**Sleep Quality, Quality of Life, and Cognitive Performance**

**among Adolescents with Type 1 Diabetes Compared to Healthy Controls**

**Introduction**

Adolescence is an intermediate period between childhood and adulthood during which biological, social, psychological, and cognitive changes occur. A chronic illness such as diabetes makes the task of coping with these changes even more difficult. Diabetes is a group of metabolic diseases characterized by high blood glucose levels caused by the body’s inability to secrete insulin. Type 1 diabetes (T1D) accounts for 5–10% of all cases of the disease and occurs most commonly in children and adolescents.

Sleep patterns of adolescents with T1D differ from those of healthy adolescents. Adolescents with T1D present poor sleep quality, a longer period of stage 2 sleep, a shorter period of deep sleep, and more sleep disorders. They also experience daytime fatigue and a lower quality of life. T1D can also affect cognitive performance skills such as planning capability, organization, function in complex tasks, executive functions, and language capabilities, which may affect school grades. The link between T1D and decreased cognitive function is well described in the literature, but the findings are inconsistent.

**Hypothesis**

**Sleep quality**, **quality of life (QoL)**, and **cognitive performance** (measured by executive functions, processing accuracy and speed, short-term memory, visual attention, reasoning, memory, attention, perception, and general score) of adolescents with T1D will be lower than those of healthy control adolescents.

**Method**

**Participants: Eighty adolescents aged 11 to 20 years (mean age 14±2.31) from both sexes (38.7% boys) were divided into two groups:**

**A. 44 adolescents with T1D** (from "EMEK" Medical Center).

**B. 36 control adolescents without T1D.**

The study was approved by the Helsinki Committee of "EMEK" Medical Center and the institutional review board (IRB) of Emek Yezreel Academic College.

**Tools:**

***Demographic data*** includingage, grade in school, height and weight, and level of parental education were collected.

***Objective and subjective sleep*** of participants was measured for one week by actigraph (Respronix, Philp).

***School Sleep Habits Survey*** (Wolfson & Carskadon, 1989; Shochat, Flint-Bretler, & Tzischinsky, 2010)

***The Pediatric Quality of Life Inventory—PedsQL Short Form*** (Chen et al., 2007; Tzischinsky & Shochat, 2011)

***Cognitive function*** was measured by a computerized test (CogniFit® computerized neurocognitive evaluation program) and pencil-and-paper tests.

**Results**

***Cognitive functioning***

Significantly higher **cognitive functioning** was found in control adolescents compared to the T1D group in several indices:

* ***In computerized functions (Table 1):*** Memory, attention and concentration, coordination, perception, and global score
* ***In pencil-and-paper tests (Table 2):*** Verbal symbol and digit span total

***Objective and subjective sleep measures***

* Both groups (T1D and control) had a shorter sleep duration (7:33±0:53 hours) than recommended for this age (< 8.00).
* The two groups did not differ in sleep duration (7:47±1:03 vs. 7:20±0:41), sleep efficiency (85±4 % vs. 85±5 %), or sleep latency (15±19 min vs. 13±10 min) and in subjective sleep pattern.

***Quality of life***

No difference was found in overall quality-of-life scores.

**Conclusions**

* The findings of the present study partially support the literature findings that adolescents with T1D perform less well than healthy adolescents in ***cognitive function***, using computerized and paper-and-pencil tests.
* More significant differences were found in computerized tests than in paper-and-pencil tests. Explanations for this are the increased sensitivity of the computerized tests, interaction that may cause anxiety during paper-and-pencil tests, and greater cooperation developed across the screen technology.
* Few differences were found between adolescents with T1D and healthy control adolescents in cognitive function, perhaps related to the lack of reference to their glycemic control and/or age of disease onset.
* The lack of disparities in ***sleep quality*** between the T1D group and the control group may be explained by the fact that the differences are more pronounced in sleep stages; however, all the adolescents experienced significant sleep-pattern changes (such as short sleep duration and late sleep onset). Thus, all participants experienced sleep deprivation, feelings of fatigue, and lower ***quality of life.***