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An interactive program to enhance protective factors for eating disorders in girls with Type 1 diabetes

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The authors declare that there are no conflicts of interests.

Running Head: Interactive program to enhance

Abstract

Aims: This study evaluated the effectiveness of a pilot program in enhancing protective factors for eating disorders in young girls with Type 1 diabetes (T1D). *Methods:* Twenty girls with T1D (*M* age= 11.06 years), attended two X four-hour group sessions. A 4-week baseline control period was compared against changes at post-program and at 1-month follow-up on measures of eating disorder risk factors and indicators of glycaemic control. *Results:* At post-intervention, significant improvements were found for self-efficacy related to diabetes management, self-esteem, body-esteem, thin-ideal internalisation and perfectionism. These gains were maintained at 1-month follow-up. Participants were also rated by their parents as assuming more responsibility for specific diabetes-related tasks at follow-up. *Conclusions:* A brief interactive program can favourably impact protective factors for disordered eating. The development of effective disordered eating prevention strategies for girls with T1D is an urgent priority and the current study is a first step in this direction.

Keywords: eating disorders; prevention; Diabetes Mellitus, Type 1; risk factors

Young females with Type 1 diabetes (T1D) are more susceptible to developing clinical and sub-threshold eating disorders than their peers without T1D [1]. A variety of reasons explains this phenomenon including: a required adherence to a strict, externally prescribed diet; the need for vigilance with regard to food and exercise; rapid weight gain upon commencement of insulin therapy; and, a higher stable body mass index (BMI) than non-diabetic peers. Insulin omission is employed by approximately 34% of older adolescents and young adults with T1D in an attempt to attenuate the impact on body weight [2], as this behaviour forces excess calories to be rapidly purged from the bloodstream. The co-occurrence of T1D and disturbed eating behaviours (including insulin manipulation) has been shown to impair glycaemic control, advance the onset of health complications, and is associated with a threefold increase in the risk of mortality [2, 3].

The development of effective prevention strategies for disordered eating is therefore an important priority in this population, with the need to show improvements in both glycaemic control and disordered eating, or risk for disordered eating. Only two published studies have investigated the effects of programs aimed at reducing eating disorder risk and both included female participants with T1D who *already* displayed disturbed eating attitudes and behaviours. Although one of these targeting young females (aged 12 to 20 years) demonstrated reductions in eating disturbance, it had no influence on glycaemic control [4]. The other program targeting adult women (*M* age = 32.5 years) was no more effective in reducing disordered eating than a wait-list control group [5].

To the best of our knowledge, there are no published investigations of a program with a T1D population that is *unlikely* to yet be displaying disordered eating symptoms [6]. Targeting preadolescents who are either not yet likely to be engaging in eating pathology or who are displaying early subclinical indicators of disordered eating is strongly encouraged, as clinical eating disorder symptoms that co-occur with T1D are extremely difficult to treat. Thus the purpose of the current study was to address this gap, by piloting a program developed specifically for an early-adolescent demographic (i.e., 10-12 year-old females with T1D).

We were particularly interested to assess if it was possible to simultaneously improve both glycaemic control and eating disorder risk factors. Apart from glycosylated haemoglobin A_{1c} (HbA_{1c}) levels, glycaemic control can be indicated by improvements of self-efficacy or confidence with managing diabetes. While HbA_{1c} levels were measured, the pilot nature of the current study meant the follow-up time frame (1-month) was not sufficient for assessing meaningful change in these levels. Therefore our primary outcome variable was self-efficacy with respect to diabetes management (Self-Efficacy for Diabetes scale) [7]. This measure has been found to be predictive of glycaemic control [7, 8], which is decreased by insulin omission, a frequently employed form of

disordered eating by young adolescent females [2]. Thus self-efficacy represents a proxy variable for disordered eating relating to insulin manipulation, while also being an indicator of T1D management. Disordered eating (e.g., binge eating, purging etc) was not explicitly measured. Our secondary outcome variables included a range of empirically identified eating disorder risk factors (e.g., self-esteem, thin-ideal internalization, perfectionism).

The program was developed for this study and was informed by the principles of efficacious eating disorder prevention [9] such as ensuring the program was: interactive rather than didactic; without psychoeducational content on eating disorders; evaluated with validated outcome measures; multiple-session; and delivered by professionals trained in prevention delivery. Of key importance was ensuring program content targeted developmentally-relevant risk factors and this was largely informed by previous program content that delivered significant benefits in participants of a similar age to those in the current study by targeting media literacy [10], perfectionism [11] and self-esteem [12]. Such content has significantly improved a range of eating disorder risk factors including self-esteem, perfectionism and depression and is consistent with recent suggestions for potentially valuable prevention program targets in young adolescent females with T1D [6].

This case series study conforms to the recommendations of the Medical Research Council (MRC) framework [13] in that it provides an exploratory trial (Phase II) to develop a protocol for an effective disordered eating prevention program for young females with T1D which can ultimately be compared to an appropriate alternative. An additional novel component of this study was to assess parents' perception of their child's diabetes management at study beginning and endpoint, and the inclusion of parent information sessions designed to augment their daughter's benefit from the prevention program.

Method

Participants

Participants were 20 girls aged between 10 – 12 years ($M = 11.06$, $SD = .64$), with a diagnosis of T1D for at least one year, recruited via the diabetes outpatient clinic of the Women's and Children's Hospital in Adelaide, South Australia. Patients and their parents were informed of the study during their usual outpatient appointments and self-selected to participate. Approval for the study was received from the Flinders University Social and Behavioural Research Ethics Committee and the Children, Youth and Women's Health Service Human Research Ethics Committee. Parental consent and participant assent for completion of questionnaires was obtained.

Intervention

Participants attended two group sessions each of 4-hours duration, held in two consecutive weeks of the school break. The program was conducted on two occasions (January 2008 and April 2008) and was administered by a female clinical psychology postgraduate student (KS) and a Diabetes Nurse Educator (TK) employed by the hospital to groups consisting of 10 girls. The program included features of previously efficacious eating disorder risk factor reduction programs with young-adolescents targeting: perfectionism [11], media literacy [10], and self-esteem [12]. While evidence-based prevention programs do exist for older (e.g., young-adult), high-risk females [14], the content was deemed not well suited to the much demographic included in the current study. The content of the sessions is further described in **Table 1**. During the program, participants' parents were invited to attend two interactive information sessions delivered by the hospital's Chief Child Psychologist that focused on the same risk factors being targeted in their daughters program (i.e., perfectionism, media literacy, self-esteem). This was designed to augment the content of their daughter's learning to maximize program potency. The sessions for both parents and their daughters were fully attended with no absentees.

{Put Table 1 About Here}

Procedure

Participants completed eating disorder risk factor and T1D management measures on 4 occasions: baseline (T1); pre-treatment (T2); post-treatment (T3) and; 1-month follow-up (T4), while their parents completed measures at T1 and T4. All participants (i.e., children and parents) completed measures at each time point (i.e., there was no attrition). T1 measures were mailed out to all participants 5 weeks before the start of the group, with completed questionnaires being returned within 1 week. Prior to commencing session 1, participants completed T2 measures (i.e., 4 weeks after T1). This period (T1-T2) served as a no intervention control period for comparison with later assessments. Post-treatment (T3) measures were completed by participants at the conclusion of session 2, while T4 measures were mailed to participants 1-month later.

Measures

Self-report measures completed by the children are described in **Table 2** with all showing satisfactory levels of internal reliability. Measured outcome variables were selected based on their relevance to program content (media literacy, perfectionism and self-esteem). Media literacy variables included thin-ideal internalization, depression and body esteem (body dissatisfaction), which have been longitudinally implicated[15, 16] in the development of disordered eating in the dual pathway model of bulimic pathology[17]. Perfectionism has been implicated prospectively[18] and experimentally [19] in the development of disordered eating symptoms where two variables were assessed: personal standards (the extent to which an individual sets high standards for

themselves) has been associated with disturbed eating behaviour in an experimental manipulation[20], while concern over mistakes (the extent to which an individual has excessive concern about making mistakes and their consequences for their self-worth and standing with others) has been uniquely associated with eating disorders compared to other psychiatric disorders [21]. Low self-esteem in 11-12 year-old girls has been prospectively found to predict disordered eating by age 15-16 years [22] and has been found to be predict disordered eating in older-adolescent samples [23].

In addition, glycosylated haemoglobin A_{1c} (HbA_{1c}) levels as analysed by high-performance liquid chromatography were used as an indicator of glycaemic control. This assesses mean glucose concentration for the 8-12 weeks preceding the test with higher values indicating poorer glycaemic control. The closest HbA_{1c} readings recorded prior to baseline (T1) and post follow-up (T4) were drawn from each child's medical record.

Parents of participants completed a brief questionnaire at T1 to gain information regarding age, height, weight, type of insulin regimen (e.g., number of injections prescribed or insulin pump therapy), and diagnosis dates, while two questionnaires regarding their child's T1D management were completed at T1 and T4 (see **Table 2**).

{Put Table 2 About Here}

Results

Baseline Data

Participants' age of T1D onset varied from 2.01 to 11.01 years ($M = 6.85$, $SD = 2.72$) and duration ranged from 1 to 10.01 years ($M = 4.21$, $SD = 2.87$). Mean BMI (based on parent report) was 20.41 ($SD = 3.32$), and 70% of participants administered their insulin via injections, versus 30% using an insulin pump as their primary method of treatment.

The McKnight investigators [24] have proposed that coefficients > 0.6 reflect adequate stability in variables across time. According to this criterion, the intraclass correlation coefficients confirmed stability across the control period (T1 to T2) for all dependent variables apart from depression ($r = .57$, $p = .004$), thus this variable was not included in further analyses.

Repeated Measures

Program effectiveness was evaluated using linear mixed model analyses (Time: T1, T2, T3, T4), where alpha values of $p < .05$ were considered to be statistically significant. Effect sizes for score differences during the no intervention control period (T1-T2) and pre-program to follow-up (T2-T4) were calculated using the

formula $M_{T2} - M_{T1}/SD_{T1}$ [25] where M_{T2} represents the mean score at the most proximal time point, while M_{T1} refers to the mean score at the earlier time point, with SD_{T1} also being from that time point. This gave an indication of the magnitude of change during the no-intervention control period (T1-T2) and from pre-program to 1-month follow-up (T2-T4).

Results revealed significant main effects for time on each of the six children self-report variables in the desired directions, as summarized in **Table 3**. It can be seen that two variables (body esteem and concern over mistakes) improved significantly over the baseline period, indicating a possible impact of measurement. However, all measures continued to improve from T2 to T4, with effect sizes ranging from small to medium, the strongest of which was yielded by the self-efficacy and concern over mistakes variables. No significant differences in mean values existed between Times 3 and 4 for any dependent variable, indicating that gains were maintained at 1-month follow-up, but did not significantly improve over follow-up.

The effect sizes in Table 3 reveal greater change during the active intervention component (T2-T4) than the control period (T1-T2) for all variables, with this difference particularly strong for self-efficacy, self-esteem and body-esteem, while personal standards showed evidence of change during the control period.

{Put Table 3 About Here}

Secondary Analyses – Parent Program and Glycaemic Control

Paired t-tests were conducted to assess the degree of change from baseline (T1) to 1-month follow-up (T4) in the parent measures and glycaemic control. Results revealed no significant change in parental diabetes self-efficacy [$t(19) = -.36$, $p = .72$], but moderate effects were detected with regard to responsibility of diabetes management [$t(19) = -2.57$, $p = .02$; ES = .50]. Specifically, diabetes responsibility scores increased from baseline ($M = 1.80$, $SD = 0.21$) to follow-up ($M = 1.91$, $SD = 0.21$), indicating that the participating children were assuming more responsibility for specific diabetes-related tasks at follow-up compared to baseline. No significant changes were yielded in glycaemic control from baseline ($M = 8.38$, $SD = 0.88$) to follow-up ($M = 8.49$, $SD = 0.92$), as reflected by HbA1$_c$ levels [$t(19) = -0.78$, $p = .445$].

Qualitative Feedback

Students were asked to complete a feedback sheet commenting how valuable and enjoyable they perceived the program to be. The media literacy content was most frequently described as the participants' favourite content in the program. Statements about learning from the program included "like yourself the way you are" and "being able to tell other people how I feel." Other positive themes that emerged included making new friends and connecting with other girls with T1D.

Discussion

This is the first study to evaluate the potential benefit of a program in reducing eating disorder risk factors in a pre-adolescent subgroup. In the absence of a control group, we found support for our primary aim of positively impacting self-efficacy relating to diabetes management. Additionally, while no significant improvements in parent self-efficacy were yielded, parent questionnaires revealed that children were assuming more responsibility for specific diabetes-related tasks one-month following the program.

Enhancement of diabetes self-efficacy is critical when considering reduction of risk of disordered eating within a young T1D population. The diabetes literature highlights the role of self-efficacy in fostering desirable self-care and HbA1c levels [26] and where lower T1D regimen adherence is associated with lower self-efficacy in adolescents [27]. Given the mean age of our participants indicates that they are emerging into adolescence, it seems a developmentally appropriate goal for them to be taking more responsibility for their diabetes management and indeed some authors have suggested "a greater focus on diabetes self-efficacy may have lasting effects on diabetes management" p. 93; [28]. Further, other research has found that self-efficacy in adolescents with T1D is not significantly associated with age [29], and thus these score changes were not likely to be reflecting natural changes over time. Thus our finding for the primary outcome variable was encouraging. It is important to note however that given our audience was of a pre-adolescent age, it would be preferable to also see an accompanying improvement in parent self-efficacy for diabetes management to ensure maximum benefit to T1D management [28].

Significant benefits were found for other measured eating disorder risk factors including self-esteem, body-esteem, thin-ideal internalisation, and perfectionism following the program. Given that eating disorder risk factors typically increase over time during pre- and early-adolescence, it was a positive finding to see significant reductions across a range of variables and this also provided support that it was possible to simultaneously improve self-efficacy of diabetes management while also reducing eating disorder risk factors. Such risk factors have been implicated in the dual-pathway model of bulimic pathology [30] and the cognitive-behaviour theory of eating disorders [31] and as such, reductions on these variables are likely to be of value in reducing eating disorder risk. While we did not see significant differences on four of our six variables between the start of the program (T2) and one-month follow-up (T4), given the low number of participants and therefore low power, our small to medium effect size changes in the desired directions over this time suggest that these differences would be significant with a larger sample. This is further supported by the larger effect sizes over this time than T1 to T2.

These results should be interpreted in the context of four substantial limitations. These include: a lack of an active control group; small sample size; short-follow-up; and the lack of measurement of eating disorder behaviours. These behaviours were not measured given concerns that provision of information about eating disorders to samples unlikely to be experiencing clinical symptoms might inadvertently have a harmful psychoeducational effect [32]. Related to this is the finding that targeting eating disorder risk factors (e.g., media internalization) are likely to be of greater benefit than directly addressing eating behaviours and attitudes [9]. Nevertheless, the absence of data regarding participants' level of disordered eating is a limitation, particularly where established measures of disordered eating with children do exist [33].

Additional limitations include the use of parental self-report BMI data, the follow-up period not being of sufficient length to detect meaningful change in participant levels of $HbA1_c$ [34], the small sample size not allowing sufficient power for the investigation of potential covariates (e.g., BMI), and the presence of some measure instability as evidenced by significant differences between Time 1 and Time 2 scores on some variables (e.g., body esteem and concern over mistakes). Further, Table 3 reveals that significant reductions in eating disorder risk at post-program (T3) and follow-up (T4) were more commonly occurring in comparison to baseline (T1) rather than pre-treatment (T2) scores (e.g., personal standards).

Conclusions

Informed by the MRC's framework outlining the development of complex interventions [13], the current study provided a first step towards the developing effective eating disorder prevention programs for young-adolescents with T1D. We believe this is an urgent priority. Findings suggest that a brief interactive program can favourably impact protective factors for disordered eating. The limitations of the current study provide clear future directions for this research. Namely, the inclusion of an active control group (e.g., stress management) that can rule out nonspecific effects of the group experience, a larger sample size (where based on the procedures of Hedeker et al.[35] and results of the current study an estimated sample of approximately 105 participants per group would be adequate to detect effect sizes of .30 and above) , longer follow-up that will adequately capture possible changes over time in physiological measures of glycaemic control (i.e., HbA_{1c} levels) as well as cover the period of risk through early adolescence (e.g.,2-3 years in line with other such programs with young-adolescents[10]) and more rigorous assessment of participants' disordered eating status across the study would add considerably to the internal validity of future trials. Each of these improvements would allow more confident conclusions about the effectiveness of the program, along with further refinement of program content.

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Table 1.

Description of the session content

Session 1 overview	Session 2 overview
1. Building a positive sense of self and exploring individuality	1. Media advertising: What tactics do they use
2. Stereotypes: We are not all the same	2. Pressure: Looking after ourselves and our peers
3. Diabetes and stress	3. Ways of dealing with stress
4. Good and not-so-good things about diabetes	4. Building a positive sense of self
5. Valuing our differences	5. What about diabetes?
6. What is perfectionism?	6. Body image
	7. Exploring perfectionism

Table 2.

Summary and description of self-report measures

Variable	Measure name, number of items Cronbach's alpha and example item
Self-efficacy	Self-Efficacy for Diabetes Scale [7], 23 items (α =.86)
	e.g., Keep track of my own blood sugar levels, 1 = "very sure I can't" to 5 = "very sure I can",
Self-esteem	Rosenberg Self-Esteem Scale [36], 10 items (α =.84)
	e.g., I feel that I have a number of good qualities, 1 = "strongly agree" to 4 = "strongly disagree"
Body esteem	Body Esteem Scale for Children [37], 20 items (α =.94)
	e.g., I worry about the way I look 0 = "no", 1 = "sometimes", and 2 = "yes
Thin-ideal internalization	Sociocultural Attitudes Towards Appearance Questionnaire-3 [38], 9 items (α =.97)
	e.g., I compare my body to the bodies of TV and movie stars, "definitely disagree" to 5 = "definitely agree"
Concern over mistakes	Multidimensional Perfectionism Scale [39], 9 items (α =.81)
	e.g., If I fail partly, it is as bad as being a complete failure, 1 = "strongly agree" to 4 = "strongly disagree"
Personal standards	Multidimensional Perfectionism Scale [39], 7 items (α =.91)
	e.g., I have extremely high goals, 1 = "strongly agree" to 4 = "strongly disagree"
Depression	Child Depression Inventory –Short Form [40], 10 items (α =.71)
	e.g., 0 = "I am sad once in a while" to 2 = "I am sad all the time".
Parental self-efficacy*	Parental Self-Efficacy for Diabetes [7], 19 items, (α =.87)
	e.g., be the one in charge of giving insulin injections to my child, 1 = "very sure I can't" to 5 = "very sure I can"
Diabetes Management*	Diabetes Family Responsibility Questionnaire [41], 17 items (α =.71)
	e.g., 1 = "parent takes or initiates responsibility for this almost all of the time" to 3 = "child takes or initiates responsibility for this almost all of the time"

Note: Mean Cronbach alpha across 4 waves of data collection reported for prevention program participants and across 2 waves (T1 and T4) for parent data collection; * indicates that the parents and not the girls completed these questionnaires

Table 3.

Mixed models estimated marginal means for eating disorder risk factors by time (4)

Variable	Mean T1 (SE)	Mean T2 (SE)	Mean T3 (SE)	Mean T4 (SE)	F (*p*)	df	T1 to T2 Effect size Cohen's *d*	T2 to T4 Effect size Cohen's *d*
Self-efficacy*	4.00 (.08) [a]	3.97 (.13) [a]	4.27 (.11) [b]	4.31 (.10) [b]	15.34 (<.001)	3, 18.06	.01	.56
Self-esteem*	3.07 (.12) [a]	3.08 (.13) [a]	3.35 (.10)	3.39 (.08) [b]	5.84 (.005)	3, 19.07	.02	.57
Body-esteem*	2.32 (.12) [a]	2.43 (.11) [b]	2.61 (.08) [b]	2.56 (.08) [b]	5.68 (.006)	3, 19.14	.15	.32
Internalisation	2.63 (.29) [a]	2.32 (.26)	1.84 (.23) [b]	1.86 (.27)	3.17 (.048)	3, 19	.24	.40
Concern over mistakes	1.81 (.15) [a]	1.63 (.13) [b]	1.33 (.08) [b]	1.28 (.07) [b]	5.29 (.008)	3, 18.97	.28	.65
Personal standards	2.53 (.12) [a]	2.34 (.14)	2.18 (.13) [b]	2.06 (.11) [b]	6.22 (.004)	3, 19.10	.35	.48

Note: Different superscripts indicate significant differences between the mean values; For measures indicated by * higher scores are favourable, whereas lower scores are favourable for the remainder; Cohen's *d*:0.2=small, 0.5-medium, 0.8=large. Effect size for T1 to T2 provides an indication of the magnitude of change during the no-intervention control period, while effect size for T2 to T4 provides an indication of the magnitude of change between program start point and 1-month follow-up.