Psychological and behavioral complications in children and adolescents with type 1 diabetes mellitus in Sohag

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**Abstract**

**Background:** Type 1 diabetes mellitus is a chronic disease mainly diagnosed in children and adolescents. It has multiple psychiatric comorbidities. Our aim in this study was to determine the prevalence of psychological and behavioral problems in children and adolescents diagnosed with type 1 diabetes and to find if there is a strong correlation between these problems and different epidemiological and disease-related factors such as age of the child, duration of diabetes, and other risk factors. We conducted a cross-sectional study and compared between 564 children diagnosed with diabetes mellitus type 1 (who attended Specialized Health Insurance Clinic in Sohag City, Upper Egypt, during the year 2018/2020) and 564 non-diabetic children matched with the diabetic children for age, sex, and socio-economic status. We used "Strengths and Difficulties Questionnaire (SDQ)" to screen for behavioral, social, and emotional problems in diabetic and control children. "SDQ" is a 25-item brief behavioral screening questionnaire that consists of five subscales which are emotional problems, hyperactivity-inattention problems, conduct problems, peer problems, and prosocial behavior subscales. It generates total score and individual score for each subscale.

**Results:** In our study, we found that diabetic children had significantly higher prevalence of emotional and behavioral problems than control children (92.37% of diabetic children versus 20.2% of control children had abnormal total SDQ score with P value < 0.001). All subscales of SDQ except prosocial subscale were significantly affected in children with type 1 diabetes mellitus than control children with P value < 0.001. Certain factors were significantly associated with impaired subscales of SDQ scale. We found a positive correlation between age and emotional, hyperactivity and conduct problems as these problems were more frequent in older children. Female children had more hyperactivity and conduct problems than male children (68.6%, 71.7% vs. 58.0%, 62.0%, P 0.002 and 0.003, respectively) while male children were more affected by emotional problems than female children (68% vs. 57.4%, P 0.003). Peer problems were more prevalent in children of parents with higher educational level. Children with positive family history of diabetes were less affected by emotional problems than children with negative family history (50% vs.64.3%, P 0.04). Longer duration of disease was associated with increased prevalence of peer and emotional problems. Poor control of diabetes increased the prevalence of conduct and emotional problems (P 0.007 and 0.022, respectively).

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Conclusion: Children with type 1 diabetes mellitus have more emotional, hyperactivity, conduct, and peer problems than non-diabetic children. These findings indicate a need to screen diabetic children and adolescents for behavioral and emotional problems and treat these problems if found.

Keywords: Psychological, Behavioral, Emotional, Type 1 diabetes mellitus, Children, Adolescents

Background
Diabetes mellitus type 1 is usually diagnosed in children and adolescents [1]. As a chronic disease, patients suffering from diabetes mellitus are at a high risk for psychological, behavioral, and social problems [2]. “The International Society for Paediatric and Adolescent Diabetes (ISPAD) recommends that children and adolescents with type 1 diabetes are screened for psychological problems [3],” but there is no definite accurate guidelines based on evidence to address specific disorders or use specific tools in screening [4]. We reviewed the studies done to investigate the psychological, emotional, and behavioral impact of diabetes mellitus type 1 in children and adolescents, and we found that most of these studies were conducted on limited numbers of patients [5–7]. In our study, we tried to add to the previous work done in this area and tried to include a large representative sample and tried to avoid confounding factors that might affect the accuracy of the results. Also, we tried to found factors correlated with different psychological and behavioral problems like age at diagnosis of diabetes mellitus, duration of the disease, glyemic control, family history of diabetes, and other factors as we will show in results.

Methods
Study design, setting, and population
This study is a cross-sectional study conducted on 564 children with type 1 diabetes attending the specialized health insurance clinic in Sohag City, Upper Egypt, during the year 2018/2020.

Inclusion criteria
Age from 4 to 17 years. At least 6 months from diagnosis of diabetes and on insulin therapy. No complications from diabetes, e.g., diabetic nephropathy or neuropathy. No other major medical illness. No organic brain diseases such as intellectual impairment.

Exclusion criteria
We excluded patients with diabetic complications, e.g., diabetic nephropathy or neuropathy, patients with other major medical illnesses or organic brain insults.

Sample size and technique
We calculated the sample size using EPI info program. Using a prevalence rate of diabetes 18%. The calculated sample size was 490 with a drop out 10% so total are 564 at confidence interval 95%. We selected the patients from diabetic children attending health insurance clinic in Sohag City during the period of the study. Control group consisted of 564 children with no diabetes. We selected the control children from kindergarten schools of the same area of patients group. Both patients and control group were matched regarding age, sex, and family’s socioeconomic level.

Data collection tools
To collect data we used a semi-structured questionnaire that included socio-demographic factors such as age of the child, sex of the child, residence, family income, job and education of the parents, and family history of diabetes. The questionnaire included also variables related to the disease as age at diagnosis of the child at diagnosis, duration since diagnosis, type of insulin used and frequency of use, blood glucose level, and last glycated hemoglobin (HbA1c).

Tool I
To assess socio-economic level, we used family socio-economic status scale prepared by Abd El-Twab, 2012 [8]. It includes four items: family income, level of education of parents, job of parents, and lifestyles. It gives total score and separate score for each item. The three classes of the total score are low, moderate, and high.

Tool II
We used the Strengths and Difficulties Questionnaire (SDQ) to identify the behavioral, social, and emotional problems in diabetic and control children. The Strengths and Difficulties Questionnaire (SDQ) is a brief behavioral screening tool used for children and adolescents. The 25 items in the SDQ comprise 5 subscales of 5 items each. The subscales include (1) emotional symptoms subscale, (2) conduct problems subscale, (3) hyperactivity/inattention subscale, (4) peer relationships problem subscale, and (5) prosocial behavior subscale (Goodman, 1997) [9]. Scoring of SDQ gives separate score for each subscales and gives total score by summation of the first 4 subscales (excluding prosocial subscale). Total score ranges from 0 to 40, with scores 0–15 considered normal, 16–19 borderline, and 20–40 abnormal. Each individual subscale has a separate scoring: emotional problems subscale scoring as follows: normal
from 0 to 5, borderline from 6 and abnormal from 7 to 10. Conduct problems subscale scored is interpreted as normal from 0 to 3, borderline 4, and abnormal from 5 to 10. The hyperactivity-inattention sub-scale is interpreted as normal from 0 to 5, borderline 6, and abnormal from 7 to 10. Peer problems sub-scale is interpreted as normal from 0 to 3, borderline from 4 to 5, and abnormal from 6 to 10. The prosocial behavior subscale scores are normal from 6 to 10, borderline 5, and abnormal from 0 to 4 [9]. SDQ is widely used, and its validity and reliability are well-established in several studies (Goodman 2001, Muris et al. 2003, Obel et al. 2004, Niclasen et al. 2012) [10–13]. In our study, we used the Arabic version of the SDQ (Almaqrami and Shuwail, 2004) [14].

Field work
We conducted a pilot study on 5% of the sample. We conducted this pilot study to assess the clarity of the questions and if they need any rewording and to determine the time needed in fulfilling the questionnaire. During this pilot study, the participants needed about 20–25 min to complete the questionnaire. We included data obtained from the pilot study were included in the study group. We interviewed each child individually. One of the researchers was available either in the health insurance clinics for the studied children or in the classroom for the control group.

Study period
We conducted our study from October 2018 to June 2020.

Statistical analysis
We used SPSS software (version 16) to analyze the data. In descriptive statistics, we presented quantitative data in the form of mean and standard deviation (SD) while qualitative data were presented in the form of frequencies and percentages. We used chi-square test to test the difference between the proportions of variables to compare between diabetic children and control children. To clarify the independent demographic variables and disease-related variables that are associated with psychological and behavioral problems, we used bivariate and multivariate logistic regressions. P value < 0.05 is considered statistically significant.

Results
Sociodemographic data
Patients group
The number was 564 children with age range 4–16 years. The mean age was 12.6 ± 3.3 (mean ± SD). Male children were 47.2% of them.

Control group
Five hundred sixty-four non-diabetic children with age range 4.5–16 years. The mean age was 13.2 ± 3.2. Male children were 51% of the sample.

No significant difference between patients and control group regarding age and sex (P 0.48 and 0.37, respectively) (Fig. 1).

Socioeconomic class of control children; 48% low, 32% moderate, and 20% high. There is no significant difference between patients and control group regarding socioeconomic status (P 0.18).

Table 1 shows Difficulty Index Score in diabetic and control children. 92.37% of diabetic children (n = 521 out of 564) had abnormal total score compared to 20.2% of the control children (n = 114 out of 564). In comparison with control children, diabetic children were significantly affected in all subscales except prosocial subscale (P value < 0.001).

Table 2 is showing the relation between different demographic and disease related variables different subscales of SDQ in diabetic children. Certain factors were significantly associated with impaired subscales of SDQ scale. Regarding age, older children had higher prevalence of emotional, hyperactivity, and conduct problems than younger children. Regarding sex of the child, girls were more affected by hyperactivity and conduct problems than boys ((68.6%, 71.7% vs. 58.0%, 62.0%) and less affected by emotional problems than boys, 57.4% vs. 68.0%). Peer problems were more prevalent in children of parents with higher educational level. Children with positive family history of diabetes experienced less emotional problems. Children with longer duration of diabetes had significantly higher peer and emotional problems. Conduct and emotional problems were significantly higher in children with poor glycemic control (Table 3).

Multivariate logistic analysis shows that age and sex of the diabetic child, the educational level of the mother, duration of diabetes, and family history of diabetes were
predictors of emotional problems. For hyper-activity and conduct problems, the predictors were age and sex of the child and were predictors of conduct problems and hyperactivity problems. Educational level of father and duration of diabetes in years were predictors of peer relationship problems (Fig. 2).

### Discussion

**Principal findings**

In our study, we found that diabetic children had significantly higher prevalence of psychological, behavioral, and social problems than control children (92.37% vs. 20.2%, P 0.001). All subscales of SDQ except prosocial subscale were significantly affected in children with type 1 diabetes mellitus than control children. The higher prevalence of emotional and behavioral problems in diabetic children may be explained by the stress of chronic illness diagnosis and stress of treatment as painful injections and diet and life style restrictions as well as stigma and social stressors from peers and the society as a whole.

Certain factors were significantly associated with impaired subscales of SDQ scale. We found a positive correlation between age and emotional, hyperactivity, and conduct problems as these problems were more frequent in older children. Female children had more hyperactivity and conduct problems than male children (68% vs. 58%, P 0.002 and 0.003, respectively), while male children were more affected by emotional problems than female children (68% vs. 57.4%, P 0.003). Peer problems were more prevalent in children of parents with higher educational level. Children with positive family history of diabetes were less affected by emotional problems than children with negative family history (50% vs. 64.3%, P 0.04). Longer duration of disease was associated with increased prevalence of peer and emotional problems. Poor control of diabetes increased the prevalence of conduct and emotional problems (P 0.007 and 0.022, respectively).

### Relation to other studies

Previous studies which were done to determine the psychological and behavioral complications of diabetes in children and adolescents found that diabetic children had higher prevalence of these problems. Different studies focused on certain psychological problems such as depression, eating problems, and suicide. Most of these studies included small numbers of patients. In our study, we tried to add to the previous work done in this area and tried to include a large representative sample and tried to avoid confounding factors that might affect the accuracy of the results. Also, we tried to find factors correlated with different psychological and behavioral problems like age at diagnosis of diabetes mellitus, duration of the disease, glycemic control, and family history of diabetes. Our results confirm the results in previous studies. Most of these studies were small and investigated specific disorders [5–7]. Three recent large studies showed similar results Denmark, Sweden, and Australia [15–17].

A large Danish study compared 5084 child and adolescent patients diagnosed with type 1 diabetes mellitus with age- and sex-matched controls regarding diagnosis with one or more psychiatric disorders. The researchers found significant higher incidence of anxiety disorders, depression, eating disorders, somatization disorders, and dissociations in diabetic group [15].

A second large Swedish study followed 17,122 child and adolescent diagnosed with diabetes mellitus type 1 for 5 years. The control subjects (n = 18,847) were the healthy siblings of the patients (this was a strength point in this study as patients and controls are to large extent similar in genetics and social factors). The researchers found that the incidence of different psychiatric disorders was twice more common in patients than controls. The main psychiatric disorders diagnosed in patients group were depression, anxiety, eating disorders, inattention, hyperactivity, conduct disorder, and abuse of addictive substances [16].

A third large study from Australia, compared between 1303 patients with type 1 diabetes and 6422 healthy

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### Table 1 Difficulty Index Scores of diabetic and control children

| Difficulty Index Score | Children with diabetes (564) | Control children (564) |
|------------------------|-----------------------------|------------------------|
|                        | Normal n (%) | Borderline n (%) | Abnormal n (%) | Normal n (%) | Borderline n (%) | Abnormal n (%) | P value |
| Emotion scale          | 151(26.77)    | 60(10.63)        | 353(62.58)    | 340(60.28)   | 91(16.13)        | 135(23.9)      | <0.001 |
| Hyperactivity scale    | 137(24.29)    | 68(12)           | 359(63.65)    | 267(47.34)   | 185(32.8)        | 112(19.85)     | <0.001 |
| Conduct scale          | 131(23.22)    | 55(9.75)         | 378(67)       | 371(65.78)   | 32(5.67)         | 164(29.0)      | <0.001 |
| Prosocial scale        | 509(90.24)    | 27(4.78)         | 28(4.96)      | 525(93)      | 24(4.25)         | 15(2.65)       | 0.18   |
| Total score            | 173(3)        | 26(4.6)          | 52(92.37)     | 372(65.95)   | 78(13.8)         | 114(20.2)      | <0.001 |

P value < 0.05 is considered statistically significant. P value < 0.001 is considered highly significant.
| Variables                              | N = 564 | Difficulty index subscale | Conduct n = 378 (%) | Peer n = 464 (%) | Hyperactivity n = 359 (%) | P value |
|----------------------------------------|---------|----------------------------|---------------------|-----------------|--------------------------|---------|
| **Age in years**                       |         | Emotional n = 352 (%)      |                     |                 |                          |         |
| 4 < 6                                  | 40(7.1) | 11 (26.7)                  | 12 (30.0)           | 16 (40.0)       | 30 (76.7)                | 0.000   |
| 6 < 12                                 | 219(38.8)| 141 (64.6)                 | 144 (65.9)          | 136 (62.2)      | 190 (87.2)               | 0.000   |
| ≥ 12                                   | 305(54.0)| 200 (65.5)                 | 222 (72.9)          | 207 (67.7)      | 244 (79.5)               | 0.10    |
| **Sex of the child**                   |         |                            |                     |                 |                          |         |
| Male                                   | 267(47.3)| 182 (68.0)                 | 166 (62.0)          | 155 (58.0)      | 216 (81.0)               | 0.03    |
| Female                                 | 297(52.7)| 170(57.4)                  | 213 (71.7)          | 204 (68.6)      | 248 (83.4)               | 0.52    |
| **Birth order**                        |         |                            |                     |                 |                          |         |
| First                                  | 100(17.7)| 67(66.7)                   | 76 (76.0)           | 73 (73.3)       | 82 (82.7)                | 0.79    |
| Second                                 | 144(25.5)| 89(62.0)                   | 89(62.0)            | 92(63.9)        | 123(85.2)                | 0.138   |
| Third                                  | 320(56.7)| 196 (61.2)                 | 213 (66.7)          | 194 (60.4)      | 259 (80.8)               | 0.614   |
| **Education of child’s mother**        |         |                            |                     |                 |                          |         |
| Illiterate                             | 221(39.2)| 124 (56.0)                 | 137(62.0)           | 13(59.0)        | 167(75.9)                | 0.003   |
| < 12 years                             | 109(19.3)| 85 (78.0)                  | 85 (78.0)           | 80(73.2)        | 90(82.9)                 | 0.041   |
| ≥ 12 years                             | 234(41.4)| 143 (61.1)                 | 157 (66.9)          | 149 (63.4)      | 207 (88.0)               | 0.001   |
| **Education of child’s father**        |         |                            |                     |                 |                          |         |
| Illiterate                             | 142(25.1)| 76 (53.8)                  | 90 (63.2)           | 90 (63.2)       | 100 (70.8)               | 0.103   |
| < 12 years                             | 111(19.6)| 74(66.3)                   | 83 (74.7)           | 72(65.1)        | 90(81.9)                 | 0.093   |
| ≥ 12 years                             | 312 (55.3)| 203 (65.0)                 | 207 (66.2)          | 197 (63.2)      | 274(87.6)                | 0.953   |
| **Family history of diabetes**         |         |                            |                     |                 |                          |         |
| Yes                                    | 74(13.2)| 37 (50.0)                  | 53(71.4)            | 48(64.3)        | 64(87.5)                 | 0.088   |
| No                                     | 490(86.8)| 315 (64.3)                 | 326 (66.5)          | 311 (63.5)      | 400 (81.5)               | 0.271   |
| **Duration of diabetes in years**      |         |                            |                     |                 |                          |         |
| < 1 year                               | 72(12.8)| 25(35.2)                   | 43(59.3)            | 43(59.3)        | 59(83.3)                 | 0.040   |
| 1 to < 3 years                         | 143(25.3)| 91 (63.6)                  | 88(61.2)            | 87(60.7)        | 101(71.0)                | 0.000   |
| 3 to < 5 years                         | 188(33.3)| 128 (68.1)                 | 155(82.4)           | 117 (62.4)      | 160 (85.1)               | 0.014   |
| ≥ 5 years                              | 161(28.6)| 108 (66.9)                 | 120(74.6)           | 112(69.4)       | 144 (88.4)               | 0.214   |
| **Glycemic control**                   |         |                            |                     |                 |                          |         |
| Controlled                             | 209(37.1)| 145 (69.4)                 | 157 (75.2)          | 144 (68.8)      | 167 (80.3)               | 0.022   |
| Uncontrolled                           | 355(62.9)| 207 (58.3)                 | 221 (62.4)          | 215 (60.5)      | 297 (83.5)               | 0.088   |

P value < 0.05 is considered statistically significant. P value < 0.001 is considered highly significant.
individuals matched with the patients group for age and sex. The researchers found that 14.3% of patients groups were diagnosed with ant psychiatric disorder, while in control subjects, only 6.2% were diagnosed with a psychiatric disorder. The main psychological problems diagnosed in patients group were depression, anxiety, eating disorders, and conduct disorders. Poor control of diabetes was significantly associated with diagnosis of different psychiatric disorders [17].

Factors associated with different psychiatric problems
In our study, we tried to address certain factors that may be associated with different psychological and behavioral problems. We selected certain factors which were significant in previous studies and added other risk factors that we speculated may be associated with psychological problems.

Age at diagnosis of type 1 diabetes mellitus
In our study, we found a positive correlation between age and emotional, hyperactivity, and conduct problems as these problems were more frequent in older children. The Danish study found that the highest risk for diagnosis with any psychiatric disorder occurred when diabetes was first diagnosed between 10 and 14 years of age [15]. This finding was also noticed in the Swedish study as the researchers found an increasing incidence of psychological problems when diabetes was first diagnosed in older children [16]. A suggested, explanation of these findings is that pre-adolescence and adolescence are naturally sensitive periods of development, combined with the stress of diagnosis of diabetes mellitus and the possible social and emotional strains commonly occurring in this age group [18]. Our explanation to this relation may be that as the child is older his perception of the disease and social stressors is increased and also the duration of the illness and suffering from it is mostly longer as the child is older.

Sex of the patients
In our study, we found that female children had more hyperactivity and conduct problems than male children (68.6%, 71.7% vs. 58.0%, 62.0%) while male children were more affected by emotional problems than female children (68% vs. 57.4%).

Table 3

| Subscale    | Significant variables | Significant independent | OR   | P value |
|-------------|-----------------------|-------------------------|------|---------|
| Emotional   | Duration of diabetes  | ≥ 5 years               | 3.2  | 0.004   |
|             | Child age             | Older child             | 5.1  | 0.001   |
|             | Child gender          | Female                  | 0.6  | 0.012   |
|             | Family history diabetes | No                   | 2.1  | 0.015   |
|             | Mother education      | High                    | 0.5  | 0.04    |
| Conduct     | Child age             | Older child             | 5.4  | 0.001   |
| Hyperactivity| Child age            | Older child             | 2.8  | 0.02    |
|             | Child gender          | Female                  | 1.6  | 0.03    |
| peer        | Duration of diabetes  | ≥ 5 years               | 3.2  | 0.002   |
|             | Father education      | High                    | 2.5  | 0.009   |

OR odds ratio, CI confidence interval = 95%

Fig. 2 Glycemic control in diabetic children
Other factors associated with psychological and behavioral problems

Some other factors are found to be associated with certain problems in diabetic children. Peer problems were more frequent in children of parents with higher educational level. Children with positive family history of diabetes were less affected by emotional problems than children with negative family history (50% vs. 64.3%, P 0.04); this may be explained by the experience of the family about the disease and its management. Longer duration of disease was associated with increased prevalence of peer and emotional problems. Poor control of diabetes increased the prevalence of conduct and emotional problems, and this may be explained by the biological effects of hyperglycemia on mood and behavior and also the stress of management of the complications of poor glycemic control which add to the stress of management of the disease itself.

Limitations of the study

We recommend the use of more accurate and specific questionnaires for screening and diagnosis of different psychiatric disorders in the following studies.

Conclusions

In this study, we confirmed the previously noticed results that a number of behavioral, emotional, and social problems commonly occur in children and adolescents with diabetes mellitus type 1. More studies are needed to define accurate tools for diagnosis of specific disorders and also to determine the benefits of early detection and proper management of these psychiatric disorders. Also, there is a need for more collaboration between child and adolescent psychiatrists and pediatricians to improve the quality of life of these children and adolescents.

Abbreviations

ISPAD: International Society for Paediatric and Adolescent Diabetes; SDQ: Strengths and Difficulties Questionnaire

Acknowledgements

We are expressing our cordial gratitude to the appreciated effort and time given by all patients, their parents, and the control group participants.

Declarations

Authors’ contributions

S.H.: contribution in research idea selection, applying the questionnaires, paper writing, revising the references, and paper submission. M. M.A.: contribution in research idea selection, sampling planning, and supervising the field work. T. A. S.: recruiting and interviewing the patients, applying the questionnaires, and sample collection. All authors have read and approved the final manuscript.

Funding

The authors of this manuscript declare that no funding bodies were involved in sponsoring or funding this research.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study protocol was approved by the Medical Research Ethics Committee of Faculty of Medicine, Sohag University. An official permission was obtained from director of Health Insurance Institute for Upper Egypt for the studied children. Central Agency for Public Mobilization and Statistics (CAPMAS), Issue number 771 and Ministry of Education, Sohag Governorate, for collecting data for the control children. Informed consent was obtained from the caregivers of the children participating in the study. The researchers assured voluntary participation and confidentiality of each child who agrees to participate in this study.

Consent for publication

Consent for publication was obtained.

Competing interests

All authors declare that they have no competing interests.

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Received: 28 April 2021 Accepted: 14 June 2021
Published online: 02 August 2021

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