COGNITIVE FUNCTIONS IN CHILDREN WITH TYPE I DIABETES

By

Ahmed Awad Eldamom*, Ali Abd-Ellatif Afia*, Ali Abdul Fattah Alnabawy, Abdelsattar Abdullah Elsayeh*, Nabil Fathy Esmael*****

Pediatric*, Psychiatry**& Clinical Pathology Departments***, Faculty of Medicine, Al- Azhar University

ABSTRACT

Background*: Type 1 diabetes mellitus (T1DM) is a common chronic disease characterized by hyperglycemia as a cardinal biochemical feature caused by deficiency of insulin secretion due to pancreatic β-cell damage. T1DM is the most common endocrine-metabolic disorder of childhood and adolescence, with important consequences on physical and emotional development. There is increasing agreement that children with T1DM are at higher risk of developing slight cognitive disabilities compared to healthy age-matched peers.*

Objectives*: To quantify the magnitude and pattern of cognitive difficulties in pediatric type 1 diabetes as well as the effects associated with earlier disease onset and longer duration of diabetes.*

Research design and methods: *This is a case-control study. The study was conducted over a period from November 2016 to November 2018. Our study included fifty patients with T1DM matched with age and gender of fifty apparently healthy controls. All cases were subjected to history, clinical examination, investigations and cognitive functions which assessed by Modified Mini-Mental State examination (3MS), Intelligence Quotient (IQ) test and Pediatric Symptoms Checklist (PSC).*

Results: *The present study shows high significant differences between patients and control groups as regard to IQ, Modified Mini-Mental State examination (3MS) and Pediatric Symptoms Checklist (PSC). The best cut off point for IQ to detect cognitive dysfunction in diabetic patients was found ≤ 83 with sensitivity of 88%, specificity of 86% and area under curve (AUC) of 91.4. The best cut off point for 3MS to detect cognitive dysfunction in diabetic patients was found ≤ 27 with sensitivity of 58%, specificity of 76% and AUC of 74.4. Finally the best cut off point for PSC to detect cognitive dysfunction in diabetic patients was found ≤ 42 with sensitivity of 84%, specificity of 92% and AUC of 96.1%. The PSC was found the better predictor of cognitive dysfunction in diabetes with area under curve (AUC) 96.1% followed by IQ with AUC of 91.4% and lastly the 3MS with AUC of 74.4%.*

Conclusion: *From our study we concluded that diabetic children have lower cognitive performance than non- diabetic and those cognitive dysfunction increased in diabetic patient with disease duration >5 years and in those with poor glycemic control.*

Key Words: *Child; HbA1c; executive functioning; intelligence; memory; type 1 diabetes mellitus.*

INTRODUCTION

Type 1 diabetes mellitus (T1DM) is a common chronic disease characterized by hyperglycemia as a cardinal biochemical feature caused by deficiency of insulin secretion due to pancreatic β-cell damage.T1DM is the most common endocrine-metabolic disorder of childhood and adolescence, with important consequences on physical and emotional development. Morbidity and mortality result from acute metabolic derangements and from long-term complications **(Crimmins and Dolan, 2008)**.

Diabetes in a child affects the lifestyle and interpersonal relationships of the entire family. Family conflict has been associated with poor treatment adherence and poor metabolic control among youths with T1DM **(Svoren and Jospe, 2015)**.

There is increasing agreement that children with T1DM are at higher risk of developing slight cognitive disabilities compared to healthy age-matched peers. Evidence suggests that early-onset diabetes (younger than 7 yr) is associated with cognitive difficulties compared to late-onset diabetes and healthy controls **(Gaudieri et al, 2008)**.

The cognitive difficulties observed were primarily learning and memory skills (both verbal and visual) and attention/executive function skills. It is likely that the impact of diabetes on pediatric cognition appears shortly after diagnosis. Indeed, it has been observed that early-onset diabetes and longer duration of diabetes in children with diabetes adversely affect their school performance and educational achievements **(Gaudieri et al, 2008)**.

Findings indicate that children with earlier diabetes onset (EOD), before the age of 7years, show evidence of greatest cognitive disruption compared to their disease contrast group with later onset (LOD). Reliable cognitive differences are documented in children who have average disease duration of just 5.23 years **(Strudwick, et al, 2005)**.

Ethical Considerations:

1. Approval of ethical committee, Faculty of Medicine, Al-Azhar University.
2. Written consents from the parents of the patients.
3. The patients have the right to withdraw from the study at any time.
4. All the obtained data are confidential and the patients have the right to keep them.
5. The authors declare that there is no any financial conflict regarding the research and publication.
6. No conflict of interest regarding the study and publication.

PATIENT AND METHODS

This is a case-control study which was designed to determine the relationship between cognitive function and Type 1 diabetes mellitus in young Egyptian population 4-18 years of age. The study was conducted over a period from November 2016 to November 2018. Our study included fifty patients with Type 1 diabetes mellitus matched with age and gender of fifty apparently healthy controls.

Patients:

(A) Diabetic group:

Fifty patients with type 1 diabetes from Al -Hussein hospital and Al-Fordous Insurance hospital in Mansoura city were enrolled in our study.

Inclusion criteria:

1) Age from 4-18 years.
2) Both newly diagnosed and old cases.

Exclusion criteria:

1) Patients with neurological diseases.
2) Patients with other autoimmune diseases.
3) Patients with other chronic diseases (as liver, kidney and heart).

(B) Control group:

Fifty children not suffering from diabetes or any other significant chronic illness were enrolled from outpatient clinic in a private hospital in Mansoura city. They were coming for minor acute illness, routine laboratory investigations as CBC or stool and urine analysis or as a preoperative investigation for tonsillectomy as RBS, liver and renal function and PT &PTT. The healthy children were selected in a way matching to the age and gender of patients to give a good representative sample of the studied population.

Methods:

All cases were subjected to the following:

Thorough history (from the caregivers and the child) and clinical examination using predesigned printout questionnaire form. Cognitive functions assessed by :

Modified Mini-Mental State examination (MMMS), Intelligence Quotient (IQ) test and Pediatric Symptoms Checklist (PSC).

1) Modified Mini-Mental State Examination (MMMS), a screening test of higher mental function, has been modified slightly for use in a pediatric outpatient setting. The test, which takes 5 to 10 minutes to administer, covers a range of cognitive functions including orientation, attention-concentration, memory, language, and constructional ability. In this study, we have found that the test can be applied from the age of 4 years. Highly significant correlations were found between the MMMSE score and chronologic age ($r = .57$; $P < .001$), reading age ($r = .79$; $P < .001$), and mental age ($r = .83$; $P < .001$). MMMSE scores reach a plateau at a mental age of approximately 10 years. The MMMSE is a suitable instrument for screening higher mental function in children at the age of 4 years and above and can be readily incorporated into the routine neurologic examination of children **(Ouvrier, 1993)**.

● Orientation		Score	Points
1.what is the	Years? Season? Date? Day? Month?		1 1 1 1 1
2.where are we?	Country State or territory Town or city Hospital or suburb Floor or address		1 1 1 1 1

● Registration

3. Name three objects, taking one second to say each. Then ask the patient all three after you have said them(tree,clock,boat)give one point for each correct answer. Repeat the answer until patient learns all three.		3

● Attention and calculation

4. serial sevens. Give one point for each correct answer. Stop after five answers		5
5. spell WORLD backwards		5

● Recall

6. Ask for names of three objects learned in Q.3. Give one point for each correct answer		3

● Language

7. Point to a pencils and a watch. Have the patient name them as you point		2
8. Have the patient repeat "No ifs, ands or buts		1
9. Have the patient follow a three stage commend. Take a piece of paper in your right hand. Fold the paper in half. Put the paper on the floor?		3
10. Have the patient read and obey the following(CLOSE YOUR EYES) (write it in large letters)		1
11.Have the patient write a sentence of his or her choice.(the sentence should contain a subject and object, and should make sense. Ignore spelling errors when scoring).		1
12. Have the patient copy the design printed below. (give one point if all sides and angles are preserved and if the intersecting sides from diamond shape).		1
TOTAL		35

(Ouvrier, 1993)

Interpretation of 3MS

Method	Score	Interpretation
Education	21 <23 <24	Abnormal for 8th grade education Abnormal for high school education Abnormal for college education
Severity	24-35 18-23 0-17	No cognitive impairment Mild cognitive impairment Severe cognitive impairment

(2) I.Q TEST:

Historically, IQ is a score obtained by dividing a person's mental age score, obtained by administering an intelligence test, by the person's chronological age, both expressed in terms of years and months. The resulting fraction is multiplied by 100 to obtain the IQ score **(Gottfredson, 1997)**.

The Stanford–Binet Intelligence Scale is now in its fifth edition (SB5) and was released in 2003. It is a cognitive ability and intelligence test that is used to diagnose developmental or intellectual deficiencies in young children.

The SB5 can be administered to individuals as early as two years of age. These factors include fluid reasoning, knowledge, quantitative reasoning, visual-spatial processing, and working memory. Many of the familiar picture absurdities, vocabulary, memory for sentences, and verbal absurdities still remain from the previous editions **(Janzen, Obrzut, & Marusiak, 2003)**, however with more modern artwork and item content for the revised fifth edition.

Factors	Domains	
	Nonverbal	Verbal
Fluid reasoning	**Nonverbal fluid reasoning** Object series\ matrices	**Verbal fluid reasoning** Early reasoning (levels2-3) Verbal absurdities (Level 4) Verbal Analogies (Levels 5-6)
Knowledge	**Nonverbal knowledge** Procedural knowledge (levels2-3) Picture absurdities (Levels 4-6)	**Verbal knowledge** Vocabulary
Quantitative reasoning	**Nonverbal Quantitative reasoning** Quantitative reasoning (levels2-3)	**Verbal Quantitative reasoning** Quantitative reasoning (levels2-6)
Visual- Spatial processing	**Nonverbal Visual- Spatial processing** **From board** (levels1-2) **From patterns** (levels3-6)	**Verbal Visual- Spatial processing** Position and direction (levels2-6)
Working memory	**Nonverbal Working memory** Delayed response (Level 1) Block span (Levels 2-6)	**Verbal Working memory** Memory for sentences (Levels 2-3) Last word (Levels 4-6)

Stanford- Binet intelligence Scales: Fifth Edition subtests and activities in relation to verbal and nonverbal domains and CHC Stratum II factors.

Interpretation of IQ score:

Stanford–Binet Fifth Edition (SB5) classification	
IQ Range ("deviation IQ")	IQ Classification
145–160	Very gifted or highly advanced
130–144	Gifted or very advanced
120–129	Superior
110–119	High average
90–109	Average
80–89	Low average
70–79	Borderline impaired or delayed
55–69	Mildly impaired or delayed
40–54	Moderately impaired or delayed

(3) Pediatric symptoms checklist

PSC is one of the most promising methods of identifying children in need of psychiatric services through their pediatricians consultation.

The pediatric symptom checklist PSC **(Jellink et al., 1988)** is one of the only questionnaires that have been validated for use in pediatric office screening.

The PSC is a 32- items questionnaire designed to be completed in pediatrician waiting room by parents of 4-18 years old children. The PSC take less than 5 minutes to complete and score and reflect the parent's impression of his or her school aged child psychosocial functioning. The PSC identify dysfunctional children likely to benefit from further psychiatric evaluation.

PSC consists of 32 symptoms that parents rate as (often, sometimes or never) present in the child which are given score of 0,1,2 respectively , then the mean score for all patients was compared by the mean score for the control group.

Arabic version of the PSC done by **(El-dafrawi and Zietoun, 1997)** in the instrument was initially translated into Arabic for use with Egyptian parents, the translation was reviewed by child psychiatrist and clinical psychologist who were all fully bilingual.

(3) Pediatric symptoms checklist

Score	2	1	0

Symptom Checklist		No	Sometimes	Often
01	Complains of aches/pains without a physical cause			
02	Spends more time alone			
03	Tires easily			
04	Fidgety, unable to sit still			
05	Has trouble with teachers			
06	Less interested in school			
07	Acts as if driven by a motor			
08	Daydreams too much			
09	Distracted easily			
10	Afraid of new situations			
11	Feels sad, unhappy			
12	Is irritable, angry			
13	Feels hopeless			
14	Has trouble concentrating			
15	Less interest in friends			
16	Fights with others			
17	Absent from school			
18	School grades dropping			
19	Is down on him or herself			
20	Visits doctor with doctor finding nothing wrong			
21	Has trouble sleeping			
22	Worries a lot			
23	Wants to be with parents more than before			
24	Feels he or she is bad			
25	Takes unnecessary risks			
26	Gets hurt frequently			
27	Seems to be having less fun			
28	Acts younger than children his or her age			
29	Does not listen to rules			
30	Does not show feelings			
31	Does not understand other people's feelings			
32	Teases others			

Statistical Analysis:

The data were collected, tabulated, and analyzed by SPSS

(Statistical Package for Social Science) computer software program version 19.

Two types of statistics were done:

- Descriptive statistics {e.g. percentage (%), mean (x) and standard deviation (SD)},
- Analytical statistics: which include the following tests:
- Student (t) test: was used to study statistical significance between two quantitative variables.
- Chi-square test (x2): was used to study statistical significance between two qualitative variables.
- P-value of < 0.05 was considered statistically significant.

RESULTS

Table (1): Demographic Data of the Studied Groups

Item		Healthy group No. = 50	Diabetic group No. = 50	Test value	P-value	Sig.
Sex	Female Male	10 (20%) 40 (80%)	17 (34%) 33 (66%)	2.486*	0.115	**NS**
Age (Y)	Mean ± SD Range	11.82 ± 3.80 4 – 18	11.46 ± 3.21 5 – 18	0.511	0.610	**NS**
Wt. kg Percentile	Median (IQR) Range	50 (50 – 75) 10 – 95	50 (25 – 50) 10 – 95	-2.308ǂ	0.021	**S***
Ht. cm. Percentile	Mean ± SD Range	147.56 ± 19.19 108 – 179	142.48 ± 17.28 110 – 175	1.391	0.167	**NS**
	Median (IQR) Range	50 (25 – 75) 10 – 95	25 (25 – 50) 10 – 95	-1.692ǂ	0.091	**NS**
BMI Percentile	Median (IQR) Range	75 (50 – 85) 5 – 95	50 (50 – 75) 10 – 95	-2.428ǂ	0.015	**S***

(IQR=inter quarter range)

This table shows that there was significant difference between cases & control groups as regard to weight percentile and BMI percentile, being lower in diabetic group, but there was no significant difference between them as regard to sex, age, and height.

Table (2): Age of Onset and Duration of Diabetes in Patient Group

Item		Diabetic group
		No. = 50
Age of Onset (y)	Mean ± SD	8.54 ± 2.26
	Range	4 – 13
Duration of disease	Median (IQR)	3 (2 – 4)
	Range	1 – 8
	< 5 yrs	43 (86.0%)
	5 yrs or more	7 (14.0%)

This table shows that the mean age of onset of diabetes in our studied cases was 8.54 ± 2.26 years with range of 4-13 years and the median of duration of illness was 3 years, with range of 1-8 years and 86% of patients had more than 5 years and rest of patients were less than 5 years duration of disease.

Table (3): IQ, PSC and 3MS among Studied Groups

Item		Control group	Diabetic group	Test value•	P-value	Sig.
		No. = 50	No. = 50			
IQ	Mean ± SD	86.90 ± 3.74	77.54 ± 5.72	9.688	0.000	HS
	Range	79 – 97	67 – 90			
3MS	Mean ± SD	28.62 ± 1.76	26.60 ± 2.29	4.939	0.000	HS
	Range	25 – 32	22 – 31			
PSC	Mean ± SD	50.26 ± 4.88	38.96 ± 4.03	12.629	0.000	HS
	Range	41 – 59	31 – 49			

This table shows that diabetic groups had significantly lower IQ , 3MS and PSC than control groups.

Table (4): Receiver operating characteristic (ROC) curve for IQ, 3MS and PSC to detect cognitive dysfunction in diabetic cases

Variables	Cut off point	AUC	Sensitivity	Specificity	+PV	-PV
IQ	≤ 83	0.914	88.00	86.00	86.3	87.8
3MS	≤ 27	0.744	58.00	76.00	70.7	64.4
PSC	≤ 42	0.961	84.00	92.00	91.3	85.2

The previous table shows that the best cut off point for IQ to detect cognitive dysfunction in diabetic patients was found ≤ 83 with sensitivity of 88%, specificity of 86% and area under curve (AUC) of 91.4. Also the table shows that the best cut off point for 3MS to detect cognitive dysfunction in diabetic patients was found ≤ 27 with sensitivity of 58%, specificity of 76% and AUC of 74.4. Finally the best cut off point for PSC to detect cognitive dysfunction in diabetic patients was found ≤ 42 with sensitivity of 84%, specificity of 92% and AUC of 96.1%. The PSC was found the better predictor of cognitive dysfunction in diabetes with area under cure (AUC) 96.1% followed by IQ with AUC of 91.4% and lastly the 3MS with AUC of 74.4%.

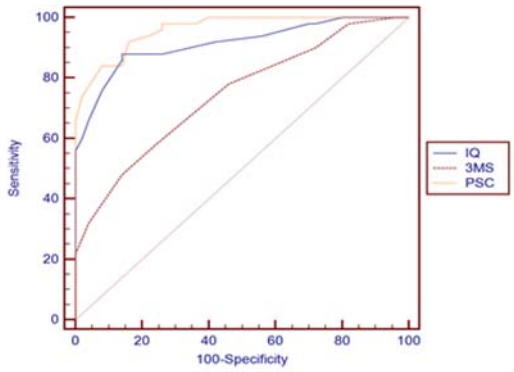

Figure (1): Receiver operating characteristic (ROC) curve for IQ, 3MS and PSC to detect cognitive dysfunction in diabetic cases

DISCUSSION

Young children with type 1 diabetes are particularly prone to experiencing extreme fluctuations in glucose levels at a time when the developing brain is undergoing wide ranging maturational changes **(Giedd and Rapoport, 2010)**. White matter proliferation, neuronal pruning and refining of neuronal networks are all actively occurring in childhood **(Bullmore and Sporns, 2012)**.

Meta-analytic cognitive studies also provide contrasting findings, with one reporting positive association between hypoglycemia history and cognitive deficit **(Blasetti, 2011)** and another finding no association **(Gaudieri, 2008)**.

Many, but not all studies of adults and children with childhood-onset type 1 diabetes (T1D) have documented an association between severe hypoglycemia (with seizures or loss of consciousness) and either poorer cognitive outcomes or brain changes **(Perantie et al., 2011)**.

There is preliminary evidence to suggest that this association can be detected quite early in young children and youth with recent onset diabetes **(Aye et al., 2011)**. On the other hand, results from the Diabetes Control and Complications Trial (DCCT) long-term follow-up study showed no effect of severe hypoglycemia history on cognitive function in adults with T1D, even in the youngest age subgroup (ages 13-18 at study entry), who were carefully followed for an average of 18 years (The Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications **(DCCT/EDIC) Study Research Group, 2011)**.

Our study showed no significant difference between patients and control groups as regard to sex and age (table1). This is in agreement with **(Atabek et al., 2006)** and **(Harrington et al., 2010)** who stated that there are no significant differences between diabetic patients and control group regarding age and sex.

Also in our study, there are statistical significant differences between the studied groups regard to weight percentile and BMI percentile being lower in diabetic group (table1). **(Knerr et al., 2005)** explored the relationships of body weight, height and BMI with onset of type 1 diabetes in a large cohort of 9,248 patients. They concluded that a higher BMI was associated with a younger age of diabetes manifestation. Therefore, increased weight gain in childhood

could be an additional factor for the early manifestation of type 1 diabetes through metabolic and immunological disturbances.

(Gimenez et al., 2007) investigated the relationship between BMI and the age at onset of type 1 diabetes in a large cohort of Mediterranean subjects in whom diabetes became manifest. They concluded that increasing BMI is not uniformly associated with younger age at diagnosis.

In the current study (table2) the mean age of onset of diabetes in our studied cases was 8.54 ± 2.26 years with range of 4-13 years and the median of duration of illness was 3 years, with range of 1-8 years and 86% of patients had more than 5 years of duration of disease and the rest of patients were less than 5 years of duration of disease.

In the current study (table 3) diabetic groups had significant lower IQ than control groups.

Children with type 1 diabetes demonstrated slightly lower performance than control subjects (overall cognition −0.13) in all cognitive domains, except learning and memory. Lower scores were found in intelligence (crystallized and fluid), psychomotor activity and speed of information processing (psychomotor efficiency and motor speed), attention/executive function, visual motor integration, and academic achievement **(Lin et al., 2010)**.

(Northam et al., 2009), who studied children at the time of diagnosis and 2 years following disease onset, found significant relationships between cognitive findings (executive functions of auditory attention, working memory; and verbal and visual learning and memory) and both chronic hyperglycemia and recurrent severe hypoglycemia. It is important to note, however, that these associations were confined to the older children in the cohort within the age range of 7 to 14.

In our study (table 3) we screened the mental state of patients with type 1 diabetes through the modified mini mental status examination, show that there was high significant difference between diabetic and control groups as regard to 3MS, being lower in diabetic patients, similar results found by **(Shuba, 2012)**.

In our study (table 3) shows that diabetic group had significant lower Pediatric Symptoms Checklist than control group similar results found by **(Reynolds, 2011)**.

In our study (table 4) shows that the best cut off point for IQ to detect cognitive dysfunction in diabetic patients was found ≤ 83 with sensitivity of 88%, specificity of 86% and area under curve (AUC) of 91.4. Also the table shows that the best cut off point for 3MS to detect cognitive dysfunction in diabetic patients was found ≤ 27 with sensitivity of 58%, specificity of 76% and AUC of 74.4. Finally the best cut off point for PSC to detect cognitive dysfunction in diabetic patients was found ≤ 42 with sensitivity of 84%, specificity of 92% and AUC of 96.1%. the PSC was found the better predictor of cognitive dysfunction in diabetes with area under cure (AUC) 96.1% followed by IQ with AUC of 91.4% and lastly the 3MS with AUC of 74.4% , similar results found by **(Ramírez, 2004)**.

(Northam et al., 2009)'s longitudinal evaluation of 90 newly diagnosed children revealed cognitive changes over just a 6-year period. After only two years, children with diabetes, particularly those with early onset of diabetes, exhibited less improvement on measures of nonverbal visuospatial skills than those with LOD or controls.

(Gaudieri et al., 2008) quantified the magnitude and pattern of cognitive difficulties in pediatric type 1 diabetes as well as the effects associated with earlier disease onset and severe hypoglycemia. They concluded that the impact of diabetes upon pediatric cognition appears to begin shortly after diagnosis. **(Naguib et al., 2009)** identified mild cognitive impairments in children with diabetes compared to children without diabetes.

CONCLUSION

From our study we concluded that diabetic children have lower cognitive performance than non-diabetic and those cognitive functions decreased in diabetic patient with disease duration >5 years and in those with poor glycemic control.

RECOMMENDATIONS

1. Routine screening of diabetic children for cognitive impairment should be done especially for those with disease duration >5 years and poor glycemic control.

2. IQ, MMMS, PSC are valuble screening tools.

3. Longitudinal follow up of this study will better characterize any association of these cognitive changes with dysglycemia.

4. We recommend that this research is done on a larger number of patients.

Limitation of the study

*There are some in cooperative patients.

*The research needs to be done on a larger number of patients.

*The investigation of research is cost.

REFERENCES

1. **Atabek ME, Kurtoglu S, Pirgon O, et al. (2006):** Arterial wall thickening and stiffening in children and adolescents with type 1 diabetes. Diabetes Research and Clinical Practice; 74: 33–40.
2. **Aye T, Reiss AL, Kesler S, et al. (2011):** The Feasibility of Detecting Neuropsychologic and Neuroanatomic Effects of Type 1 Diabetes in Young Children. Diabetes Care; 34(7): 1458–1462.
3. **Barnea-Goraly N, Raman M, Mazaika P, et al. (2013):** Alterations in white matter structure in young children with type 1 diabetes mellitus. Diabetes Care. 37(2): 332–340. Published online 2014 Jan 11. doi: 10.2337/dc13-1388.
4. **Blasetti A, Chiuri RM, Tocco AM, et al. (2011):** The Effect of Recurrent Severe Hypoglycemia on Cognitive Performance in Children With Type 1 Diabetes: A Meta-analysis. Journal of Child Neurology; 26(11): 1383–1391.
5. **Bruce DG, Davis WA, Casey GP, Starkstein SE, Clarnette RM, Foster JK, Almeida OP, Davis TM. (2008):** Predictors of cognitive impairment and dementia in older people with diabetes. Diabetologia. 2008 Feb; 51(2):241-8.
6. **Bullmore E, Sporns O (2012):** The economy of brain network organization. Nature Reviews Neuroscience; 13(5): 336–349.
7. **Crimmins NA and Dolan LM (2008):** Definition, Diagnosis, and Classification of Diabetes in Youth in Epidemiology of Pediatric and Adolescent Diabetes. Edited by Dabelea D, Klingensmith GJ; by Informa Healthcare USA, Inc; 1-19.
8. **DCCT/EDIC Research Group (2011):** Intensive diabetes therapy and glomerular filtration rate in type 1 diabetes. N Engl J Med; 365(25): 2366-76.
9. **Folstein MF, Folstein SE. (1975):**"Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res.;12(3):189-98.
10. **Gaudieri PA, Chen R, Greer TF, et al (2008):** Cognitive function in children with type 1 diabetes: a meta-analysis, Diabetes Care 31:1892–1897.
11. **Giedd JN, Rapoport JL (2010):** Structural MRI of Pediatric Brain Development: What Have We Learned and Where Are We Going? Neuron; 67(5): 728–734.
12. **Gottfredson, Linda S. (1997):** "Mainstream Science on Intelligence (editorial)" (PDF). Intelligence. 24:

13–23. doi:10.1016/s0160-2896(97)90011-8. ISSN 0160-2896. Archived (PDF) from the original on 22 December 2014.

13. **Harrington J, Pena AS, Gent R, et al. (2010):** Aortic intima media thickness in an early marker of atherosclerosis in children with type 1 diabetes mellitus. J Pediatr; 156: 237-41.

14. **Janzen, John E. Obrzut, Christopher W. Marusiak (2003):** Stanford-Binet Intelligence Scales, Fifth Edition (SB:V). Canadian Journal of School Psychology Volume19, Pages 235-244.

15. **Jellink et al., (1988):** Pediatric Symptom Checklist: Screening school-age children for psychosocial dysfunction.The Journal of Pediatrics Volume 112, Issue 2, Pages 201-209.

16. **Knerr I, Wolf J, Reinehr T, et al. (2005):** The 'accelerator hypothesis': Relationship between weight, height, body mass index and age at diagnosis in a large cohort of 9,248 German and Austrian children with type 1 diabetes mellitus. Diabetologia; 48: 2501-2504.

17. **Lin A, Northam EA, Rankins D, et al. (2010):** Neuropsychological profiles of young people with type 1 diabetes 12 yr after disease onset. Pediatric Diabetes; 11: 235–243.

18. **Naguib JM, Kulinskaya E, Lomax CL, et al. (2009): Neuro-cognitive Performance in Children with Type 1 Diabetes- A Meta-analysis. Journal of Pediatric Psychology; 34(3): 271–282.**

19. **Northam EA, Anderson PJ, Jacobs R, et al. (2009):** Neuropsychological Profiles of Children With Type 1 Diabetes 6 Years After Disease Onset. Diabetes Care; 24: 1541–1546.

20. **Ouvrier RA1, Goldsmith RF, Ouvrier S, Williams IC (1993) :**The value of the Mini-Mental State Examination in childhood: a preliminary study. J Child Neurol. Apr;8(2):145-8.

21. **Perantie DC, Koller JM, Weaver PM, et al. (2011):** Prospectively Determined Impact of Type 1 Diabetes on Brain Volume During Development. Diabetes; 60(11): 3006–3014.

22. **Ramírez, R. M., Chirivella-Garrido, J., Caballero, M. C., Ferri-Campos, J., & Noe-Sebastian, E. (2004):** Intelligence, memory and malingering: Correlation between scales. Revista de neurologia, 38(1), 28-33.

23. **Reynolds, K. A., & Helgeson, V. S. (2011):** Children with diabetes compared to peers: depressed? Distressed? A meta-analytic review. Annals of Behavioral Medicine, 42(1), 29-41.

24. **Shuba, N. (2012):** Assessment of the cognitive status in diabetes mellitus. Journal of clinical and diagnostic research: JCDR, 6(10), 1658.

25. **Strudwick SK, Carne C, Gardiner J, et al (2005):** Cognitive functioning in children with early onset type 1 diabetes and severe hypoglycemia. J Pediatr 147:680–685.

26. **Svoren BM and Jospe N (2015):** TYPE 1 Diabetes mellitus in Behrman R.E Kleigman R.M .and Jenson H. B. (eds) Nelson Textbook

of Pediatrics. 19th Edition, WB SAUNDERS Company, P 1969-97.

27. **Turer CB, Lin H and Flores G (2013):** Prevalence of Vitamin D Deficiency Among Overweight and Obese US Children. PEDIATRICS Volume 131, Number 1, January 2: e152-162.

الوظائف المعرفية لدى اطفال السكرى النوع الأول

احمد عوض الدعموم *علي عبداللطيف عافيه*على عبد الفتاح النبويعبد الستار عبدالله السايح *نبيل فتحي اسماعيل*****

(اقسام الاطفال* وامراض النفسية والباثولوجيا الإكلينيكية***، كلية الطب، جامعة الازهر)**

إن داء السكري من النوع الأول هو اضطراب الغدد الصماء الأكثر شيوعًا في سن الطفولة والمراهقة، مع التطور البدني والعاطفي والمعرفي. تنجم مضاعفات المرض والوفيات عنه بسبب الاضطرابات الأيضية الحادة والمضاعفات طويلة الأجل.

هناك اتفاق متزايد على أن الأطفال الذين يعانون من داء السكري هم أكثر عرضة لحدوث اختلافات صغيرة في القدرات المعرفية مقارنة مع أقرانهم الأصحاء وذلك مع تقدم العمر. تشير الدلائل إلى أن مرض السكري في سن مبكر (أقل من 7 سنوات) يرتبط بصعوبات إدراكية مقارنة بمرض السكري في السن المتأخر.

الهدف من هذه الدراسة:

هو تقييم حجم ونمط الصعوبات المعرفية في داء السكري من النوع الأول للأطفال، وكذلك علاقتهم مع بداية المرض ومدة المرض.

المرضى وطرق البحث:

ولقد اشتملت الدراسة الحالية على 50 طفلا مصابين بالنوع الأول من داء السكري (المجموعة المرضية) و 50 طفلا على ما يبدو يتمتعون بصحة جيدة (المجموعة الضابطة). هذا الأخير كان السن والجنس متطابقة. وإجمالي عدد الأطفال الذين شملهم المسح، كان 66 ٪ من مرضى السكري و 80 ٪ من الأطفال الأصحاء من الذكور وكانت نسبة الاناث 34 ٪ من مرضى السكري و 20 ٪ من الأطفال الأصحاء. متوسط العمر (بالسنوات) للمرضى مقابل الضوابط كان 11.46 ± 3.21 مقابل 11.82 ± 3.8.

تم البحث من خلال متابعة التاريخ المرضى للحالات واجراء الفحوصات و التحاليل وتقييم الوظائف المعرفية بالمرضى عن طريق معدل ذكاء و فحص الحالة العقلية المصغرة المعدلة وقائمة فحص أعراض الطفل.

نتائج الدراسة:

أن الأطفال المصابين بمرض السكري لديهم أداء إدراكي أقل من غير المصابين بالسكري وأن هذا الانخفاض المعرفي يزداد في مريض السكري مع مدة المرض التي هي أكثر من 5 سنوات وايضا مع الذين يعانون من سوء السيطرة على الهيموجلوبين السكرى.

وأخيرًا نوصي بـ:

يجب إجراء الفحص الروتيني على الوظائف الإدراكية والمعرفية للأطفال المصابين بالسكري خاصة للذين يعانون من المرض أكثر من 5 سنوات.

ويعتبر اختبار معدل الذكاء وقائمه فحص اعراض الطفل وفحص الحالة العقلية المصغرة المعدلة أدوات فحص فعاله

المتابعة الطولية لهؤلاء المرضى منعا لحدوث مضاعفات حادة أو طويلة الأمد أو إدراكية ومعرفية.