SERUM INTERLEUKIN-6 LEVEL IN CHILDREN WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER

By

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ABSTRACT

Introduction: *Attention deficit hyperactivity disorder (ADHD) is characterized by pervasive and impairing symptoms of inattention, hyperactivity, and impulsivity according to Diagnostic and Statistical Manual of Mental Diseases (DSM-V). It is estimated that around 60%–100% of children with ADHD also exhibit one or more comorbid disorders that often continue into adulthood 1. Elevated levels of some inflammatory markers have been reported in children with various neuropsychiatric disorders, including ADHD, indicating that inflammation may have a role in the pathogenesis of these disorders 2.*

Objectives: *The aim of this study was to measure the level of serum interleukin-6 (IL-6) as an indicator of inflammatory markers in children with ADHD.*

Subjects and Methods: *This case control study, the participants were consecutively recruited by simple random method from the pediatric neurology clinic in Bab-El Sharyia university hospital in the period from June 2019 to February 2020. Twenty children diagnosed as ADHD (fulfilling the criteria of Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, for ADHD diagnosis) and 20 healthy children as a control .Both groups were subjected to complete history taking, clinical examination, psychometric tests and Serum interleukin-6 was measured by enzyme-linked immunosorbent assay (ELISA).*

Results: *In the patients group, 85% of patients were males while15% were females. Regarding subtypes of ADHD, 55% of ADHD patients were of the combined type, 25% were of the inattentive type while 15% of the hyperactive type. 70% of the studied ADHD patients were from rural areas and 30% were from urban areas.IQ was lower in ADHD patients than controls. There were significant higher Conners' scores in ADHD patients compared to the control. The mean serum level of IL-6 was 23.35 ± 13.47 pg/ml in ADHD patients, while it was 7.57 ± 3.47 pg/ml in the controls, with highly significant difference.*

Conclusion: *Serum IL-6 values were significantly higher in ADHD patients compared to healthy control children.*

Keywords: *cytokines, ADHD, IL-6, Inflammation, immune.*

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is the most common neurobehavioral disorder of childhood and one of the most prevalent chronic diseases found in school children[3].

Attention deficit hyperactivity disorder is characterized by pervasive and impairing symptoms of inattention, hyperactivity, and impulsivity according to Diagnostic and Statistical Manual of Mental Diseases (DSM-V). It is estimated that around 60%–100% of children with ADHD also exhibit one or more comorbid disorders that often continue into adulthood[1]

The reported prevalence of ADHD in children varies from 2 to 18 percent depending upon the diagnostic criteria and the population studied (eg, primary care versus referral)[4].

In Egypt, Prevalence of ADHD among school children in Menoufia governorate was 6.9%. ADHD is associated with many risk factors either modifiable or non-modifiable such as consanguinity, antenatal illness, antenatal drug use, abnormality at birth, large family size, family history of psychiatric or medical illness, and sex. Prevention, early detection, and management of its modifiable risk factors should be undertaken alongside increasing community awareness[5].

Both genetic and environmental factors are implicated in the etiology of ADHD, with genetic factors representing a major role, but the exact etiology and pathogenesis of ADHD is not completely well defined6.Some studies have reported an association between ADHD and autoimmune diseases, suggesting that ADHD could be an immune-related disorder due to an altered immune response[7, 8].

In recent years, there has been an interest in the potential role of atopy and allergic immunopathology in ADHD. In addition, indications of immunological dysregulation leading to chronic Th2-cell mediated inflammation including an increased cytokine profile and eosinophilic activity, support the theory that there is an immunological background that can be part of the causation cascade of symptoms or partly responsible for symptom exacerbation in a subgroup of patient diagnosed with ADHD[9].

In addition, some genes that are detected in ADHD patients have immune functions and genes that alter inflammatory signaling in the brain have been found to be

associated with ADHD. Two previous studies have reported an association between ADHD and the polymorphism of genes encoding some cytokines, mainly IL-2, IL-6, and TNF-a[10, 11].

IL-6 is an interleukin that acts as both a pro-inflammatory and anti-inflammatory cytokine. IL-6 role as an anti-inflammatory cytokine is mediated through its inhibitory effects on TNF-a, and IL-1, and activation of IL-lra and IL-10. IL-6 inhibits neurogenesis in the hippocampus through blockade of the differentiation of neural progenitor cells into neurons, which may create serious problem in developing brains and could result in an increased risk from ADHD[12].

Aims of the Work

The aim of our study was to compare the level of IL-6 in the serum of children with ADHD compared with healthy control children.

PATIENTS AND METHODS

This study was carried on 20 children with ADHD aged 6-16 years. The participants were consecutively recruited from the pediatric neurology clinic in Bab-El Sharyia university hospital in the period from June 2019 to February 2020.

Inclusion criteria were:

1. Age 6-16 years.
2. An ADHD diagnosis based on the DSM-V criteria (2001) (the diagnosis of ADHD requires the presence of 6 or more symptoms of hyperactivity and impulsivity and/or 6 or more symptoms of inattention, which persist for at least 6 months).
3. No history of neuropsychiatric drug intake.
4. No other comorbid psychiatry disorder in axis I. (e.g., major depression, bipolar disorders).
5. Absence of active microbial disease in the last two months.
6. Not received vitamins or micronutrients supplements in the last two months.

Exclusion criteria were:

1. Chronic medical illness, for example, diabetes mellitus, renal, hepatic or epilepsy.
2. Recent trauma, infection, or pertussis vaccination.
3. Taking anti-inflammatory drugs like NSAIDs during the previous 2 months.
4. Comorbid autism spectrum disorder; depression or mood disorders
5. Using any drug with proven effects on inflammatory

Cytokines during the previous 2 months.

The control group included 20 healthy children matched for age and sex, recruited from the general pediatric clinic in Bab-El Sharyia university hospital, with no history of recent infection, trauma, or vaccination.

A case-control design was used. Both patients and controls were assessed using the following methods:

1. History taking, with emphasis on perinatal, developmental, family, and psychiatric history.
2. Complete physical examination, including neurologic examination.
3. Developmental and psychometric tests, which are explained in detail below:

   a. Conners' Abbreviated Parent-Teacher Rating Scale for ADHD (CPRS-HI)[13, 14].

   The Conners' Abbreviated Parent-Teacher Rating Scale for ADHD (CPRS-HI), which is an abbreviated form of the Conners' Parent-Teacher Rating Scale that consists of 10 items, includes the hyperactivity index (HI) from the long versions of the Conners scales.

   It assesses both hyperactivity and inattention and is also known as the Conners' 10-item scale. CPRS-HI was used to assess the severity of ADHD symptoms in the present study. An Arabic version validated in Egyptian children was used[15].

   b. Wechsler Intelligence Scale for Children-Third Edition (WISC-III)[16].

   The third edition of the Wechsler Intelligence Scale for Children (WISC-III) was used to evaluate the Intelligence Quotient (IQ) in children aged 6 to 17 years and yields a Verbal IQ, a Performance IQ, and a combined Full-Scale IQ. Children who had an IQ of less than 70 were excluded from the study.

   The administration of both CPRS-HI and WISC-III was carried out by a trained psychiatrist.
4. Measurement of Serum Interleukin-6 (IL-6) by Enzyme-Linked Immunosorbent Assay Technique.

Assay of serum IL-6 was performed in the same day of clinic attendance. In brief, 2 ml venous blood samples were collected from every participant

into a plain vacutainer tube and left to clot at room temperature then centrifuged at 3000 rpm for 20 min. Separated sera were kept frozen at –20 C until analysis. Hemolyzed sera were excluded. Serum IL-6 concentration was determined by enzyme linked immunosorbent assay (ELISA) kit (Shanghai Sunred Biological Technology Co., Ltd, Shanghai, China, Catalogue No. 201- 12-0901). The kit employs a double-antibody sandwich ELISA technique. The assay was carried out according to the manufacturer's instructions.

Expected values in children 6-16 years of age range from 5 to 15pg/mL.

Ethical Considerations:

1. Approval of ethical committee in the university was obtained before the study.
2. Full informed consent was taken from parents.
3. Any risks during the course of the research were cleared to the participants and to the Ethical Committee on time.
4. Privacy of participants and confidentiality of the data were maintained.
5. The patient has the right to withdraw from the study at any time.
6. The authors declared that there is no conflict of interest or any financial support regarding the study or publication.

Statistical Analysis:

Statistical Package for Social Science (SPSS v20) was used after transforming the data from Excel 2013 sheet. Categorical variables were presented by number and percent. They were compared using Chi-square test or Fischer's exact test when appropriate. Continuous variables were presented by mean and standard deviation or median and range. They were compared by student's t-test if parametric data and using Mann Whitney U test if non parametric data. In all tests, P value was considered significant if less than 0.05.

RESULTS

Demographic characteristics of studied cases:

Table (1) showing: The age, residence and sex distribution of studied ADHD patients and controls.

Table (1): ADHD patients and controls

	ADHD patients (20)	Controls (20)	p. value
Age (years)			
Range	6 – 16	6 – 14	.3655
Mean ±SD	8.4±2.28	9.0±1.84	
Sex			
Male	17	13	.144
Female	3	7	
Residence			
Rural	14	13	.736
Urban	6	7	

There was no significant difference between patients and controls as regard age, sex or residence

Table (2): Types of ADHD in the studied patients

Type of ADHD	N	%
Hyperactive	4	20
Inattentive	5	25
Combined	11	55
Total	20	100

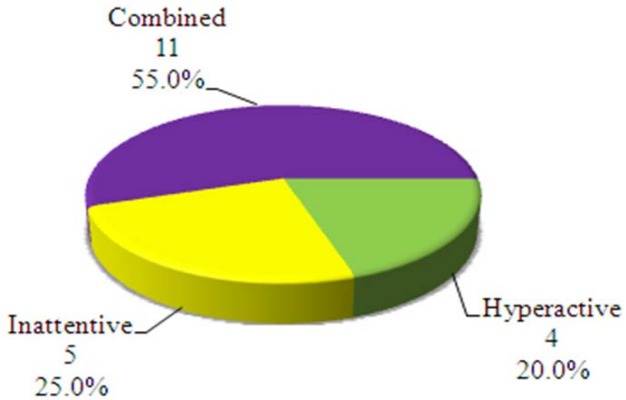

Figure (1): Type of ADHD in the studied patients

Table (2) and **figure (1)** showing that 55% of the studied ADHD patients were of the combined type, 25% were of the inattentive type while 20% were of the hyperactive type.

Sex distribution across ADHD subtypes:

Table (3): Correlation between Sex and ADHD types

ADHD Type \ Sex		Male	Female	Total
Hyperactive	N	4	0	4
	%	23.5	0	20
Inattentive	N	4	1	5
	%	23.5	33	25
Combined	N	9	2	11
	%	53	67	55
Total	N	17	3	20
	%	100	100	100
Chi-square	x^2	0.890		
	MCp-value	1.000		

p: p value for comparing between the studied group

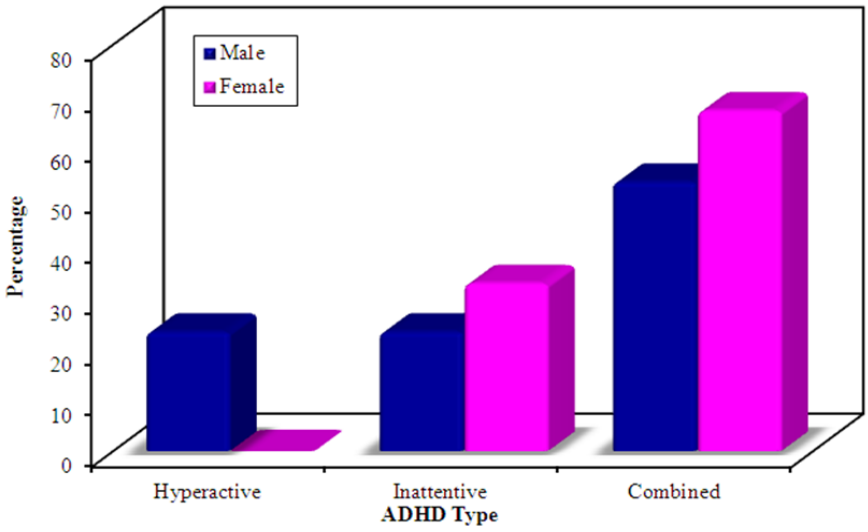

Figure (2): Sex distribution across ADHD subtypes

Table (3) and **figure (2)** showing that 53% of males and 67% of females were of the combined type. ADHD children were mainly combined and inattentive type without statistical difference between three types regarding sex.

Intelligence quotient among children studied by Wechsler intelligence children scale (WICS):

Table (4): Intelligence quotient among children studied by Wechsler intelligence children scale (WICS)

IQ	ADHD patients	Control
Range	70.0 – 97.0	90.0 – 107.0
Mean ±SD.	82.67 ±7.57	95.55 ±4.78
t. test	13.621	
P. value	0.001*	

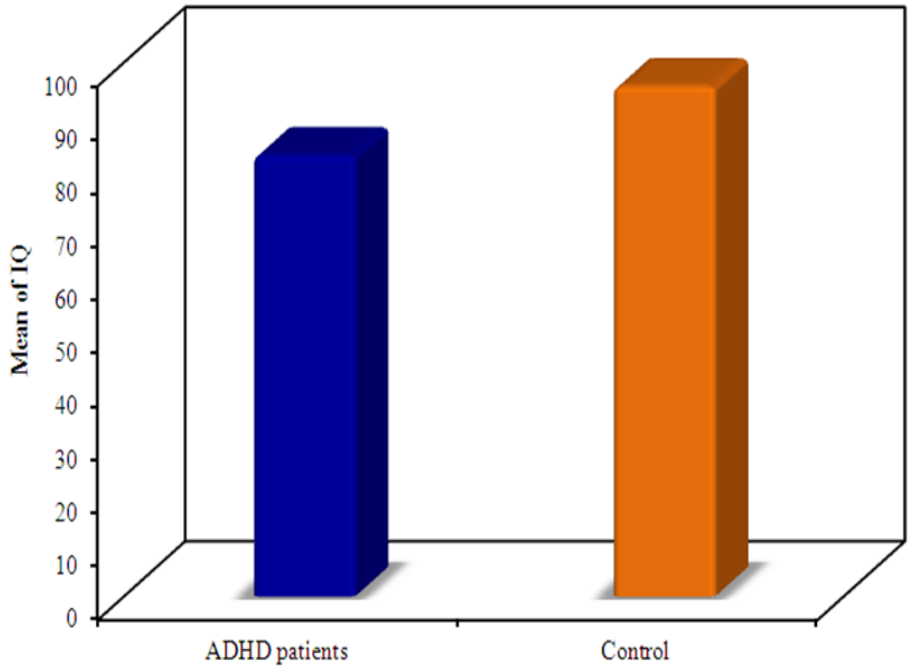

Figure (3): Intelligence quotient among children studied by Wechsler intelligence children scale (WICS)

Table (4) and **figure (3)** showing that Intelligence quotient among children studied by Wechsler intelligence children scale (WICS) ranged from (70-97), while in the controls ranged from (90-107).Intelligence quotient was lower in ADHD patients than controls.

Conner's parent rating scale for ADHD symptoms (Abbreviated form):

Table (5): Conner's parent rating scale for ADHD symptoms (Abbreviated form)

Conner's rating scale	ADHD patients	Control
Range	17.0 – 25.0	2.0 – 8.0
Mean ±SD.	20.0 ±3.36	6.1 ±1.83
t. test	34.045	
P. value	0.001*	

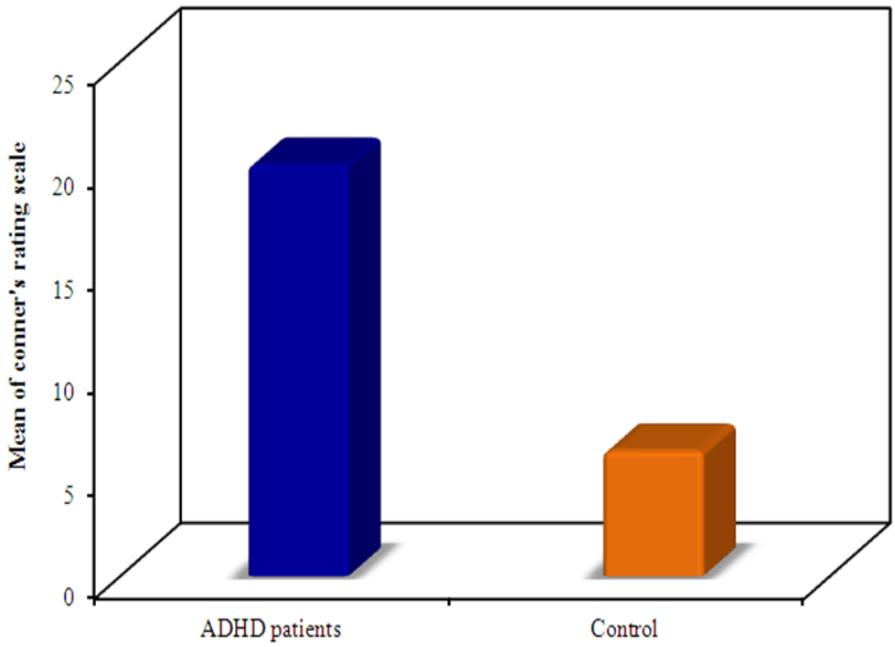

Figure (4): Conner's parent rating scale for ADHD symptoms (Abbreviated form).

Table (5) and **figure (4)** showing conners parent rating scale for ADHD symptoms ranged from (17-25) in the studied ADHD patients, and (2-8) in the controls .There was significantly higher scores in ADHD patients compared to the Controls.

Serum IL-6 Levels in patients and controls:

Table (6): Serum IL-6 levels in patients and controls

IL-6 (pg /ml)	ADHD patients	Control
Range	6.2 – 58.2	1.86 – 14.74
Mean ±SD.	23.35 ±13.47	7.57 ±3.47
t. test	31.263	
P. value	0.001*	

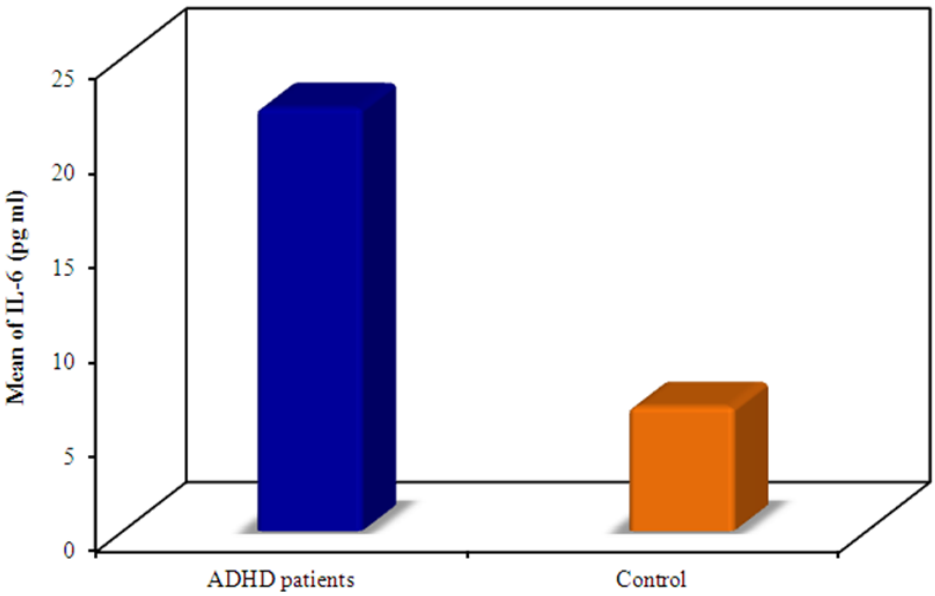

Figure (5): Serum IL-6 levels in patients and controls.

Table (6) and **figure (5)** showing that there was significant difference between ADHD patients and controls regarding serum level of IL-6.

DISCUSSION

Attention deficit hyperactivity disorder (ADHD) is a behavioral disorder with symptoms of hyperactivity, impulsivity, and inattention. It is estimated that the prevalence of ADHD worldwide is 5.29% in children and adolescents, and it is more common in males[17].

ADHD is an early onset, highly prevalent, with genetic, environmental and biological etiologies that persist into adolescence and adulthood in a sizeable majority of affected

children and adolescents of both sexes[18].

ADHD etiology is not completely understood, but common comorbid dysfunction of the immune system suggests that these systems may be affected by a common genetic background and molecular mechanisms[19].

The present study investigated the role of cytokines and the immune system in the pathogenesis of ADHD through measurement of serum interleukin-6 in both ADHD and normal children. We found a significantly higher serum level of IL-6 in ADHD children compared to normal children of matched age, sex, and residence. In accordance with our findings, 2 previous studies have also reported higher serum level of IL-6 in ADHD patients compared with normal control children[20,21].

Donfrancesco et al.,[20] found significantly higher levels of serum IL-6 and IL-10 in ADHD children than control group; however, they found insignificant difference in the levels of other cytokines (IL-2, IL-4, IL-17, IFN-g, and TNF-a). **Oades et al.[21]** also reported higher serum IL-6 level in ADHD patients than in controls, but the difference was statistically insignificant. They also found non-significantly higher levels of other cytokines (IL-2, IFN-γ, IL-16, IL-10, IL-13) in ADHD patients than normal control children.

In our study, 85% of the studied ADHD patients were males and 15% were females, This is in agreement with **Fayyad et al.,[22]**; **Abdel Sattar et al.,[23]** and **Cornejo et al.,[24]** who found that males-to-females ratios varies from 3: 1 to 9: 1 in both urban and rural area.

- **Different factors may contribute to this gender difference and the high prevalence of boys than girls:**

1. Girls with ADHD manifest mainly the inattentive type of the disorder and this is supported by **Biederman et al.,[25]** and since symptoms of inattention are more covert than those of hyperactivity and impulsivity, so parents of girls with ADHD may not seek medical advice.
2. Disruptive behaviour disorders are clearly less prevalent in girls regardless of ADHD status. The low risk of disruptive behaviour disorders in girls would have led to under identification or under referral of girls with ADHD, consistent with this suggestion girls with ADHD had fewer school problems than boys

with ADHD. This is supported by **Ruchkin et al.,**[26] who find that studies drawing ADHD samples from the community find that girls are significantly less likely to have comorbid oppositional defiant disorder and conduct disorder and less intellectual deficits.

As regard the clinical type of ADHD we found that 55% of the studied ADHD children were of the combined type, 25% were of the inattentive type, 20% were of the hyperactive impulsive type.

As regard sex distribution across ADHD sub-types; 53% of males were of the combined type, and 33% of females were of the inattentive type, and higher severity of hyperactivity in male patients. This was in agreement with several studies that revealed that the combined type is the predominant type among ADHD children.

Pelham et al.,[27] found that the combined type represents 65% of ADHD children, while hyperactive and inattentive type represent 24.6% and 10.3% respectively.

Similar to our finding, **Cardo et al.,**[28] found that ADHD children in island of Mallorca, the combined type represents 49.2%, while hyperactive and inattentive types were 27.6% and 23.2% respectively.

Possamde et al.,[29] found that the combined type was the most prevalent type of ADHD, representing 51.4% of ADHD children.

In contrast **Lahey et al.,**[30] found that inattentive type was the most prevalent type among ADHD children, it was 50%, combined type was 37%, hyperactive- impulsive type was 13%.

Additionally, **Froehlich et al.,**[31] found similar results of the higher prevalence of ADHD inattentive and combined subtypes than the hyperactive impulsive subtype.

In Egypt, **Eltallawy et al.,**[32] studied the prevalence of ADHD in primary school children in Assuit city, they found that the hyperactive type was 55%, the combined type was 33% and the inattentive type was 22%.

In our study IQ as measured by WICS was lower in ADHD patients compared to control children. This was in agreement with **Sergeant et al., 2007** who concluded that most WCST studies could distinguish ADHD from normal controls, but these findings depend on which variables were used. In most of

studies preservative response (which is considered a sensitive parameter in WCST), preservative errors and failure to maintain set were used to differentiate between ADHD and normal controls.

Our study is in concordance with other studies that found set shifting impairment in ADHD patients in comparison to normal control, for example the study of **Barkley et al.,**[33] and **zokzanis et al.,**[34].

Scheres et al.,[35] results were not in concordance With our results as they found that preservative errors and failure to maintain set did a poor job in discriminating between ADHD and normal control.

In our study, we found that there was significant difference between ADHD patients and controls as regard to Conner's parent rating scale to assess severity of ADHD symptoms.

Conner's parent rating scale for ADHD symptoms was used in this Study, score higher than 15 reflects presence of ADHD, higher score reflects severity of ADHD , there was significantly higher scores in ADHD patients compared to control group.

In our study 70% of ADHD patients were from rural areas and 30% were from urban areas.

Similarly, **(Anderson et al.,**[36]**)** found that rural children are more often identified with an ADHD diagnosis than urban children, On the contrary **(Uebel et al.,**[37]**)** found no difference in the prevalence of ADHD between urban and rural areas.

In our study we found that there was significantly higher serum level of (IL-6) in ADHD patients compared to controls.

Similar to our results, **(Oades et al.,**[21]**)** reported that IL-6 was higher in ADHD patients than control group, but the difference was not statistically significant.

They also found not significantly higher levels of other cytokines (IL-2, INF-γ, IL-16, IL-10, IL-13) in ADHD patients than Control group. These higher levels of cytokines were normalized after treatment of ADHD with psycho stimulant medication.

We found no correlation between increased IL-6 and Conners score. contrary to our findings **(Oades et al.,**[21]**)** found a correlation between increased cytokines and certain symptoms of ADHD, specifically, increased IL-13 (anti-inflammatory) and inattention and increased IL-16 proinflammatory) and hyperactivity.

Another study which explored association between increased IL-6 and paternal smoking found that there was an association between increased IL-6 and paternal smoking **(Oades,[21]** and **Mitchell and Goldstein,[38])**. **(Monje et al.,[13])** found that IL-6 inhibits neurogenesis in the hippocampus through blockade of the differentiation of neural progenitor cells into neurons, which may create serious problem in developing brains and could result in an increased risk of ADHD.

Buske-Kirschbaum et al.,[39] Showed that the dysregulated immune response in children with ADHD has been further corroborated by more frequent episodes of physical ill health and elevations in pro-inflammatory cytokines with four times higher concentrations of IL-1 and IL-6, which support a chronic immune-mediated neurological inflammation.

ADHD etiology is not completely understood, but common comorbid dysfunction of the immune system suggests that these affected by a common genetic background and molecular mechanisms. For example, increased levels of specific cytokines were observed in ADHD, while several genes that are linked to ADHD have immune functions. An immune imbalance, probably requiring a predisposing genetic background, is suggested to contribute to ADHD etiology **(Verlaet et al.,[40])**.

It is known that proinflammatory pleiotropic cytokines such as interleukin-6 (IL-6) are expressed in the central nervous system (CNS)during disease conditions and affect several brain functions including memory, and learning **(Drtilkova et al.,[41])**.

Excessive cytokine release may impact on the central nervous system (CNS) in the light of the capability to pass the blood-brain barrier, possibly affecting both neurotransmission and brain circuits known to be involved in ADHD symptomatology **(Dantzer and Kelley,[42])**.

Higher concentrations of IL-6 support a chronic immune-mediated neurological inflammation. This overproduction of cytokines can lead to chronic inflammation in brain tissue, which is consistent with findings of gray matter heterotopia and reduced cortical volume and folding in ADHD, and behavioral effects. Thus, overproduction of cytokines and chronic inflammation in brain

tissue may play a role in the pathogenesis of ADHD.

CONCLUSION

Serum IL-6 levels were significantly higher in ADHD children compared with the healthy control children; however, the IL-6 levels did not correlate with the severity of ADHD symptoms. Elevated levels of IL-6 in ADHD children indicate that immune activation may have a place in the pathogenesis of ADHD.

RECOMMENDATIONS

Our finding that children with ADHD have elevated levels of serum IL-6 could have implications for efforts to define pathogenesis of ADHD. Further studies are needed to investigate the role of IL-6 and other cytokines in the pathogenesis of ADHD. Treatment directed toward neuroinflammation in ADHD is a new approach that needs further research.

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مستوى الانترلوكين 6 بالدم للاطفال المصابين باضطراب فرط الحركة و قصور الانتباه

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يعتبر عدم الانتباه وفرط النشاط والاندفاع من الخصائص السلوكية التي توجد لدى جميع الأطفال الصغار والتي تنخفض تدريجيًا عند وصولهم إلى مرحلة البلوغ، والأطفال المصابين باضطراب فرط الحركة ونقص الانتباه يتم تميزهم عن أقرانهم الطبيعيين من خلال زيادة عدم الانتباه وفرط النشاط والاندفاع نسبة إلى من هم في نفس السن والجنس وغالبًا ما تستمر هذه الاختلافات في السلوك الي مرحلة البلوغ. وهؤلاء الأطفال يعانون ايضا من ضعف في عدة مجالات، بما في ذلك التحصيل الدراسي في المدرسة، والتفاعل مع الآباء والأشقاء، وعلاقات الأقران.

كان الهدف من هذه الدراسة هو تقييم مستوى الإنترلوكين -6 في الدم في الاطفال المصابين بفرط الحركة وتشتت الانتباه والمقارنة بينهم وبين الاطفال الغير مصابين.

وقد اجريت هذه الدراسة على 40 طفلاً تتراوح أعمارهم بين 6 و16 عامًا تم تقسيمهم الي:

مجموعــه (1): وقــد اشــتملت علــي 20 طفــلا مصــابين باضــطراب فــرط الحركــة ونقــص الانتبــاه الــذين تــم اختيــارهم مــن عيــادة أعصــاب الأطفــال فــي مستشــفى بــاب الشــعرية الجــامعي فــي الفتــرة من يونيو 2019 إلى 1 فبراير 2020.

مجموعــه (2): وقــد اشــتملت علــي20 طفــلًا كمجموعــه ضــابطه تــم اختيــارهم مــن العيــادة الخارجيــة لقســم طــب الأطفــال، متطــابقين حســب العمــر، ولا يســتوفون معــايير اضــطراب فــرط الحركــة وتشــتت الانتبــاه ولــيس لــديهم تــاريخ مــن الاضــطرابات النفســية أو العصبية الأخرى.

وقد خضع جميع الأطفال في هذه الدراسة الي ما يلي:

1. أخــذ التــاريخ المرضــي كــاملا والحالــة الاجتماعيــة والاقتصادية.
2. الفحص السريري الشاملز
3. اختبارات النمو والتقييم النفسي:
   - مقياس تقييم كونر للآباء والمعلمين المختصر.
   - اختبار ويكسلر لقياس معدل الذكاء لدي الأطفال.
4. الفحوصات التاليه:
   - قياس الانترلوكين -6.

نتائج البحث:

لقد انقسم الأطفال الذين يعانون من فرط الحركة وقله الانتباه في هذه الدراسة الي 20 % يعانون منفرط الحركة فقط و25 % يعانون من زياده في عدم التركيز وكثره التشتت فقط و 55 % يعانون من الاثنين معا ومع عدم وجود أي فرق ذات دلاله إحصائية في هذه الأنواع داخل المجموعة من حيث الجنس وعلي الرغم من ان هناك فرق في المجموعة الكلية في الأطفال التي أجريت عليهم الدراسة كان عدد الذكور الذين يعانون من فرط الحركة وقله الانتباه اكثر من الاناث حيث كان معدل الذكور 85 % والاناث15% .

70% من أطفال فرط الحركة وقله الانتباه الخاضعين للدراسة من مناطق ريفيه و 30% منهم من المدينة.

كما ظهر فرق ذات دلاله إحصائية بين الأطفال الذين يعانون من فرط الحركة وقله الانتباه من حيث معدل الذكاء حيث ان معدل الذكاء كان قليلا بطريقه ملحوظه في الأطفال الذين يعانون من فرط الحركة وقله الانتباه عن الأطفال الذين استخدموا كمجموعه ضابطه.

ظهر فرق ذات دلاله إحصائية بين الأطفال الذين يعانون من فرط الحركة وقله الانتباه والأطفال الذين استخدموا كمجموعه ضابطه من حيث مقياس كونر المختصر للآباء حيث ان المجموعة الاولي من الأطفال حصلوا علي درجات عالية والذي يفيد ذلك في تشخيص المرض ومدي صعوبته ،

فـــي نفـــس الوقـــت الـــذى حصـــل فيـــه أطفـــال المجموعـــة الثانيـــة علـــي درجات قليله جدا.

ظهـــر فـــرق ذات دلالـــه إحصـــائية بـــين الأطفـــال الـــذين يعـــانون مـــن فـــرط الحركـــة وقلـــه الانتبـــاه والأطفـــال الـــذين اســـتخدموا كمجموعه ضابطه من حيث نسبه الانترلوكين -6 في الدم.

تتناســـب نســـبه الانترلـــوكين -6 فـــي الـــدم تناســـبا عكســـيا مـــع نســـبه الـــذكاء المقاســـة بمقيـــاس ويكســـلر فـــي أطفـــال هـــذه الدراســـه وأيضـــا تتناســـب نســـبه الانترلـــوكين -6 فـــي الـــدم تناســـبا طرديـــا مـــع النتـــائج المقاســـة بمقيـــاس كـــونر المختصـــر للآبـــاء مـــع عـــدم وجـــود فرق ذو دلاله إحصائية بينهم.

استنتاجات البحث:

1. قـــيم الانترلـــوكين -6 كانـــت أكثـــر ارتفاعـــا فـــي الأطفـــال الـــذين يعـــانون مـــن فـــرط الحركـــة وقلـــه الانتبـــاه مقارنـــه بالأطفـــال الـــذين استخدموا كمجموعه ضابطه.

2. يمكـــن اســـتخدام الانترلـــوكين –6 فـــي اكتشـــاف الســـبب فـــي حـــالات فـــرط الحركـــة وقلـــه الانتبـــاه حيـــث انـــه يعطـــي دلالـــه عـــن الحالـــة المناعيـــة لـــدي هـــؤلاء الأطفـــال وقصـــور الحالـــة المناعيـــة من احد أسباب هذا المرض.

3. القصـــور فـــي الحالـــة المناعيـــة نتيجـــة أي التهـــاب فـــي المـــخ او غيـــره يظهـــر فـــي صـــوره ارتفـــاع فـــي نســـبه معـــدلات الالتهـــاب

والسيتوكينات مثل الانترلوكين -6 في الدم والذي تم اثبات ارتفاعه في هؤلاء الأطفال.

توصيات البحث:

1. علي ضوء هذه النتائج نوصي بأن الانترلوكين -6 من السيتوكينات المهمة الموجودة في خلايا المخ ويمكن ان يستخدم في تشخيص السبب في حالات فرط الحركة وقله الانتباه ويمكن استخدامه في التنبؤ للحالة المناعية للذين يعانون من هذا المرض.

2. لابد من عمل دراسات متعددة على مجموعه كبيره من حالات فرط الحركة وقله الانتباه لمسانده هذا البحث لإثبات ارتفاع نسبه الانترلوكين -6 في هذه الحالات ولاستخدامه من ضمن التحاليل والفحوصات التي يتم عملها كروتين في هذا المرض.