Psychological characteristics of Korean children and adolescents with type 1 diabetes mellitus

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Purpose: This study investigates the behavioral and emotional characteristics of Korean children and adolescents with type 1 diabetes mellitus (T1DM) as compared to healthy controls, and examines whether their psychological status is associated with glycemic control, insulin regimens, or disease duration.

Methods: A total of 37 Korean children and adolescents with T1DM, aged 6–17 years, and 38 sex- and age-matched healthy controls were included in this study. Psychological distress was assessed using the Korean child behavior checklist (K-CBCL) and children’s depression inventory (CDI) after the subjects and their parents were interviewed.

Results: The CDI and K-CBCL scores were significantly higher in T1DM subjects compared to normal controls. The T1DM subjects with “poorly controlled” blood glucose (glycosylated hemoglobin $\geq 8\%$) and “old patients” (disease duration $\geq 1$ year) had a tendency to show higher CDI and K-CBCL scores. There were no significant differences in CDI and K-CBCL scores between the intensive and conventional insulin therapy groups.

Conclusion: Children and adolescents with T1DM seem to have inferior psychological adjustment to their normal counterparts, which might be associated with glycemic control and disease duration. Psychological evaluation and intervention should be considered in the management of T1DM in children and adolescents.

Keywords: Type 1 diabetes mellitus, Diabetes, Psychosocial, K-CBCL, CDI

Introduction

Type 1 diabetes mellitus (T1DM) is a chronic disease resulting from defects in insulin secretion and necessitating close attention to glucose monitoring, adherence to insulin regimens, and meal planning. Among individuals with comparable chronic disease, the course of a disease and treatment responsiveness may vary greatly. These differences may be due in part to the ways in which individuals cope with the disease and other stressful experiences. Depression is a serious health problem affecting a significant percentage of chronically ill persons. Coping with T1DM can be very difficult, and these patients have an increased risk of greater psychiatric morbidity compared with the general population, with depression being the most commonly overlooked disturbance.

Adolescents with T1DM are at particular risk for depression. Depression is the single most common disorder in children and adolescents with T1DM, the prevalence of which is 20% in children and adolescents with T1DM, compared with 7% in those without T1DM. Concomitant challenges of puberty, peer pressure, self-identity, and increasing independence from parents result in a 10-fold increase in suicide and suicidal ideation. It has been found that a person with T1DM and a psychiatric disorder is more likely to have poorly controlled T1DM. Depression, along with poor metabolic control, may result in more complications, poorer outcomes, and more frequent hospitalization.

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a period with a higher rate of acute complications and relative mortality risks for individuals with diabetes. Therefore, psychological evaluation and intervention are important in the management of T1DM in children and adolescents because diabetes care could be compromised during this period. However, few studies have examined the impact of psychological characteristics on glycemic control in children and adolescents with T1DM.

In the present study, we investigate the behavioral and emotional characteristics of Korean children and adolescents with T1DM as compared to healthy controls, and examine whether their psychological status is associated with glycemic control, insulin regimens, or disease duration.

Materials and methods

1. Subjects

This study was based on an examination of 37 children with T1DM between the ages of 6 and 17 years, and 38 children without diabetes of comparable age and sex. The subjects were recruited from children and adolescents who visited the outpatient Pediatric Endocrinology Clinic of the Department of Pediatrics, Korea University Ansan Hospital in Gyeonggi-do, Korea.

2. Methods

Data were obtained through the administration of a questionnaire interview to subjects and their parents. Psychological distress was measured using the Korean child behavior checklist (K-CBCL) and the children’s depression inventory (CDI). Glycemic control was assessed by glycosylated hemoglobin (HbA1c) level. Glycemic control was considered "well controlled" at HbA1c < 8.0%, and "poorly controlled" at HbA1c ≥8.0%. A patient was considered a "new patient" if his/her disease duration was < 1 year, or an "old patient" if his/her disease duration was ≥ 1 year.

The K-CBCL was given to the parents in order to assess the children’s psychological distress. The K-CBCL is a parent-report questionnaire with 119 items providing data on various emotional and behavioral problems found in children. The reliability and validity of the K-CBCL are well established in Korean children and adolescents. A total problem behavior score was computed by summing the scores obtained for each item. Two broad-band syndromes (internalizing problems and externalizing problems) and nine clinical scales (withdrawal, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior) were also produced. Externalized behavior problems are represented by attention problems and aggressive and delinquent behavior; internalized behavior comprises withdrawal, depressed behavior, and somatic complaints. The social functioning scale includes socialization and academic functioning. In the K-CBCL, the computed score is based on Korean normative samples, with the total problem behavior score computed by summing the scores obtained for each item. Raw scores for each clinical factor are transformed into T-scores based on published norms (Available from: http://www.cbl.or.kr). In this study, T-scores ≥70 were considered indicative of psychological distress.

The Korean version of the CDI, originating from Kovacs and Beck’s Scale, was also used. It is a self-rated inventory test with 27 items providing quantification of depressive symptoms experienced over the previous 2 weeks. The normative data, factor structures, and reliability of the CDI were examined by Korean researchers. They found that the CDI mean scores for Korean children were higher than those in Kovacs’s original sample and that it was reliable and useful for measurements in children of different ages. Each of the 27 items is scored on a three-point scale (0, absent; 1, moderate; 2, severe) reflecting the increasing severity of symptoms. In this study, patients with total CDI scores greater than 22 were considered having psychological distress.

3. Statistical analyses

All data were analyzed using the IBM SPSS ver. 20.0 (IBM Co., Armonk, NY, USA) Network version program. Differences among respondent groups were tested using the chi-square test, Student t-test, or analysis of variance. The data are expressed as mean±standard deviation unless otherwise indicated. P-values < 0.05 were considered statistically significant.

4. Ethics statement

This study was approved by the Institutional Review Board of Korea University Ansan Hospital in Gyeonggi-do, Korea (IRB number AS13028). Written informed consents were obtained from all subjects and their parents.

Results

The clinical characteristics of the study subjects are shown in Table 1. There were no significant differences in sex distribution between the subjects with T1DM and the normal control group. A three-point scale (0, absent; 1, moderate; 2, severe) was used. The disease duration was ≥ 1 year. The HbA1c was ≥8.0%. A patient was considered a “new patient” if his/her disease duration was < 1 year, or an “old patient” if his/her disease duration was ≥ 1 year.

Table 1. General characteristics of subjects

| Variable               | T1DM (n=37) | Normal control (n=38) | P-value |
|------------------------|-------------|-----------------------|---------|
| Age (yr)               | 13.8±2.7    | 12.7±3.1              | 0.115   |
| Sex (male:female)      | 18:19       | 19:19                 | 0.907   |
| HbA1c (%)              | 9.1±2.0     |                       |         |
| Disease duration (yr)  | 3.6±2.9     |                       |         |
| Insulin regimen        |             |                       |         |
| Conventional           | 23          |                       |         |
| Intensive              | 14          |                       |         |

Values are presented as mean±standard deviation. T1DM, type 1 diabetes mellitus; HbA1c, glycosylated hemoglobin.
and mean age between T1DM and normal control group. The mean HbA1c level of the T1DM subjects was 9.1%±2.0%. Twenty-three T1DM subjects were being treated with conventional insulin therapy, and 14 subjects were being treated with intensive insulin therapy.

Table 2 shows that CDI and K-CBCL total behavior problem scores were significantly higher in the T1DM subjects (CDI: 13.0±8.5; K-CBCL total behavior problem scores, 49.6±12.3) than in the normal control subjects (CDI, 6.5±5.6; K-CBCL total behavior problem scores, 41.9±7.8). A total of 10 T1DM subjects were classified as “well-controlled” subjects, and 27 as ‘poorly controlled’ subjects. The difference in HbA1c between the well-controlled (6.7±0.9) and poorly controlled subjects (10.1±1.5) was significant. CDI and K-CBCL total behavior problem scores were significantly higher in poorly controlled subjects (CDI, 13.9±8.3; K-CBCL total behavior problem scores, 50.8±12.7) than in normal control subjects (CDI, 6.2±5.6; K-CBCL total behavior problem scores, 41.9±7.8). However, differences in CDI and K-CBCL total behavior problem scores between the well-controlled and normal control subjects were not significant (Table 3).

A total of 9 T1DM subjects were classified as “new patient” subjects, and 28 as “old patient” subjects. CDI and K-CBCL total behavior problem scores were significantly higher in old patient subjects (CDI, 13.1±9.1; K-CBCL total behavior problems, 51.1±10.5) than in normal control subjects (CDI, 6.2±5.6; K-CBCL total behavior problem scores, 41.9±7.8). However, differences in CDI and K-CBCL total behavior problem scores between new patient and normal control subjects were not significant (Table 4).

There were no significant differences in CDI and K-CBCL total behavior problem scores between subjects receiving conventional and intensive insulin therapy (Table 5).

Discussion

In this study, we demonstrated that Korean children and adolescents with T1DM had higher CDI and K-CBCL total behavior problem scores than healthy controls. These findings suggest that children and adolescents with T1DM seem to have a higher risk of developing psychological distress. T1DM is the third most common chronic condition in children under 16 years of age\(^{20}\). Children and adolescents with T1DM are at high risk for psychosocial morbidity including depression, poor health-related quality of life, low self-efficacy, and difficulty with medical adherence and metabolic control\(^{21}\). Adolescents with

| Table 2. Comparison of T-scores of CDI and K-CBCL between T1DM and normal control group |
|-----------------------------------------------|
| Variable          | T1DM (n=37) | Normal control (n=38) | P-value |
| CDI               | 13.0±8.5  | 6.2±5.6  | < 0.001 |
| K-CBCL            |           |          |         |
| Withdrawn         | 51.0±10.0 | 48.0±7.1 | 0.180   |
| Somatic complaints| 50.2±9.7  | 46.3±6.0 | 0.062   |
| Anxious/depressed | 49.8±11.0 | 43.7±7.6 | 0.014   |
| Internalizing problems | 49.6±11.4 | 44.1±7.7 | 0.032   |
| Social problems   | 50.5±9.7  | 46.0±7.8 | 0.040   |
| Thought problems  | 50.4±7.3  | 48.4±5.5 | 0.222   |
| Attention problems| 50.9±10.4 | 45.0±7.5 | 0.008   |
| Delinquent behavior| 51.4±10.1 | 44.4±3.9 | < 0.001 |
| Aggressive behavior| 51.2±12.5 | 42.1±7.8 | < 0.001 |
| Externalizing problems | 51.1±12.4 | 41.7±7.5 | 0.001   |
| Total behavior problems | 49.6±12.3 | 41.9±7.8 | 0.005   |

Values are presented as mean±standard deviation. CDI, children’s depression inventory; K-CBCL, Korean child behavior checklist; T1DM, type 1 diabetes mellitus.

| Table 3. Comparison of T-scores of CDI and K-CBCL among “well-controlled”, “poorly controlled” and normal control groups |
|-----------------------------------------------|
| Variable          | Well-controlled (n=10) | Poorly-controlled (n=27) | Normal control (n=38) | P-value for ANOVA |
| Age (yr)          | 12.0±2.5               | 14.4±2.5\(^{a,b}\) | 12.7±3.1               | 0.023 |
| HbA1c (%)         | 6.7±0.9                | 10.1±1.5              | 6.2±5.6                | < 0.001 |
| CDI               | 10.7±8.8               | 13.9±8.3\(^{a}\)     | 6.2±5.6                | < 0.001 |
| K-CBCL            |                       |                       |                       |         |
| Withdrawn         | 49.7±11.4              | 51.6±9.6              | 48.0±7.1               | 0.320   |
| Somatic complaints| 50.9±9.3               | 49.9±10.1             | 46.3±6.0               | 0.132   |
| Anxious/depressed | 46.9±11.6              | 51.1±10.7\(^{a}\)    | 43.7±7.6               | 0.018   |
| Internalizing problems | 48.6±11.8 | 50.1±11.5 | 44.1±7.7 | 0.072   |
| Social problems   | 49.6±10.3              | 50.9±9.7              | 46.0±7.8               | 0.116   |
| Thought problems  | 48.8±7.9               | 51.1±7.2              | 48.4±5.5               | 0.297   |
| Attention problems| 49.0±11.9              | 51.8±9.8\(^{a}\)     | 45.0±7.5               | 0.023   |
| Delinquent behavior| 46.3±6.7              | 53.7±10.7\(^{a,b}\)  | 44.4±3.9               | < 0.001 |
| Aggressive behavior| 46.3±8.2              | 53.5±13.6\(^{a}\)    | 42.1±7.8               | 0.001   |
| Externalizing problems | 45.8±8.6 | 53.6±13.3\(^{a}\) | 41.7±7.5 | < 0.001 |
| Total behavior problems | 46.9±11.5 | 50.8±12.7\(^{a}\) | 41.9±7.8 | 0.007   |

Values are presented as mean±standard deviation. CDI, children’s depression inventory; K-CBCL, Korean child behavior checklist; ANOVA, analysis of variance; HbA1c, glycosylated hemoglobin.

\(^{a}\)P < 0.05 compared with normal control. \(^{b}\)P < 0.05 compared with well-controlled group.
Our findings are consistent with the results of these studies. Type 2 diabetes mellitus significantly associated with hyperglycemia in both type 1 and type 2 diabetes mellitus. There is evidence of associations between depression and higher HbA1c levels. Moreover, the remission of depression is associated with a reduction in HbA1c levels in diabetic patients. We found that CDI and K-CBCL total behavior problem scores were higher in poorly controlled subjects (HbA1c ≥8%) than in normal control subjects. We also found that there were no differences in CDI and K-CBCL total behavior problem scores between well-controlled (HbA1c <8%) and normal control subjects. Therefore, it is assumed that T1DM patients with higher HbA1c seem to have a higher risk of developing psychological distress.

Table 4. Comparison of T-scores of CDI and K-CBCL among “new patient”, “old patient” and normal control groups

| Variable          | New patient (n=9) | Old patient (n=28) | Normal control (n=38) | P-value for ANOVA |
|-------------------|-------------------|--------------------|-----------------------|-------------------|
| Age (yr)          | 11.3±2.5          | 14.6±2.3<sup>a</sup> | 12.7±3.1              | 0.003             |
| Disease duration (yr) | 0.6±0.2          | 4.5±2.7            | < 0.001               |
| HbA1c (%)         | 8.1±2.7           | 9.5±1.7            | 0.069                 |
| CDI               | 12.7±6.4          | 13.1±9.1<sup>a</sup> | 6.2±5.6               | 0.001             |

K-CBCL

| Withdrawn         | 50.3±9.5          | 51.2±10.4          | 48.0±7.1              | 0.363             |
| Somatic complaints | 45.6±9.3          | 51.6±9.5<sup>b</sup> | 46.3±6.0              | 0.028             |
| Anxious/depressed | 44.7±11.3         | 51.4±10.6<sup>b</sup> | 43.7±7.6              | 0.008             |
| Internalizing problems | 45.0±11.6        | 51.1±11.2<sup>b</sup> | 44.1±7.7              | 0.026             |
| Social problems   | 49.0±8.6          | 50.9±10.2          | 46.0±7.8              | 0.109             |
| Thought problems  | 48.4±8.3          | 51.1±7.1           | 48.4±5.5              | 0.272             |
| Attention problems| 48.4±13.2         | 51.7±9.5<sup>a</sup> | 45.0±7.5              | 0.021             |
| Delinquent behavior | 50.9±13.4       | 51.6±9.2<sup>a</sup> | 44.4±3.9              | 0.004             |
| Aggressive behavior | 48.6±17.6        | 52.1±10.8<sup>a</sup> | 42.1±7.8              | 0.002             |
| Externalizing problems | 48.1±18.3     | 52.1±10.3<sup>a</sup> | 41.7±7.5              | 0.001             |
| Total behavior problems | 44.7±16.7     | 51.1±10.5<sup>a</sup> | 41.9±7.8              | 0.004             |

Values are presented as mean±standard deviation.
CDI, children’s depression inventory; K-CBCL, Korean child behavior checklist; ANOVA, analysis of variance; HbA1c, glycosylated hemoglobin.

Table 5. Comparison of CDI and K-CBCL between conventional and intensive insulin therapy groups

| Variable          | Conventional (n=23) | Intensive (n=14) | P-value |
|-------------------|---------------------|-----------------|---------|
| Age (yr)          | 13.5±3.0            | 14.2±2.2        | 0.594   |
| Disease duration (yr) | 2.9±2.7           | 4.6±3.1         | 0.091   |
| HbA1c (%)         | 9.1±2.0             | 9.2±2.2         | 0.913   |
| CDI               | 13.5±8.3            | 12.2±9.2        | 0.520   |

K-CBCL

| Withdrawn         | 50.3±8.6            | 51.6±13.3       | 0.999   |
| Somatic complaints | 48.8±8.4            | 53.2±12.1       | 0.381   |
| Anxious/depressed | 49.1±114            | 51.3±10.5       | 0.636   |
| Internalizing problems | 48.8±10.4        | 51.4±14.0       | 0.493   |
| Social problems   | 50.7±10.7           | 50.0±7.7        | 0.999   |
| Thought problems  | 50.7±7.5            | 50.0±7.4        | 0.623   |
| Attention problems| 50.8±10.1           | 51.2±11.5       | 0.981   |
| Delinquent behavior | 49.9±8.0           | 54.8±13.7       | 0.418   |
| Aggressive behavior | 50.2±11.6          | 53.7±14.6       | 0.654   |
| Externalizing problems | 49.9±11.3       | 54.0±15.0       | 0.62    |
| Total behavior problems | 48.8±11.9        | 51.3±13.6       | 0.795   |

Values are presented as mean±standard deviation.
CDI, children’s depression inventory; K-CBCL, Korean child behavior checklist; HbA1c, glycosylated hemoglobin.

T1DM are at increased risk for depression and anxiety, which can adversely affect diabetes management and quality of life. Our findings are consistent with the results of these studies.

Although depression is a relatively common condition in patients with diabetes, its association with glycemic control has only recently been studied. A meta-analysis of 24 studies showed that depression in patients with diabetes was significantly associated with hyperglycemia in both type 1 and type 2 diabetes mellitus. There is evidence of associations between depression and higher HbA1c levels. Moreover, the relationship may be bidirectional with suboptimal metabolic control leading to depressed mood, and thus, to fewer self-management behaviors and inferior metabolic control.

In this study, we found that CDI and K-CBCL total behavior problem scores were higher in old patient subjects (disease duration ≥1 year) than in normal control subjects. We also found that there were no differences in CDI and K-CBCL total behavior problem scores between well-controlled (HbA1c <8%) and normal control subjects. Therefore, it is assumed that T1DM patients with higher HbA1c seem to have a higher risk of developing psychological distress.

Given the relationship identified between depressive symptoms and HbA1c level, prospective research is needed to find the underlying mechanisms. The relationship may be bidirectional with suboptimal metabolic control leading to depressed mood, and thus, to fewer self-management behaviors and inferior metabolic control.

In this study, we found that CDI and K-CBCL total behavior problem scores were higher in old patient subjects (disease duration ≥1 year) than in normal control subjects. We also found that there were no differences in CDI and K-CBCL total behavior problem scores between well-controlled (HbA1c <8%) and normal control subjects. Therefore, it is assumed that T1DM patients with higher HbA1c seem to have a higher risk of developing psychological distress.

There were no significant differences in CDI and K-CBCL total behavior problem scores between conventional and intensive insulin therapy subjects. It is suggested that the number of daily insulin injections does not affect the risk of developing psychological distress.

This study has implications for clinicians, in that the risk of developing psychological distress was higher in the T1DM subjects. Therefore, it is suggested that clinicians need to pay...
attention to the psychosocial wellness of children with T1DM. It is further suggested that because the risk of developing psychological distress was related to glycemic control and disease duration, clinicians need to work to maintain reasonable levels of glycemic control and pay more attention to those who have had T1DM for longer than one year.

Psychological screening, appropriate intervention, and good metabolic control hold promise for early identification of, and may ultimately help prevent deterioration in, diabetes management (22). For these reasons, diabetes clinicians should always be concerned about metabolic control, psychosocial prevention, and simple interventions that can be added to clinical encounters. The American Diabetes Association recommends that annual psychological screening should be part of routine best practice (26). Anderson (27) argues that diabetes teams should be aware of signs of depression in this age group, as undiagnosed and untreated depression can contribute to a vicious cycle of adverse psychiatric and diabetes-related health problems (28). Therefore, it is important to be sensitive to the presence of depression and consider appropriate interventions.

In conclusion, there is need for an interest in psychological evaluation and intervention in the management of T1DM in children and adolescents. A possible limitation of this study was the relatively small sample size. Therefore, our findings should be validated by further evidence obtained from large-scaled studies.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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