Postprint: Application of a Time-Matched Intervention Program Developed Based on Intervention Mapping Theory in Disabled Patients with Schizophrenia

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Date: 2023-01-03T00:00:00+00:00

Abstract

Objective To investigate the intervention effects of a Disability Point Matching (DPM) protocol constructed based on intervention mapping on disability severity, negative symptoms, insight, self-esteem, and family functioning in patients with schizophrenia-related disabilities. Methods A quasi-experimental study design was utilized. Patients at three time points—P1 (70 cases), P2 (70 cases), and P3 (70 cases)—were randomly assigned to an intervention group (35 cases) or a control group (35 cases) using SPSS-generated random numbers. The control groups at all three time points received routine care, whereas the intervention groups received disability point matching intervention in addition to routine care. The intervention duration was 8 weeks, with one session per week. Assessments were conducted at baseline, post-intervention, 3 months post-intervention, and 6 months post-intervention using the WHO Disability Assessment Schedule II (WHO-DAS II), Positive and Negative Syndrome Scale-Negative Symptom subscale (PANSS-N), Insight and Treatment Attitudes Questionnaire (ITAQ), Self-Esteem Scale (SES), and Family APGAR Questionnaire (APGAR). Health outcomes between the two groups at each time point were compared using repeated measures ANOVA. Results No significant differences in baseline characteristics were observed between the two groups at P1, P2, and P3 time points ($P>0.05$). Repeated measures ANOVA revealed that following DPM intervention, patients at P1 demonstrated main effects of time and group, and time×group interaction effects for disability severity, negative symptoms, insight, and self-esteem. Family functioning exhibited main effects of time and time×group interaction effects. Improvements in all these measures in the intervention group were superior to those in the control group at post-intervention, 3 months post-intervention, and 6 months post-intervention, with statistically

significant differences (P<0.05). At P2, patients showed main effects of time and group, and interaction effects for disability severity, insight, self-esteem, and family functioning. Except for disability severity and self-esteem at 3 months post-intervention, which showed no significant between-group differences (P>0.05), all other indicators differed significantly between groups at post-intervention, 3 months post-intervention, and 6 months post-intervention (P<0.05). At P3, patients' disability severity and insight level showed main effects of time and group, and interaction effects. Improvements in these indicators in the intervention group were superior to those in the control group at post-intervention, 3 months post-intervention, and 6 months post-intervention, with statistically significant differences (P<0.05). Conclusion The DPM intervention protocol based on intervention mapping demonstrates significant efficacy in improving disability severity and negative symptoms, and enhancing insight, self-esteem, and family functioning in patients with schizophrenia-related disabilities.

Full Text

Preamble

Time-Point Matched Intervention Program Based on Intervention Mapping Theory in Patients with Schizophrenia-Related Disability

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Abstract Objective To explore the effect of a time-point matched intervention (DPM) program, constructed based on intervention mapping theory, on disability severity, negative symptoms, insight, self-esteem, and family functioning in patients with schizophrenia-related disability. **Methods** A quasi-experimental study design was employed. Patients at three time points—P1 (70 cases), P2 (70 cases), and P3 (70 cases)—were randomly divided into intervention (35 cases) and control (35 cases) groups using SPSS-generated random numbers. The control groups at all three time points received routine care, while the intervention groups received disability time-point matched intervention in addition to routine care. The intervention lasted 8 weeks, with one session per week. Assessments were conducted at baseline, post-intervention, 3 months post-intervention, and 6 months post-intervention using the WHO Disability Assessment Schedule (WHO-DAS II), Positive and Negative Syndrome Scale-Negative Subscale (PANSS-N), Insight and Treatment Attitudes Questionnaire (ITAQ), Self-Esteem Scale (SES), and Family Adaptability, Partnership, Growth, Affection, and Resolve (APGAR) questionnaire. Health outcomes between the two groups at each time point were compared using repeated measures ANOVA. **Results** No significant differences in baseline data were found between the two groups at P1, P2, and P3 (P>0.05). Repeated measures ANOVA revealed that

after DPM intervention, patients at P1 showed time, group, and interaction effects for disability severity, negative symptoms, insight, and self-esteem. Family functioning showed time main effects and time-by-group interaction effects. The intervention group demonstrated significantly better improvement than the control group at post-intervention, 3 months, and 6 months post-intervention ($P<0.05$). At P2, disability severity, insight, self-esteem, and family functioning showed time, group, and interaction effects. Except for disability severity and self-esteem at 3 months post-intervention ($P>0.05$), all other indicators showed significant between-group differences at post-intervention, 3 months, and 6 months post-intervention ($P<0.05$). At P3, disability severity and insight showed time, group, and interaction effects. The intervention group showed significantly better improvement than the control group at all follow-up points ($P<0.05$). **Conclusion** The DPM intervention program based on intervention mapping theory is effective in improving disability severity and negative symptoms while enhancing insight, self-esteem, and family functioning in patients with schizophrenia-related disability.

[Keywords] schizophrenia; time-point matched intervention; disability severity

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Schizophrenia is a chronic mental disorder characterized by impairments in emotion, cognition, behavior, and social functioning, representing the highest level of disability among all mental disorders [1]. In schizophrenia research, disability resulting from schizophrenia is referred to as schizophrenia-related disability [2]. A large European cohort study reported that the incidence of schizophrenia-related disability reaches as high as 85% [3], underscoring the substantial disabling impact of this condition. Schizophrenia-related disability leads to declines in self-management abilities, social functioning, and quality of life [4], and constitutes a major contributor to years of life lost due to schizophrenia [5]. The high disability burden of schizophrenia accounts for approximately 12.3% of the global disease burden [5]. Therefore, reducing disability severity, improving quality of life, and alleviating the burden on families and society represent critical priorities that demand urgent solutions.

The development of schizophrenia-related disability is a dynamic process, with varying degrees of disability and influencing factors at different time points [6-7]. However, previous intervention studies have not adequately considered the developmental patterns and temporal characteristics of disability, failing to address disability status in patients with schizophrenia at early stages and consequently missing optimal intervention windows, which leads to further deterioration of disability. This study employed a time-point matched intervention (DPM) program previously developed by our research team based on intervention mapping theory. According to the risk factors for disability at different time points, we implemented targeted interventions centered on "medication management, psychological intervention, and social skills training" to reduce disability severity at each time point and provide practical evidence for the broader implementation of DPM interventions.

1.1 Study Participants

The study participants were patients with schizophrenia-related disability receiving treatment at a psychiatric specialty hospital in Harbin from September 2019 to September 2020, along with their primary caregivers. Inclusion criteria were: (1) meeting ICD-10 diagnostic criteria for schizophrenia, aged 18-60 years; (2) being in the recovery phase with psychotic symptoms essentially resolved or partially present, and a Brief Psychiatric Rating Scale (BPRS) total score <35; (3) diagnosed with psychiatric disability: WHO-DAS II score $ $52; (4) receiving maintenance doses of medication; (5) primary caregivers being first- or second-degree relatives living with the patient; (6) patients and caregivers possessing adequate communication and comprehension abilities to interact effectively with researchers and complete all assessments; (7) informed consent and voluntary participation. Exclusion criteria were: (1) presence of severe physical illness; (2) comorbid other severe mental disorders; (3) currently receiving other psychological interventions. At baseline, 210 participants were enrolled, with 70 cases at each of three time points: P1 (within one year of disability), P2 (two to three years of disability), and P3 (three or more years of disability). Researchers randomly assigned them to intervention and control groups (35 cases each).

1.2 Research Methods

1.2.1 Construction of the DPM Intervention Program

Our research team previously developed the disability time-point matched intervention program under the guidance of intervention mapping theory [8], through literature review, guideline analysis, and expert panel meetings [9]. The program comprises three core intervention models: P1 focuses on medication management, P2 on psychological intervention, and P3 on social skills training. Specific intervention protocols are detailed in Tables 1, 2, and 3.

1.2.2 Implementation of the DPM Intervention Program

A quasi-experimental design was employed, with the control group receiving routine care and the intervention group receiving DPM intervention in addition to routine care. The intervention team consisted of one psychiatrist, one psychosocial rehabilitation physician, two psychiatric nurses, and two graduate students specializing in mental health. Interventions were conducted at the psychotherapy room of a psychiatric specialty hospital in Harbin. Patients were divided into four groups for group interventions. Due to pandemic restrictions, family members participated via online platforms (WeChat groups and public accounts) rather than in-person sessions. The intervention cycle consisted of one 60-minute session per week for 8 weeks. At each time point (P1, P2, P3), the intervention centered on its respective core component while incorporating the other two intervention modalities.

(1) P1 Time Point Intervention Protocol (Medication Management as Core) Table 1 DPM Intervention—P1 Time Point (Medication Management as Core)

Session	Content
Session 1 (Week 1)	(1) Establish therapeutic alliance through empathy, genuineness, and positive regard; (2) Distribute health education manuals. **Homework:** Review manifestations before onset and relapse.
Session 2 (Week 2)	Patients and family members share and discuss "hospitalization and treatment experiences"; facilitators supplement with information on primary symptoms and treatment. **Homework:** Read health education manuals and review disease-related knowledge.
Session 3 (Week 3)	(1) Discussion on "relapse causes, warning signs, and coping strategies"; facilitators supplement on relapse risk factors, prodromal symptoms, and crisis response; (2) Instruction and practice of the "Prodromal Symptom Checklist" and development of crisis response plans. **Homework:** Practice using the Prodromal Symptom Checklist.
Session 4 (Week 4)	Members share and discuss medication management knowledge and identify barriers encountered; facilitators guide patients through brainstorming solutions and analyze common themes. **Homework:** Read health education manuals to reinforce antipsychotic medication knowledge.

Session	Content
Session 5 (Week 5)	(1) Discussion on medication side effects and management strategies with facilitator analysis and summary; (2) Instruction and practice of the "Medication Self-Assessment Form" with encouragement for daily use. **Homework:** Develop medication plans and consider methods to improve adherence; practice the Medication Self-Assessment Form.
Session 6 (Week 6)	(1) Viewing of *A Beautiful Mind* film clip followed by member reflection; (2) Facilitator-guided discussion on rational approaches to social stigma, strategies for coping, and reconstruction of self-stigmatizing beliefs.
Session 7 (Week 7)	Members share and discuss "the growing self"; facilitators use psychological techniques (affirming personal value, evidence-based debate, positive self-suggestion) to enhance patient confidence. **Homework:** Read health education manuals on practical psychological adjustment methods.
Session 8 (Week 8)	(1) Summarize gains and future outlook; (2) Feedback session for participants to provide suggestions.

(2) P2 Time Point Intervention Protocol (Psychological Intervention as Core) Table 2 DPM Intervention—P2 Time Point (Psychological Intervention as Core)

Session	Content
Session 1 (Week 1)	(1) Establish therapeutic alliance through empathy, genuineness, and positive regard; (2) Distribute health education manuals. **Homework:** Review manifestations during onset, relapse, and previous medication adherence.
Session 2 (Week 2)	(1) Viewing of schizophrenia educational animation followed by group discussion; (2) Facilitator provides disease and medication knowledge to improve understanding and adherence. **Homework:** Read health education manuals and review disease and medication knowledge.
Session 3 (Week 3)	Learn and practice the "Negative Automatic Thought Exploration Form"; use evidence-testing techniques to help patients and families distinguish "reality" from "thoughts" and reconstruct beliefs about illness and medication. **Homework:** Practice negative thought exploration and conversion exercises.
Session 4 (Week 4)	Use the "Strengths Wheel" game to identify positive resources (support systems, personality, hobbies, values, abilities) and explore their role in coping. **Homework:** Apply learning to real-life situations.
Session 5 (Week 5)	(1) Teach ABC theory of emotion to identify coping biases; (2) Present case stories of two patients with different coping styles; members discuss outcomes. (3) Facilitator guides members to discover positive meanings hidden in negative emotions. **Homework:** Practice the ABC Function Form.

Session	Content
Session 6 (Week 6)	Group discussion on seeking external support when encountering difficulties; facilitator summarizes. **Homework:** Apply learning to daily life.
Session 7 (Week 7)	Role-playing of three scenarios: problem-solving, emotion regulation, and over-dependence; group discussion based on experiential learning. **Homework:** Apply learning to daily life.
Session 8 (Week 8)	(1) Summarize gains and future outlook; (2) Feedback session for participants to provide suggestions.

(3) P3 Time Point Intervention Protocol (Social Skills Training as Core) Table 3 DPM Intervention—P3 Time Point (Social Skills Training as Core)

Session	Content
Session 1 (Week 1)	(1) Establish therapeutic alliance through empathy, genuineness, and positive regard; (2) Distribute health education manuals. **Homework:** Read health education manuals.
Session 2 (Week 2)	(1) View schizophrenia educational animation; facilitator provides professional clarification of questions and misconceptions; (2) Map illness trajectory to clarify relationships among symptoms, treatment, relapse, and disability; (3) Invite well-recovered patients to share treatment and rehabilitation experiences. **Homework:** Read health education manuals to consolidate learning.

Session	Content
Session 3 (Week 3)	(1) Read "Schizophrenia Patient Monologue"; members share reflections; (2) Facilitator analyzes discussions and summarizes effective cognitive adjustment methods (positive self-talk, self-appreciation, self-suggestion) to help view problems from multiple perspectives and reduce negative emotions. **Homework:** Read health education manuals and practice self-suggestion.
Session 4 (Week 4)	(1) Games: "Instant Face Change" and "Blind Number Search"; members share insights; (2) Facilitator supplements and summarizes interpersonal principles such as respect.
Session 5 (Week 5)	(1) Role-playing of four interpersonal scenarios: family, friends, doctors, and strangers to identify skill deficits and cognitive issues; (2) Facilitator provides feedback, demonstrates basic interpersonal skills, and uses positive reinforcement with token rewards to maintain positive behaviors. **Homework:** Apply learning to daily life.
Session 6 (Week 6)	**Career Planning:** "Minesweeping" game where members voluntarily share their "mines" (challenges); facilitator identifies common difficulties and guides brainstorming solutions. **Homework:** Discuss future plans with family members.
Session 7 (Week 7)	Psychoeducation: Challenge irrational beliefs about employment and encourage engagement in feasible work.
Session 8 (Week 8)	(1) Summarize gains and future outlook; (2) Feedback session for participants to provide suggestions.

1.2.3 Outcome Measures

1. **Self-made General Situation Questionnaire (SGSQ):** Collected sociodemographic data (name, gender, age, education level) and disease characteristics (course of illness).
2. **WHO Disability Assessment Schedule (WHO-DAS II):** Assesses disability status and severity across 36 items covering six domains: understanding and communication, mobility, self-care, interpersonal relationships, life activities, and social participation. Scores range from 36-180, with higher scores indicating greater disability severity. Cronbach's α = 0.898.
3. **Insight and Treatment Attitudes Questionnaire (ITAQ):** Assesses insight into illness and attitudes toward treatment across 11 items. Higher scores indicate better insight. Cronbach's $\alpha = 0.602$.
4. **Positive and Negative Syndrome Scale-Negative Subscale (PANSS-N):** Developed by Stanley R. Kay et al. and introduced to China by He Yanling et al. [10]. Si Tianmei et al. reported standardized Cronbach's $\alpha = 0.8707$ [11]. Cronbach's α in this study = 0.882.
5. **Self-Esteem Scale (SES):** Comprises 10 items rated on a 4-point scale (1 = very true, 2 = true, 3 = untrue, 4 = very untrue). Total scores range from 10-40, with higher scores indicating higher self-esteem. Cronbach's $\alpha = 0.773$.
6. **Family Adaptability, Partnership, Growth, Affection, and Resolve (APGAR) Questionnaire:** Contains 5 items rated on a 3-point scale, assessing five aspects of family functioning. Higher scores indicate better family functioning. The APGAR demonstrates good applicability in China with internal consistency reliability Cronbach's $\alpha = 0.94$ [12].

1.2.4 Data Collection

Data were collected at four time points: pre-intervention, post-intervention, 3 months post-intervention, and 6 months post-intervention. Assessment instruments included WHO-DAS II, ITAQ, PANSS-N, SES, and APGAR. Follow-up surveys required prior contact with patients; telephone interviews were conducted when patients could not attend follow-up appointments in person.

1.3 Statistical Methods

SPSS 25.0 software was used for statistical analysis. Quantitative data were described as mean ± standard deviation, and categorical data as frequencies and percentages. Between-group comparisons of baseline data used t-tests or ^{2} tests. Changes in scale scores across time points were analyzed using repeated measures ANOVA. Statistical significance was set at $P<0.05$.

2.1 Patient Sociodemographic Characteristics

At baseline, 70 participants were enrolled at each time point (P1, P2, P3), with 35 in each intervention and control group. Attrition rates were 5.7% (4 cases) at P1, 8.6% (6 cases) at P2, and 8.6% (6 cases) at P3. T-tests and ^{2} tests analyzed baseline characteristics across groups. Results showed no significant baseline differences between intervention and control groups at any time point (P>0.05), confirming group comparability (Table 4).

Table 4 Comparison of Baseline Data Between Intervention and Control Groups at Each Time Point

Characteristic	P1 Intervention (n=35)	P1 Control (n=35)	P2 Intervention (n=35)	P2 Control (n=35)	P3 Intervention (n=35)	P3 Control (n=35)
Age (years)	37.21$±8.18	36.30±8.83	36.73±5.95	37.45±8.76	39.25±6.49	38.97±7.80
Gender : *Male*	26(78.8±3.44	5.15±3.23	7.21±3.00	6.84±3.33	8.97±2.75	8.78±$2.95

2.2 Comparison of Scale Scores at P1 Time Point

Repeated measures ANOVA revealed significant time, group, and interaction effects for WHO-DAS II, ITAQ, PANSS-N, and SES scores at P1. APGAR scores showed significant time main effects and time-by-group interaction effects, but no significant group main effect. Simple effects analysis indicated that WHO-DAS II scores were significantly lower at post-intervention, 3 months, and 6 months compared to baseline. PANSS-N scores were significantly lower at post-intervention and 3 months compared to baseline. ITAQ, SES, and APGAR scores were significantly higher at all follow-up points compared to baseline. Between-group comparisons showed no significant pre-intervention differences, but the intervention group had significantly lower WHO-DAS II and PANSS-N scores and significantly higher ITAQ, SES, and APGAR scores than the control group at all follow-up points (P<0.05) (Table 5).

Table 5 Comparison of Scale Scores Between Two Groups of Schizophrenia Patients with Disability at P1

Scale	Group	Baseline	Post-intervention	3-month follow-up	6-month follow-up
WHO-DAS II	Intervention	67.76±8.16	62.48±8.40^{bc}	62.03±8.28^{bc}	68.09±11.71
	Control	68.42±10.73	68.18±11.78	62.24	
8.577, *Fbetween*− *group* = 4.404, *Ftime* = 6.799; *Pinteraction* = 0.000, *Pbetween*− *group* = 0.04, *Ptime* = 0.000					
PANSS− *N*	*Intervention*	23.97±3.52	24.36±3.88	22.64±4.06^{a}	24.36±3.23
Control		21.27±3.02^{bd}	21.42		
4.080, *Fbetween*− *group* = 9.574, *Ftime* = 4.976; *Pinteraction* = 0.010, *Pbetween*− *group* = 0.003, *Ptime* = 0.004					
ITAQ	*Intervention*	14.48±3.44	14.85±5.17	12.06±4.03^{bc}	11.18±3.23^{bd}
Control		12.8			
4.981, *Fbetween*− *group* = 7.140, *Ftime* = 5.331; *Pinteraction* = 0.004, *Pbetween*− *group* = 0.010, *Ptime* = 0.002					
SES	*Intervention*	13.18±2.69	13.55±2.56	15.79±3.45^{bc}	15.91±3.05^{bc}
Control		13.97			
5.290, *Fbetween*− *group* = 5.765, *Ftime* = 6.392; *Pinteraction* = 0.002, *Pbetween*− *group* = 0.019, *Ptime* < 0.001					
APGAR	*Intervention*	25.36±2.30	28.30±2.11^{bd}	27.79±1.90^{bd}	27.94±1.95^{bd}
Control					

Scale	Group	Baseline	Post-intervention	3-month follow-up	6-month follow-up
		F interaction=11.222, F between-group=12.011, F time=11.003; P interaction<0.001, P between-group=0.001, P time<0.001			

Note: {a}P}<0.05, {b}P}<0.01 compared with baseline; {c}P}<0.05, {d}P}<0.01 compared with control group; *P<0.05, **P<0.01; Follow-up 1 = 3 months post-intervention, Follow-up 2 = 6 months post-intervention.

2.3 Comparison of Scale Scores at P2 Time Point

Repeated measures ANOVA revealed significant time, group, and interaction effects for WHO-DAS II, ITAQ, SES, and APGAR scores at P2. PANSS-N scores showed significant time and group main effects but no time-by-group interaction effect. Simple effects analysis showed WHO-DAS II scores were significantly lower at all follow-up points compared to baseline, while ITAQ, SES, and APGAR scores were significantly higher at all follow-up points compared to baseline. Between-group comparisons showed no significant pre-intervention differences. The intervention group had significantly lower WHO-DAS II scores at post-intervention and 6 months, significantly higher ITAQ and APGAR scores at all follow-up points, and significantly higher SES scores at post-intervention and 6 months compared to the control group (P<0.05) (Table 6).

Table 6 Comparison of Scale Scores Between Two Groups of Schizophrenia Patients with Disability at P2

Scale	Group	Baseline	Post-intervention	3-month follow-up	6-month follow-up
WHO-DAS II	Intervention	68.88±7.19	63.33±7.60^{bc}	63.15±7.27^{b}	62.00±10.74^{bc}
	Control	69.26±10.88	69.06±11.26	68.3	
		$3.838, Fbetween-group = 4.186, Ftime = 4.749; Pinteraction = 0.014, Pbetween-group = 0.045, Ptime = 0.005$			
	PANSS-N	Intervention	24.64±2.73	24.06±2.90	24.27±1.92
	Control	24.74±4.53	24.32±3		
		$0.509, Fbetween-group = 0.580, Ftime = 0.709; Pinteraction < 0.677, Pbetween-group = 0.449, Ptime < 0.550$			
	ITAQ	Intervention	15.06±3.66	13.33±3.27	13.18±2.69
	Control	15.42±5			
		$2.187, Fbetween-group = 4.590, Ftime = 3.058; Pinteraction = 0.99, Pbetween-group = 0.36, Ptime = 0.35$			
	SES	Intervention	13.61±2.62	16.09±2.30^{bd}	16.12±2.85^{bc}
	Control	13.8			
		$6.279, Fbetween-group = 7.265, Ftime = 8.633; Pinteraction < 0.001, Pbetween-group = 0.007, Ptime < 0.001$			
	APGAR	Intervention	25.61±2.77	28.67±2.03^{bd}	27.52±2.31^{b}
	Control				

Scale	Group	Baseline	Post-intervention	3-month follow-up	6-month follow-up
		F interaction=8.523, F between-group=7.481, F time=9.936; P interaction<0.001, P between-group=0.008, P time<0.001			

Note: {a}P}<0.05, {b}P}<0.01 compared with baseline; {c}P}<0.05, {d}P}<0.01 compared with control group; *P<0.05, **P<0.01; Follow-up 1 = 3 months post-intervention, Follow-up 2 = 6 months post-intervention.

2.4 Comparison of Scale Scores at P3 Time Point

Repeated measures ANOVA revealed significant time, group, and interaction effects for WHO-DAS II and ITAQ scores at P3. PANSS-N, SES, and APGAR scores showed significant time and group main effects but no time-by-group interaction effects. Simple effects analysis showed WHO-DAS II scores were significantly lower at all follow-up points compared to baseline, while ITAQ scores were significantly higher at all follow-up points compared to baseline. Between-group comparisons showed no significant pre-intervention differences. The intervention group had significantly lower WHO-DAS II scores and significantly higher ITAQ scores than the control group at all follow-up points (P<0.05) (Table 7).

Table 7 Comparison of Scale Scores Between Two Groups of Schizophrenia Patients with Disability at P3

Scale	Group	Baseline	Post-intervention	3-month follow-up	6-month follow-up
WHO-DAS II	Intervention	70.00$±9.70	62.94±10.49^{bc}	63.41±8.87^{bc}	63.84±9.59^{bc}
	Control	69.69±11.37	69.47±9.86	69.16	
		2.902, $Fbetween-group$ = 4.421, $Ftime$ = 3.379; $Pinteraction$ = 0.042, $Pbetween-group$ = 0.040, $Ptime$ = 0.024			
ITAQ	Intervention	25.00±3.69	25.16±3.75	24.69±3.51	25.38±3.37
	Control	24.56±			
		0.212, $Fbetween-group$ = 0.439, $Ftime$ = 0.417; $Pinteraction$ < 0.888, $Pbetween-group$ = 0.510, $Ptime$ < 0.742			
PANSS-N	Intervention	16.28±4.41	16.97±3.51	13.84±3.99	16.25±4.19
	Control	14.28±3.17	16.25±3		
		1.521, $Fbetween-group$ = 7.299, $Ftime$ = 6.331; $Pinteraction$ < 0.218, $Pbetween-group$ = 0.009, $Ptime$ = 0.001			
SES	Intervention	14.47±2.72	14.16±2.94	16.75±3.19^{bd}	16.41±3.12^{bc}
	Control	15.69			
		4.195, $Fbetween-group$ = 6.002, $Ftime$ = 8.181; $Pinteraction$ < 0.007, $Pbetween-group$ = 0.017, $Ptime$ < 0.001			
APGAR	Intervention	26.50±4.20	26.66±3.52	28.31±3.56	26.38±2.06
	Control	28.84			

Scale	Group	Baseline	Post-intervention	3-month follow-up	6-month follow-up
		F interaction=2.411, F between-group=6.192, F time=3.070; P interaction<0.076, P between-group=0.016, P time=0.035			

Note: {a}P}<0.05, {b}P}<0.01 compared with baseline; {c}P}<0.05, {d}P}<0.01 compared with control group; *P<0.05, **P<0.01; Follow-up 1 = 3 months post-intervention, Follow-up 2 = 6 months post-intervention.

3.1 Effects of DPM Intervention on Health Outcomes at P1 Time Point

3.1.1 DPM Intervention Significantly Improved Disability Severity at P1

Our findings demonstrate that the intervention group showed significantly better improvement in disability severity than the control group at post-intervention, 3 months, and 6 months post-intervention (P<0.05). Insight and self-esteem also improved significantly in the intervention group at post-intervention and follow-up points. These results indicate that the DPM intervention program based on intervention mapping theory is not only scientifically rigorous but also demonstrably effective.

Poor medication adherence and misconceptions about illness and medication represent primary risk factors for schizophrenia-related disability at P1 [13,14]. Poor adherence can trigger disease relapse and subsequent disability [15], primarily due to insufficient knowledge about illness and medication [16]. Therefore, P1 interventions centered on medication management, guiding patients and families to master antipsychotic knowledge and learn to identify and manage side effects, thereby developing accurate perceptions and autonomous medication-taking behaviors. This approach promotes informed adherence rather than blind compli-

ance. Addonizio et al. [17] reported that addressing common adherence barriers (e.g., lack of medication knowledge) significantly improves medication cognition, attitudes, and reduces rehospitalization. P1 interventions supplemented medication management with psychological intervention and social skills training. Psychological techniques such as affirming personal value, evidence-based debate, and positive self-suggestion eliminated irrational beliefs about mental illness, fostering positive attitudes and acceptance while improving self-esteem. Social skills training helped patients identify relapse prodromal symptoms and develop coping strategies, further enhancing medication adherence. The synergistic effects of these three components improved adherence, reduced disability severity, and enhanced insight.

3.1.2 DPM Intervention Improved Family Functioning at P1

Patients with schizophrenia-related disability typically return home post-discharge for family-based care, making family environment a critical factor influencing medication adherence. Family intervention should therefore be prioritized throughout treatment to create supportive rehabilitation environments [18]. A Taiwanese study revealed that most family caregivers of psychiatric patients have unmet educational needs regarding illness and medication [19]. DPM interventions address these needs, helping families recognize the importance of timely treatment and medication adherence, thereby improving outpatient adherence through family supervision and creating positive home rehabilitation environments that enhance family functioning. These findings align with Chen et al. [20], who demonstrated that social support interventions significantly alleviate psychotic symptoms and improve social support levels, promoting patient recovery.

3.2 Effects of DPM Intervention on Health Outcomes at P2 Time Point

3.2.1 DPM Intervention Significantly Improved Disability Severity at P2

Results showed that compared to the control group, the intervention group demonstrated significantly improved disability severity at post-intervention and 6 months post-intervention ($P<0.05$), with improvements in negative symptoms and insight at post-intervention and follow-up points. These findings confirm that the DPM intervention program effectively reduces disability severity, alleviates negative symptoms, and improves insight at P2.

Negative coping strategies [21] and negative symptoms [22] constitute primary risk factors for schizophrenia-related disability. Psychological interventions effectively address psychological needs and improve mental status [23-25]. Therefore, P2 interventions centered on psychological intervention, using disease-related psychoeducation to correct cognitive biases about illness, self, family, and society. Facilitators guided members to identify positive resources (sup-

port systems, hobbies, etc.) and explore their role in coping, while employing techniques such as "positive self-dialogue" and rational emotive therapy to enhance emotion regulation and develop positive coping styles.

Negative symptom improvement may be related to enhanced emotion regulation capacity, which effectively addresses anhedonia—a core negative symptom manifestation [26]. A meta-analysis of 72 randomized controlled trials corroborates our findings, demonstrating that psychological interventions reduce negative symptoms and should be incorporated into treatment [27]. Negative symptoms drive disability severity, and their reduction leads to decreased disability. Additionally, coping styles mediate the relationship between negative symptoms and disability; patients with severe negative symptoms often use avoidant coping, which impairs social adaptation and worsens disability. Positive coping can mitigate this effect through the pathway of negative symptoms → coping style → disability [21]. Disability severity at P2 improved significantly post-intervention with sustained effects, consistent with Miao et al. [28], who found that comprehensive psychological intervention reduces relapse and delays social functional decline. Furthermore, insight correlates negatively with negative symptoms [29]; severe negative symptoms may increase treatment passivity, reduce treatment needs, and worsen adherence, negatively impacting insight [30]. Insight improvement at P2 may thus be related to negative symptom reduction.

3.2.2 DPM Intervention Improved Family Functioning at P2

Caregiver psychological needs warrant attention alongside patient needs. Family caregivers of schizophrenia patients often experience anxiety and depression due to caregiving burden and social stigma, directly affecting care quality and hindering recovery [32]. Hsiao et al. [33] demonstrated that family-oriented interventions reduce caregiver burden while alleviating patient symptoms and improving social support. Therefore, P2 interventions focused on helping caregivers reframe negative emotions through Socratic questioning to challenge negative illness cognitions and reduce role sensitivity. Peer support enabled sharing of treatment knowledge and caregiving experiences with mutual encouragement. These approaches improved caregiving skills and enhanced family functioning, consistent with Mayoral et al. [34].

3.3 Effects of DPM Intervention on Health Outcomes at P3 Time Point

3.3.1 DPM Intervention Improved Disability Severity at P3

Negative symptoms and social skill deficits represent primary risk factors for schizophrenia-related disability at P3 [21,35]. Social skills training effectively improves social adaptation and reduces negative symptoms [36]. Therefore, P3 interventions centered on social skills training, deconstructing complex skills into manageable units. Facilitators demonstrated basic interpersonal skills (appearance, verbal expression, facial expressions) and used role-playing to help

patients identify skill deficits. Positive feedback based on performance increased social confidence and interest. Social skills training may improve negative symptoms by breaking long-term rehabilitation goals into short-term, actionable steps that patients can implement daily. This goal-directed behavioral activation increases motivation and social participation, thereby improving negative symptoms, social skills, and reducing disability severity [37], consistent with Turner et al. [38].

3.3.2 DPM Intervention Improved Family Functioning at P3

Family support is crucial for treatment adherence. Social support improves schizophrenia symptoms and correlates with better clinical outcomes [39]. However, Munikanan et al. [40] found that approximately 72% of schizophrenia patients perceive low social support. Therefore, P3 interventions guided families to maintain good communication and support patients' community reintegration, thereby improving perceived social support—a protective factor for schizophrenia patients [41-42]. Family involvement ensures rehabilitation effectiveness and promotes social integration. Post-intervention family functioning improved significantly, suggesting that family intervention should be incorporated into rehabilitation protocols.

In summary, the DPM intervention based on intervention mapping theory reduces disability severity across different time points in schizophrenia patients while improving negative symptoms, self-esteem, insight, and family functioning to varying degrees. These findings underscore the importance of considering primary risk factors and disease characteristics at different time points and implementing matched, targeted interventions to optimize rehabilitation outcomes.

Author Contributions: Cao Xiaolang conceptualized and designed the study and drafted and revised the manuscript; Wang Xue constructed the intervention protocol; Wang Weiliang and Yu Hong guided manuscript revision and data analysis; Zhou Yuqiu revised the final version and is responsible for the integrity of the work.

Funding: National Natural Science Foundation of China (Grant No. 71673071)

Conflict of Interest: The authors declare no conflict of interest.

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