The associations of self-care, illness perceptions and psychological distress with metabolic control in Singaporean adolescents with Type 1 Diabetes Mellitus

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ABSTRACT

This is the first study to investigate the associations of self-care, illness perceptions and psychological distress with metabolic control in Singaporean adolescents with Type 1 Diabetes Mellitus (T1DM). A cross-sectional sample of 41 adolescents (aged 14–20) completed measures of self-care, illness perceptions and psychological distress. Demographic and medical information were also obtained. Glycated haemoglobin (HbA1c) levels were analysed both as continuous variable to explore dose–effect relationships and as a categorical variable to classify poor versus good metabolic control. A total of 65.9% (n = 27) of the adolescents had poor metabolic control (HbA1c < 7.5%). Logistic regression modelling showed that poor metabolic control was associated with lower beliefs in treatment control (OR = 5.51), lower levels of foot care (OR = 3.81) and general diet (OR = 2.44) (total Nagelkerke R square = 78.6%). Similar associations for treatment control beliefs and diet have been noted when modelling HbA1c as a continuous variable. The results highlight the importance of the perceptions of treatment control and dietary self-care in diabetes outcomes for adolescents with T1DM. Future studies are warranted to replicate findings in larger samples and explore longitudinal associations.

1. Introduction

Type 1 Diabetes Mellitus (T1DM) is one of the most common childhood chronic illnesses. The treatment regimen of T1DM involves a complex self-regulation process for adolescents with T1DM (Hood, Peterson, Rohan, & Drotar, 2009). These individuals need to coordinate a number of self-care behaviours on daily basis including blood glucose checks, calculating and administering insulin doses, and keeping to dietary and exercise
recommendations. Regular foot checks are also recommended (Mayfield, Reiber, Sanders, Janisse, & Pogach, 2004) due to the potential for reduced blood flow, numbness and subsequent injury or infection among patients with Diabetes Mellitus (DM) (Diabetes UK, 2015). The treatment regimen is aimed to achieve good metabolic control, thereby reducing the risk of complications associated with hyperglycaemia. Poor metabolic control can cause vascular complications in the longer term leading to dysfunction and failure of the organs and is shown to be associated with frequent hospital admissions, higher health care costs and shorter life expectancy (Anderson, Svoren, & Laffel, 2007; Hu et al., 2001; Wibell et al., 2001).

Adequate diabetes management is particularly challenging during adolescence, a developmental period characterised by marked biological, cognitive and socio-emotional changes. During puberty, due to the increase in counter-regulatory hormones to insulin as part of the normal growth phase, there is a marked decrease in insulin sensitivity (Bloch, Clemons, & Sperling, 1987). This, in turn, results in a need to regularly evaluate the insulin requirements and adjust the self-care regimen of the adolescent. Metabolic control has been shown to deteriorate, and rates of non-adherence tend to be higher, in adolescents compared to other age groups (Goldston, Kovacs, Obrosky, & Iyengar, 1995; Hamilton, & Daneman, 2002; Palta, Shen, Allen, Klein, & D’lessio, 1996).

Adherence behaviours are thought to be a set of coping responses and have been shown to be influenced by patients’ beliefs (Harvey & Lawson, 2009). Building on the self-regulatory model (SRM), Moss-Morris and colleagues (2002) highlighted that emotional representations (degree of concern toward illness and extent of emotional impact of illness) and coherence (the extent the patient understands his or her illness) are important dimensions to be included in relevant measures of patients’ models of the illness.

Research on adolescents with T1DM reported significant associations between illness perceptions and self-care/adherence behaviours, most notably for perceptions of personal control (Griva, Myers, & Newman, 2000), treatment control and perceived consequences (Nouwen, Urquhart, Hussain, McGovern, & Napier, 2009; Skinner & Hampson, 2001). Direct associations with metabolic control have also been noted albeit not consistent for all the components of illness perceptions (Griva, Myers, & Newman, 2000).

Illness perceptions are conceptualized within the SRM developed by Leventhal and Cameron (1987) and Leventhal, Diefenbach, and Leventhal (1992). According to the SRM, people develop implicit beliefs and emotions about their illness, which span across dimensions: (i) identity: beliefs about the nature of illness and its symptoms, (ii) timeline: duration of the illness, (iii) consequence: beliefs about the impact of illness on the individual’s life, (iv) cause: perceptions of the cause of the illness and (v) cure/control: beliefs about how available treatments and individual’s behaviour can influence the course of the illness. These beliefs help to guide the management of health threat and how people cope with symptoms and the diagnosis/condition and any associated treatments.

Symptoms of depression and emotional distress are common in patients with T1DM (Blanz, Rensch-Riemann, Fritz-Sigmund, & Schmidt, 1993; Northam, Matthews, Anderson, Cameron, & Werther, 2005) and have been shown to be associated with poor metabolic control in both adult (Lustman et al., 2000) and adolescent patients with T1DM (Grey, Whittemore, & Tamborlane, 2002; Kovacs, Goldston, Obrosky, & Iyengar, 1992). There is also increasing evidence of an association between illness perceptions and
outcomes such as metabolic control and treatment adherence in diabetes mellitus (Hagger & Orbell, 2003; Harvey & Lawson, 2009; McSharry, Moss-Morris, Kendrick, 2011; Nouwen et al., 2009).

Although previous work has highlighted the importance of self-care behaviours, illness perceptions and emotional distress for good metabolic control, these have typically been examined in isolation. Little is known on the relative importance or their synergistic effects with regard to metabolic control. Furthermore, the majority of the studies reviewed were conducted in Western settings and may not be easily extrapolated in different settings and ethnically diverse patient populations (i.e. of southeast Asian Descent, e.g. Chinese, Malay or South-Indian).

Illness perceptions have been shown to differ in different cultural groups (Bean, Cundy, & Petrie, 2007; Hjelm, Bard, Nyberg, & Apelqvist, 2003), with evidence that such culture-driven beliefs influence use of, preference for different types of treatment (Bishop, 1998a) and patterns of health care utilization. Singaporeans tend to seek medical advice and care from both Western doctors well as Chinese practitioners. But when they perceive the disease to be life-threatening, they were more likely to visit a Conventional Western Medicine doctor as compared to visiting a traditional medicine practitioner, using a home remedy or taking traditional Chinese medications (Bishop, 1998b; Tan & Bishop, 1996).

Previous studies have also identified health-related quality of life (HQoL) differences among Singaporean ethnic groups (e.g. Chinese, Malay and Indian) and have noted links between HQoL, distress and metabolic control in adult patients with DM (Co et al., 2015; Wee, Li, Cheung, Fong, & Thumboo, 2006). However, research in youth with DM is largely lacking. No studies to date have explored the role of psychological and behavioural factors in metabolic control outcomes among Singaporean adolescents with T1DM.

The present study aimed to explore the relationship between self-care, illness perceptions and psychological distress with metabolic control in Singaporean adolescents with T1DM. Guided by the SRM and previous research in other settings, it is hypothesised that poorer metabolic control will be associated with lower adherence/self-care behaviours, more negative illness perceptions (i.e. lower perceptions of control; more perceived consequences and symptoms, stronger identity) and higher distress.

2. Method

2.1. Participants

This study is part of a longitudinal study investigating distress, adherence to treatment, and QOL in adults and adolescents with diabetes. Participants were recruited from the National University Health System (NUHS) diabetes clinic for children and adolescents. Eligible patients had to meet the following inclusion criteria: aged between 14 and 20 years, diagnosed with T1DM for at least a year, Singaporean citizen, permanent resident, or intending to reside in Singapore, English speaking, able to give informed consent, willing and able to comply with study protocol including access to personal records for the documentation of relevant clinical information on diabetes and medical history. Adolescents who had mental illness; any known or ongoing treatment for psychological or psychiatric disorders; significant cardiovascular disease, renal failure or significant liver failure; pregnant (having gestational diabetes) were excluded.
In general, adolescents in Singapore are well versed in the English language, which is taught as first language in schools. Most T1DM children and adolescents are under the care of tertiary paediatric diabetes clinics as recommended by the Ministry of Health clinical practice guidelines. Therefore the study population in the NUHS clinic is representative of the T1DM adolescent population in Singapore.

The study was approved by the Ethics Committee of the National Healthcare Group Domain Specific Review Board. Written informed consent was obtained from participants and their parents before their enrolment. Parental authorisation provided access to medical records for HbA1c and other illness information.

2.2. Procedure
Potential participants were identified ahead of their regularly scheduled clinical appointment by medical staff following chart review or case notes to confirm eligibility. Research staff approached the eligible patients on the day of their clinical appointment and invited them to participate in the study. Following individual and parental consent, questionnaires were administered to self-complete while waiting for the medical consultation or complete at home and return back using stamped self-addressed envelopes provided for the purposes of the study. A reimbursement of 10 dollars (SGD) was given as a token of appreciation for their time.

All procedures and instruments were tested in a pilot with N = 5 adolescents.

2.3. Measures
Age, gender, ethnicity and education were collected via self-report. Medical records were reviewed to extract information on diagnosis, duration of diagnosis, medication, presence of other medical conditions and glycated haemoglobin levels (HbA1c). HbA1c reflects the average metabolic control over the past three months, with higher levels indicating poorer metabolic control. Clinical targets in the participating hospital followed the recommendations of the International Society for Pediatric and Adolescent Diabetes recommendations, that is, HbA1c of <7.5% (58 mmol/mol) for all children and adolescents (Acerini, Craig, de Beaufort, Maahs, & Hanas, 2014). Blood samples for HbA1c measurements were taken at the time of assessment as part of routine care, with the corresponding final lab results later extracted by medical staff from medical records.

2.3.1. Summary of diabetes self-care activities (SDSCA) measure
Self-care was measured using the SDSCA (Toobert, Hampson, & Glasgow, 2000). The SDSCA consists of 11 items combined into 5 subscales: general diet, specific diet, exercise, blood glucose checks, foot care and smoking status. The general diet subscale measures how frequent the participants had followed a healthful eating plan while the specific diet subscale measures specific behaviours (e.g. consumption of fruits/vegetables or high-fat food). Participants indicate rate how many day(s) of the last 7 days they engaged in the listed particular behaviour with higher score indicating better self-care. The smoking status subscale was excluded from further analyses as there were no smokers in the sample.

Cronbach alphas for general diet, specific diet, exercise, blood glucose checks and foot care in this sample were .911, −.667, .664, .839 and .802, respectively. The low (and negative) alpha for the specific diet subscale indicates that the two items in the specific subscale did not
measure self-care in the same direction, for example, adolescents reporting both frequent consumption of five or more servings of vegetables and fruits and high-fat food (which is contraindicated in diabetes-specific diet). The developers of the tool had noted the low inter-item correlations in the specific diet subscale and recommended that individual items for specific diet scale be used separately for analysis (Toobert et al., 2000). This stand-alone item approach was therefore adopted in our study as per their recommendations.

2.3.2. Brief illness perception (BIP) questionnaire

The BIP is a nine-item self-report questionnaire developed as an alternative to longer versions of the instrument, namely Illness Perception Questionnaire (IPQ) and Illness Perception Questionnaire-Revised (IPQ-R) (Broadbent, Petrie, Main, & Weinman, 2006). The BIP measures the cognitive and emotional components of illness perceptions within a short administration time, reducing the burden on the participants. Broadbent et al. (2006) had established good test–retest reliability and concurrent validity with patients with chronic illness.

Each item on the scale assesses one dimension of the illness perceptions: (1) consequences – perceived impact on functioning, (2) timeline – expected duration of diabetes, (3) personal control – perceived personal control over illness, (4) treatment control – perceived treatment effectiveness, (5) identity – number of commonly experienced symptoms, (6) concern – degree of concern toward illness, (7) coherence – understanding of illness and (8) emotional representation – extent of emotional impact of illness, corresponding to the list of eight items in the questionnaire. Additionally, the questionnaire also includes a qualitative component where participants are prompted to list in rank-order the three most important factors that they believed had caused their illness. This item was not included in the subsequent statistical analyses.

The items are scored on a 11-point Likert-type scale ranging from 0 to 10 with higher scores on the consequences, timeline, identity, concern and emotional representation dimensions representing more negative beliefs while high scores on the personal control, treatment control and coherence dimensions representing more positive beliefs.

2.3.3. Kessler psychological distress scale (K10)

The K10 is a generic questionnaire, consisting of 10 items designed to measure level of psychological distress over the past four weeks (Kessler et al., 2005). Each item in the K10 is scored on 5-point Likert scale (1 = None of the time, 5 = All the time). Item responses summed to produce an overall score, ranging from 10 (indicative of no distress) to a maximum of 50 (indicative of severe distress). Cut-offs have also been proposed to qualify levels of symptoms of distress. A score of 10–19 indicates that the individual may not be experiencing significant feelings of distress; 20–24 indicates mild levels of distress; 25–29 indicates moderate levels of distress and 30–50 indicates severe levels of distress (Coombs, 2005). The Cronbach coefficient alpha of .907 was obtained in this sample, indicating excellent internal consistency.

2.4. Statistical analyses

Statistical analyses were performed using IBM Statistical Package for Social Sciences (SPSS; Version 20.0). A two-sided $p$ value of <.05 was taken to indicate statistical significance.
HbA1c levels were analysed as both a continuous and a categorical variable (i.e. dichotomised based on clinical cut-offs of <7.5% and ≥7.5%) to classify poor versus adequate metabolic control. We have opted for the dual approach as both methods have been used in previous research, without any clear consensus as to the best way to analyse HbA1c data. Categorising HbA1cs based on clinical cut-offs has been shown to have clinical significance in terms of the development of complications whereas analysing HbA1c levels as a continuous variable allows for dose–effects associations to be explored.

The associations between HbA1c levels and sociodemographic, clinical, self-care and psychological parameters were examined using univariate where appropriate (i.e. Pearson’s correlations, Spearman’s rank-order correlation, one-way analyses of variance (ANOVAs), Kruskal–Wallis and chi-square analyses) and multivariate analyses. As indicated by Kolmogorov–Smirnov test, several variables were not normally distributed (i.e. timeline, treatment control, identity, illness concern, emotional representation, general diet, blood glucose checks and foot care). As such, non-parametric tests for univariate associations were performed for these variables. We did not conduct non-parametric regressions for multivariate modelling as such models need a larger sample to provide the model structure and estimates. Also, the skewness and kurtosis results do not suggest that the data are far away from a normal distribution. Therefore, we have decided to proceed with parametric modelling.

Only the variables with significant univariate associations were subsequently entered in the multivariate models, that is, multiple regression or a multiple logistic regression for HbA1 as a continuous or categorical variable, respectively.

### 3. Results

#### 3.1. Participants

Out of the 69 eligible patients at the diabetes clinic, 64 were approached. Twenty-two patients declined to participate due to lack of interest or time and 1 patient withdrew after consent. The final sample consisted of 41 participants (response rate = 64.1%) (19 males, 22 females) with a mean age of 16.78 (SD = 2.02) years. All participants were aged between 14 and 20 years. The sample had 26 Chinese, 9 Malay, 4 Indian and 2 of

| Table 1. Descriptives and frequencies of variables. |
|--------------------------------------------------|
| Variables                                      | Total sample (N = 41) | Good metabolic control (n = 14) | Poor metabolic control (n = 27) | Univariate differences |
| Age                                            | 16.78 (2.02)          | 16.89 (2.00)                    | 16.74 (2.09)                    | F-value                |
| Diabetes duration                              | 7.89 (5.19)           | 6.69 (5.09)                     | 5.52 (5.23)                     | 1.06                   |
| HbA1c                                          | 8.61 (2.04)           | 6.69 (0.52)                     | 9.61 (1.80)                     | 0.19 \( \chi^2 \)     |
| Gender                                         |                       |                                |                                | 2.75                   |
| Males                                          | 46.3% (n = 19)        | 47.4% (n = 9)                   | 52.6% (n = 10)                  |                        |
| Females                                        | 53.7% (n = 22)        | 22.7% (n = 5)                   | 47.3% (n = 17)                  |                        |
| Ethnicity                                      |                       |                                |                                | 6.35                   |
| Chinese                                        | 63.4% (n = 26)        | 38.5% (n = 10)                  | 61.5% (n = 16)                  |                        |
| Malay                                          | 22.0% (n = 9)         | 11.1% (n = 1)                   | 88.9% (n = 8)                   |                        |
| Indian                                         | 9.8% (n = 4)          | 25.0% (n = 1)                   | 75.0% (n = 3)                   |                        |
| Others                                         | 4.9% (n = 2)          | 100% (n = 2)                    | 0.00% (n = 0)                   |                        |
other ethnicities. The average duration of diagnosis was 7.89 (SD = 5.19) years. All the participants were on insulin treatment. The mean HbA1c of the entire sample was 8.61 (SD = 2.04), with 14 of the adolescents having good metabolic control (<7.5%; mean HbA1c = 6.69, SD = 0.52) and 27 adolescents having poor metabolic control (≥7.5%; mean HbA1c = 9.61, SD = 1.80). There were no differences between the groups in any of the sociodemographic or clinical parameters (see Table 1).

3.2. Univariate associations with metabolic control

3.2.1. Metabolic control as a continuous variable

Pearson Product-Moment correlations and Spearman rank-order correlations between the HbA1c levels and self-care, illness perception and psychological distress variables were performed as appropriate.

These indicated that higher HbA1c levels were associated with lower self-care in terms of general diet ($r_s = -0.649, p < .01$); lower beliefs in treatment control ($r_s = -0.570, p < .01$), lower coherence ($r = -0.337, p < .05$) and higher levels of psychological distress ($r = 0.422, p < .01$). None of the sociodemographic or clinical parameters was significantly associated with HbA1c levels.

3.2.2. Metabolic control as a dichotomous variable

Analyses of dichotomised HbA1c levels are presented in Table 2. Adolescents with poor metabolic control reported lower levels of adherence to general diet [$H = 9.15, p < .01$]

| Table 2. Descriptive statistics for self-care activities, illness perceptions and Kessler psychological distress scale (K10) scores. |
|---------------------------------------------------------------|
| Good metabolic control | Poor metabolic control | Univariate differences | Correlation with HbA1c | Skewness | Kurtosis |
|------------------------|------------------------|------------------------|------------------------|----------|----------|
| Self-care activities   |                        |                        |                        |          |          |
| General diet           | 5.31 1.41              | 3.42 1.73              | 9.15*                  | $.649**  | -.127    | -.085    |
| Specific diet (more veg)| 3.92 2.69              | 3.29 2.37              | 0.55                   | -.189    | 0.106    | -1.253   |
| Specific diet (more high fat)| 2.54 2.76            | 3.60 1.89              | 1.96                   | .313     | 0.095    | -1.068   |
| Exercise               | 3.58 1.59              | 2.83 1.82              | 1.54                   | -.026    | 0.497    | -0.109   |
| Blood glucose checks   | 5.21 1.83              | 4.29 2.39              | 0.99                   | -.289    | -0.578   | -0.913   |
| Foot care              | 3.18 2.69              | 0.94 1.39              | 8.42*                  | -.242    | 1.275    | 0.498    |
| Consequences           | 4.29 2.37              | 5.37 2.31              | 2.00                   | .176     | -.265    | -0.495   |
| Timeline               | 8.64 2.02              | 8.78 2.12              | 0.17                   | .174     | -1.581   | 1.392    |
| Personal control       | 7.43 1.45              | 6.33 2.24              | 2.74                   | -.285    | 0.678    | 1.620    |
| Treatment control      | 8.57 1.16              | 6.33 2.09              | 11.0*                  | -.570**  | 0.472    | -0.490   |
| Identity               | 4.36 1.91              | 5.04 1.97              | 0.25                   | .023     | -.030    | -.014    |
| Illness concern        | 6.29 2.30              | 7.04 2.07              | 0.75                   | .104     | -.953    | 1.546    |
| Coherence              | 7.38 1.61              | 6.63 1.78              | 1.68                   | -.337*   | -.110    | -0.951   |
| Emotional representation| 4.77 3.09              | 6.04 2.62              | 2.04                   | .280     | -.765    | -0.195   |

$^a$Kruskal–Wallis test and Spearman rank-order correlation conducted for variables with non-normal distribution.

*$p < .05$.

**$p < .01$.  

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and foot care \[H = 8.42, p < .01\] and lower perceptions of treatment control \[H = 11.0, p = .001\] relative to those with good metabolic control. There were no significant group differences in emotional distress or any other of the sociodemographic and clinical parameters (see Figure 1).

### 3.3. Multivariate associations

#### 3.3.1. Multiple linear regression to predict HbA1c

A multiple regression was performed between HbA1c as the criterion and psychological distress, general diet, blood glucose testing, treatment control and coherence (shown to be significant in univariate analyses) as independent variables. Screening indicated very low levels of multicollinearity \(VIF = 1.17\) for K10, \(VIF = 1.32\) for general diet, \(VIF = 1.27\) for blood glucose testing, \(VIF = 1.27\) for treatment control and \(VIF = 1.30\) for coherence).

Table 3 displays the unstandardised regression coefficients \(B\), standard error of \(B\) \(SE(B)\), the standardised regression coefficients \(\beta\), \(t\)-values and \(p\)-values. The final model explained \(R^2 = .567\) (adjusted \(R^2 = 49.5\%\)) of the variability in HbA1c levels \([F(5,30) = 7.868, p < .001]\). Only general diet and treatment control were significant.

#### Table 3. Summary of multiple regression statistics for the predictor variables.

| Predictor variables                        | \(B\)  | \(SE(B)\) | \(\beta\) | \(t\)   | \(p\)  |
|--------------------------------------------|--------|------------|-----------|---------|--------|
| General diet                               | -0.489 | 0.148      | -0.456    | -3.300  | .003   |
| Blood glucose taking                       | 0.053  | 0.115      | 0.062     | 0.458   | .650   |
| Treatment control                          | -0.335 | 0.124      | -0.365    | -2.690  | .012   |
| Coherence                                  | -0.061 | 0.144      | -0.058    | -0.422  | .676   |
| Kessler Psychological Distress Scale (K10) | 0.048  | 0.029      | 0.216     | 1.662   | .107   |

Figure 1. Percentage distribution of K10 scores.
### Table 4. Multiple logistic regression analysis of adolescents with T1DM for metabolic control.

|                          | $\beta$ | SE  | Wald's $\chi^2$ | df | $p$ | EXP ($\beta$) | 95% CI for EXP ($\beta$) |
|--------------------------|---------|-----|-----------------|----|-----|---------------|---------------------------|
| Intercept                | -20.015 | 7.842 | 6.515           | 1  | .011 | 0.000         |                           |
| General diet             | 0.892   | 0.475 | 3.516           | 1  | .061 | 2.439         | 0.961 - 6.193             |
| Foot care                | 1.358   | 0.674 | 4.061           | 1  | .044 | 3.888         | 1.038 - 14.561            |
| Treatment control        | 1.707   | 0.729 | 5.475           | 1  | .019 | 5.510         | 1.319 - 23.015            |

#### 3.3.2. Multivariate logistic regression

The multivariate logistic regression model to predict poor vs. good metabolic control (dichotomised HbA1c levels based on clinical cut-offs) included treatment control, general diet and foot care (significant in univariate analyses) as independent variables. The resulting multivariate model showed a similar pattern of multivariate associations (see Table 4).

The overall model had good fit (Hosmer and Lemeshow Test, $\chi^2(8, N = 38) = 4.22$, ns) and good classification rate (86.8%). Perceived treatment control and levels of foot care were significant accounting for 78.6% (Nagelkerke $R^2$ square). Self-care in relation to general diet was marginally significant ($p = .061$). Odd ratios indicated that with a unit increase in perceived treatment control, the odds of good metabolic control increased by 5.51. For an additional day in a week the adolescents conducted a foot check, the odds of good metabolic control increased by 3.89.

#### 4. Discussion

The present study is the first to investigate the role of self-care, illness perceptions and psychological distress in T1DM management in a sample of Singaporean youth. None of the sociodemographic variables or duration of diagnosis were significantly associated with HbA1c, indicating that background profile is unrelated to metabolic control.

Multivariate modelling indicated that foot care, adherence to general diet and perceived treatment control are significant predictors of good metabolic control. It is noteworthy that foot care emerged as a significant predictor. Although performance of foot care is unlikely to directly affect metabolic control, the observed association may reflect increased levels of conscientiousness. In a study done by Vileikyte, Rubin, and Leventhal (2004), only conscientiousness out of the Big Five personality traits (Costa & McCrae, 1992) was associated with better foot care. Diabetes-related foot complications are uncommon in children and adolescents and usually not emphasised or a focus of discussion by the paediatric healthcare team, but nonetheless it is a well-documented diabetes-related complication in general diabetic patient guides to diabetes care, and also routine information during diabetes education sessions. It is therefore plausible that adolescents who made the effort to conduct regular foot checks also engage in other self-care activities. This view is support by studies (Skinner, Hampson, & Fife-Schaw, 2002; Waller et al., 2013). Other explanations for the observed association between foot care and metabolic control may represent autonomous motivation or patients’ beliefs about future complications.

The general pattern of results obtained from associations of self-care activities and illness perceptions with metabolic control, albeit not significant, supports the SRM. Adolescents with poorer metabolic control tend to have poorer self-care behaviours and hold
more negative illness perceptions when compared with those with good metabolic control. It is possible that stronger relationships might emerge with a larger sample.

Contrary to what was hypothesised, general psychological distress was not predictive of poor metabolic control. This may relate to low distress scores and hence insufficient variation to allow relationships (if any) to emerge. It is also possible that there might be a stronger effect size may be obtained if a diabetes-specific distress assessment tool such as the Problem Areas in Diabetes Survey (PAID; Polonsky et al., 1995) is used instead. Polonsky and colleagues reported that PAID was positively associated with other related psychosocial measures of distress as well as HbA1c and negatively associated with self-care. Related to this, it is likely that diabetes distress encompassing various diabetes-related concerns such as fear of hypoglycaemia or long-term complications, increase in diabetes-related responsibilities or lack of social support (Cameron et al., 2008; Green, Wysocki, & Reineck, 1990; Helgeson, Reynolds, Escobar, Siminerio, & Becker, 2007) may have been more closely related to suboptimal HbA1c or may have mediated the relationship of general distress to diabetes outcomes (Van Bastelaar et al., 2010). Nevertheless, it is particularly encouraging that over 50% of the young patients experienced no or mild levels of distress as this indicates that many youth with T1DM experience minimal distress over their chronic health condition during this period of development. It is possible that in our sample, other aspects of life, such as good family functioning or peer relations, help to buffer against diabetes-specific distress, although these were not directly measured in this study.

Results of our study highlight the importance of treatment control cognitions (i.e. patients’ perceived treatment impact over illness) over psychological distress in predicting metabolic control outcomes. Furthermore, results of the regression model revealed that treatment control perception is also the most significant predictor among the constructs assessed in the current study. Study findings are in line with those in Western settings, indicating that treatment perceptions have relevance across different cultures and settings. This has implications for patient care. Existing literature has evidenced that such cognitions can be modified through interventions. For example, in the meta-analysis done by Winkley, Landau, Eisler, and Ismail (2006), it was reported that psychological therapy was associated with a significant improvement in metabolic control (an estimated reduction in HbA1c by 0.5%) in 10 studies which looked at children and adolescents with T1DM. This small reduction is sufficient to reduce future complications (Diabetes Control and Complications Trial Research Group, 1994). Keogh et al. (2011) had also showed that changes in illness perceptions (i.e. coherence, personal control, concern and identity) were associated with changes in HbA1c, with the greatest effects for patients with the poorest metabolic control.

Given that metabolic control is a clinically significant outcome and is associated with reductions in future complications, intervention strategies to improve metabolic control for Singaporean adolescents with T1DM should try to work on strengthening perceptions of treatment control as well as improving self-care behaviours, or intrinsic motivation which is reflected as better self-care behaviours.

There are several limitations in the present study. First and foremost, the cross-sectional design prevents causal interpretations or exploration on how shifts in beliefs or self-care may affect diabetes management and vice versa. Relationships are likely to be bidirectional. SRM postulates that beliefs are dynamic and subject to change as a result of appraisal and...
feedback processes related to outcomes. Low beliefs in treatment control can influence self-care behaviours thereby resulting in higher HbA1c levels and on the other hand high HbA1c levels too can lead to or reinforce perceptions of low treatment control. The study warrants further research with a longitudinal design and adequate power to determine the directionality and inter-relationships between cognition, emotion and behaviours as such investigations could potentially identify targets of intervention.

Second, the sample size albeit comparable to several other studies on youth with T1DM (McCaul, Glasgow, & Schafer, 1987; Smith et al., 2014; Williams, Sharpe, & Mullan, 2014) was small and study generally considered underpowered to detect small or moderate-sized effects (Tabachnick & Fidell, 2007). Significance levels were also not adjusted for multiple comparisons, thereby increasing the risk of Type I error. Given the paucity of data available in Singaporean youth with T1DM, the strategy adopted in this study was to be exploratory and generate hypotheses for further research. Findings should therefore be considered preliminary and conclusions should be drawn with great caution until replication with larger samples. Responder/selection bias may also be a significant consideration in interpretation of data in any study. It is likely that the more emotionally distressed patients or patients with poorer self-care and more negative health beliefs may have declined to participate in the study. Further research is required that is adequately powered and longitudinal in order to examine the direction and inter-relationships between cognition components, emotion and behaviour so as to identify intervention targets.

Third, focus was on the role of individual cognition, mood and self-care behaviours. The role of social/interpersonal factors such as family relationships, interactions with peers shown to affect diabetes management (Grey, Boland, Yu, Sullivan-Bolyai, & Tamborlane, 1998; Lewin et al., 2006; Storch et al., 2006) or the role of diabetes-related distress has not been evaluated.

Finally, future work should also explore the cultural validity of measures in the local population. The IPQ has been validated across different cultures and illnesses (Chen, Tsai, & Lee, 2008; Husain, Dearman, Chaudhry, Rizvi, & Waheed, 2008; Patel, Chew-graham, Bundy, Kennedy, Blickem, & Reeves, 2015), but this is the first study in Singapore. Although there was no need for translation of the measure and the pilot testing indicated good face validity with our young respondents, the small sample size prevents any further analyses and hence conclusions on its psychometric properties.

5. Conclusion

In conclusion, the present study contributes to a growing body of literature that patients’ views about their treatments, better adherence to general dietary and foot check recommendations are related to better metabolic control. This holds implications that management of adolescents with T1DM should be geared towards identifying these areas to direct appropriate additional psychological support for individuals with ineffective self-care and suboptimal diabetes control.

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