Clinical Report

Impact of type 1 diabetes mellitus on academic performance

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Abstract
Objective: To examine the effect of type 1 diabetes on academic performance.
Methods: Ethnically Saudi students with type 1 diabetes, and age, sex, ethnicity and socio-economic status-matched nondiabetic control students were recruited from eight schools. Overall academic grades were recorded, based on the scores obtained in written examinations in English, mathematics, physics, chemistry, biology and humanities.
Results: Students with type 1 diabetes (n=36) obtained significantly lower academic grades compared with their nondiabetic control classmates (n=36) (86.58 ± 1.48 vs 90.62 ± 1.36).
Conclusions: Overall academic performance is significantly lower in students with type 1 diabetes compared with their nondiabetic classmates. This decline in academic performance may be explained by an association between diabetes and cognitive function.

Keywords
Type 1 diabetes mellitus, academic grades, cognitive function

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Introduction
Diabetes mellitus is an incurable lifelong disease, and is one of the most challenging health issues of the 21st century. The incidence of diabetes mellitus is increasing in all age groups, in both sexes and in developing (as well as in developed) countries. The global prevalence of diabetes mellitus has
risen from 171 million people in 2000, to 366 million people in 2011,\textsuperscript{1} with 552 million people expected to be affected in 2030.\textsuperscript{2}

Rapid socio-economic changes in the Arab world have resulted in alterations in patterns of health and disease in the region. In general, people are eating more and exercising less, resulting in a higher incidence of obesity and diabetes mellitus,\textsuperscript{3} with both type 1 and type 2 diabetes becoming increasingly common.\textsuperscript{4} The prevalence of type 1 diabetes is around 109.5 per 100 000 children and adolescents in Saudi Arabia.\textsuperscript{5} Diabetes causes failure of various physiological functions, organs and systems,\textsuperscript{6} with wide-ranging complications including diminished neuronal function.\textsuperscript{7,8} Hypoglycaemia and hyperglycaemia have an impact on academic performance of children and adolescents.\textsuperscript{9} Data regarding the relationship between type 1 diabetes and academic performance are limited and unclear, however, and no studies have been conducted in countries of the Arab world. The aim of this study was to examine academic performance in students with type 1 diabetes and their nondiabetic classmates.

**Subjects and methods**

**Study population**

This cross-sectional study was conducted in the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia, between September 2011 and June 2012. Investigators visited eight schools in Riyadh, Saudi Arabia and selected ethnically Saudi students with type 1 diabetes mellitus, together with nondiabetic students from the same class, with similar age and sex. Exclusion criteria were: tobacco use; gross anaemia (which is known to impair cognitive function),\textsuperscript{10,11} any debilitating disease such as tuberculosis, rheumatic fever or rheumatoid arthritis; vision, hearing, mobility or behavioural problems; any medication or hospital admissions other than for diabetes mellitus.

An English-language questionnaire with Arabic translation was developed, and information regarding age, sex, ethnicity, percentage of glycosylated haemoglobin (HbA1c), type of diabetes and duration of disease was obtained from students and their parents. Data regarding level of study, school attendance and academic grades were obtained from the school administration offices.

The Institutional Review Board, College of Medicine, King Saud University, Riyadh, Saudi Arabia, approved the study, and all participants provided written informed consent.

**Statistical analyses**

Academic grades were based on the mean of scores obtained in written examinations in English, mathematics, physics, chemistry, biology and humanities subjects. Grades were collected from participants’ respective schools and compared. Data were presented as mean ± SEM and compared using Student’s \( t\)-test. Statistical analyses were performed using SPSS\textsuperscript{12} software, version 16.0 (SPSS Inc., Chicago, IL, USA) for Windows\textsuperscript{13}. A \( P\)-value < 0.05 was considered statistically significant.

**Results**

The study included 36 students with type 1 diabetes (29 males/seven females [80.55/19.44\%]; mean age 17.02 ± 0.53 years; age range 14.2–19.4 years) and 36 nondiabetic control subjects (29 males/7 females [80.55/19.44\%]; mean age 17.85 ± 0.41; age range 14.4–19.5 years). There were no significant between-group differences in age or sex distribution. The mean duration of diabetes was 6.11 ± 0.65 years and the mean HbA1c was 8.37 ± 0.21\%. 
Students with diabetes achieved significantly lower mean examination scores, compared with nondiabetic controls (86.58 ± 1.48% vs 90.62 ± 1.36%; \( P = 0.02 \)).

**Discussion**

Diabetes is associated with diminished neuronal functioning that ultimately leads to cognitive dysfunction in areas including intelligence, learning, memory, information processing, attention, executive function, visual motor integration and academic achievement.\(^{12}\) The present study evaluated overall grades based on written examinations in several academic subjects, representing the combination of multiple cognitive domains, and found that students with type 1 diabetes had significantly lower overall academic grades than their nondiabetic classmates.

Diabetes has been shown to impair intelligence, memory, attention and understanding in children and adolescents,\(^{13-15}\) as well as verbal (and therefore overall) intelligence quotient.\(^{16}\) Type 1 diabetes is associated with cognitive deficits in adolescents, independent of the quality of metabolic control and the duration of disease.\(^ {17}\) In addition, basic academic knowledge\(^ {18}\) and performance\(^ {19}\) may be adversely affected in children with diabetes. Neurocognitive performance (conceptual reasoning, memory and learning) has been shown to deteriorate in patients with diabetes compared with healthy controls.\(^ {20,21}\) This reduction in cognitive function is associated with disease duration\(^ {9}\) and hyperglycaemia,\(^ {22}\) with early onset increasing the risk of learning problems.\(^ {23}\) These data are in accordance with the present finding, that students with diabetes showed significantly lower academic grades than nondiabetic controls.

In contrast to the findings of the present study, it has been reported that diabetes did not impair overall academic performance in children, and students with diabetes performed better than controls in both mathematics and reading.\(^ {24}\) This may be explained by between-study differences in grade assessment methodology (class performance including reading versus written examinations, for example). A study of students with diabetes in Sweden found that academic performance (measured by mean examination scores) was slightly but significantly lower in children with diabetes, compared with controls.\(^ {14}\)

The present study is limited by its small sample size and short duration. On the other hand, all students were of the same ethnic background and the groups were well matched for age, sex, socio-economic status and school environment. The study employed a standardized measure of academic achievement, based on overall scores obtained in written examinations including English, mathematics, physics, chemistry, biology and humanities, representing the main domains of cognitive functions.

In conclusion, overall academic performance is significantly lower in students with type 1 diabetes compared with their nondiabetic classmates. Further studies, with larger cohorts and of a longer duration, are required to confirm these findings.

**Declaration of Conflicting Interest**

The authors declare that there are no conflicts of interest.

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References


