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O'Hare, Kirstie J. M.

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Association of Subclinical Psychosis with Suicidal Ideation: A Twin Study

Running title: Subclinical Psychosis and Suicidal Ideation

Kirstie J. M. O'Hare^{1,*}, Tellervo Korhonen², Antti Latvala³, Jaakko Kaprio^{2,4}, Richard J. Linscott¹

Affiliations:

¹Department of Psychology, University of Otago, Dunedin, New Zealand

²Institute for Molecular Medicine Finland, University of Helsinki, Helsinki, Finland

³Institute of Criminology and Legal Policy, University of Helsinki, Helsinki, Finland

⁴Department of Public Health, University of Helsinki, Helsinki, Finland

* Corresponding author at: Department of Psychology, University of Otago, P. O. Box 56,

Dunedin 9054, New Zealand. Tel.: +64 3 479 5689; fax: +64 3 479 8335.

E-mail address: kirstie.ohare@gmail.com

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Abstract

Subclinical psychosis, including schizotypal indicators and psychotic experiences, predicts future suicidal ideation. This relationship may reflect unmeasured confounding from environmental factors, genetic factors, or both. We used a genetically-informative twin design to understand if the association between subclinical psychosis and suicidal ideation is independent of shared genetic and environmental factors. We analysed cross-sectional associations of age-22 self-reported subclinical psychosis (positive, negative, and disorganised features) with suicidal ideation in twins participating in the FinnTwin12 study (maximum $n = 1213$). Then, we analysed the reverse association of age-14 suicidal ideation with age-22 subclinical psychosis. Associations were studied first among individuals and then within monozygotic (MZ) and dizygotic (DZ) pairs. Individual-level analyses showed that all subclinical psychosis factors were associated with suicidal ideation. In within-pair analyses, estimates of associations were lower for MZ pairs than DZ pairs, except for the negative schizotypy–suicidal ideation association where estimates were consistent across individual-level and within-pair analyses. Findings provide evidence that the association between negative features and suicide ideation is not explained by familial factors and may be causal, though the possibility of confounding by individual-specific environmental factors and reverse causation cannot be ruled out. The relationships of positive and disorganised subclinical psychosis features with suicidal ideation cannot be explained by confounding due to environmental factors shared between siblings, but their associations may be due to shared genetic factors.

Key words: Psychotic Experiences, Schizotypy, Suicide, Twins, Genetics, Causality

1. Introduction

Suicide is a major public health problem, with over 800,000 people taking their own lives each year (World Health Organization, 2014). Suicidal ideation and behaviours (SIB) are particularly prominent in adolescents and young adults, and represent a leading cause of death in this age group (Hawton et al., 2012). Despite a large increase in the number of published studies on suicide risk factors in the past 50 years, predictive ability of these factors has not improved (Franklin et al., 2017) and there is a lack of progress in understanding risk factors that generate suicidal thoughts and behaviours (Glenn et al., 2017; Prinstein, 2008). The past decade has seen accumulating evidence that subclinical psychosis predicts SIB (Taylor *et al.*, 2015; Honings *et al.*, 2016; Hielscher *et al.*, 2018; Yates *et al.*, 2019).

Diverse terms are used to describe subclinical psychosis, including *psychotic* or *psychotic-like experiences*, *delusion-* and *hallucination-like experiences*, *psychosis-proneness*, *psychoticism*, and *schizotypy*. Although there are not clear measurement boundaries among these, distinction can be drawn between two main but overlapping categories, namely isolated positive features (hallucinations and delusions) known as *psychotic experiences*, and a broader set of positive, negative, and disorganisation traits known as *schizotypy*. Schizotypy is thought of as a multidimensional construct (Raine et al., 1994), and different components are heterogeneous in that they have differential relationships with environmental and genetic factors, (e.g. Esterberg et al., 2009; Jones et al., 2018; Morton et al., 2016). Most research on the subclinical psychosis-SIB relationship has focused on psychotic experiences, but there is evidence that interpersonal or negative (Jahn *et al.*, 2016) and disorganised (Teraishi et al., 2014) features also relate to suicidality.

Whether this schizotypy-SIB relationship is spurious or causal is unclear. Some have suggested that the schizotypy-SIB relationship can be explained as arising from the common influence of environmental risk factors (DeVylder *et al.*, 2015; Jahn *et al.*, 2016), but there is

no consensus on which environmental factors are confounding this relationship (Hielscher et al., 2018). Another potential explanation for the relationship is that schizotypy and SIB are spuriously associated because they share some of the same underlying genetic vulnerability. Previous twin studies have indicated that schizotypy is a moderately heritable trait, with around 40% to 60% of the variance attributable to genetic factors (Ericson et al., 2011; Lin et al., 2007; Linney et al., 2003). Suicidal ideation is also moderately heritable, with around 40% of the variance attributable to genetic factors (Brent and Mann, 2005). Currently, there are no studies examining genetic confounding of the schizotypy-SIB relationship.

Examining whether the schizotypy-SIB relationship is the result of confounding by shared genetic factors, environmental factors, or both is difficult due to the observational nature of research on the association. Statistical adjustment for confounding factors is problematic because it relies on complete and accurate identification and measurement of confounders (McGue *et al.*, 2010). Furthermore, statistical control of variables may generate misleading results if the variable is not a true confounder of the relationship of interest (Meehl, 1971). Within-pair twin analyses can be used to identify confounding by shared environment or genetic factors by comparing the association within monozygotic (MZ) and dizygotic (DZ) twin pairs (McGue *et al.*, 2010). Co-twins from both MZ and DZ twin pairs share factors related to their family background (i.e., household, neighbourhood, and parenting factors) as well as other environmental influences, and MZ pairs have the same genomic sequence, while DZ pairs share, on average, 50% of their segregating genes (McGue *et al.*, 2010). Thus, by relating within-pair differences in schizotypy to within-pair differences in suicide ideation, it can be tested whether the schizotypy-suicidal ideation relationship is present independently of shared environmental and genetic factors.

Though research on the schizotypy-SIB relationship has exclusively focused on the forward association where schizotypy or its components are assumed to cause suicidal

ideation or behaviours, it is also feasible that the association could be due to reverse causation. For example, it has been proposed that schizotypy or psychotic experiences are a psychological response to the self-directed threat of SIB (Murphy et al., 2018) that or, similarly, that schizotypal indicators could be a psychological adaption to distress occurring from SIB (Hielscher et al., 2018). The relationship between schizotypy and suicidal ideation in general population samples has been tested longitudinally with schizotypy as a predictor of ideation (Yates et al., 2019), but, to our knowledge, not previously with ideation as a predictor of schizotypy. Thus, alongside testing the relationship of schizotypy features with suicidal ideation cross-sectionally, we tested the longitudinal relationship of suicide ideation with subsequent schizotypy.

Our aim was to test whether schizotypy features relate to suicidal ideation in adolescence and young adulthood when controlling for shared genetic and environmental factors. It was hypothesised that schizotypy features predict suicidal ideation in DZ and MZ twin pairs that are discordant for suicidal ideation. Furthermore, the reverse association was tested, that is, whether suicide ideation predicts schizotypy features. If the schizotypy-SIB relationship is due to reverse causation, prior suicidal ideation will be related to subsequent schizotypy at the individual level and in within-pair comparisons of DZ and MZ twins.

2. Method

2.1. Participants and Procedure

Participants were members of the FinnTwin12 cohort, a population-based longitudinal twin study that began in 1994, using Finland's Population Register Centre to identify Finnish families with twins born from 1983 to 1987. Details about this sample have been reported elsewhere (Kaprio, 2013, 2006). Briefly, at baseline when the twins were aged 11-12, families identified from the register ($n = 2724$ families, 87% participation rate) were mailed questionnaires. Of these families, 40% ($n = 1035$ families) were selected for intensive

assessment. Most of this subsample (72.3%) was selected at random, but 27.7% were selected on assumed elevated familial risk of alcoholism, based on parents' (one or both) scores on the 11-item lifetime version of the Malmö-modified Michigan Alcoholism Screening Test (Seppä *et al.*, 1990).

Measures in the present study were obtained when participants were aged 14-years and 22-years on average (range 19.9 to 26.6). At age 14 years, twins were interviewed face-to-face using the Finnish translation of the adolescent version of the Semi-Structured Assessment for the Genetics of Alcoholism (C-SSAGA-A) (Bucholz *et al.*, 1994) by interviewers trained using procedures from the Collaborative Studies on Genetics of Alcoholism (COGA) (Edenberg, 2002). Of invited participants, 90% participated, resulting in $n = 1852$ interviewees. They were invited to participate in a follow-up study in young adulthood, and 1347 SSAGA interviews were completed. At age 22 years, psychiatric assessment occurred in-person in Helsinki ($n = 812$) or via telephone interviews ($n = 535$). Some in-person assessments were completed by telephone due to time restrictions. Participants were administered the SSAGA (Bucholz *et al.*, 1994) and completed self-report questionnaires (in person or mailed at the time of the interview). All participants provided written informed consent. Data collection procedures were approved by the Ethics Committee of Helsinki and the Institutional Review Board of Indiana University, Bloomington, USA.

2.2. Measures

Schizotypy was measured at age 22 with the Finnish translation of the Schizotypal Personality Questionnaire–Brief (SPQ-B) (Raine and Benishay, 1995), a 22-item self-report questionnaire designed for the assessment of schizotypal traits. Items require a *yes* or *no* response. Recent, comprehensive, cross-national analyses have indicated that the SPQ-B is best described by three factors corresponding to positive (cognitive-perceptual disturbances), negative (interpersonal difficulties), and disorganisation features (Fonseca-Pedrero *et al.*,

2017), so scores were calculated for each of these three subscales, alongside a total score. Sporadic missing items (fewer than 5 missing ratings) were estimated by using prorated mean subscale scores. Continuous scores were calculated for the three subscales and the total score, then due to the different numbers of items in each subscale, standardised scores were calculated to aid interpretation. Cronbach's alpha coefficient was calculated for the three subscales and total scores.

The Finnish translation of the suicide section of the C-SSAGA-A and the SSAGA was used to assess lifetime suicidal ideation. Lifetime suicidal ideation was classified from responses to a single question, "Have you ever had any thoughts of suicide?", which was administered at age 14 and age 22 interviews. At age 22, the item, "Have you ever tried to commit suicide?" was also administered but was not included in present analyses due to the low number of participants reporting suicide attempts ($n = 24$).

2.3. Analysis

We first tested the forward association of suicidal ideation with SPQ-B scores, both obtained at age 22 years. Individual-based analyses (i.e. analyses with no matching of twin-pairs, twins are treated as individuals) were conducted using logistic regression with robust standard errors to account for non-independence of observations among twin pairs (Williams, 2000). Analyses were adjusted for age and sex. Then, within-pair associations were estimated using conditional logistic regression among twin pairs discordant for suicidal ideation. Within-pair comparisons determine whether the co-twin that reports higher schizotypy also reports more suicidal ideation (and vice versa), as compared to his or her co-twin. Analyses were conducted separately for DZ pairs and MZ pairs. These three analyses (individual level, DZ within-pair, MZ within-pair) were conducted first with the total SPQ-B score, and then for each of the three subscale scores. The reverse association was then tested by predicting age 22 SPQ-B scores from age 14 suicide ideation. In individual analyses, linear regression

was used with robust standard errors and age and sex as covariates. Fixed effects linear regression models (Allison, 2009) were used to test within-pair associations, with separate analyses for DZ and MZ pairs. These three analyses were conducted with the SPQ-B total score and each of the subscale scores.

One of three patterns of results can be expected to be found (Kujala et al., 2002). If the schizotypy-suicidal ideation relationship is not confounded by shared genetic or environmental factors, the association of schizotypy and suicidal ideation will be the same in the total population as within the matched twin pairs (*left model* of Figure 1). If the relationship is confounded by shared environmental factors, then the association of schizotypy and suicidal ideation would be expected to be lower in the matched twin pairs (both DZ and MZ) than the total population (*centre model* of Figure 1). If the relationship is confounded by genetic factors, then the schizotypy-suicidal ideation association will be lower in MZ matched pairs than DZ pairs (*right model* of Figure 1).

INSERT FIGURE 1 ABOUT HERE

Additionally, given evidence indicating that schizotypy and suicidal ideation are associated with substance use (Darvishi et al., 2015; Esterberg et al., 2009), the association of random selection (i.e. not selected for increased familial alcoholism risk) with SPQ-B subscales and suicide outcomes was tested using multinomial logistic regression. Intraclass and cross-twin cross-trait correlations were also calculated for the three SPQ-B subscales (positive, negative, and disorganised), and examined for evidence of genetic covariance among the SPQ-B scales. As a sensitivity analysis, the age 22 within-pair analyses were repeated with any ideation (i.e. responded *yes* to the suicidal ideation item at *either* age 14 or age 22 assessment) as the outcome.

All analyses were conducted using Stata version 14.2.

3. Results

3.1. Sample Characteristics

The sample consisted of 1213 participants who had completed the SSAGA interview and had full data on the SPQ-B at age 22. Of these, 1104 also completed the suicide section of the C-SSAGA-A interview at age 14. SPQ-B subscales or suicide outcomes were not associated with random selection for participation in the study, except for negative schizotypy, which was inversely associated with participation (Table S1). Intraclass and cross-twin cross-trait correlations were consistently higher for MZ pairs than DZ, implying genetic contributions to all three subscales, and genetic contributions to covariation between SPQ-B subscales (Table S2). Sample characteristics are displayed in Table 1.

INSERT TABLE 1 ABOUT HERE

3.2. Association between schizotypy and suicidal ideation at age 22

At age 22, there was strong evidence that all SPQ-B subscales and total SPQ-B score were associated with suicide ideation when adjusted for age and sex (Table 2). In conditional logistic regression analyses in DZ twin pairs discordant for suicide ideation at age 22, all SPQ-B total and subscale scores were associated with suicidal ideation. In MZ twin pairs, although statistically non-significant, the effect size of the estimate suggested that the negative SPQ-B subscale score was associated with suicidal ideation, and the size of this effect was consistent with the effect in the individual level and within-DZ-pairs analysis. SPQ-B total, positive, and disorganisation scores were associated with suicidal ideation in within-DZ-pair comparisons, but the size of the effect dropped in within-MZ-pair comparisons and there was no longer robust evidence of an association. Results did not differ significantly when analyses were repeated with any reported ideation as an outcome (Table S3), though the relationship between negative schizotypy and suicidal ideation in within-MZ

pair comparisons became statistically significant and the size of the effect was larger than in the relationship with age 22 suicidal ideation only.

3.3. Association between suicidal ideation at age 14 and schizotypy at age 22

In linear fixed effects regression of SPQ-B at age 22 on suicide ideation at age 14, suicide ideation at age 14 was a significant predictor of SPQ-B total, negative, and disorganised scores at the individual level (Table 3). There was marginal evidence that suicidal ideation also predicted positive features. In within-pair comparisons, suicidal ideation did not predict SPQ-B disorganisation in DZ or MZ pairs. The effect size of the associations of suicidal ideation with SPQ-B negative and total scores in within-pair comparisons of MZ and DZ pairs were consistent with the individual level associations, and the association of the negative score remained statistically significant within MZ pairs.

INSERT TABLE 2 to 3 ABOUT HERE

4. Discussion

We examined the association of schizotypy features and suicidal ideation cross-sectionally at age 22. At the individual level, all schizotypy features were associated with suicidal ideation. As suggested by the effect sizes of the point estimates, negative schizotypy was associated with suicide ideation also within DZ and MZ twin pairs discordant for ideation, suggesting that this relationship is not the result of confounding by shared family environment or genetic factors. In contrast, positive, disorganised, and total schizotypy were associated with suicidal ideation at the individual level, and within DZ pairs, but not within MZ pairs, suggesting shared genetic influences explain the relationship. The temporally reverse association of suicide ideation at age 14 with schizotypy at age 22 was also tested. An association of age 14 suicidal ideation with age 22 negative and total schizotypy was found at

the individual level, and point estimates were consistent across within-pair analyses of DZ and MZ pairs.

Within-pair analysis of the association of age 22 SPQ-B scores with age 22 suicidal ideation revealed that all SPQ-B subscale scores were significantly associated with suicide ideation at the individual level, and within DZ twin pairs discordant for ideation. This suggests that the schizotypy-suicidal ideation relationship is likely not the result of confounding by shared familial environmental factors, contrary to previous research that has suggested that psychosocial or environmental factors (DeVylder et al., 2015) confound the schizotypy-suicidal ideation relationship.

In MZ pairs discordant for ideation, total, positive, and disorganised schizotypy were not associated with suicide ideation. The relationship of positive (i.e., psychotic experiences) and disorganised aspects of schizotypy with suicidal ideation may therefore result from genetic confounding. Negative schizotypy scores were higher in MZ twins with suicide ideation than in their co-twin without ideation ($OR = 1.81$, 95% $CI = 0.97, 3.39$). The magnitude of this association was consistent with that of the association observed for DZ pairs ($OR = 1.46$, 95% $CI = 1.07, 1.98$) and in the individual level analysis ($OR = 1.78$, 95% $CI = 1.53, 2.07$), supporting an association independent of shared genes. That the finding in MZ pairs did not reach statistical significance, was likely due to reduced statistical power in the smaller sample of MZ pairs discordant for ideation. Importantly, the pattern of associations suggests that negative schizotypy and suicidal ideation are related even when shared environmental and genetic factors are taken into account. The pattern is consistent with there being a causal relationship between schizotypy and suicidal ideation, although confounding by individual-specific environmental factors cannot be ruled out. This result should be treated with caution due to the relatively small sample size of the MZ pair comparison.

A causal relationship from negative schizotypy to suicidal ideation is consistent with contemporary theoretical models of suicide, such as the interpersonal theory of suicide (IPTs) (Van Orden et al., 2010). In formulating the IPTs, the authors proposed that active suicidal ideation results from a combination of two interpersonal experiences: thwarted belongingness and perceived burdensomeness. It is feasible that negative schizotypy could cause suicidal ideation by increasing the likelihood of thwarted belonging or perceptions of burden, or increasing the degree to which these are experienced. This idea is supported by preliminary evidence that aspects of the schizotypy-suicidal ideation relationship are consistent with some of the assumptions of the IPTs model (Schimanski et al., 2017). That all three components of schizotypy were not uniformly associated with suicidal ideation is consistent with conceptualisations of schizotypy as a heterogeneous construct (Kwapil and Barrantes-Vidal, 2015), and suggests the schizotypy-suicidal ideation could be specific to negative components of schizotypy.

The SPQ-B negative scale has been criticised for largely being composed of social anxiety items (Cohen et al., 2010). If the SPQ-B negative scale is principally a measure of social anxiety, the association of negative schizotypy with suicide ideation may not reflect a causal influence of schizotypy per se. However, cross-twin cross-trait correlations suggested that the SPQ-B negative subscale shares genetic factors with the positive and disorganised subscales (Table S2). This indicates that the negative subscale shares aetiology with the schizotypy construct and is not likely an independent construct.

Tests of reverse association—of the prediction of schizotypy at 22 years from suicidal ideation at 14 years—revealed that suicide ideation was significantly associated with total, negative, and disorganised schizotypy at the individual level, and marginally associated with positive schizotypy. For negative and total scores, point estimates were consistent across individual level, and within-pair analyses for both DZ and MZ pairs, indicating that co-twins

with suicidal ideation had increased risk for total and negative schizotypy. These findings are consistent with a potential causal relationship from suicidal ideation to negative and total schizotypy. Disorganised schizotypy was not associated with suicidal ideation in within-pair comparisons, suggesting that the ideation–disorganisation relationship is likely due to confounding from shared environmental and genetic factors.

At face value, this pattern suggests reverse causation may affect observed associations between schizotypy and suicidal ideation. However, even with longitudinal designs, it is difficult to distinguish the temporal sequence of schizotypy and suicidal ideation. Schizotypy is regarded as a stable construct (Debbané and Barrantes-Vidal, 2015), not an acquired outcome with a discrete adolescent or early adulthood onset (Meehl, 1990, 1962). Consequently, schizotypal traits measured at age 22 would be highly correlated with unmeasured schizotypal traits at age 14 and before. Thus, the relationship of age 14 suicidal ideation with age 22 schizotypy in within-pair comparisons of MZ twins, does not necessarily reflect a temporal sequence from which reverse causality can be inferred. Indeed, assuming stability of schizotypy from adolescence through young adulthood, the associations observed in the analyses of reverse causation would also be compatible with a causal relationship from unmeasured schizotypy to suicidal ideation. Despite this limitation, this is the first study to our knowledge to test this reverse association using direct assessment of psychosis features and suicidal ideation, adding to previous research using hospitalisation records (Murphy et al., 2018). That suicidal ideation at age 14 predicts schizotypal indicators eight years later supports the need for further research into this association.

4.1. Strengths and Limitations

This study has several strengths. The twin design implicitly controls for genetic and shared familial environment factors without relying on accurate identification and measurement of confounders. Adjustment for confounding factors can generate inaccurate

estimates of relationships between variables if the factors controlled for are not true confounders (i.e. are a consequence rather than a cause of schizotypy), or there is unmeasured or residual confounding. The twin design avoids these problems through addressing confounding *a priori*. The protocol included assessment of *lifetime* suicide ideation, which compared to current ideation is a better predictor of death by suicide (Beck et al., 1999). The predictive value of lifetime ideation may be better as it is an indicator of a latent capacity insofar as the extent to which suicidal ideation has occurred in the past represents the potential for this ideation to become reactivated as part of future processing patterns (Williams et al., 2006). If lifetime suicidal ideation is an accurate predictor of more severe suicidal outcomes this improves the potential for clinical utility of the findings.

Several limitations may affect the interpretation of the study results. First, interpretation of results was limited by the sample size, as there was a relatively small number of MZ twins discordant for ideation ($n = 86$). Second, there are limitations with the use of the SPQ-B due to its psychometric properties (Cohen et al., 2010). There are mixed findings regarding the factor structure of the SPQ-B, with adequate but not unequivocal evidence for a three factor solution (Compton et al., 2009; Fonseca-Pedrero et al., 2017), the forced choice item response has been shown to have lower reliability in SPQ (Wuthrich and Bates, 2005), and the SPQ-B had low to moderate internal consistency in this sample. Further, reliance on self-report could be considered a limitation, though self-report is useful in understanding subjective experiences and observer ratings can introduce additional sources of bias or error (Linscott and van Os, 2013).

Third, suicidal ideation was measured with a single question. It is possible that suicide ideation at age 22 was underreported. In the present sample, 62% of those who reported suicide ideation at age 14 did not report lifetime suicide ideation at age 22. Thus, individuals may have been misclassified as having never experienced suicidal ideation at age 22, when in

fact they had. However, when analyses were conducted with any reported ideation as an outcome, results did not differ substantially from analyses with age 22 ideation only as an outcome (Table S3). Nevertheless, it is likely there is unmeasured ideation at other time-points. We also cannot rule out the ideation measure being interpreted differently at different developmental stages, or participants at different ages having different thresholds for responding, introducing measurement error into the results. Lastly, the FinnTwin12 sample is not fully representative of the general population due to oversampling for a parental history of alcohol-related problems. The non-random selection on the basis of familial alcoholism was not associated with any of the suicide or schizotypy variables, except negative schizotypy (Table S1). Although the sample may overrepresent individuals with high negative schizotypy, this would not likely change relationships between variables. Finally, co-twin analyses do not enable control for non-shared, individual-specific environmental risk exposures that may contribute to schizotypy and suicidal ideation. However, as there is no consensus on which factors are true confounders of the schizotypy-suicidal ideation relationship we did not control for any individual-specific factors due to the likelihood they could be mediators, and adjustment would generate inaccurate estimates of relationships.

4.2. Conclusions

We found evidence that the relationship between negative schizotypy and suicidal ideation is likely not a result of confounding by shared genetic or common environmental factors. This implies that negative schizotypy and suicide ideation may be causally related, though the possibility of confounding by individual-specific environmental factors cannot be ruled out. Further, the results provide evidence that environmental factors shared between siblings do not explain the relationships of positive or disorganised schizotypy with suicidal ideation, but that their associations may be due to shared genetic factors. Analysis of the reverse association indicated that a reverse causation mechanism, where suicidal ideation

causes negative schizotypy, could not be ruled out as an explanation. Schizotypy should be considered as a possible causal factor for suicidal ideation, and assessment should consider negative features as well as psychotic experiences. Understanding the pathways linking schizotypy and suicidal ideation is a key focus for future research.

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Figure 1. Prototypical patterns of associations in within-twin pair comparisons

Table 1

Sample Characteristics at Age 14 (n = 1104) and Age 22 (n = 1213) Assessment

	<i>N</i>	%	<i>M</i>	<i>SD</i>	Min	Max	α
Male	552	45.5					
Age							
Age 14 interview			14.2	0.1	14.0	14.9	
Age 22 questionnaire			22.4	0.7	20.5	26.5	
Age 22 interview			22.4	0.7	19.9	26.6	
Zygosity at age 22							
Dizygotic, opposite sex	338	27.9					
Dizygotic, same sex	354	29.2					
Monozygotic	520	42.9					
Unknown	1	0.1					
Suicidality outcomes							
Ideation age 14	81	7.7					
Ideation age 22	205	16.9					
Ideation at 14 and 22	31	2.9					
Schizotypy							
SPQ-B Total			5.69	4.37	0	22	0.83
SPQ-B Positive			1.75	1.71	0	8	0.63
SPQ-B Negative			2.26	2.16	0	8	0.78
SPQ-B Disorganised			1.68	1.61	0	6	0.68

Note. SPQ-B = Schizotypal Personality Questionnaire–Brief

Table 2

Prediction of Age 22 Suicidal Ideation from Age 22 SPQ-B Scores in Individual and Within-Pair Analyses

	Individual ^a (<i>n</i> = 1213)			Dizygotic twins ^b (<i>n</i> = 192)			Monozygotic twins (<i>n</i> = 86)		
	OR	95% CI	<i>p</i>	<i>OR</i>	95% CI	<i>p</i>	<i>OR</i>	95% CI	<i>p</i>
SPQ-B Total	2.22	1.90, 2.60	< .001	2.06	1.40, 3.05	< .001	1.46	0.87, 2.44	.152
SPQ-B Positive	2.00	1.73, 2.32	< .001	2.22	1.46, 3.36	< .001	1.33	0.82, 2.17	.250
SPQ-B Negative	1.78	1.53, 2.07	< .001	1.46	1.07, 1.98	.016	1.81	0.97, 3.39	.061
SPQ-B Disorganised	1.87	1.61, 2.18	< .001	1.77	1.23, 2.57	.002	1.06	0.66, 1.69	.824

Note. SPQ-B = Schizotypal Personality Questionnaire–Brief

^aadjusted for age and sex

^badjusted for sex

Table 3

Prediction of Age 22 SPQ-B Scores from Age 14 Suicide Ideation in Individual and Within-Pair Analyses

	Individual ^a (<i>n</i> = 1104)			Dizygotic twins ^b (<i>n</i> = 644)			Monozygotic twins (<i>n</i> = 461)		
	β	95% CI	<i>p</i>	β	95% CI	<i>p</i>	β	95% CI	<i>p</i>
SPQ-B Total	.36	.12, .60	.003	.17	-.19, .53	.357	.35	-.06, .76	.091
SPQ-B Positive	.23	-.01, .45	.051	.13	-.25, .50	.517	.19	-.26, .63	.905
SPQ-B Negative	.29	.04, .55	.025	.11	-.27, .48	.577	.46	.03, .89	.036
SPQ-B Disorganised	.34	.09, .60	.008	.19	-.18, .55	.322	.14	-.28, .57	.511

Note. SPQ-B = Schizotypal Personality Questionnaire–Brief

^aadjusted for age and sex

^badjusted for sex