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Associations between HbA1c and depressive symptoms in young adults with early-onset type 1 diabetes☆

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Summary
Objective: This study sought to evaluate the associations between metabolic control and each DSM-5 (Diagnostic and Statistical Manual, fifth edition) symptom of depression among young women and men with early-onset long-duration type 1 diabetes.
Methods: The data of 202 18—21-year-old patients with type 1 diabetes from a population-based, nationwide survey (40.1% male) with a mean age of 19.4 (standard deviation 0.9) years, a mean HbA1c level of 8.3% (1.6%) (i.e., 67 [17.5] mmol/mol), and a mean diabetes duration of 15.7 (1.0) years were included. The German version of the Patient Health Questionnaire (PHQ-9) was used to assess depression symptoms. For each PHQ-9 depressive symptom, the mean HbA1c values of screening-positive and screening-negative patients were compared via *t*-test. The associations between HbA1c levels and depressive symptoms were analyzed using multiple linear regression analyses and stepwise adjustments for individual, socioeconomic and health-related covariates.

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Results: Exactly 43.0% and 33.3% of female and male participants reported at least one depressive symptom, and 5.0% and 2.5% met the DSM-5 criteria for major depressive syndrome. HbA1c levels increased with psychomotor agitation/retardation (women), overeating/poor appetite (men/women), lethargy (men), and sleep difficulty (men). Overeating/poor appetite, lethargy, and total PHQ-9 score (per score increase by one) were associated with increased HbA1c levels of 1.10, 0.96 and 0.09 units (%), respectively.
Conclusions: The associations between depressive symptoms and HbA1c levels vary by symptom and sex. Differentiating the symptoms of depression and targeted interventions might help to improve metabolic outcomes in young adults with early-onset type 1 diabetes and depression.

1. Introduction

Depression and diabetes have serious individual, societal and economic effects, and they often co-occur (Roy and Lloyd, 2012). According to Manarte et al. (2010), the prevalence of depression among patients with diabetes is rapidly increasing; furthermore, diabetes and depression will become the most prevalent health problems in the 21st century. According to the results of three systematic reviews (Anderson et al., 2001; Groot et al., 2001; Barnard et al., 2006), the prevalence of clinical depression among adults with type 1 diabetes was approximately four times greater than that of a control group without diabetes (12.0% vs. 3.2%) (Roy and Lloyd, 2012). Compared with type 2 diabetes, however, the data regarding the prevalence of comorbid depression among patients with type 1 diabetes remain scarce, thereby limiting the reliability of the reported findings (Barnard et al., 2006; Roy and Lloyd, 2012).

The coexistence of depression or depressive symptoms and type 1 diabetes has been associated with insufficient diabetes outcomes and increased admission to hospitals, emergency units and outpatient consultations, resulting in higher total healthcare costs and increased mortality rates (Ciechanowski et al., 2000; Groot et al., 2001; Lawrence et al., 2006; Roy and Lloyd, 2012; van Dooren et al., 2013; Plener et al., 2014). Depression has been frequently associated with elevated hemoglobin A1c (HbA1c) levels (Lawrence et al., 2006; Sacco and Bykowski, 2010; Corathers et al., 2013; Melin et al., 2013; Plener et al., 2014). In turn, HbA1c levels have been associated with acute and chronic complications (Bryden et al., 2003; Peters and Laffel, 2011). Therefore, HbA1c is likely a central mediator of the association between depression and long-term outcomes (Bot et al., 2013).

In this context, young adults with type 1 diabetes are of special interest. During development, they are challenged in various ways; like their peers without diabetes, they must overcome educational, economic and social challenges. In addition, they must take full responsibility for their disease management (Arnett, 2000; Hamilton and Daneman, 2002; Anderson, 2010; Johnson et al., 2013). Specific challenges arise during the transition from pediatric to adult diabetes care, which is recommended to occur between the ages of 18 and 21 years (Cooley and Sagerman, 2011). In a subsample of the SEARCH for Diabetes in Youth Study, leaving pediatric diabetes care was associated with a 2.5-fold increase in the odds for poor diabetes control; however, the factors that mediate this effect have not yet been identified (Lotstein et al., 2013).

Previous research suggested that young adults with type 1 diabetes are at an increased risk for depressive symptoms, which result in insufficient metabolic control. However, the association between these conditions has rarely been analyzed. Of the 23 studies included in a recently published systematic review on the prevalence and metabolic implications of depression among patients with type 1 diabetes up to the age of 25 years (Johnson et al., 2013), only one study included the data of patients older than 18 years (de Wit and Snoek, 2011). The wide participants' age range (age 9—19 years) and the small number of adults in that study limit the validity of the results with regard to young adults. Another recent study assessed the prevalence and associations between the symptoms of depression/antidepressant medication and the metabolic outcomes among patients with type 1 diabetes who were younger than 25 years. However, this study was based on a clinical diagnosis of depressive symptoms rather than standardized measures, and specific age groups were not targeted (Plener et al., 2014). Former research on the association between depression (using the DSM-IV criteria) and glycemic control primarily concentrated on depression in its entirety without differentiating between its distinct symptoms, as was previously recommended (Lux and Kendler, 2010; Bot et al., 2013). Additional knowledge concerning the associations between each depressive symptom and specific glycemic outcomes might provide deeper insight into the etiology of comorbid depression. This research might also help to develop individualized interventions for young adults (Bot et al., 2013). To the best of our knowledge, only two studies have thoroughly analyzed the associations between the specific symptoms of depression and metabolic control among patients with type 1 diabetes (McGrady and Hood, 2010; Bot et al., 2013). Although female and male participants are differentially affected by depression (Grey et al., 2002; Manarte et al., 2010), those studies did not report sex differences. The age range of the participants was wide, and none of the studies focused on age groups with potentially increased risks for both depressive symptoms and poor metabolic control.

Patients with long disease durations are predisposed to late diabetes sequelae (Dabelea, 2009; Downie et al., 2011). Like in other groups, the comorbid depression in emerging adulthood associated with poor metabolic control (Lawrence et al., 2006; Sacco and Bykowski, 2010; Corathers et al., 2013; Melin et al., 2013; Plener et al.,