

Suicidal ideation in people with psychosis not taking antipsychotic medication: Do negative appraisals and negative metacognitive beliefs mediate the effect of symptoms?

Running Head: Suicidal ideation and psychosis

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Abstract

Between 5 and 10 percent of people with psychosis will die by suicide, a rate which is 20 to 75 times higher than the general population. This risk is even greater in those not taking antipsychotic medication. We examined whether negative appraisals of psychotic experiences and negative metacognitive beliefs about losing mental control mediated a relationship between psychotic symptoms and suicidal ideation in this group. Participants were diagnosed with schizophrenia-spectrum disorders, antipsychotic-free for 6 months at baseline, and were participating in an 18-month randomised controlled trial of cognitive therapy v. treatment as usual. We conducted a series of mediation analyses with bootstrapping on baseline (N=68), follow-up data (9-18 months; n=49), and longitudinal data (n=47). Concurrent general symptoms were directly associated with suicidal ideation at baseline, and concurrent negative symptoms were directly associated with suicidal ideation at 9-18 months. Concurrent positive, negative, general and overall symptoms were each indirectly associated with suicidal ideation via negative appraisals and/or negative metacognitive beliefs, at baseline and 9-18 months, except for negative symptoms at baseline. Controlling for baseline suicidal ideation and treatment allocation, baseline general symptoms were indirectly associated with later suicidal ideation, via baseline negative appraisals and negative metacognitive beliefs. Baseline negative metacognitive beliefs also had a direct association with later suicidal ideation. These findings suggest the clinical assessment of suicidal ideation in psychosis may be enhanced by considering metacognitive beliefs about the probability and consequences of losing mental control.

Keywords: Psychosis, schizophrenia, suicide, antipsychotic medication, appraisals, metacognitive beliefs

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Introduction

Estimates of suicide rates among individuals diagnosed with schizophrenia spectrum disorders range from 5 to 10 percent, making it a leading cause of premature death in this population.¹⁻³ Non-use of antipsychotics is thought to increase this risk further, with one large observational study reporting a 37 times greater risk of suicide in inpatients who were not taking antipsychotics.⁴ Given antipsychotics have their strongest effects on the positive symptoms of psychosis⁵ it is plausible that individuals not taking this medication may have greater positive symptom severity than those who do - and that this accounts for their increased suicide risk.

However the evidence on the contribution of positive symptoms to suicide risk remains unclear. One meta-analysis suggested they were associated with a lower risk,³ one found no association⁶ whereas another found they were associated with a higher risk.⁷ Although this inconsistency may reflect methodological differences, the absence of a robust relationship may indicate the presence of underlying mechanisms that have yet to be fully accounted for. As predicted by cognitive theories,^{8,9} several studies have found that the way a person interprets or ‘appraises’ their psychotic experiences may be more important than symptom severity for predicting suicidal behaviour.^{10,11} Importantly, one review found that people with psychosis who die by suicide were more likely to have ‘fears of mental disintegration’ than matched controls.³

This latter finding suggests ‘metacognition’^{12,13} may be important for understanding their suicidality. Whereas cognition refers to knowledge and appraisals of the external world, metacognition refers to knowledge and beliefs relating to the structure and integrity of the self, and one’s own cognitive processes. Although the distinction between metacognition and cognition has been debated,¹³ Moritz and Lysaker¹³ review how it has been usefully applied in psychosis to understanding the psychological mechanisms implicated in (i) awareness of cognitive biases,¹⁴ such as the ‘jumping to conclusions’ bias,^{15,16} (ii) concepts of self and others, including perceived self-integration¹⁷ and (iii) negative metacognitive beliefs about the controllability and danger of worry and rumination.¹⁸ In relation to the latter, high levels of negative metacognitive beliefs are associated with psychotic symptom severity and chronicity,¹⁹⁻²² and changing these beliefs may lead to improvements in psychotic symptoms.²³⁻²⁶ Although worry and rumination are associated with suicidality in various populations²⁷⁻²⁹ and although a cross-sectional study (N=1920) found that rumination was associated with increased suicidality in people with schizophrenia,³⁰ negative metacognitive beliefs have not featured prominently in theoretical accounts of their increased suicide risk.³¹

In this study, we set out to test a metacognitive model of suicidal ideation in this group (see Figure 1).³² We focused on recent suicidal ideation (past 2 weeks) because of its strong relationship to dying from suicide in psychosis (OR 30, 95% CI 12-73)³ and we focused on those who have been antipsychotic-free for an extended period of time, because they are considered to be at particularly high risk of suicide.⁴ The model we tested is a version of a model of psychosis-related distress we developed for a recent case-series of metacognitive therapy (MCT),³³ but adapted to explain suicidality. According to this, a person may have suicidal thoughts because of an increase in the severity and negative content of their psychotic symptoms, which may in turn activate cognitive appraisals involving defeat and hopelessness (e.g., “*I am powerless to influence or control my experiences*”).¹¹ However, the effect of symptoms and symptom appraisals on suicidal ideation will be magnified by negative ‘metacognitive’ beliefs about the uncontrollability and danger of worry (e.g., “*My worrying thoughts persist, no matter how I try to stop them*”, “*My worrying could make me go mad*”). The emergence of suicidal ideation can be conceptualised as not only a response to symptoms

and related perceptions of defeat and entrapment, but also as attempts at cognitive control, motivated by worry about the uncontrollability and danger of worry itself.

To test the model, we examined whether negative cognitive appraisals and negative metacognitive beliefs mediate the relationship between psychotic symptoms (overall, positive, negative or general) and suicidal ideation at baseline (month 0) and at follow-up (months 9-18). We then examined whether their initial cognitive appraisals and metacognitive beliefs mediated the relationship between initial symptom severity and future suicidal ideation.

Methods

Study Design, Participants, and Procedures

This study is a secondary analysis of baseline and 9-18 month data obtained from the ACTION RCT, a pilot trial designed to assess the effects of cognitive therapy in individuals with a schizophrenia spectrum diagnosis not receiving antipsychotic medication for at least 6 months.³² The trial was approved by the UK NHS National Research Ethics Service (09/H1014/53) and conducted in two sites (Manchester and Newcastle) between 2010 and 2013 (see protocol³⁴ for further information).

Measures

Symptoms: Positive and Negative Syndrome Scale (PANSS)

The PANSS³⁵ is a 30-item interview based measure developed to assess the following symptom subscales associated with schizophrenia: General Psychopathology (16 items), Negative Symptom Scale (7 items), and Positive Symptom Scale (7 items). Symptoms in the preceding week are assessed using a 1-7 point Likert scale.

Cognitive appraisals: Personal Beliefs About Experiences Questionnaire (PBEQ)

The PBEQ is a revised version of the Personal beliefs about Illness Questionnaire (PBIQ),^{36,37} and is designed to measure cognitive appraisals about psychotic experiences. Rating of the 13 items is on a 4-point Likert type scale, which ranges from 'strongly disagree' to 'strongly agree'. Factor analysis suggests the PBEQ measures three specific domains of cognitions: Negative Appraisal of Experience (5 items), External Shame (2 items), and Internal Shame/Defectiveness (6 items).³⁸ The PBEQ was also shown to have adequate internal reliability and validity. The Negative Appraisal of Experience subscale, which assesses the respondent's negative appraisals and expectations of their own psychotic experiences, was used in this analysis. Items include "I am powerless to influence or control my experiences" and "My experiences frighten me".

Negative metacognitive beliefs: The Metacognitions Questionnaire 30-item version (MCQ-30)

The MCQ-30³⁹ is a 30-item self-report questionnaire, which measures individual metacognitive beliefs and processes, grouped under five different subscales; positive beliefs about worrying, negative beliefs about uncontrollability and danger of worry, cognitive confidence, beliefs about the need to control thoughts, and cognitive self-consciousness. Items are scored on a 4-point Likert type scale with 1 representing 'I do not agree' and 4 representing 'I agree very much'. The MCQ-30 has good internal consistency, validity, and reliability.³⁹ We used the 'Negative beliefs about uncontrollability and dangerousness of thoughts' subscale in the current analysis. This assesses negative metacognitive appraisals and expectations about worrying and thinking. Items include "My worrying could make me go mad" and "My worrying is dangerous for me".

The Beck Depression Inventory for Primary Care (BDI-PC)

The Beck Depression Inventory for Primary Care (BDI-PC)⁴⁰ is a self-report questionnaire which measures depression severity. In this analysis, responses to item 7 (item 9 in the full BDI-2) were used to measure suicidal ideation. This item requires participants to select which of four statements best describe their experiences over the preceding 2 weeks. The statements are “*I don’t have any thoughts of killing myself*” (score of 0), “*I have thoughts of killing myself, but I would not carry them out*” (score of 1), “*I would like to kill myself*” (score of 2), and “*I would kill myself if I had the chance*” (score of 3). Responses correlate highly with the Beck Scale of Suicidal Ideation ($r = 0.56 - 0.58$),⁴¹ and individuals scoring ≥ 2 on this item were 6.9 times more likely to commit suicide than those scoring < 2 .⁴²

Statistical Analyses

Mediation analyses were conducted to concurrently test the direct effect of psychotic symptoms (overall, positive, negative or general) on suicidal ideation, and their hypothesised indirect effects through cognitive appraisals and metacognitive beliefs, at the two time points when we assessed each variable. To minimise the loss of power introduced by missing data at follow-up, we combined into one group those who had full datasets at either 9 months ($n=39$) or 18 months ($n=10$). To assess the risk of bias introducing by missing data, we tested for differences in baseline characteristics between the full baseline sample ($N=68$) and those for whom we had full baseline and full follow-up data ($n=47$). We also ran all baseline mediation analyses in both samples, and covaried for the follow-up assessment time-point (9 or 18 months).

We tested a model whereby, after controlling for participant differences in age, gender, years of education, group allocation (follow-up analysis only) and the point when suicidal ideation was assessed (follow-up analysis only), psychotic symptoms activate negative cognitive appraisals, which then activate negative metacognitive beliefs, which in turn activates greater suicidal ideation (Figure 1). All mediation analyses were performed using Model 6 of the PROCESS⁴³ macro for the IBM Statistical Package for Social Sciences (SPSS) (see Figure 2). This macro is based on a logistic regression-based path analytic framework and employs bootstrapping to determine the magnitude and significance of the direct (unmediated) and indirect (mediated) effects.⁴⁴ Bootstrapping is a non-parametric approach that can be applied to smaller sample sizes and non-normal data.⁴⁵ All models were conducted with bias-corrected confidence intervals based on 5,000 samples. In line with previous studies,⁴⁶⁻⁴⁹ suicidal ideation scores were treated as a continuous variable in all analyses.

We used linear regression to explore the potential prospective association between psychotic symptoms, metacognitive beliefs and suicidal ideation over time. This analysis focuses on the residual variance in suicidal ideation once baseline levels are accounted for. For the linear regression model, suicidal ideation at 9-18 months was first regressed onto symptoms (positive, negative and general) and covariates (same as 9-18 month cross-sectional analysis, but with the addition of baseline suicidal ideation). We then examined whether models also incorporating (a) baseline negative cognitive appraisals and (b) baseline negative metacognitive beliefs helped to explain additional variance.

We then tested whether cognitive appraisals and negative metacognitive beliefs at baseline mediated a relationship between psychotic symptoms at baseline and suicidal ideation at 9-18 months, using the same covariates for the linear regression. For this, the baseline value of each symptom category was the independent variable, the mediating variables of interest were baseline appraisals and metacognitive beliefs, and the dependent variable was suicidal ideation

at 9-18 months. We also examined the effect of symptom categories with and without other symptom categories as covariates.

For all mediation analyses the unstandardised direct (UDE) or indirect (UIE) effects, and the completely standardised (CSE) indirect effects were calculated as measures of effect size. The UDE and UIE represent the unit change in the dependent variable per unit change in the independent, whether direct (unmediated; UDE) or indirect (mediated; UIE). The CSE represents the proportion of standard deviation change in the dependent variable per 1 standard deviation (SD) unit change in the independent variable, occurring through change in the mediator. Cohen's guidelines for interpreting standardised mean differences can therefore be applied to the CSE to provide an approximate appraisal of the magnitude of the dependent variable change (0.2=small; 0.5=moderate; 0.8=large),⁵⁰ per a large (1 SD) change in the independent variable. Cohen's criteria were also used to interpret correlations (0.1=small; 0.3=moderate; 0.5=large).

Results

Participant Characteristics (Table 1)

The mean age of the full sample (N=68) was 31 (SD = 12.75). Just under half (n=31, 46%) were female. Overall, 60% (n=41) of these participants reported suicidal ideation at trial entry; 50% (n=34) reported having mild suicidal ideation whereas 10% (n=7) reported severe to very severe ideation involving intent. There were no significant differences in demographics, symptom severity, suicidal ideation, negative cognitive appraisals or negative metacognitive beliefs between the full sample, and those who provided full data at baseline and 9-18 months (all $p>0.1$).

Correlations (Table 2).

No correlation was observed between suicidal ideation and negative symptoms at baseline, but a moderate correlation ($r=0.30$) was evident at 9-18 months. At baseline, moderate correlations were observed between suicidal ideation and positive and overall symptoms for the sample with 9-18-month data. These associations were large at 9-18 months ($r=0.47-0.51$). Large correlations ($r=0.43-0.57$) between suicidal ideation and negative cognitive appraisals, negative metacognitive beliefs and general symptoms were also observed at both baseline (both samples) and at 9-18 months.

Cross-sectional analyses

Baseline (Supplementary Table 1)

All results in the full sample (reported here) were replicated in those with full baseline and follow-up data. Total symptoms were related to suicidal ideation through the negative cognitive appraisals alone (CSE 0.13, 95% CI 0.04, 0.25) and the combined negative cognitive appraisals and negative metacognitive beliefs pathways (CSE 0.03, 95% CI -0.00, 0.11). No direct (unmediated) effect was observed. The same pattern was observed for positive symptoms. Overall, the effects suggest a 1 SD increase in overall or positive symptoms were indirectly associated with small increases in suicidal ideation (CSEs 0.12 - 0.18), with approximately 70% of the indirect effects accounted for by the negative cognitive appraisals alone pathway, and 20% by the combined negative cognitive appraisals and negative metacognitive beliefs pathway. Negative symptoms did not have a direct or indirect relationship with suicidal ideation. General symptoms had both a direct effect on suicidal ideation, suggesting a 0.03 unit increase in suicidal ideation scores for each unit increase in general symptoms [unstandardised

direct effect (UDE) 0.03, standard error (SE) 0.012, $p < 0.05$] and an indirect (mediated) effect (CSE 0.19, 95% CI 0.09, 0.34), suggesting that for a 1 SD increase in general symptoms, there was an additional 0.19 SD increase in suicidal ideation. As with total and positive symptoms, approximately 70% of this was accounted for by negative cognitive appraisals (CSE 0.14, 95% 0.05, 0.26).

The indirect effect of positive symptoms was not robust to controlling for negative and general symptoms. However, both the direct and indirect effects of general symptoms remained significant after controlling for positive and negative symptoms. Although the overall indirect effect was marginally smaller (CSE 0.17, 95% CI 0.06, 0.31), the proportion explained by negative cognitive appraisals was larger (80%) in this analysis.

9-18 months (Supplementary Table 3)

No direct effect of total symptom severity on suicidal ideation was observed at 9-18 months, however this had an indirect effect through the combined pathway of negative cognitive appraisals and negative metacognitive beliefs (CSE 0.10, -0.00, 0.29). For a 1 SD increase in total symptoms, there was an overall 0.27 SD (95% CI 0.06, 0.26) indirect increase in suicidal ideation. The combined appraisals and negative metacognitive beliefs pathway accounted for approximately 37% of this effect. There was also no direct effect of positive symptoms. Although they had a significant indirect effect on suicidal ideation, with a 1 SD increase in positive symptoms indirectly associated with a 0.31 SD (95% CI 0.04, 0.61) increase in suicidal ideation, no one individual pathway was significant. The relative contributions of each individual pathway to this effect was similar to that for total symptoms. Negative symptoms had a direct effect on suicidal ideation at this timepoint, but no indirect effect. For each unit increase in negative symptoms, there was a 0.043 unit increase in suicidal ideation (SE 0.021, $p < .05$). As with total and positive symptoms, general symptoms were not directly associated with suicidal ideation. As with total symptoms, general symptoms had an indirect effect on suicidal ideation via the combined appraisals and metacognitive beliefs pathway (CSE 0.10, 95% CI 0.01, 0.30). The effect sizes and relative contribution of individual pathways was similar to that for total and positive symptoms.

When we entered other symptom categories as covariates in the analyses of positive, negative and general symptoms, the indirect effects for positive symptoms were no longer significant and the analysis of negative symptoms remained unchanged. General symptoms continued to not have a direct effect after controlling for positive and negative symptoms. The indirect effect remained significant, however the contribution of the individual pathways changed, and the total indirect effect fell from a 0.32 SD (95% CI 0.09, 0.58) change in suicidal ideation per 1 SD change in general symptoms, to a 0.22 SD (95% CI 0.04, 0.45) change. The contribution of negative metacognitive beliefs to this effect increased from a nonsignificant 49% to a significant 70% (CSE 0.16, 95% CI 0.01, 0.43), and the contribution of the combined appraisals and metacognitive beliefs pathway fell from a significant 31% to a non-significant 24%.

Longitudinal analyses

Multiple linear regression (Supplementary Table 2)

Baseline psychotic symptoms and suicidal ideation, together with covariates, accounted for 54% of the variance in suicidal ideation at 9-18 months. Adding baseline negative cognitive appraisals to the model did not account for additional variance, however adding negative metacognitive beliefs accounted for a further 5% ($p < 0.05$). An effect of female gender also

emerged; this was associated with a significant reduction in BDI suicidal ideation scores (0.4 points, $p < 0.05$).

Mediation analysis (Table 3)

No direct effects of baseline symptoms on suicidal ideation at 9-18 months were observed. There were also no indirect effects of baseline negative or positive symptoms. Baseline total symptoms and general symptoms, however, had indirect effects on suicidal ideation at follow-up via the combined appraisals and metacognitive beliefs pathway. A 1 SD increase in baseline overall symptoms and baseline general symptoms accounted for a 0.03 SD (95% CI 0.00, 0.12) and 0.04 SD (95% CI 0.00, 0.14) increase in suicidal ideation at 9-18 months via this pathway, respectively.

The analyses for general, positive and negative symptoms were largely unaffected by controlling for other symptom categories, although a significant direct effect of baseline negative metacognitive beliefs (UDE 0.051, SE 0.023, $p = 0.03$) emerged in the general symptoms analysis and, as with the linear regression, a significant association between suicidal ideation and female gender emerged in each analysis, with a similar effect size.

4. Discussion

We tested a metacognitive model of suicidal ideation in people with psychosis not taking antipsychotic medication, a group considered to be at particularly high risk of suicide.^{3,4} We tested whether psychotic symptoms may contribute to increased suicidal ideation not only directly, but also indirectly via appraisals of symptoms, and metacognitive beliefs about the probability and consequences of losing mental control.^{24,33}

We found no evidence that positive or total symptom severity has a direct effect on suicidal ideation in this group. Only concurrent general symptoms had a direct effect at baseline, and only concurrent negative symptoms had a direct effect at follow-up. Concurrent general symptoms also had an indirect effect on baseline suicidal ideation, mediated by negative cognitive appraisals. This was robust to controlling for other symptom categories. However no indirect effect of negative symptoms was found, and the indirect effect of positive symptoms was not robust to controlling for general and negative symptoms. At 9-18 months, a similar pattern emerged. However, negative metacognitive beliefs played a more significant role at this point, which suggests the psychological mechanisms involved in suicidal ideation in psychosis may change over time in this group. They either formed part of the indirect pathway, mediating the mediating effect of negative cognitive appraisals (positive symptoms, general symptoms), or were a sole mediator (general symptoms controlling for positive and negative symptoms). Again, the pathway linking general symptoms and suicidal ideation was the only indirect pathway robust to controlling for other symptom categories.

The longitudinal analyses are relevant to interpreting these findings. No direct effect of baseline general symptoms on later suicidal ideation was evident, but it had an indirect effect through concurrently measured negative cognitive appraisals and negative metacognitive beliefs. Although this indirect pathway explained only a very small amount of future suicidal ideation, both the linear regression and the mediation analyses (general symptoms, controlling for negative and positive symptoms) suggested a 1 point increase in baseline negative metacognitive beliefs may directly account for a 0.05 point increase in suicidal ideation at 9-18 months, which corresponds to a 0.5 point increase on the BDI suicide item (scored 0-3) per 10-point increase in negative metacognitive beliefs (scored 6-24). Notably, these beliefs did

not predict concurrent suicidal ideation at baseline. If further research confirms these findings, high negative metacognitive beliefs at baseline may be a useful predictor of later increases in suicidal ideation in people with psychosis who are not currently taking antipsychotic medication, both directly and as a mediator of early general symptoms.

Limitations

We used a single-item measure of suicidal ideation, however Dessailles and colleagues, in a study of 281 suicide-attempters,⁵¹ concluded the single suicide item represented a valid approach to assess suicidal ideation, a finding replicated by Brown and colleagues in a sample of 5319 patients.⁵² Endorsing suicidal ideation on the BDI item also has important implications for clinical risk assessment.⁵² The BDI data were treated as interval for the analyses. This is in line with previous studies,^{46–49} and dichotomising the data for logistic regression would incur a substantial loss of statistical power.^{53,54} There is debate over the best way to conceptualise questionnaire data,⁵⁵ but we encourage attempts to replicate these findings using full scale measures (e.g., the Beck Scale for Suicidal Ideation⁵⁶). Evidence suggests the PANSS may have a 5-factor structure.^{57,58} We used the traditional 3-factor structure,³⁵ since this is widely used and interpretable by clinicians.⁵⁹ Although a larger sample would have greater power to detect smaller effects with greater precision, in-depth psychological studies of people with psychosis who are antipsychotic-free are rare, partly because few people with psychosis are not taking antipsychotics. Finally, the analyses tested a theoretically driven model, but alternative ordering of the variables is also plausible. Causal claims await the results of randomised controlled ‘interventionist-causal’ trials,⁶⁰ where the effect of selectively reduce negative metacognitive beliefs on suicidality can be assessed.

Implications

Consistent with previous findings, that fears of mental disintegration are strongly associated with suicide in psychosis,³ our results suggest that the way people appraise their symptoms and their consequences, including whether they heighten concerns about losing mental control, may partly determine whether they lead to thoughts of suicide. RCTs of interventions which either address negative metacognitive beliefs, such as Metacognitive Therapy (MCT),⁶¹ or directly enhance self-integration, such as Metacognitive Reflection and Insight Therapy (MERIT)⁶² and Cognitive Analytic Therapy (CAT)^{63,64} may be warranted to examine their effect on suicidality. Overall, our findings emphasise the importance of clinicians promoting a recovery-focused and appropriately optimistic outlook when working with people with psychosis, taking care to avoid providing information that might heighten negative illness appraisals and/or fears of losing mental control.

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Conflict of interest statement

DT receives royalties from books he has published on cognitive therapy, has received fees for delivering workshops on cognitive therapy, and has received lecture fees from pharmaceutical companies. PH, FD, HS and PT declare they have no conflicts of interest.

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Tables

Table 1: Participant characteristics

Variable	All	9-18 month completers	
	0 months (N=68)	0 months (n=47-49)	9-18 months (n=49)
Age, mean (SD)	31.28 (12.75)	29.92 (11.18)	
Gender, n female (%)	31 (46%)	23 (47%)	
Years of education, mean (SD)	12.59 (3.03)	12.31 (2.86)	
MCQ-30: 'Negative Beliefs about Uncontrollability and Danger' subscale, mean (SD)	17.28 (4.82)	16.98 (4.55) ¹	15.87 (4.70)
PBEQ: 'Negative Appraisals of Experiences' subscale, mean (SD)	14.09 (3.16)	14.22 (3.16) ²	12.92 (3.78)
PANSS: Positive symptoms, mean (SD)	20.99 (4.89)	20.29 (4.30)	16.63 (6.21)
PANSS: Negative symptoms, mean (SD)	14.75 (4.52)	14.73 (4.90)	13.90 (4.48)
PANSS: General symptoms, mean (SD)	36.69 (7.54)	36.02 (7.36)	31.98 (9.34)
PANSS: Total symptoms, mean (SD)	72.43 (13.77)	71.04 (13.41)	62.51 (17.44)
BDI-7: Suicidal ideation, mean (SD)	0.74 (0.73)	0.73 (0.81)	0.53 (0.71)
BDI-7: Suicidal ideation, n no ideation (%)	27 (40%)	22 (45%)	28 (57%)
BDI-7: Suicidal ideation, n mild (%)	34 (50%)	20 (41%)	17 (35%)
BDI-7: Suicidal ideation, n moderate-severe (%)	5 (7.4%)	5 (10%)	3 (6%)
BDI-7: Suicidal ideation, n severe (%)	2 (3%)	2 (4%)	1 (2%)

Note: SD, Standard Deviation; MCQ-30, Metacognition Questionnaire 30-item version; PBEQ, Personal Beliefs about Experiences Questionnaire; PANSS, Positive and Negative Syndrome Scale; BDI-7, Beck Depression Inventory 7-item version. ¹N=48; ²N=47

Table 2: Correlations between variables (Pearson's r, 2-tailed)

	Time-point (month)	N	Age	Education	MCQ Negative beliefs	PBEQ Negative appraisals	Positive symptoms	Negative symptoms	General symptoms	Overall symptoms
Education	0	68	-.02							
	0	49	-.17							
	9-18	49	-.17							
MCQ Negative beliefs	0	68	-.08	.10						
	0	48	-.14	-.08						
	9-18	49	.02	-.12						
PBEQ Negative appraisals	0	68	-.17	-.01	.59**					
	0	47	-.04	-.10	.58**					
	9-18	49	.12	-.10	.72**					
Positive symptoms	0	68	.20	-.05	.16	.17				
	0	47-49	.08 ¹	-.06 ¹	.30^{2*}	.29^{3*}				
	9-18	49	.23	-.24	.64**	.58**				
Negative symptoms	0	68	-.12	-.21	-.02	.13	.25*			
	0	47-49	-.16 ¹	-.23 ¹	.05 ²	.13 ³	.27 ¹			
	9-18	49	.06	-.13	.15	.31*	.39**			
General symptoms	0	68	-.03	-.04	.37**	.42**	.60**	.49**		
	0	47-49	-.15 ¹	-.03 ¹	.40^{2**}	.43^{3**}	.59^{1**}	.48^{1**}		
	9-18	49	.19	-.04	.63**	.58**	.78**	.56**		
Overall symptoms	0	68	.01	-.11	.25*	.33**	.77**	.68**	.92**	
	0	47-49	-.12 ¹	-.12 ¹	.33^{2*}	.38^{3**}	.74^{1**}	.72^{1**}	.91^{1**}	
	9-18	49	.20	-.14	.60**	.59**	.87**	.69**	.96**	
BDI-7 suicidal ideation	0	68	-.01	-.02	.43**	.51**	.25*	.00	.45**	.34**
	0	47-49	-.02 ¹	-.02 ¹	.46^{2**}	.51^{3**}	.36^{1*}	-.02 ¹	.45^{1**}	.36^{1*}
	9-18	49	.11	-.07	.57**	.47**	.50**	.30*	.47**	.51**

Note: BDI-7, Beck Depression Inventory, 7-item version; MCQ, Metacognitions Questionnaire 30-item version; PBQ, Personal Beliefs about Experiences Questionnaire;

¹N=49; ²N=48; ³N=47; *p<0.05; ** p<0.01; All significant results (p<0.05) are highlighted in bold

Table 3: Results of longitudinal mediation analyses

Model (all n=47)	Predictor		Suicidal ideation in 9 or 18 month completers, b	
			Unstandardised coefficients (SE)	Completely standardised coefficients (95% CI)
Overall symptoms	Control variables	Age (baseline)	0.010 (0.008)	-
		Gender (fixed)	-0.325 (0.170)†	-
		Education (baseline)	-0.013 (0.029)	-
		Treatment allocation ²	-0.082 (0.168)	-
		Suicidal ideation at month 0 9 or 18-month data	0.515 (0.122)**	-
			0.299 (0.200)	-
	Independent variables	Overall symptoms at month 0 (direct effect)	0.001 (0.007)	-
		Negative cognitive appraisals at month 0	-0.022 (0.034)	-
		Negative metacognitive beliefs at month 0	0.043 (0.023)†	-
		R ²	0.562**	
	Bootstrap indirect effects of:	Overall symptoms ¹ > Negative cognitive appraisals ¹	-0.001 (0.002) 95% CI (-0.007, 0.001)	-0.022 (-0.049, 0.253)
		Overall symptoms ¹ > Negative metacognitive beliefs ¹	0.002 (0.003) 95% CI (-0.001, 0.011)	0.038 (-0.029, 0.235)
		Overall symptoms ¹ > Negative cognitive appraisals ¹ > Negative metacognitive beliefs ¹	0.001* (0.001) 95% CI (0.000, 0.006)	0.028* (0.000, 0.120)
		Total indirect effect	0.002 (0.003) 95% CI (-0.002, 0.012)	0.045 (-0.049, 0.253)
Positive symptoms	Control variables	Age (baseline)	0.010 (0.008)	-
		Gender (fixed)	-0.354* (0.167)¹	-
		Education (baseline)	-0.014 (0.029)	-
		Treatment allocation ²	-0.067 (0.166)	-
		Suicidal ideation at month 0 9 or 18-month data	0.538** (0.121)¹	-
			0.308 (0.196)	-

Model (all n=47)	Predictor		Suicidal ideation in 9 or 18 month completers, b		
			Unstandardised coefficients (SE)	Completely standardised coefficients (95% CI)	
	Independent variables	Positive symptoms at month 0 (direct effect)	-0.012 (0.020)	-	
		Negative cognitive appraisals at month 0	-0.020 (0.034)	-	
		Negative metacognitive beliefs at month 0	0.045 [†] (0.023) ¹	-	
		R ²	0.566***¹	-	
		Positive symptoms ¹ > Negative cognitive appraisals ¹		-0.002 (0.004) 95% CI (-0.017, 0.002)	-0.013 (-0.135, 0.018)
		Positive symptoms ¹ > Negative metacognitive beliefs ¹		0.005 (0.009) 95% CI (-0.005, 0.032)	0.041 (-0.040, 0.231)
		Positive symptoms ¹ > Negative cognitive appraisals ¹ > Negative metacognitive beliefs ¹		0.002 (0.004) 95% CI (-0.002, 0.014)	0.019 (-0.013, 0.105)
		Total indirect effect		0.006 (0.009) 95% CI (-0.017, 0.002)	0.048 (-0.054, 0.236)
	Negative symptoms	Control variables	Age (baseline)	0.011 (0.007)	-
			Gender (fixed)	-0.322 [†] (0.161) ¹	-
Education (baseline)			-0.005 (0.029)	-	
Treatment allocation ²			-0.125 (0.167)	-	
Suicidal ideation at month 0			0.522** (0.115)¹	-	
9 or 18-month data			0.269 (0.194)	-	
Independent variables		Negative symptoms at month 0 (direct effect)	0.022 (0.017)	-	
		Negative cognitive appraisals at month 0	-0.024 (0.033)	-	
		Negative metacognitive beliefs at month 0	0.044 [†] (0.022) ¹	-	
		R ²	0.580***¹	-	
Independent variables		Negative symptoms ¹ > Negative cognitive appraisals ¹		-0.001 (0.006) 95% CI (-0.015, 0.002)	-0.009 (-0.118, 0.016)
		Negative symptoms ¹ > Negative metacognitive beliefs ¹		-0.001 (0.006) 95% CI (-0.014, 0.011)	-0.013 (-0.125, 0.079)

Model (all n=47)	Predictor		Suicidal ideation in 9 or 18 month completers, b		
			Unstandardised coefficients (SE)	Completely standardised coefficients (95% CI)	
		Negative symptoms ¹ > Negative cognitive appraisals ¹ > Negative metacognitive beliefs ¹	0.001 (0.003) 95% CI (-0.002, 0.011)	0.011 (-0.018, 0.016)	
		Total indirect effect	-0.001 (0.006) 95% CI (-0.012, 0.014)	-0.010 (-0.111, 0.105)	
General symptoms	Control variables	Age (baseline)	0.009 (0.008)	-	
		Gender (fixed)	-0.347† (0.173) ¹	-	
		Education (baseline)	-0.014 (0.029)	-	
		Treatment allocation ²	-0.075 (0.166)	-	
		Suicidal ideation at month 0 9 or 18-month data	0.531** (0.125)¹ 0.318 (0.203)	- -	
		Independent variables	General symptoms at month 0 (direct effect)	-0.004 (0.014)	-
	Negative cognitive appraisals at month 0		-0.020 (0.034)	-	
	Negative metacognitive beliefs at month 0		0.044† (0.023) ¹	-	
	R ²		0.562**¹	-	
			General symptoms ¹ > Negative cognitive appraisals ¹	-0.002 (0.004) 95% CI (-0.015, 0.003)	-0.025 (-0.171, 0.035)
			General symptoms ¹ > Negative metacognitive beliefs ¹	0.005 (0.006) 95% CI (-0.001, 0.023)	0.061 (-0.019, 0.248)
			General symptoms ¹ > Negative cognitive appraisals ¹ > Negative metacognitive beliefs ¹	0.003* (0.002)¹ 95% CI (0.000, 0.013)	0.035* (0.004, 0.141)
			Total indirect effect	0.006 (0.007) ¹ 95% CI (-0.031, 0.024)	0.071 (-0.044, 0.279)

Note: Exact p-values for completely standardised indirect effects not available. Significance (p<0.05) inferred when 95% confidence intervals exclude zero; †p<0.1; *p<0.05; **p<0.01; ¹Remained or became significant (p<0.05) after entering other symptom groups as covariates; All significant results (p<0.05) are highlighted in bold.

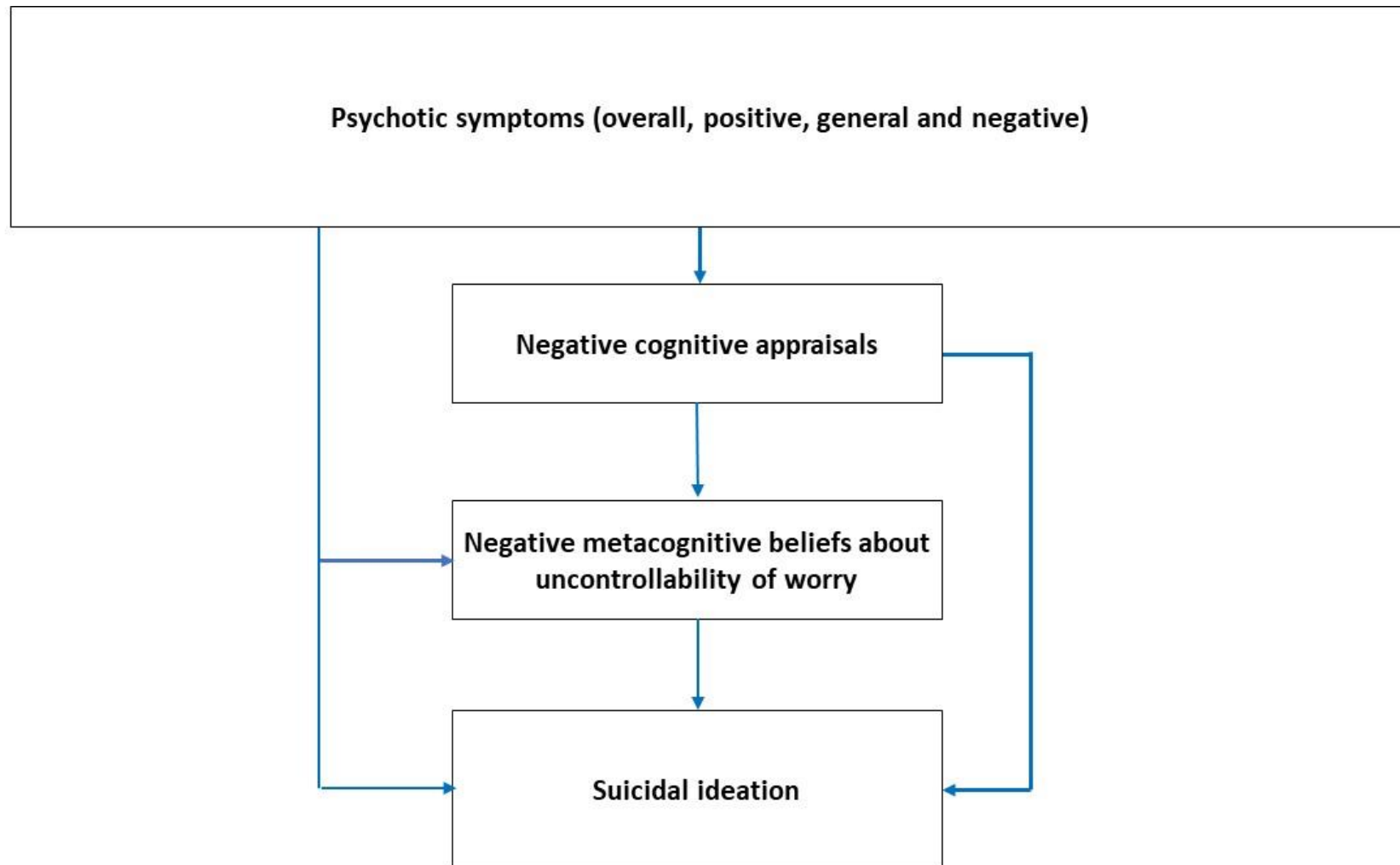


Figure 1: Metacognitive model of suicidal ideation in psychosis

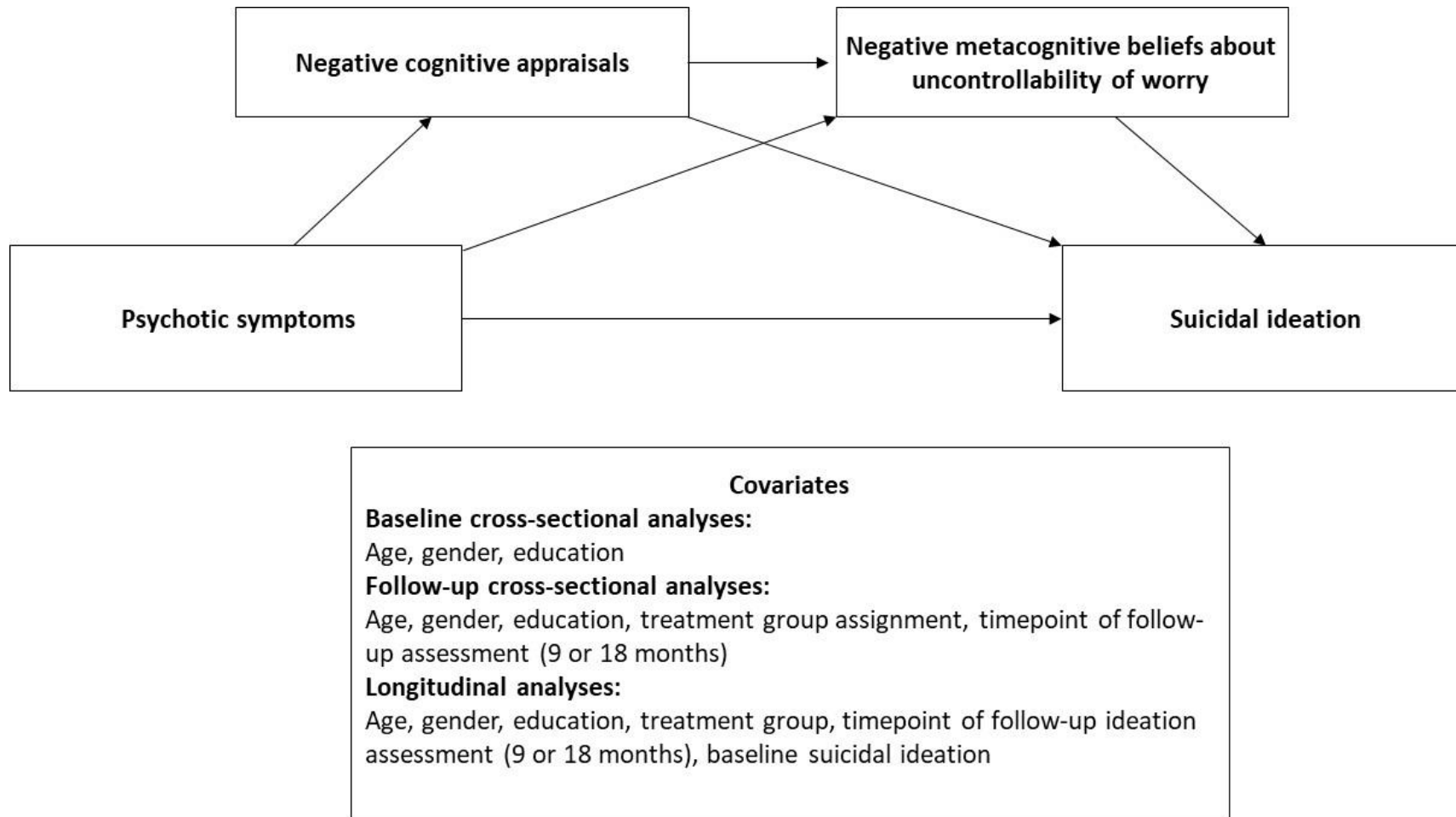


Figure 2: General mediation model tested (i.e., PROCESS Model 6)