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Effectiveness of Metacognition-Based Training on Self-Care Behaviors in Adolescent Girls with Type 1 Diabetes



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ABSTRACT

Objective: This research aimed to investigate the effectiveness of metacognition based training on insulin induced anxiety and coping styles in girls adolescents with Type 1 diabetes.

Methods and Materials: Current study was a quasi-experimental one with pretest-posttest design and a 2-month follow-up along with a control group. The statistical population comprised all girl adolescents with Type 1 diabetes Shahinshahr City, Iran, during 2025. 30 girls meeting inclusion criteria were selected via purposive sampling method and assigned to two groups randomly, experimental and control group (n=15 for each group). Data were gathered using Observational Scale of Behavioral Distress – Revised (R- OSBD) (Elliott ,1987) and Stressful Situations Coping Scale (CISS) (Endler & Parker, 1990). The intervention was metacognition training derived from Wells (2009) protocol including 8 weekly sessions trained in experimental group. Data analysis involved descriptive statistics (mean, SDs) and two factorial analysis of variance with repeated measures on one factor(mixed analysis of variance) using SPSS-24.

Findings: Results showed that effects of time, group and the interaction of time and group were significant on variables of Insulin Induced Anxiety, task focused coping style and emotion focused coping style($p<0.01$), but this effect was not significant about avoidant coping style($p>0.05$).The results also showed that metacognition training caused to reduce emotional style as well as increase task focused style.

Conclusion: According to the findings, training the metacognitive skills decrease anxiety of insulin induced and improve coping styles in adolescent girls with Type 1 diabetes.

Keywords: Metacognition, Self-Care, Adolescent, Type 1 Diabetes, Psychological Intervention.

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Introduction

Diabetes is a major and growing global health challenge, and type 1 diabetes requires continuous insulin therapy and daily self-management from diagnosis onward (IDF, 2025; Chiang et al., 2014). For adolescents, the treatment burden extends beyond insulin administration to glucose monitoring, dietary planning, physical activity, recognition of hypo- and hyperglycemia, and prevention of complications.

Adolescence is also marked by rapid biological, cognitive, emotional, and social change. Increasing autonomy can complicate the transfer of diabetes responsibilities from parents to adolescents, and suboptimal adherence remains common. Better adherence is consistently associated with better glycemic outcomes, whereas diabetes distress and competing developmental demands can undermine self-care (Hood et al., 2009; Datye et al., 2015; Hagger et al., 2016). Contemporary guidelines therefore recommend developmentally appropriate psychological assessment and support as part of routine pediatric diabetes care (de Wit et al., 2022).

Protective psychological factors are associated with more consistent self-care and more favorable clinical outcomes in people with type 1 diabetes (Loseby et al., 2022). Metacognition refers to knowledge, monitoring, and regulation of one's own cognitive processes. In Wells' model, persistent worry, rumination, threat monitoring, and maladaptive control strategies form a cognitive-attentional syndrome that maintains emotional distress (Wells, 2009). Negative metacognitive beliefs are also associated with anxiety and depression across chronic physical illnesses (Capobianco et al., 2020).

Metacognitive therapy shifts attention from the literal content of thoughts to the processes that prolong distress. Evidence supports its efficacy for anxiety and depression, although most trials have focused on psychiatric rather than chronic-disease populations (McEvoy, 2019; Normann & Morina, 2018). Randomized and long-term studies also suggest that changes can be durable (Callesen et al., 2020; Solem et al., 2021). Psychological interventions in type 1 diabetes may improve clinically relevant outcomes when they address the mechanisms that interfere with daily self-management (Winkley et al., 2006).

Related evidence from adolescents with type 1 diabetes indicates that psychologically oriented training can improve self-care behaviors (Ghorbani et al., 2023). More broadly, a biopsychosocial approach supports integrating cognitive and emotional care with medical management of chronic illness (Seyed Alitabar, 2025). Nevertheless, direct evidence for metacognition-based training in adolescent girls with type 1 diabetes remains limited. The present study therefore examined whether an eight-session metacognitive training program improved total self-care and its components and whether any gains were maintained at a two-month follow-up.

Methods and Materials

Study Design and Participants

This quasi-experimental study used a pretest-posttest control-group design with a two-month follow-up. The study population comprised female students with physician-confirmed type 1 diabetes who attended public or private lower- and upper-secondary schools in Shahin Shahr, Iran, during 2024. Thirty eligible adolescents were selected through purposive sampling and randomly assigned to the metacognitive-training group or the control group (15 participants per group). The target sample was based on an anticipated effect size of 0.40, 95% confidence, 80% power, and allowance for attrition.

Inclusion criteria were female sex; enrollment in lower- or upper-secondary school; a diagnosis of type 1 diabetes for at least one year; no psychological treatment since diagnosis; no acute or chronic condition that would prevent participation; no severe mental disorder; and no current psychotropic medication use or substance abuse. Exclusion criteria included missing more than two sessions, withdrawal of consent, a new serious medical or psychological condition, concurrent psychological treatment, incomplete assessment data, a major change in insulin regimen that could directly affect the outcomes, or a major family or social crisis during the study.

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Procedure

After coordination with the local education authority and schools, parents or legal guardians provided written informed consent and the adolescents provided informed assent. Participants were informed that participation was voluntary, data would remain confidential, and withdrawal would have no adverse consequences.

Eligible participants were assigned numerical codes and randomly allocated in equal numbers to the two groups. Both groups completed baseline assessment before the intervention. Beginning in October 2024, the experimental group received eight weekly 90-minute sessions of metacognitive skills training over two months; the control group continued routine care and received an educational package after completion of the study. Both groups completed posttest assessment and a two-month follow-up assessment. Data were analyzed in SPSS version 24 using a significance level of 0.05.

Instruments

Summary of Diabetes Self-Care Activities

Self-care was assessed with the Summary of Diabetes Self-Care Activities measure (SDSCA), which evaluates the frequency of diabetes-related behaviors during the previous seven days (Toobert et al., 2000). The version used in this study comprised 15 items covering general and diabetes-specific diet, exercise, blood-glucose testing, medication or insulin use, and foot care. Each item was scored from 0 to 7 days; higher scores indicated more consistent self-care. Component scores and a total score were calculated for analysis.

Intervention

The intervention followed Wells' staged metacognitive protocol and emphasized case formulation, detached mindfulness, postponement of worry, modification of beliefs about uncontrollability and danger, behavioral experiments, reduction of maladaptive thought-control strategies, and relapse prevention (Wells, 2009). The researcher delivered the sessions after relevant training and under supervisory review. The structure and principal content of the protocol were maintained throughout the intervention (Table 1).

Table 1

Implementation Protocol for Metacognitive Training Sessions

Session	Session Content
Session 1	In the first session, the pretest was completed by the client. Then, the interview was conducted.
Session 2	Preparing the group to begin treatment; implementing the thought-suppression experiment; developing the case formulation; preparation; implementing the suppression experiment through introduction of the model and the thought; beginning to challenge beliefs related to uncontrollability; practicing detached mindfulness; introducing postponement of worry. Homework: practicing detached mindfulness and preparation if needed, verbal and behavioral reattribution, and postponing worry.
Session 3	Reviewing homework; continuing postponement of worry; continuing to challenge beliefs about uncontrollability; conducting the loss-of-control experiment; presenting different evidence regarding uncontrollability; stopping treatment; examining and providing control in the session; addressing avoidant behaviors. Homework: continuing introduction of the loss-of-control experiment, worry time, maladaptive control, and reversing behaviors related to postponing worry and avoiding worry; conducting the loss-of-control experiment.
Session 4	Reviewing homework; continuing to challenge beliefs about uncontrollability if needed; beginning to challenge beliefs related to danger; attempting to lose control or harm oneself through the worry experiment. Homework: inducing worry to test perceived dangers.
Session 5	Reviewing homework; continuing to challenge beliefs related to danger; emphasizing the reversal of any remaining maladaptive strategies. Homework: behavioral experiments to challenge beliefs related to danger.
Session 6	Reviewing homework; beginning to challenge positive beliefs, if negative beliefs have reached zero. Homework: implementing the mismatch strategy and behavioral strategies to challenge positive beliefs.
Session 7	Reviewing homework; continuing to challenge positive beliefs; implementing the mismatch strategy during the therapy session. Homework: experiments aimed at reducing the level of worry, such as increase-and-behavioral experiments.
Session 8	Reviewing homework; working on reversing remaining symptoms; implementing the mismatch strategy during the therapy session; continuing to challenge positive beliefs; working on the treatment plan; providing a clear explanation of strengthening the alternative plan and preventing relapse with examples; planning booster sessions. Homework: identifying ongoing applications of treatment. Administration of the posttest.

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Statistical Analysis

Descriptive statistics were calculated for participant characteristics and outcome variables. Baseline group comparability was examined using one-way analysis of variance and frequency comparisons. Normality was evaluated with the Shapiro-Wilk test and inspection of skewness and kurtosis. Levene's test, Mauchly's test, and Box's M test were used to evaluate relevant assumptions. When sphericity was violated, Greenhouse-Geisser corrections were applied. Repeated-measures multivariate and univariate analyses of variance assessed the effects of time, group, and their interaction, followed by Bonferroni-adjusted pairwise comparisons.

Findings and Results

The two groups were comparable at baseline. There was no significant between-group difference in mean age ($p = 0.24$) or duration of illness ($p = 0.11$), and the distribution of participants across public and private schools was identical (Table 2).

Table 2

Descriptive Characteristics of the Participants

Variable	Group Membership	Metacognitive Training	Control Group	F	P-value
Duration of illness (years)	Mean ± SD	3.13 ± 1.35	3.93 ± 1.33	2.653	0.11
Age (years)	Mean ± SD	15.13 ± 1.35	15.67 ± 1.11	1.387	0.24
Type of school	Public	12 students (80%)	12 students (80%)	-	-
	Private	3 students (20%)	3 students (20%)	-	-
Total		15	15		

Descriptive outcome statistics across the three measurement occasions are shown in Table 3. Although several individual distributions yielded significant Shapiro-Wilk tests, standardized skewness and kurtosis values remained within acceptable limits. Levene's tests supported homogeneity of variance. Because Mauchly's test indicated violations of sphericity for several outcomes, Greenhouse-Geisser-adjusted degrees of freedom were used. Box's M test did not indicate a violation of equality of covariance matrices.

Table 3

Descriptive Statistics and Normality Indices Across Measurement Stages

Variable	Measurement Stage	Group	Mean	Standard Deviation	Shapiro–Wilk Statistic	P-value
Total self-care score	Pretest	Experimental	54.86	6.419	0.954	0.62
		Control	58.86	4.452	0.957	0.68
	Posttest	Experimental	78.79	5.786	0.956	0.66
		Control	58.36	4.106	0.834	0.013
	Follow-up	Experimental	78.79	5.659	0.929	0.29
		Control	56.64	4.50	0.900	0.11
Diet	Pretest	Experimental	20.07	3.385	0.863	0.03
		Control	20.07	3.990	0.922	0.23
	Posttest	Experimental	28.29	2.813	0.985	0.99
		Control	20.50	3.481	0.965	0.80
	Follow-up	Experimental	28.29	3.124	0.978	0.96
		Control	20.21	3.620	0.948	0.53
Exercise	Pretest	Experimental	7.71	2.355	0.865	0.03
		Control	8.43	2.102	0.919	0.21
	Posttest	Experimental	10.43	1.785	0.907	0.14
		Control	8.79	1.672	0.897	0.10
	Follow-up	Experimental	10.57	1.990	0.869	0.04
		Control	8.57	1.604	0.953	0.61
Blood glucose testing	Pretest	Experimental	6.93	2.165	0.950	0.56
		Control	9.07	2.056	0.916	0.19

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	Posttest	Experimental	12.14	1.703	0.891	0.08
		Control	8.43	1.828	0.893	0.09
	Follow-up	Experimental	12.07	1.859	0.905	0.13
		Control	8.07	1.817	0.907	0.14
Medication use	Pretest	Experimental	3.86	1.406	0.921	0.22
		Control	3.86	1.657	0.941	0.42
	Posttest	Experimental	4.14	1.351	0.940	0.41
		Control	4.00	1.177	0.921	0.22
	Follow-up	Experimental	4.36	1.692	0.903	0.12
		Control	4.29	1.383	0.934	0.34
Foot care	Pretest	Experimental	16.00	3.013	0.932	0.32
		Control	16.86	3.325	0.957	0.67
	Posttest	Experimental	23.43	2.709	0.930	0.30
		Control	15.50	2.066	0.914	0.17
	Follow-up	Experimental	23.50	2.682	0.917	0.20
		Control	15.50	2.029	0.891	0.08

Table 4

Repeated-Measures Multivariate Tests for the Study Outcomes

Variable	Value	F	Effect df	Error df	P-value	Eta Squared	Statistical Power
Total score	4.415	55.182	2	25	0.001	0.81	1.000
Diet	0.663	8.287	2	25	0.002	0.39	0.93
Exercise	0.236	2.947	2	25	0.047	0.29	0.72
Blood glucose testing	1.564	19.549	2	25	0.001	0.61	1.000
Medication use	0.004	0.052	2	25	0.950	0.004	0.057
Foot care	1.190	14.874	2	25	0.001	0.54	0.99

The multivariate results in Table 4 indicated significant change for total self-care, diet, exercise, blood-glucose testing, and foot care ($p< 0.05$), but not for medication or insulin use ($p> 0.05$). Univariate analyses in Table 5 showed significant effects of time, group, and time by group for the same outcomes. For total self-care, the time-by-group effect was large ($F= 100.462$, $p< 0.001$, partial eta squared = 0.79).

Table 5.

Repeated-Measures Analysis of Variance by Time, Group, and Time by Group

Variable	Source of Variation	Sum of Squares	df	Mean Square	F	P-value	Effect Size	Statistical Power
Self-care	Time	2387.810	1.165	2050.118	80.122	0.001	0.75	1.000
	Time × Group	2994.000	1.165	2570.579	100.462	0.000	0.79	1.000
	Error	774.857	52	14.901				
	Between groups	348172.191	1	348172.191	6618.690	0.001	0.99	1.000
Diet	Time	337.452	1.036	325.717	19.458	0.001	0.42	0.99
	Time × Group	293.643	1.036	283.431	16.932	0.001	0.39	0.98
	Error	450.905	26.937	16.739				
	Between groups	586.714	1	586.714	32.981	0.001	0.55	1.000
Exercise	Time	43.024	1.134	37.926	6.434	0.01	0.19	0.72
	Time × Group	30.452	1.134	26.844	4.554	0.03	0.14	0.57
	Error	173.857	29.495	5.895				
	Between groups	20.012	1	20.012	4.602	0.04	0.15	0.54
Blood glucose testing	Time	89.238	1.100	81.090	20.151	0.001	0.43	0.99
	Time × Group	168.286	1.100	152.920	38.00	0.001	0.59	1.000
	Error	115.143	28.613	4.024				
	Between groups	72.429	1	72.429	11.096	0.003	0.29	0.89
Medication use	Time	3.024	1.224	2.471	1.050	0.329	0.039	0.181

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	Time × Group	0.071	1.224	0.058	0.025	0.91	0.001	0.05
	Error	4.905	31.815	2.354				
	Between groups	0.107	1	0.107	0.03	0.86	0.001	0.05
Foot care	Time	174.071	1.047	166.304	14.258	0.001	0.35	0.95
	Time × Group	363.167	1.047	346.962	29.746	0.001	0.53	1.000
	Error	317.429	27.214	11.664				
	Between groups	530.012	1	530.012	56.893	0.001	0.68	1.000

Table 6.

Bonferroni Pairwise Comparisons of Measurement Stages by Group

Variable	Measurement Stages	Experimental Group Mean Difference	Experimental Group P-value	Control Group Mean Difference	Control Group P-value
Self-care	Pretest–Posttest	-23.929	0.001	0.500	1.000
	Pretest–Follow-up	-23.929	0.001	2.214	0.52
	Posttest–Follow-up			1.714	0.074
Diet	Pretest–Posttest	-8.214	0.001	-0.429	1.000
	Pretest–Follow-up	-8.214	0.001	0.143	1.000
	Posttest–Follow-up	0.000	1.000	0.286	0.49
Exercise	Pretest–Posttest	-2.714	0.01	-0.357	1.000
	Pretest–Follow-up	-2.857	0.009	-0.143	1.000
	Posttest–Follow-up	0.143	1.000	0.214	1.000
Blood glucose testing	Pretest–Posttest	-5.21	0.001	0.643	0.90
	Pretest–Follow-up	-5.143	0.001	1.000	0.377
	Posttest–Follow-up	-0.071	1.000	0.357	0.16
Foot care	Pretest–Posttest	-7.429	0.001	1.357	0.76
	Pretest–Follow-up	-7.500	0.001	1.357	0.76
	Posttest–Follow-up	-0.071	1.000	0.000	1.000

Bonferroni comparisons in Table 6 showed significant pretest-to-posttest and pretest-to-follow-up improvements in the experimental group for total self-care, diet, exercise, blood-glucose testing, and foot care (all $p < 0.01$). Corresponding changes in the control group were not significant. Posttest-to-follow-up differences were also nonsignificant, indicating that the observed gains were maintained over the two-month follow-up.

Discussion and Conclusion

The findings indicate that metacognition-based training improved total self-care and the voluntary behavioral domains of diet, exercise, blood-glucose testing, and foot care in adolescent girls with type 1 diabetes. These gains were maintained at follow-up. The pattern is consistent with evidence that psychologically oriented interventions can strengthen self-care in adolescents with type 1 diabetes (Ghorbani et al., 2023) and with broader evidence linking protective psychological factors to effective self-management (Loseby et al., 2022).

Metacognitive training may help adolescents identify worry and rumination, disengage from unhelpful attentional patterns, and redirect cognitive resources toward planned health behavior. This interpretation is plausible because diabetes management depends on executive processes such as planning, task completion, monitoring, and flexible problem solving. Executive-function difficulties have been associated with poorer diabetes management and lower readiness for independent self-care (Hansmann et al., 2023; Vitale et al., 2025). These regulatory systems continue to mature during adolescence (Luna et al., 2015), making this developmental period a relevant target for structured metacognitive skills training.

The medication or insulin-use component did not change significantly. Insulin administration is highly prescribed and may depend more strongly on treatment technology, family organization, parental supervision, and clinician-directed routines than on the adolescent's autonomous cognitive regulation. Family processes and collaborative parenting remain important correlates of adjustment and diabetes

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management during adolescence (Jaser & Grey, 2010). Accordingly, metacognitive training may be more effective when combined with family-based and developmentally tailored diabetes support, as recommended in contemporary practice guidelines (de Wit et al., 2022).

The results also support viewing diabetes self-care through an integrated biopsychosocial framework. Psychological skills can complement, but not replace, medical treatment and diabetes education. A coordinated model that connects cognitive-emotional processes with family, school, and healthcare supports is more consistent with the complex demands of chronic-disease management (Seyed Alitabar, 2025). This interpretation should remain cautious because meta-analytic evidence on psychological interventions and glycemic outcomes is heterogeneous (Winkley et al., 2006).

Limitations and Recommendations

The sample was small, limited to adolescent girls from one city, and recruited purposively; generalization to boys, other age groups, and other settings should therefore be cautious. Outcomes were based on self-report, the follow-up period was short, and biological outcomes such as HbA1c were not included. The study also did not control the type of insulin or insulin-delivery technology. Future research should use larger randomized samples, blinded outcome assessment where feasible, longer follow-up, objective adherence indicators, and clinically relevant metabolic outcomes. Family involvement and treatment technology should be measured as potential moderators.

Eight sessions of metacognition-based training improved total self-care, diet, exercise, blood-glucose testing, and foot care among adolescent girls with type 1 diabetes, and the gains were maintained for two months. Medication or insulin use did not change significantly. The intervention may serve as a complementary psychological component of multidisciplinary diabetes care, but larger randomized studies are needed before routine implementation.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study was approved by the Research Ethics Committee of Islamic Azad University, Najafabad Branch (IR.IAU.NAJAFABAD.REC.1403.057). Written informed consent was obtained from parents or legal guardians, and informed assent was obtained from adolescent participants. Confidentiality, anonymity, voluntary participation, and the right to withdraw were explained before enrollment.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors contributed to the study conception, implementation, data collection, interpretation, manuscript preparation, and critical revision, and approved the final manuscript.

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