Pediatric School Psychology
Type 1 Diabetes in Children

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Type 1 diabetes is a relatively common childhood chronic health condition in which the pancreas makes insufficient insulin (Watson & Logan, 1998). Insulin is necessary in order to metabolize glucose (or sugar) in the blood, which the body then uses as its main source of energy. Type 1 diabetes is an autoimmune disease for many patients because the pancreas stops making enough insulin when the immune system destroys most of the beta cells in the pancreas. Still, for some patients with Type 1 diabetes, there is no known cause.

Prior to diagnosis, children with Type 1 diabetes often experience a combination of the following symptoms: increased blood sugar, frequent urination, excessive thirst/appetite, weight loss, elevated blood sugar (hyperglycemia), glucose in the urine, and a significant increase in ketones found in the blood and/or urine. Ketones are chemicals produced when the body breaks down fat for energy due to insufficient insulin. Because the child with Type 1 diabetes does not produce sufficient insulin, insulin must be administered, usually by insulin pump or insulin injection. Most children maintain healthy blood sugar levels by using a combination of rapid acting and long acting insulin. Rapid acting insulin begins to lower blood sugar almost immediately, while long acting insulin begins to lower blood sugar within 4 to 6 hours. In order to determine how much insulin they need, children with diabetes must check their blood sugar multiple times per day using a blood glucose meter. In addition, a child's HbA1c (glycosylated hemoglobin) is a blood test that provides a measure of average glycemic control over several months. Glycemic control is the degree to which blood glucose is maintained within the normal range of glucose values. The amount of insulin that the child needs throughout the day is also determined by counting the number of carbohydrates the child will eat or has eaten during meals or snacks. Thus, the treatment regimen for children diagnosed with Type 1 diabetes requires frequent, close monitoring of the child's diet and blood sugar levels. Consequently, parents and children must be educated in the skills necessary for successful treatment adherence. A certified diabetes educator provides this education to families, most commonly at a local hospital. Typically, an Individualized Health Plan (IHP) is developed with the school to ensure that the child's health needs are recognized and addressed in the school setting as well.

Without acceptable treatment adherence and the availability of sufficient insulin, children with Type 1 may experience a range of short-term and long-term effects (Watson & Logan, 1998). A child's treatment adherence determines how well the diabetes is controlled, and poor glycemic control has been associated with increased negative effects. These effects may be physical, cognitive, academic, psychosocial, or behavioral in nature.

Short-Term Effects

Diabetes often results in acute effects because of hypoglycemic or hyperglycemic episodes. These episodes arise when insulin, diet, and physical activity are not properly balanced. Hyperglycemia occurs when blood glucose is abnormally high, while hypoglycemia occurs when blood glucose is lower than normal. The short term physical effects of poor control may include a return of prediagnosis symptoms if the child is hyperglycemic. Individuals experiencing hyperglycemia or hypoglycemia may present with symptoms that include confusion, hunger, trembling, sweating, sleepiness, inability to speak, blurred vision, fatigue, dry mouth, irritability, excessive thirst, and/ or excessive urination. A child experiencing hypoglycemia with a rapid drop in blood glucose levels may appear shaky, pale, or sweaty. At this time, children may require an injection of glucagon in order to raise their blood sugar. Glucagon is a hormone produced by the pancreas that acts to raise blood sugar. The potential similarity in symptoms between hypoglycemia and hyperglycemia highlights the importance of learning the child's unique behavioral symptoms for each condition. Though these effects are transient when the condition is treated immediately, they do have important implications for school performance. Possible mood changes, as well as deficiencies in motor speed, attention, and mental efficiency, may result from an episode of hypoglycemia, which can contribute to slowed performance on tasks requiring rapid reaction time (Ryan, Gurtunca, & Becker, 2006). It may take 30 minutes or longer before the effects of hypoglycemia subside. Although hyperglycemia is also

thought to impact mental efficiency, it has been reported to influence emotion and behavior more than intellectual performance (Martin, Davis, & Jones, 2006).

Long-Term Effects

Cognitive Effects. Research focusing on cognitive development in children emphasizes differences between children with diabetes and healthy children in terms of cognitive and neuropsychological functioning. Most evidence supports cognitive differences as a function of age at onset of diabetes and glycemic control. Although differences in functioning have been detected using measures of intelligence, attention, processing speed, long-term memory, and executive skills, intelligence for children with Type 1 generally falls within the average range (Greer & Holmes, 1996; Holmes, O'Brien, & Greer, 1995; Northam et al., 2001). Still, even mild hypoglycemia, if chronic, may affect fine motor development, such as copying tasks (Golden et al., 1989). Additional visuospatial-related deficits have been reported in children with chronic hypoglycemia and replicated by multiple research groups across a variety of tasks, such as the VMI, as well as the Block Design and Object Assembly subtests of the WISC (Desrocher & Rovet, 2004). A history of severe hypoglycemia may also affect attention and other executive functions, with specific evidence for effects on selection, focus, and inhibition (Rovet & Alvarez, 1997). Several groups have also reported that hypoglycemia is associated with verbal and nonverbal memory deficits, even more so for children who experience hypoglycemic seizures (Hagen et al., 1990; Hershey, Lillie, Sadler, & White, 2003; Kaufman, Epport, Engilman, & Halvorson, 1999). Also, memories that involve personal events and facts appear adversely affected (Desrocher & Rovet).

When diabetes onset is earlier in the child's life, the condition appears to negatively affect some of the same cognitive functions as hypoglycemia, including verbal and nonverbal memory (Desrocher & Rovet, 2004; Hagen et al., 1990; Rovet, Ehrlich, & Hoppe, 1988; Ryan, Longstreet, & Morrow, 1985; Wolters, Yu, Hagen, & Kail, 1996). Ryan and colleagues' findings (1985) suggest slower motor speeds in children with early-onset diabetes, while Rovet's group has found and replicated decreased visual–spatial performance on construction and puzzle tasks (Desrocher & Rovet). These difficulties may be related to slower processing speed and diminished executive skills (Ferguson et al., 2005; Holmes & Richmand, 1985; Northam et al., 2001; Ryan et al., 1985). In fact, findings suggest attention abilities, such as selective attention, may be reduced in children with early-onset diabetes (Desrocher & Rovet; Holmes, Dunlap, Chen, & Cornwell, 1992; Northam et al., 2001; Rovet and Alvarez, 1997). Another difference that has been reproduced across research groups is decreased nonverbal intelligences scores, particularly on those tasks that are timed (Holmes & Richman, 1985; Rovet et al.; Ryan et al., 1985).

Given this pattern of deficits, Desrocher and Rovet (2004) have developed a developmental explanation for these cognitive effects. In their model, early-onset diabetes mainly has detrimental effects on motor, sensory, and visual–spatial functioning. Because hypoglycemia appears to occur more frequently in younger children, it affects these domains, as well as visual–spatial attention and memory (Desrocher & Rovet). Hyperglycemia is more common during adolescence and may have greater effects on executive functioning.

Academic Achievement. In terms of academic achievement, a number of studies suggest that children with Type 1 diabetes who report adverse effects on their academic achievement also experience negative cognitive effects and increased school absenteeism. In one study, 24% of children with diabetes received special education, whereas only 13% of comparison children received these services, while others have reported that school grades decline over the first 6 years post diagnosis (Holmes et al., 1992; Holmes et al., 1995; Kovacs et al., 1992). Consistent with the overall literature, boys appear more at risk for learning problems compared to girls (Holmes, Cant, Fox, Lampert, & Greer, 1999).

Although cognitive abilities are related to achievement, lower achievement has been reported even when variations in intelligence were taken into account (Holmes et al., 1995). Thus, lower achievement scores may be related to other factors that contribute to decreased achievement, such as missing more school than their peers (Holmes et al., 1992; Holmes et al., 1999; Ryan et al., 1985). In fact, multiple groups have found a negative relationship between school absences and achievement, although achievement generally remains within the average range (Holmes et al., 1999; Kovacs et al., 1992; Ryan et al., 1985). The effect of school

absences on achievement may be mediated by other factors besides absenteeism, such as glycemic control and/or cognitive effects. For example, Fowler's group (1985) reported decreased achievement in children with chronic health conditions unrelated to an increase in school absences. Other groups have found a relationship between poor control and decreased achievement, as well as increased school absences (Holmes et al., 1999; McCarthy, Lindgren, Mengeling, Tsalikian, & Engvall, 2002; Rovet et al., 1988).

Social–Emotional Functioning. In terms of behavior, a large study of over 2600 children and adolescents with Type 1 diabetes found mildly depressed mood in 14% of participants and moderately or severely depressed mood in approximately 9% (Lawrence et al., 2006). In general, the data suggest a positive correlation between internalizing psychological disorders, including anxiety and depression, and Type 1 diabetes (Dantzer, Swendsen, Maurice-Tison, & Salamon, 2003; Eiber, Berlin, Grimaldi, & Bisserbe, 1997).

Although children with diabetes report more problems with depressive symptoms and anxiety immediately post diagnosis, these problems seem to abate after approximately 1 year and then return, perhaps due to the chronic stress of disease maintenance (Northam, Matthews, Anderson, Cameron, & Werther, 2005). Consequently, due to differences in compliance, mood lability, and fatigue, children with diabetes may have more behavior problems compared to children without diabetes (McCarthy et al., 2002). Unfortunately, these behavioral and psychological difficulties may contribute to an increased risk for hospitalization related to poor glycemic control (Stewart, Rao, Emslie, Klein, & White, 2005). Parent reports of psychosocial functioning were correlated with disease-related symptoms in children (Wake, Hesketh, & Cameron, 2000). There is historically a relationship between internalizing symptoms and control; however, six recent studies have failed to detect this relationship (Dantzer et al., 2003). Thus, if there is a relationship, it is likely complex.

For children with diabetes, decreased participation in social activities may be due, in part, to symptoms associated with acute complications of the condition, including fatigue or nausea related to hypoglycemia or hyperglycemia. These physical symptoms can affect the frequency and/or quality of participation in normal childhood social activities. As many as 55% of children with newly diagnosed diabetes fail to discuss the condition with peers, and 35% of them report that their friends would like them better if they did not have the condition (Jacobson et al., 1986; Storch et al., 2004). Storch and colleagues (2004) found that children with diabetes, in comparison to a control group, indicated higher rates of relational victimization and less frequent supportive behavior from peers, with relational victimization associated with depression and social anxiety. As such, teachers should be aware of this increased risk for bullying among children with diabetes.

Risk/Protective Factors

There are many risk factors that contribute to both short- and long-term negative effects in children with diabetes. Metabolic control is affected by family functioning (including parental involvement), access to medical care, adherence to diet and exercise regimens, as well as frequency of blood glucose monitoring. Children's treatment regimens often need adjustment, but without proper medical care these adjustments may never occur. Minority children, specifically black children with a low socioeconomic status, have been identified as having a higher risk for poor glycemic control (Delamater et al., 1999). Individuals from low socioeconomic backgrounds may also lack the means to obtain necessary diabetes testing supplies and insulin. For example, the paper strips necessary to test blood sugar with a meter can be quite expensive. Children with diabetes are especially at risk if they have less well-developed social and coping skills (Wysocki, 2006), and if parental involvement, knowledge, and skills are low (Anderson, Ho, Brackett, Finkelstein, & Laff el, 1997; Chisholm et al., 2007 Sullivan-Bolyai, Knafl, Sadler, & Gilliss, 2004; Wiebe et al., 2005). Because Type 1 is a lifelong illness, children diagnosed at a young age progress through the stages of development while attempting to regulate their condition. One of the most important skills that should be gradually fostered is that of self-care and independence (Bradford, 1997). Still, decreased treatment adherence has been found in children of parents who lack developmentally appropriate expectations for diabetes management and expect children to take too much responsibility for disease maintenance (Palmer et al., 2004).

Although a constellation of factors places children with diabetes at greater risk for psychosocial, cognitive, developmental, and academic risks (Daley, Wodrick, & Hasan, 2006), there are several protective factors that serve to counteract these potential difficulties. For example, family cohesion predicts adherence to treatment regimens (Cohen, Lumley, Naar-King, Partridge, & Cakan, 2004). Better glycemic control is associated with youth coming from two-parent families compared to those from single-parent families (Harris, Greco, Wysocki, Elder-Danda, and White, 1999). Training educators about the disease and its implications in the classroom may also empower teachers to provide more appropriate accommodations that support better disease management in the school setting (Cunningham & Wodrich, 2006).

Conclusion

Given that children with Type 1 diabetes are at risk for negative physical, cognitive, academic, psychosocial, and behavioral effects, school psychologists and other school professionals must become more educated about how students with diabetes may struggle and how we might help these children in the schools. In one recent study, teachers were asked to determine the cause of students' behavior, with health factors as one possible cause (Wodrich, 2005). When teachers were blind to the student's health condition, only 2.6% of teachers correctly identified health factors as the cause of the students' behavior (Wodrich). In contrast, when the child's diagnosis was disclosed to the teachers and disease-specific behaviors were described, including symptoms of diabetes, 50% of teachers correctly identified health factors as the cause of the students' behavior (Wodrich). Unfortunately, inaccurate assumptions that do not take into account the child's health status may lead teachers to make uninformed choices about how to best address the student's classroom behavior. Thus, when teachers are provided with more information about Type 1 diabetes, they are better able to meet students' classroom learning needs (Cunningham & Wodrich, 2006). When school personnel receive diabetes education, students with Type 1 diabetes demonstrate better glycemic control (Wagner, Heapy, James, & Abbott, 2006). When classmates receive diabetes education, children with Type 1 diabetes rate their quality of life as better than students' whose classmates did not receive this training (Wagner et al., 2006). Thus, education for school professionals and children's classmates, and collaboration among school and medical professionals, as well as family members, may contribute to improved physical, behavioral, academic, and quality of life outcomes for children with Type 1 diabetes.

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