular sleep. Although eating habits are a risk factor for ADHD, when the right eating habits are acquired, they can reduce the risk or symptoms of ADHD. However

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