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Effects of IPS plus cognitive remediation in early psychosis: 18-month functioning outcomes of a randomized controlled trial

Daniëlle van Duin [a,b,c,*], Lars de Winter [a], Hans Kroon [b,c], Wim Veling [d,e], Jaap van Weeghel [a,c]

[a] Phrenos Center of Expertise, Utrecht, the Netherlands
[b] Trimbos Institute, Utrecht, the Netherlands
[c] Tranzo, Tilburg School of Social and Behavioral Sciences, Tilburg University, Tilburg, the Netherlands
[d] University of Groningen, Groningen, the Netherlands
[e] University Medical Center Groningen, Groningen, the Netherlands

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ABSTRACT

Background: After a first episode of psychosis, cognitive impairments present an important barrier to successful (re-)entry into work and education. We assessed whether cognitive remediation (CR) as an add-on to Individual Placement and Support (IPS) can improve participation in regular employment and education.
Method: Participants with early psychosis ($N = 73$) were randomly assigned to receive IPS supplemented with computerized CR, or IPS plus an active control intervention (computer games). The primary outcome was the number of hours spent in competitive employment or regular education, which was assessed every month during the 18-month study period. Secondary outcomes included employment rate, cognitive functioning, mental health (assessed at baseline, 6 and 18 months), and job duration (assessed after 18 months). Both patients and assessors were blind to treatment.
Results: Participants receiving IPS + CR showed greater improvement of competitive employment over time in terms of hours worked (during follow-up period: 38.5 vs. 19.6 h, $B = 2.94$; Wald $\chi^2 = 5.39$; $P = .02$) and employment rate (at T2: 62.1% vs. 25.9%, $\chi^2 = 7.39$; $df = 1$; $P = .008$), compared with the IPS + control group, particularly in the longer term. The number of hours spent in regular education was lower in the IPS + CR group, with more participants having ended education for a positive reason. There was a significant beneficial effect of adjunctive CR for executive functioning, subjective cognitive functioning, and empowerment.
Conclusions: Augmenting IPS with CR has a significant impact on competitive employment in people with early psychosis, with beneficial effects being more pronounced after 18 months.

1. Introduction

People who experienced a first episode of psychosis often have poor employment outcomes (Cougnard et al., 2009; Bertelsen et al., 2008). Completing education and having access to employment are critical aspects toward recovery for this group (Rinaldi et al., 2010a). Employment provides structure, purpose, financial independence, inclusion, self-esteem, and social status (Drake et al., 2013). Besides these substantial personal merits, competitive work in people with psychosis is of great value for society: Loss of productivity due to unemployment ($21.6 billion in the US in 2002) is the factor that contributes most to the indirect costs of psychotic illness (Wu et al., 2005).

The Individual Placement and Support (IPS) model of supported employment can help people with severe mental illness to obtain competitive employment, in a job they prefer, with the level of professional help they need (Bond et al., 2001). In people who recently experienced a first psychosis, success rates of IPS vary from 40 to 65% for enrollment in competitive employment and from 20 to 30% in regular education (Killackey et al., 2008; Rinaldi et al., 2010b). Despite the beneficial effects of IPS for people with early psychosis, they encounter many barriers to successful (re-)entry into work and education, such as low self-esteem, stigma, and sedation and weight gain due to medication (Bassett et al., 2001). Another major barrier is the occurrence of cognitive deficits, such as reduced verbal and visual memory, attention, speed of information processing, and executive functioning, which are common in schizophrenia (Bowie and Harvey, 2006) and first episode

* Corresponding author at: Center of expertise for Severe Mental Illness, Da Costakade 45, PO Box 1203, 3500 BE Utrecht, the Netherlands.
E-mail addresses: dduin@kcphrenos.nl, dduin@trimbos.nl (D. van Duin).

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psychosis (Mesholam-Gately et al., 2009).

Given that cognitive deficits are associated with a reduced response to rehabilitation programs and poor work performance (Tsang et al., 2010; McGurk and Mueser, 2004), several studies have attempted to augment the effect of vocational rehabilitation by improving cognitive functioning through various cognitive remediation techniques (i.e., training focused on improvement of neurocognitive functioning). These techniques have also shown positive results in terms of symptoms (Wykes et al., 2011), and psychological gains such as improved empowerment, self-esteem, motivation and reduced self-stigma (Reeder et al., 2016; Contreras et al., 2016). Most of the studies that have combined vocational rehabilitation with cognitive remediation (CR), focused on people with schizophrenia or other severe mental illnesses (Duin van et al., 2019). Little is known about the effectiveness of such combined intervention in people with early psychosis. Evaluating results in this group is especially important because vocational rehabilitation in early psychosis can not only yield short-term experience regarding work and education, but it may also prevent development of long-term unemployment (Rinaldi et al., 2010a), and is predictive of long-term social and clinical recovery (Alvarez-Jimenez et al., 2012).

The current study evaluated to what extent CR reinforces the effects of IPS in people with early psychosis, in terms of participation in competitive employment or regular education. Our hypotheses were:

1) Employment and education outcomes improve more in the IPS + CR group than in the IPS + control group.
2) Cognitive functioning improves more in the IPS + CR group than in the IPS + control group.
3) Empowerment improves more and self-stigma and psychological distress decrease more in the IPS + CR group than in the IPS + control group.

2. Method

The study was a multi-centered randomized controlled trial (RCT) that evaluated the effect of IPS plus adjunctive CR, compared to the effect of IPS plus an active control intervention. The study (A2016.366/2014.355/NL50176.029.14) was approved by the Medical Ethics Committee of the "*Vrije Universiteit Medisch Centrum*." The study protocol (NL4705/NTR4975) was registered prospectively at the Netherlands National Trial Register (NTR).

2.1. Participants

One-hundred and fifty-one patients were assessed for eligibility by clinicians at ten specialized Early Interventions in Psychosis Services and seven general outpatient teams for people with severe mental illness (Flexible Assertive Community Treatment [FACT] Teams). Of those 151 patients, 73 were enrolled into the study between January 2015 and November 2016. Eligibility criteria were: a) experienced a first episode of psychosis during the past 5 years (including all types of psychotic disorder except for substance induced psychotic disorders and psychotic disorders due to a general medical condition); b) 18 years or older; c) desire for competitive work or education and willingness to start or continue IPS; d) objective or subjective cognitive deficits; e) intelligent quotient (IQ) above 70; and f) fluent in the Dutch language. Premorbid IQ was measured by the Dutch Adult Reading Test (Schmand et al., 1991).

2.2. Procedure

After giving informed consent and completing a baseline assessment, participants ($N = 73$) were randomly assigned to a condition by means of a computer algorithm (automatically executed following completion of the assessment). The condition was either IPS + CR or IPS + control, assigned with equal probability. The randomization algorithm included stratification by "institution," with a block-size of 2, and made use of true random codes, distributed by *Random.org*. Treatment teams were informed about the condition of each patient by an independent assistant, after which interventions started as soon as possible. Participants were blind to treatment allocation because they were directed to their intervention by a masked digital portal. Participants were assessed again at 6 months (post-treatment) and 18 months (follow-up) after the baseline assessment. Assessments were carried out at the institutions at which treatment took place, by Master's degree psychologists, who remained blind to treatment allocation.

2.3. Interventions

2.3.1. IPS

This intervention is based on eight principles (Drake et al., 2012), including: zero exclusion criteria; rapid search for employment or education; integration of the employment services and mental health treatment; and time-unlimited employment support. Since a first episode of psychosis frequently occurs at an age at which patients have not yet finished their education, in this project completing their education could be an alternative goal instead of competitive employment.

2.3.2. CR

This intervention consisted of a web-based program, called Computerized Interactive Remediation of Cognition Training for Schizophrenia (CIRCuiTS), developed by Wykes and colleagues (Reeder and Wykes, 2010). CIRCuiTS consists of tasks targeting attention, memory, and planning. The program aims to improve cognition by repetitive training (drill), learning strategies (strategy), and improving metacognition. To foster generalization of new cognitive abilities and strategies to real life, the tasks are focused on daily activities, such as traveling, using a daily schedule, and writing a curriculum vitae. Trained therapists supported the processes of motivating participants, enhancing metacognition and fostering the transfer of acquired skills to daily life. The usual program consists of 40 sessions that are executed three times a week (including two homework sessions), starting with 15 min and gradually increasing up to 60 min by the end of the program.

2.3.3. Control

This active control condition served to control for therapist attention and computer exposure. It consisted of three weekly 15-60-minute computer sessions. Participants were instructed to play a selection of six different computer games, including a racing game, mazes, Angry birds, a platform game, Bubble shooter and Rollercoaster. One session a week was supported by a facilitator, who was instructed to explain that cognitive functions were going to be trained. The facilitator was allowed to explain the rules of the games, support to attain next levels, join in a competition together, and discuss general case management issues. However, the facilitator was instructed not to discuss cognitive strategies, reinforce meta-cognitive knowledge, or foster transfer of any cognitive strategy to daily life.

2.4. Measures

2.4.1. Primary outcome

Hours worked, specified for "competitive employment" or "regular education" was monitored monthly by the IPS coaches. When IPS coaches were not able to monitor this and other vocational outcomes, they were retrospectively registered by the participant during post-treatment (T1) and follow-up (T2) assessments.

2.4.2. Secondary outcomes

Secondary vocational outcomes were monitored monthly by the IPS coaches. Cognitive and mental health functioning was monitored at baseline (T0), post-treatment (T1), and follow-up (T2).

2.4.2.1. Vocational functioning. Secondary vocational outcomes contained *employment rate* and *job duration*, specified for "competitive employment" and "regular education."

2.4.2.2. Cognitive functioning. A selection of computerized neuropsychological tests in the MINDS package (Brand and Houx, 1992) was used, assessing cognitive domains that are found to be impaired in schizophrenia (Nuechterlein et al., 2004). Sustained attention was measured with the Continuous Performance Test (CPT) (Beck et al., 1956), immediate attention with the Digit Span (forward) subtest of the Wechsler Adult Intelligence Scale-Revised (Wechsler, 1981). Psychomotor speed was measured with the Trail Making Test-Part-A (Reitan, 1979). Verbal learning and memory were assessed with a digital 15-word learning test with visual presentation of the words (Brand and Jolles, 1985), based on Rey's Auditory Verbal Learning Test (RAVLT) (Rey, 1964). Working memory was measured with the Digit Span (backward) subtest of the Wechsler Adult Intelligence Scale-Revised (Wechsler, 1981). Executive functioning was assessed with the Trail Making Test-Part-B (Reitan, 1979) and the Wisconsin Card Sorting Test (WCST) (Heaton, 1981). Subjective cognitive functioning was assessed with the Cognitive Failure Questionnaire (CFQ) (Broadbent et al., 1982) a self-rating questionnaire to evaluate the frequency of everyday cognitive errors made in the prior four weeks. The aforementioned scales have moderate to good psychometric properties, in general and as computerized versions in a schizophrenia population (Sousa-Magalhães et al., 2012; O'Halloran et al., 2008; Crawford et al., 1995; Merckelbach et al., 1996).

2.4.2.3. Mental health. Psychiatric symptoms were assessed with interviews using the Positive and Negative Syndrome Scale (PANSS) covering the prior two weeks of functioning (Kay et al., 1987). General mental health was measured with the abbreviated 5-item Mental Health Inventory (MHI-5) (Veit and Ware, 1983). Empowerment was measured with the Netherlands Empowerment List (NEL), subscale "Confidence and Purpose," (Boevink et al., 2017) a self-rating questionnaire to evaluate someone's's strength in coping with mental problems. Self-stigma was assessed with the self-rating scale for Internalized Stigma of Mental Illness (ISMI) (Ritsher et al., 2003). The psychometric properties of these scales are moderate to good (Rivera-Riquelmea et al., 2019; Ware et al., 1993; Bray and Gunnell, 2006; Kay et al., 1988).

2.4.3. Other measures

To check whether the interventions were conducted as intended, model *fidelity* was assessed at 6 and 18 months. For IPS, this was done with the 25-item version of the IPS Fidelity Scale, which has good psychometric properties (Bond et al., 2012). Since no validated scale for CIRCuiTS exists, a "proxy" for fidelity was assessed with a 16-item fidelity scale that was developed for this study, on the basis of the therapist manual written by the program developers (Duin van et al., 2021). Information on *participant characteristics* and potential *co-variates* was obtained through structured interviews at T0, T1, and T2.

2.5. Data management

The number of hours spent in competitive employment or regular education was assessed by registering these outcomes separately each month during the study period. Employment and education rates were calculated by assessing the involvement of participants in employment or education at any time point during a period of 6 months before each assessment (T0,T1,T2). Job and education duration were calculated by combining the total amount of weeks spent in employment or education during the study period.

Global cognition was computed by calculating the mean of all standardized cognitive measures (excluding premorbid IQ), which were standardized by converting percentile scores from z-scores which were computed from normative data of each assessment.

2.6. Data analyses

Analyses of outcomes assessed at multiple time points were carried out according to "intention-to-treat," using a generalized linear mixed model (GLMM) analysis for differences in treatment effects over time between the IPS + CR and IPS + control condition. We included treatment condition as the grouping variable; the time variables were: each month of assessment for hours worked; the assessment periods (6 months prior to T1 and T2) for employment rate; and the assessment points (T0,T1,T2) for the other secondary outcomes. Analyses of treatment effects over time were analyzed by calculating the treatment x time interactions of each outcome. Treatment effects on specific assessment periods or months were calculated by dummy coding each individual time variable and calculating the group effects.

The number of hours per month spent in employment or in education was analyzed separately. Job duration was calculated retrospectively for the total study period. As this outcome was only assessed at the 18-month follow-up assessment and the outcome was not normally distributed, we used a multiple linear regression analysis to assess treatment effects, while controlling for co-variates. Before analyzing the multiple linear regression model, we controlled for normal distribution of the residuals. The potential co-variates included into all analysis models were: age, duration of illness, gender, premorbid IQ, and job history.

All outcomes were also analyzed descriptively using one-way analysis of variance (ANOVA) and chi-squared tests at each specific time-point (T0,T1,T2) to assess differences between the treatment and control group at baseline, and as post hoc analysis for treatment effects during post-treatment and follow-up to interpret the primary GLMM analysis. All analyses were carried out using SPSS version 25 (IBM Corp, 2017).

3. Results

3.1. Participant flow

Participants who completed baseline assessment ($N = 73$) were considered in the intention-to-treat analyses (Fig. 1). Fifty-seven participants (78%) completed the 6-month assessment (T1), 56 participants (77%) completed the 18-month follow-up assessment (T2). The number of participants with a monthly assessment of vocational data varied from 57 to 64 assessments, with a mean assessment rate of 85.7% in the treatment period (0-6 months) and 76.5% in the follow-up period (7-18 months).

3.2. Baseline characteristics

There were no significant differences in demographics and other participant characteristics between treatment and control group at baseline (Table 1), nor between participants who completed the study and who dropped out of the study.

3.3. Intervention adherence

3.3.1. Sessions

Participants in the *CR group* completed an average of 20.8 CR-sessions (SD = 16.2), while participants in the *control group* completed an average of 19.1 computerized control-sessions (SD = 17.0). During the total 18-month study period, participants in the *CR group* attended an average of 26.1 IPS-sessions (SD = 19.4); participants in the *control group* an average of 24.0 IPS-sessions (SD = 23.1). The number of sessions did not differ significantly between the groups.

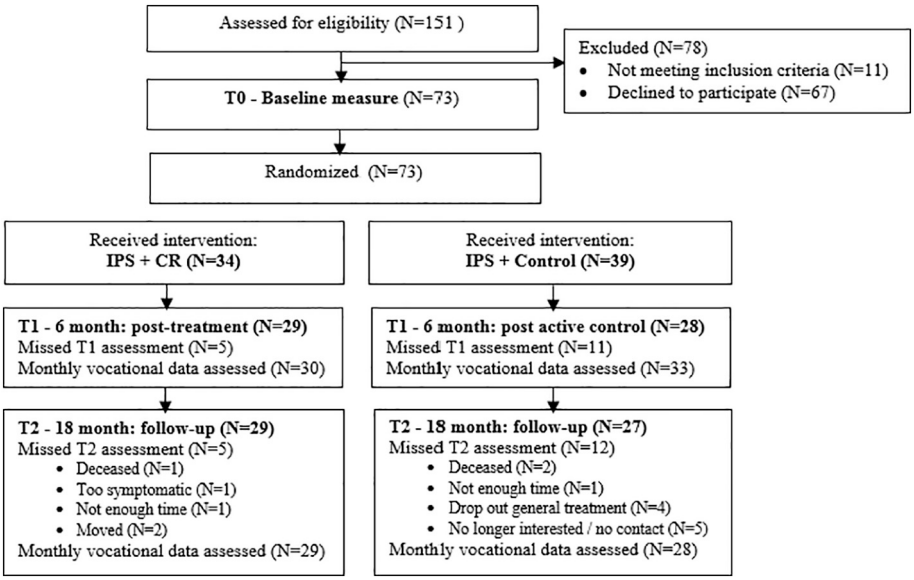

Fig. 1. Consort diagram of participant flow.

Table 1
Baseline characteristics.

Variable name	Circuits group			Control group			Differences	
	M	**SD**	**N**	**M**	**SD**	**N**	**F**	**p**
Age	28.12	6.46	34	26.00	4.83	39	2.56	0.11
Years of education	14.94	2.62	34	15.54	2.62	39	0.94	0.34
Job history (last 5 years)	2.34	1.64	34	2.20	1.90	39	0.11	0.74
Duration of illness	2.85	3.03	34	2.33	2.08	39	0.75	0.39
Premorbid IQ	90.18	10.30	34	90.33	9.54	39	0.01	0.95
Number of hospitalizations	0.77	0.86	26	1.12	1.583	26	0.96	0.33
Number of diagnoses	1.09	0.29	34	1.15	0.43	39	0.57	0.45
Number of medications	1.29	0.72	34	1.33	0.90	39	0.04	0.84
PANSS positive	13.41	15.62	34	10.38	3.33	39	1.40	0.24
PANSS negative	15.97	15.15	34	12.72	4.01	39	1.67	0.20
PANSS general	29.21	14.72	34	25.21	5.50	39	2.49	0.12
PANSS total score	51.24	15.76	34	48.36	8.68	39	0.97	0.33
	n	**%**	**N**	**n**	**%**	**N**	**X^2**	**p**
% female	9	26,5%	34	12	30,8%	39	0.16	0.80
% married or living together	6	17.6%	34	3	7.7%	39	1.67	0.29
% hospitalized (lifetime)	22	64.7%	34	27	69.2%	39	0.169	0.804
Ethnicity:								
Caucasian	24	70.8%	34	28	71.8%	39	0.01	0.91
Latin America	2	5.9%	34	6	15.4%	39	1.68	0.19
Middle East	4	11.8%	34	4	10.3%	39	0.04	0.84
Asia	2	5.9%	34	0	0.0%	39	1.36	0.24
Africa	2	5.9%	34	1	2.6%	39	0.51	0.48
Primary Diagnosis:								
Schizophrenia	7	20.6%	34	8	20.5%	39	0.00	0.99
Schizoaffective disorder	1	2.9%	34	3	7.7%	39	0.79	0.37
Psychosis NOS	23	67.6%	34	24	61.5%	39	0.30	0.59
Brief psychotic disorder	0	0.0%	34	1	2.6%	39	0.01	0.91
Delusional disorder	2	5.9%	34	2	5.1%	39	0.02	0.89
Depressive disorder with psychotic features	1	2.9%	34	1	2.6%	39	0.01	0.92
Medication use:								
1st gen antipsychotics	6	17.7%	34	6	15.4%	39	0.07	0.79
2nd gen antipsychotics	23	67.7%	34	26	66.7%	39	0.01	0.93
Antidepressants	8	23.5%	34	5	12.8%	39	1.42	0.23
benzodiazepine	2	5.9%	34	8	20.5%	39	3.29	0.07
Other medications	5	14.7%	34	7	18.0%	39	0.14	0.71

3.3.2. Fidelity

At the first assessment, 6 months after the start of the study, teams achieved fair fidelity for IPS, with an average total score of 90.5 (SD = 12.8; score range: 25-125), and fair (proxy for) fidelity for CR, with an average total score of 44.5 (SD = 6.6; score range: 16-64). At the second assessment, 18 months after the start, teams reached fair fidelity for IPS, with an average total score of 91.4 (SD = 16.9), and good (proxy for) fidelity for CR, with an average total score of 49.0 (SD = 6.4).

3.4. Primary outcome

Fig. 2 shows that over the total 18-months study period, *hours worked* per month in competitive employment was higher in the IPS + CR group (M = 29.3 h) compared to the IPS + control group (M = 17.4 h), with a

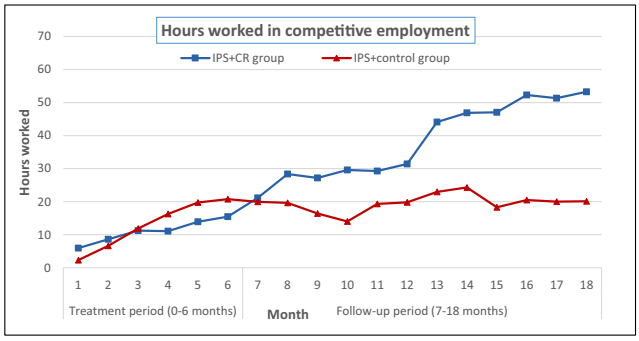

Fig. 2. Hours worked in competitive employment per month.
Hours worked competitive: group x time effect in follow-up period, 7-18 months past baseline (B = 2.94; Wald $\chi 2 = 5.39$; $p = .02$).

trend toward a treatment x time effect ($B = 1.72$; Wald $\chi^2 = 3.80$; $P = .051$). For education, hours spent was lower in the IPS + CR group (M = 8.4 h) compared to the IPS + control group (M = 16.2 h), with a trend toward a treatment x time effect ($B = -0.94$; Wald $\chi^2 = 3.18$; $P = .075$). When co-variates were included, results showed no significant effects for either outcome.

When analyzing results separately for the treatment period (0-6 months) and the follow-up period (7-18 months), there was a significant treatment x time effect during the *follow-up period* for competitive employment. Hours worked in competitive employment was significantly higher in the IPS + CR group (M = 38.5 h) compared with the IPS + control group (M = 19.6 h) ($B = 2.94$; Wald $\chi^2 = 5.39$; $P = .02$). There was no treatment x time effect for education during the follow-up period. During the *treatment period* there was no treatment x time effect for either outcome.

3.5. Secondary outcomes

Secondary outcomes are presented in Table 2.

3.5.1. Vocational secondary outcomes

Competitive *employment rate* showed a significant improvement over time in the IPS + CR group, from 29.4% to 62.1% (B = 1.17; Wald $\chi^2 = 7.61$; $P = .006$) and no significant improvement over time in the IPS + control group (from 23.1 to 25.9%). Results at T2 were significantly higher in the IPS + CR group (62.1%), compared with the IPS + control group (25.9%) ($\chi^2 = 7.39$; $df = 1$; $P = .008$). At this 18 month follow-up measurement, the *education rate* (% participating in regular education) was significantly lower in the IPS + CR group (6.9%) compared with the IPS + control group (29.6%) ($\chi^2 = 5.33$; $df = 1$; $P = .034$). There were no significant treatment x time effects for employment or education rate.

The average *job duration* for both competitive employment and education demonstrated no significant treatment effect over the 18-month study period.

3.5.2. Cognitive functioning

Executive functioning and verbal learning improved more in the IPS + CR group than in the IPS + control group, as shown by significant treatment x time differences in the number of non-perseverative errors in the card sorting task ($B = -3.30$; Wald $\chi^2 = 9.11$; $P = .003$) and a trend for verbal learning with immediate recall ($B = 2.03$; Wald $\chi^2 = 4.28$; $P = .076$). *Subjective* rating of cognitive complaints decreased more in the IPS + CR group than in the IPS + control group, as shown by a significant treatment x time effect ($B = -4.73$; Wald $\chi^2 = 9.64$; $P = .002$). Mean differences between the two groups were especially present in the long term, with a significantly lower score in the IPS + CR group (37.6) at the 18-month assessment, compared with the IPS + control group (45.3) ($F = 5.14$; $P = .027$). There were no treatment x time effects in other cognitive domains.

3.5.3. Mental health

There was no significant effect on any of the PANSS subscales and on the Mental Health Inventory. Self-stigma (ISMI) and empowerment (NEL) demonstrated no significant treatment x time effects. However, within the post-hoc analyses, results on empowerment at the 18-month assessment were significantly higher for the IPS + CR group (46.46), compared with the IPS + control group (43.15) ($F = 4.69$; df = 1; $P = .035$). There were no significant differences between the groups at any time point with regard to self-stigma.

4. Discussion

The results of this study suggest that employment outcomes can be improved when IPS is combined with CR in patients with early psychosis, particularly in the longer term. Over the complete study period, the experimental and control group both improved in the number of hours worked in competitive employment. During the *follow-up period* (months 7-18), however, participants receiving IPS with adjunctive CR worked significantly more hours per month (38.5 h) compared with participants who received IPS plus an active control condition (19.6 h). After 18 months, the IPS + CR group worked more hours in competitive employment and had a higher employment rate.

As stated in the study by Bell et al. (2008), these long-term effects indicate that participants gained something from their cognitive training that allowed them to obtain and maintain competitive employment even after CR ended. By contrast, in the control group this benefit was lessened, despite on-going assistance from IPS specialists. There was not a significant difference between the two groups within the treatment period. This might be explained by a crowding effect: Participants were too busy attending the interventions three times a week.

Our findings are in line with prior studies evaluating CR as add-on to vocational rehabilitation (Bell et al., 2008; McGurk et al., 2016; McGurk et al., 2009; Vauth et al., 2005; Lindenmayer et al., 2008), with the exception of a recent study by Christensen et al. (2019). Our study indicates that the beneficial effects of CR, which were previously demonstrated in groups with schizophrenia and other severe mental illnesses, can be generalized to people with early psychosis.

The competitive employment rate observed in our study was relatively low for participants receiving IPS alone (25.9%). This might be due to the fact that several sites in the present study started to implement IPS at the beginning of the trial. Hence, they had to build their network of competitive employers from scratch. In previous reports we also found lower employment rates during the start of implementation of IPS in the Netherlands (Winter et al., 2020; Burns et al., 2007; Erp van et al., 2007). For participants in the IPS + CR group, however, the competitive employment rate (62.1%) was relatively high. It seems fair to assume that this superior rate might be attributed to the enhancing effect of CR on IPS.

In contrast to our hypothesis, there were no superior education outcomes for IPS + CR. Participants in the IPS-only group achieved a higher education rate (32%) compared with participants with adjunctive CR (7.1%). However, only 14 participants were involved in education during the study period. Furthermore, these results could be explained by the fact that more participants in the IPS + CR group (50%) ended education for positive reasons—having completed their study or started competitive employment—compared with the control group (30%).

Findings regarding cognitive functioning were partially consistent with our hypothesis. There was a beneficial effect of adjunctive CR for subjective cognitive functioning and executive functioning and a trend toward greater improvement of immediate recall in verbal learning. Although in previous research CR alone has shown positive effects on multiple cognitive functions, when compared to treatment as usual (Wykes et al., 2011; McGurk et al., 2007a), we found no beneficial effects of IPS + CR compared with IPS + control on: delayed recall in verbal memory, attention, speed of information processing, and global

Table 2
Secondary outcomes at T0,T1,T2 and analyses of treatment effects over time.

Secondary employment and education outcomes[a]												
Job duration (weeks)	IPS + CR (*N* = 31)				IPS + control (*N* = 34)				Group effect			
	Median	Interquartile rate	M (SD)	Range	Median	Interquartile rate	M (SD)	Range	B	SE	t	*p*-value
Competitive	26	0–51	27.76 (28.2)	0–78	0	0–33	18.10 (28.8)	0–95	9.66	7.09	1.36	0.18
Education	0	0–0	6.13 (16.1)	0–64	0	0–18	15.56 (27.2)	0–77	−9.43	5.92	−1.59	0.12

	T0 - Baseline		T1 - PT (6 mnth)		T2 - FU (18 mnth)		Group x time effect		
Employment rate	IPS + CR (N = 34)	IPS + Control (*N* = 39)	IPS + CR (*N* = 29)	IPS + Control (*N* = 28)	IPS + CR (N = 29)	IPS + Control (*N* = 27)			
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	B	Wald χ^2	p-value
Competitive	10 (29.4%)	9 (23.1%)	9 (31.0%)	6 (21.4%)	18 (62.1%)	7 (25.9%)	0.93	2.73	0.10
Education	7 (20.6%)	8 (20.5%)	3 (10.3%)	6 (21.4%)	2 (6.9%)	8 (29.6%)	-0.99	1.10	0.29

Cognitive outcomes[a]									
	T0 - Baseline		T1 - PT (6 mnth)		T2 - FU (18 mnth)		Group x time effect		
Cognitive tasks	IPS + CR (N = 34)	IPS + Control (N = 39)	IPS + CR (N = 29)	IPS + Control (N = 28)	IPS + CR (N = 29)	IPS + Control (N = 27)			
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	B	Wald χ^2	p-value
CFQ[b]	43.15 (17.08)	38.95 (10.95)	40.28 (15.76)	42.74 (9.02)	37.59 (14.21)	45.30 (10.87)	−4.73	9.64	**0.002**
Global cognition	34.16 (9.99)	37.10 (11.91)	40.23 (11.97)	43.21 (16.08)	42.34 (13.53)	42.32 (12.92)	1.11	0.64	0.42
Word learning-imm	38.97 (10.77)	41.72 (11.36)	45.90 (11.42)	45.85 (12.49)	46.52 (10.99)	45.48 (12.69)	2.03	4.28	0.076
Word learning-del	7.79 (3.51)	8.38 (3.23)	9.59 (3.26)	9.81 (3.27)	9.66 (2.83)	9.48 (3.43)	0.32	0.84	0.36
CPT-median RT[b]	523.6 (197.0)	467.9 (145.8)	525.0 (193.7)	469.1 (163.7)	508.6 (181.4)	484.2 (157.0)	−12.04	0.30	0.58
CPT-SD RT[b]	105.65 (46.5)	96.8 (4201)	99.7 (39.2)	99.7 (58.0)	100.8 (35.9)	100.1 (48.0)	−4.20	0.62	0.43
WCST-pers[b]	14.21 (13.13)	11.9 (12.17)	11.52 (15.31)	10.96 (12.97)	6.79 (9.01)	7.56 (11.23)	−1.49	0.64	0.42
WCST-non pers[b]	14.62 (10.65)	10.28 (8.60)	7.03 (7.10)	10.15 (9.76)	5.00 (4.88)	7.22 (7.44)	−3.30	9.11	**0.003**
Digit span-forw	5.06 (1.18)	4.97 (1.14)	5.18 (1.42)	5.12 (1.21)	5.10 (2.01)	5.37 (0.88)	−0.26	2.20	0.14
Digit span-backw	3.71 (1.19)	4.10 (1.37)	4.36 (1.47)	4.50 (1.03)	4.31 (1.69)	4.0 (1.21)	0.29	2.23	0.14
TMT - flex	17.55 (14.38)	18.27 (11.96)	17.86 (17.90)	23.75 (19.31)	17.25 (14.51)	18.77 (12.72)	0.31	0.04	0.85

Mental health outcomes[a]									
Health questionnaire	IPS + CR (N = 34)	IPS + Control (N = 39)	IPS + CR (N = 29)	IPS + Control (N = 28)	IPS + CR (*N* = 29)	IPS + Control (N = 27)	Group x time effect		
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	B	Wald χ^2	p-value
PANSS: positive[b]	10.82 (3.96)	10.38 (3.33)	9.86 (2.55)	9.50 (2.86)	11.54 (4.21)	11.63 (3.47)	−0.37	0.56	0.45
PANSS: negative[b]	13.45 (3.83)	12.72 (4.01)	12.71 (4.97)	12.50 (3.44)	12.11 (3.85)	12.67 (5.15)	−0.63	1.00	0.32
PANSS: general[b]	27.09 (8.16)	25.21 (5.50)	24.11 (6.65)	25.46 (5.52)	27.00 (7.32)	27.59 (7.19)	−1.22	1.56	0.21
PANSS total score[b]	49.79 (13.52)	48.36 (8.68)	46.32 (11.30)	47.50 (8.93)	50.25 (13.46)	51.89 (13.21)	−1.51	0.86	0.35
MHI	18.68 (4.63)	18.95 (3.49)	19.48 (4.19)	18.74 (4.83)	20.04 (4.12)	19.89 (3.25)	−0.22	0.30	0.59
ISMI[b]	63.77 (12.50)	61.54 (12.07)	58.17 (13.94)	61.70 (14.06)	58.71 (13.91)	59.78 (11.86)	−0.60	0.19	0.66
Empowerment	41.53 (7.39)	42.51 (6.95)	43.69 (7.10)	42.26 (7.83)	46.46 (5.56)	43.15 (5.80)	0.14	2.70	0.10

CFQ = Cognitive Failure Questionnaire; CPT = Continuous Performance Task; WCST = Wisconsin Card Sorting Task; TMT = Trail Making Task; MHI = Mental Health Inventory; ISMI = Internalized Stigma of Mental Illness.

[a] All outcomes are presented without co-variates.

[b] A lower score means improved functioning.

cognition. This outcome seems partially due to the fact that several cognitive functions also improved over time in the IPS + control group (e.g., verbal learning and memory, executive functioning, immediate attention, global cognition). These cognitive functions might have been facilitated in the control group by being engaged in the effort of obtaining and maintaining employment, and by non-specific effects of computer exposure and increased staff attention. Improvements in cognition are largely in line with other studies that supplement vocational rehabilitation with CR, which have found effects in similar domains, plus verbal memory (McGurk et al., 2009; McGurk et al., 2005; Lindenmayer et al., 2008).

Cognitive functioning is a well-established correlate of work improvements (McGurk and Mueser, 2004), and thus the beneficial subjective and objective cognitive improvements in our study, combined with the real-life job participation, might have had a synergistic contribution to the superior vocational outcomes being observed in the IPS + CR group. However, there are reasons to suggest that this might not have been the *only* active ingredient of the intervention. Prior research has suggested that additional program effects of CR could have been equally important in improving vocational outcomes. For example, positive learning experiences during cognitive training (McGurk et al., 2007b) and improved subjective cognitive functioning could have

bolstered self-esteem and intrinsic motivation (Silverstein et al., 2006), contributing to better employment and education outcomes (Bell et al., 2008; Kidd et al., 2014). Consistent with this suggestion, we found an improvement on the *empowerment* scale for participants in the CR group. Furthermore, other components of the CR program, like a focus on increasing meta-cognition and better transfer of strategies to daily life, might have contributed to better vocational performance.

4.1. Strengths and limitations

Strengths of the present study are that, to our knowledge, this is the first RCT to assess whether IPS can be augmented with CR in people with early psychosis. Furthermore, we included an active control condition to control for nonspecific effects like computer exposure and staff attention, and both patients and assessors were blind to treatment. Several limitations of this study should be noted. First, the sample size of 73 was modest. This is not surprising in a RCT with two intensive interventions and three assessment points over 18 months, but it can result in analyses with relatively low statistical power. To further illustrate this point, a review of similar studies supplementing various forms of psychiatric rehabilitation with CR (Duin van et al., 2019) showed an average sample size of 78 (range: 34-174). For the primary outcome, we partially resolved this potential power problem by assessing this outcome monthly at 18 time points. Secondly, the relatively high number of outcomes being measured can increase the risk of a type 1 error, inducing false positive results. Although we tried to prevent this issue by conducting one mixed model analysis, individual outcomes should be interpreted with caution. However, we think the overall results have enough statistical and clinical relevance to draw conclusions.

5. Conclusions

Augmenting IPS with cognitive remediation has a significant impact on competitive employment in people with early psychosis, with beneficial effects mainly seen in the longer term. This phenomenon is important because employment of people with early psychosis has a strong predictive value for future (un)employment and recovery. Future studies with a larger sample size are needed to evaluate the impact of cognitive remediation as an add-on to IPS in patients with early psychosis. Future research should also focus on active ingredients of cognitive remediation in order to make the intervention more precise and personalized.

Informed consent

A written informed consent was obtained from all patients participating in the trial. IRB approval was obtained for this trial (2014.355/NL50176.029.14).

Previous presentation

Data concerning this quality-improvement project have not been presented on an international conference.

Role of funder

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CRediT authorship contribution statement

All authors contributed to the manuscript through writing or edits.

Declaration of competing interest

The authors have declared that there are no conflicts of interest in relation to the subject of this study.

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