Introduction

According to the American Diabetes Association (2008), there is a global consensus that optimization of glycemic control prevents or delays the onset of chronic complications of type 1 diabetes in adolescents. Over the years, the recommendation to promote adequate glycemic control with the aim to prevent the chronic complications of diabetes has been reinforced (Chiang et al., 2014; Haas et al., 2013; Nathan, 2014). Despite recommendations and efforts, a large number of young patients continue to have inadequate glycemic control, and thus being exposed to the risk of complications. Due to physiological changes and a decline in adherence to treatment usually associated with psychosocial factors, adolescence is a challenging period for maintaining optimal glycemic control (Hamilton and Daneman, 2002).

There are numerous research studies about the impact of psychological disorders on glycemic control. The focus of many of them is on depression, which has been significantly associated with hyperglycemia, inadequate glycemic control, higher rates of clinical complications, hospitalization, and increased health costs (Johnson et al., 2013; Stewart et al., 2005). Comorbid depression in patients with diabetes has also been shown to be significantly associated

Keywords
adolescence, chronic illness, depression, diabetes, hope

Abstract
This study investigated the association of hope and its factors with depression and glycemic control in adolescents and young adults with type 1 diabetes. A total of 113 patients were invited to participate. Significant negative correlations were found between hope and HbA1c and also between hope and depression. Hope showed a significant association with HbA1c and depression in the stepwise regression model. Among the hope factors, “inner positive expectancy” was significantly associated with HbA1c and depression. This study supports that hope matters to glycemic control and depression. Intervention strategies focusing on hope should be further explored.

Hope matters to the glycemic control of adolescents and young adults with type 1 diabetes

Fábio RM Santos, Daniel Sigulem, Kelsy CN Areco, Monica AL Gabbay, Sergio A Dib and Viviane Bernardo

Universidade Federal de São Paulo, Brazil

Corresponding author:
Fábio RM Santos, Department of Health Informatics, Universidade Federal de São Paulo, Rua Botucatu, 862, CEP. 04023-062, São Paulo – SP, Brazil.
Email: fabiomunhoz@hotmail.com
with increased risk of mortality (Coleman et al., 2013).

The emerging field of positive psychology advocates for the importance of studying positive aspects of human living, such as resilience, self-efficacy, and hope, and it has provided a particularly useful framework for identifying the ones that promote successful disease management (Joyce et al., 2012). Mednick et al. (2007) explored hope as a resilience factor and reported that high hope may serve as a protective factor against psychological distress.

The typical concept of hope emphasizes the notion, “something desired may happen.” Snyder et al. (1991) highlighted the relevance of the cognitive aspect of hope, and in addition to defining hope as the positive expectation of goal attainment, the authors included two interrelated cognitive dimensions, known as pathways and agency. The first dimension called pathways refers to an individual’s perceived abilities to find one or more effective ways to reach goals. The second agency is considered the driving force of hope and concerns self-efficacy beliefs and the commitment that helps one to move in the direction of a goal (Snyder, 2000). The Snyder Hope Scale (Snyder et al., 1996) is a self-report measuring instrument developed to assess both dimensions of hope. Some studies have investigated the factors separately, using the Snyder Scale, and reported that the agency factor has been shown to be significant: the use of prayer, as a coping strategy, was related to the agency factor only (Ai et al., 2004); the agency factor of hope revealed significant negative effects on later depression (Arnau et al., 2007) and emerged as a significant predictor of adjustment to multiple sclerosis caregiving (Madan and Pakenham, 2013).

Other conceptions of the hope construct also present relevant data in the academic literature. As defined by Dufault and Martocchio (1985), hope is “a multidimensional dynamic strength characterized by a confident, yet uncertain expectation of achieving good.” In their model, hope was conceptualized considering cognitive, emotional, behavioral, and interpersonal elements. Based on this concept, Herth (1992) developed the instrument Herth Hope Index (HHI), which incorporates the following factors: inner sense of temporality, inner positive readiness and expectancy, and interconnectedness with self and others. The HHI instrument has been widely used in patients with chronic diseases. Studies demonstrate that it has adequate reliability and quality metrics, both in investigations of cancer and diabetic patients (Herth, 1992; Sartore and Grossi, 2008; Schjolberg et al., 2011). In this literature review, no studies, which investigated the association between factors of hope (according to HHI instrument) with other variables, were found. In order to contribute to the study of hope, this research will investigate the hope factors, according to Herth’s concept.

Regardless of the instruments or the constructs used by each author, an increasing number of empirical studies have reported hope to be related to adjustment, both physical and psychological. For example, hopeful individuals showed diminished stress reactivity and more effective emotional recovery (Ong et al., 2006); hope scores were negatively correlated with pain intensity, anxiety, and depression (Brothers and Andersen, 2009); hope was a significant predictor of lower depression rates (Elliott et al., 1991) and was related to self-efficacy, optimism, and well-being (Magaletta and Oliver, 1999). Hope may serve as a potential resilience element in mothers of children with type 1 diabetes, functioning as a protective factor against psychological distress (Mednick et al., 2007). However, study findings on the relationship between glycemic control of patients with type 1 diabetes and hope are scarce. Glycemic control is usually assessed by HbA1c test, which measures the percentage of glucose in the blood cells. In the study of Vieth et al. (1997), a linear multiple regression analysis, using hope as predictor, failed to account for a significant proportion of variance in objective disease status as measured by hemoglobin HbAlc, whereas in the study by Lloyd et al. (2009) significant correlations were found among hope, perceived maternal empathy, and glycemic control. According to this literature review, there is no study evaluating the association of hope, depression, and glycemic control in patients with type 1 diabetes.
This study addresses the impact of hope on physiological parameters of patients with diabetes and evaluates the relationships between hope factors (according to the HHI) with depression and glycemic control. Due to the lack of studies on such questions, this research offers some support to clarify the association between hope, depression, and HbA1c levels in adolescents and young adults with type 1 diabetes.

**Method**

**Subjects and study design**

This cross-sectional study included a convenience sample of 113 Brazilian adolescents and young adults with type 1 diabetes. These patients were followed up at the outpatient public division of the Diabetes Center of the Federal University of São Paulo, São Paulo, Brazil. Patients were invited to participate, while waiting for their medical consultation in the waiting room of the clinic. The sample represents 21 percent of all patients who were registered and attended the clinic at the time in which the study was conducted, from February to August 2013. The inclusion criteria considered diagnosis of type 1 diabetes and absence of visual or hearing impairments. The patients recruited had long-term type 1 diabetes diagnosed according to the American Diabetes Association criteria. Informed consent was obtained from the patients who were older than 18 years of age and from the families who were responsible for patients under 18 years old. On the same occasion, the test results from HbA1C were collected and the questionnaires were applied to assess hope and depression levels. The interviews took between 20 and 30 minutes and occurred in the presence of a researcher and an assistant in a private room. Interviews with patients younger than 18 years also had the presence of a responsible relative. All questionnaires were completed online at the Diabetes Center, and the data were stored in a database on the University’s server. The questions of the questionnaires were read by the researcher or assistant along with each patient. The patients themselves used the computer mouse to click on the chosen answer. This study was approved by the regional ethics committee and performed according to the Declaration of Helsinki.

**Instruments**

The HbA1c level values were used as a parameter to determine the glycemic control degrees. The adolescents’ most recent HbA1c value was obtained from the diabetes clinic database. Samples were collected within 3 months of the date of the interview (high-performance liquid chromatography (HPLC)—Tosoh G7—certified by the National Glycohemoglobin Standardization Program, USA).

Hope scores were assessed through the HHI developed by Herth (1992) and validated for Brazilian Portuguese by Sartore and Grossi (2008). The HHI is a 12-item self-administered instrument that measures hope scores, which range from 12 to 48; the higher the score, the higher the level of hope. The instrument consists of three factors, and each factor comprises four items described as follows: *hope factor 1*—inner sense of temporality (items: presence of goals, positive outlook on life, each day has potential, scared about the future); *hope factor 2*—inner positive readiness and expectancy (items: see a light in a tunnel, a sense of direction, life has value and worth, recall happy/joyful times); and *hope factor 3*—interconnectedness with self and others (items: feel all alone, faith that comforts, deep inner strength, give and receive caring/love). Cronbach’s alpha coefficient of reliability for the Portuguese version of the instrument is .83.

Depressive symptoms were examined through the Hospital Anxiety and Depression Scale (HADS), which was developed by Zigmond and Snaith (1983). This scale consists of 14 questions: 7 items for depression and 7 for anxiety. The scores for each subscale range from 0 to 21. This study only used the subscale of depression. This instrument was validated and translated into Brazilian Portuguese by Gorenstein et al. (2000). Cronbach’s alpha coefficient of reliability for the Portuguese version of the depression subscale is .77.

**Statistical analysis**

Data analyses were conducted using SPSS version 18.0. Mean±standard deviation (SD) and minimum and maximum values were applied to
describe the quantitative data. For comparison of means between two groups, we used the Student *t*-test where the variable had a normal distribution in the two groups (parametric test) or its equivalent non-parametric Mann–Whitney. The equality of variances was tested by Levene’s test. To compare means between more than two groups, we used one-way analysis of variance (ANOVA) in cases where the variable had a normal distribution. In the case of difference of means, these were tested in pairs by Tukey’s test (multiple comparisons). In cases of very large deviation from normality, the non-parametric Kruskal–Wallis test was used. The associations of the hope scores (HHI) with HbA1c and depression (HADS) were examined by two regression models, controlled by gender, age, and disease duration (Table 2). For evaluation of correlation between hope total and factor scores (HHI), HbA1c levels, and depression (HADS), Pearson’s correlation was used (Table 3). In order to assess whether the association between hope, HbA1c, and depression remained significant in the presence of the control variables gender, age, and duration of diabetes, two multiple regression models were carried out (Table 4). The variable educational level did not enter the regression model because in this sample it was strongly correlated with age (Spearman’s rho = 0.762, *p* < 0.001). In the regression models, a standardized regression coefficient (beta/β) was applied. The level of significance was set at *α* = 0.05.

Results

Demographic traits and clinical variables of patients

Among the 135 patients who were invited to participate in the study, 113 (83.7%) agreed to enroll. In all, 21 patients (16.3%) were not enrolled in the study because either they did not meet the inclusion criteria (*n* = 14) or declined to participate (*n* = 8). Among those who declined, they either did not want to participate or lacked sufficient time to be interviewed. Table 1 describes the demographic profile of the sample.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>55</td>
<td>48.7</td>
</tr>
<tr>
<td>Male</td>
<td>58</td>
<td>51.3</td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11–18</td>
<td>62</td>
<td>54.8</td>
</tr>
<tr>
<td>&gt;18–23</td>
<td>51</td>
<td>45.2</td>
</tr>
<tr>
<td>Educational Levela</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary education</td>
<td>20</td>
<td>17.7</td>
</tr>
<tr>
<td>High school</td>
<td>68</td>
<td>60.2</td>
</tr>
<tr>
<td>Higher education</td>
<td>25</td>
<td>22.1</td>
</tr>
<tr>
<td>Duration of diabetesb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–2</td>
<td>18</td>
<td>15.9</td>
</tr>
<tr>
<td>&gt;2–6</td>
<td>34</td>
<td>30.1</td>
</tr>
<tr>
<td>&gt;6</td>
<td>61</td>
<td>54.0</td>
</tr>
</tbody>
</table>

*a*Each category includes ongoing and already completed.

*b*Time in years since the condition (type 1 diabetes) was diagnosed until the interview date.

Scores of hope total (HHI), HbA1c, and depression (HADS)

The HbA1c level in subjects was 9.3 ± 2.3 percent (mean ± SD), ranging from 5.8 to 16.1 percent. The hope (HHI) level in subjects was 38.7 ± 5.3 (mean ± SD), ranging from 19 to 48. The depression subscale (HADS) level in subjects was 4.01 ± 3.3 (mean ± SD), ranging from 0 to 17. Table 2 shows the means of HbA1c levels, depression, and hope scales and their comparison of each of the demographic variables.

Correlation among hope total and factor scores (HHI), HbA1c, and Depression (HADS)

The correlations of hope total and factor scores (HHI) with HbA1c levels and depression (HADS) are shown in Table 3. Significant correlations were found between HbA1c and depression; hope total scores with HbA1c and depression; hope factor 2 with HbA1c and depression; and hope factor 3 with depression.
Association of hope total scores (HHI) with HbA1c and depression (HADS)

The analysis of associations of hope total scores (HHI) with HbA1c and depression is shown in Table 4. In a multiple regression analysis, the hope total scores showed a significant association with HbA1c and depression (HADS).

Discussion

This study aimed to provide additional evidence that high levels of the construct hope are positively associated with improved glycemic control and negatively associated with depression in a sample of adolescents and young adults with type 1 diabetes. It specifically concentrated on the association of the hope factors on the HHI with HbA1c and depression levels, which had not been previously investigated thoroughly in the health literature. The hypothesis of this study was confirmed, suggesting that hope levels are positively associated with appropriate metabolic control and negatively...
associated with depression. In the regression model, hope levels showed significance and explained 9 percent of the variance in HbA1c levels and 30 percent of the variance in depression levels. The finding that the hope factor inner positive readiness and expectancy (HHI) is the most significant factor in this association enhances the contribution of this study.

The means of HbA1c, depression, and hope variables were investigated in this study sample of Brazilian adolescents with type 1 diabetes. The HbA1c mean level was also within the range found by other authors, but lies between the highest (Graue et al., 2004; Lustman et al., 2000; McGrady et al., 2009). Such findings reveal that a large number of young people still have an inadequate glycemic control (HbA1c ≥ 7.5), which greatly increases the risk of complications and indicates the need for constant improvement of patients’ self-care (Rewers et al., 2002). The HbA1c mean was higher in women, in younger patients, and in those with lower education, but the difference was not significant. The mean of depression scores (HADS) was also within the range found by others, but among the lowest in patients with diabetes (Reddy et al., 2010; Zhang et al., 2008). The hope (HHI) mean level obtained was similar to levels reported by other authors (Galvão et al., 2012; Herth, 1992; Orlandi et al., 2012). In this sample, female patients, younger patients, and those with lower education have significantly higher averages of hope. Partly, these results are consistent with those found by previous studies, Rawdin et al. (2013), Nothwehr et al. (2013), and Ai et al. (2004), which demonstrated that younger individuals and those with low education tend to have low levels of hope, although differences between gender were not significant.

Regarding the relation between depression and the construct of hope, the findings of this study are consistent with the ones reported by other authors. Billington et al. (2008), on adjustment to end-stage renal failure and consequent dialysis study, found that high hope was associated with low levels of depression. Through the Snyder Hope Scale, Arnau et al. (2007) revealed that the agency dimension of hope predicted decreased levels of depression 1 month later. Others, which used the HHI instrument, also observed a negative significant relationship between hope, anxiety, and depression in heart transplant patients (Evangelista et al., 2003) and in those who had acquired severe physical disabilities (Ong et al., 2006).

This study also found a significant association between depression and HbA1c, but such result will not be discussed in detail—first, because it is not part of the purpose of this investigation and, second, because the existence of this association is largely consolidated in the academic literature (Reddy et al., 2010; Zhang et al., 2008).

According to the HHI instrument, the hope factor 1, referred to as inner sense of temporality, was not associated with the HbA1c and depression levels, whereas the inner positive readiness and expectancy (the hope factor 2) was the only factor significantly associated with both variables, HbA1c and depression. This suggests the possibility that patients who have inner positive readiness and expectancy will have a proactive attitude and also be able to think of possible positive ways to solve adversities, adapting better, and becoming more resilient.

### Table 4. Multiple regression models evaluating the associations of hope total scores (HHI) with HbA1c and depression (HADS), including the variables gender, age, and duration of diabetes.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>HbA1c</th>
<th>Depression (HADS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>p</td>
</tr>
<tr>
<td>Hope total (HHI)</td>
<td>−.24</td>
<td>.02*</td>
</tr>
<tr>
<td>Gender</td>
<td>−.07</td>
<td>.42</td>
</tr>
<tr>
<td>Age</td>
<td>−.11</td>
<td>.31</td>
</tr>
<tr>
<td>Duration of diabetes</td>
<td>−.15</td>
<td>.15</td>
</tr>
<tr>
<td>Regression</td>
<td>$R^2 = .09$; $F = 2.76$; $p = .03^*$</td>
<td>$R^2 = .30$; $F = 11.97$; $p &lt; .001^{**}$</td>
</tr>
</tbody>
</table>

β = standardized beta coefficients.

*p < .05; **p < .001.
Apparently, positive outcome expectancies can help people to remain mentally engaged, even in serious conditions beyond their control and promote psychosocial functioning. Inner positive expectation can also be considered as an optimistic way of thinking or even the expression of optimistic beliefs. Fournier et al. (2002) investigated the role of optimistic beliefs and adaptation to chronic disease and suggested that positive outcome expectancies help patients to accept their situation, directly and indirectly, by using less emotion-oriented coping.

The interconnectedness with self and others, the third factor, correlated significantly with depression, showing that patients with greater social connectedness have lower levels of depression (HADS). Such results are in agreement with the literature, which reports that connections and social attachments are important factors in the psychosocial adaptation of patients with type 1 diabetes (Malik and Koot, 2009). This study brings an important contribution to the multidisciplinary care of diabetic patients because the association of each of the hope factors with HbA1c and depression levels had not yet been assessed.

In addition to the multidisciplinary care of patients, this study also has implications for diabetes education. The construct of hope can be used as a basis for educational interventions in which hope should be promoted as a protective and support factor. Some interventions have been proposed to help patients establishing clearer goals, producing pathways to attainment, and nourishing the sense of agency to achieve goals (Duggleby et al., 2007; Ho et al., 2012). There are also group interventions based on cognitive–behavioral approaches, which have shown some evidence in promoting hope and optimistic beliefs in adolescents (Brunwasser et al., 2009; Gillham and Reivich, 2004). Interventions aimed to stimulate hope, particularly targeted to young patients with type 1 diabetes, similar to those cited above, may be useful for the management of their disease.

Several limitations of this research study deserve comment. First, a longitudinal study would be ideal to further explore the relationship between hope and HbA1c levels. It is important to evaluate the psychosocial adaptation to type 1 diabetes as a process because adjustment is not a static process. Second, the data for this study are correlational in nature and cannot demonstrate causality; longitudinal and experimental designs would also help to clarify the causality. Finally, variables such as social support, self-efficacy, self-esteem, and family environment, which are known to have an effect on hope and glycemic control, were not examined in the current research. Further research studies should focus on changes in variables over time and include such factors.

To our knowledge, this is the first study to evaluate the association of hope factors, based on the Herth’s instrument, with HbA1c and depression in adolescents and young adults with type 1 diabetes. Among the hope factors investigated, the “inner positive readiness and expectancy” proved to be significantly associated with HbA1c and depression levels, suggesting that young patients, who have positive outcome expectancies, will become more resilient, less depressed, and, therefore, in better control of their glycemic levels. In conclusion, this research highlights the importance of positive readiness and expectancy as a hope factor for youths with diabetes, supporting that hope matters to glycemic control and depression.

Acknowledgements
This research was financially supported by Fundação de Amparo à Pesquisa do Estado de São Paulo—FAPESP (2010/51872-0). The Department of Health Informatics of the Universidade Federal de São Paulo provided the administrative infrastructure for the study. The Diabetes Center of the Universidade Federal de São Paulo also supported the project by allowing patients with type 1 diabetes mellitus to participate in the study.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
References


