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Original article

Winter birth, urbanicity and immigrant status predict psychometric schizotypy dimensions in adolescents

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ABSTRACT

Background: Urbanicity, immigration and winter-birth are stable epidemiological risk factors for schizophrenia, but their relationship to schizotypy is unknown. This is a first examination of the association of these epidemiological risk factors with positive schizotypy, in nonclinical adolescents, controlling for a range of potential and known confounders.
Methods: We collected socio-demographics, life-style, family and school circumstances, positive schizotypy dimensions and other personality traits from 445 high school pupils (192 males, 158 immigrants) from 9 municipalities in Athens and Heraklion, Greece, which covered a range of host population and migrant densities. Using multivariate hierarchical linear regressions models, we estimated the association of schizotypy dimensions with: (1) demographics of a priori interest (winter-birth, immigrant status, urban characteristics), including family financial and mental health status; (2) factors resulting from principal component analysis (PCA) of the demographic and personal data; (3) factors resulting from PCA of the personality questionnaires.
Results: Adolescent women scored higher on schizotypy than men. High anxiety/neuroticism was the most consistent and significant predictor of all schizotypy dimensions in both sexes. In the fully adjusted models, urbanicity predicted magical thinking and unusual experiences in women, while winter-birth and immigration predicted paranoid ideation and unusual experiences respectively in men.
Conclusions: These results support the continuum hypothesis and offer potential insights in the nature of risk conferred by winter-birth, urbanicity and immigration and the nature of important sex differences. Controlling for a wide range of potential confounding factors increases the robustness of these results and confidence that these were not spurious associations.

1. Introduction

Schizophrenia is a serious psychiatric disorder with a heterogeneous genetic and neurobiological background that alters early brain development and maturation, ultimately affecting information processing, motivation and cognition [1]. The neurodevelopmental model posits that the phenomenological diagnosis of schizophrenia based on the expression of hallucinations, delusions and disorganization typically around late adolescence-early adulthood, is the end stage of abnormal neurodevelopmental processes that began years before [2]. Stable epidemiological risk factors for schizophrenia, such as being winter-born [3], urbanicity [4] and immigration [5] have been identified, with the vast majority of this research focusing on adult psychosis. Yet, urban residency from birth to adolescence, rather than during adulthood, appears to be more strongly associated with adult psychosis [6–8] and it is the post-migratory family-social context interactions rather than pre- or peri-migrational factors that mediate the risk for psychosis [5]. Consistent with the neurodevelopmental model of schizophrenia, the above suggest that the processes leading from urban exposure or immigration to psychosis begin in adolescence, childhood or earlier.

Schizotypy is a subclinical construct tapping normative dispositions toward characteristics that are associated with

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schizophrenia [9] and indeed, elevated schizotypy is considered a potential precursor to schizophrenia-spectrum disorders. Although longitudinal studies support the dimensional nature of psychosis and risk [2] and despite the considerable interest in the pathogenesis of schizotypy in recent years, there are no studies examining the degree to which the aforementioned epidemiological risk factors for schizophrenia hold for schizotypy. There are no studies on urban exposure and immigration effects on adult or adolescence schizotypy and the few reports of winter-birth effects on schizotypy have yielded mixed results [10,11] although the study of Konrath et al. [10] confirmed an effect using a very large sample of the adult population.

For the reasons described above, examination of season of birth, urbanicity and immigration on schizotypy in late adolescence is a key area of psychosis research given that:

- around 10% of the general population presents with increased schizotypy [12] that increases their risk for developing schizophrenia-spectrum disorders [13];
- adolescence is the critical period when positive schizotypy reaches a peak [14,15] and positive schizophrenia symptoms typically begin;
- over two-thirds of the world's population are predicted to live in cities by 2050 [16];
- the immigrant population worldwide has been growing rapidly over the past fifteen years with an average 2% per year, reaching 244 million in 2015 [17].

In this study, we examined for the first time the association of season of birth, urbanicity and immigrant status with schizotypy, in nonclinical individuals in their late adolescence, controlling for a range of potentially confounding factors. We focused on positive rather than negative schizotypy, because the former taps to the "psychosis" syndrome that is unequivocally shared across genders and diagnoses of both affective and non-affective psychotic illness; psychosis also constitutes the cornerstone for the allocation of a diagnosis of schizophrenia, upon which most winter-birth, urbanicity and migration research was based [3–5].

2. Materials and methods

2.1. Study design and participants

The sample consisted of 500 adolescent pupils ($n = 500$) from the last two high school years (90%) or the first year of the Technological high school (10%), from 17 urban schools from nine municipalities, which were counterbalanced for urbanicity (inhabitants/km^2) and Migrant Density Index (MDI), defined as the ratio of total number of immigrants/total inhabitants. Specifically, we choose 4 schools from Heraklion Crete and 5 schools from 4 municipalities of Attica Prefecture with low MDI (0,5–2,5%), and 8 schools from 4 municipalities of Attica with high MDI (5,3–9,6%).

The final sample with complete valid questionnaires was $n = 445$ (192 men), born between 1990 and 1995 [age mean (SD): 18 (1.1), range: 17–22]. Of those, 287 were of Greek origin, 121 were of Albanian origin and 37 pupils came from other ethnic groups. Most non-Greek pupils were first generation Albanian immigrants who migrated in the country in their preschool years (1st/2nd generation: 124/34, Albanian/other ethnicities: 121/37). Descriptive characteristics from the sample are presented in Table 1. The study was approved by the University of Crete Ethics Committee and the Ministry of Education. Following contact with high schools administration and a presentation of the study's aims and procedures to staff and pupils, all pupils were given a written informed consent to be signed by themselves and their parents, prior to their participation to the study.

Table 1
Q7 Descriptive characteristics of study participants ($n = 445$).

Individual characteristics	Gender				
	Male ($n = 192$)		Female ($n = 253$)		
	n or mean	% or SD	*n* or mean	% or SD	*P*-value
Age	18.0	1.06	18.1	1.13	0.698
Season of birth					
May to November	120	62.8%	142	56.1%	0.173
December to April	71	37.2%	111	43.9%	
Immigration status & ethnicity					
Greeks (64.5%)	120	62.5%	167	66.%	0.484
Immigrants (35.5%)	72	37.5%	86	34.0%	
Albanians ($n = 121$, 27.2%)					
Others ($n = 37$, 8.3%)					
Population density					
< 5000	69	35.9	76	30.0%	**0.009**
5000–10,000	46	24.0	99	39.1%	
10001–50,000	50	26.0	49	19.4%	
> 50,000	27	14.1	29	11.5%	
Migration index (ratio)	7.4	8.24	6.2	7.77	0.125
Family financial status					
Bad	66	34.6%	100	39.5%	0.434
Average	79	41.4%	103	40.7%	
Good	46	24.1%	50	19.8%	
Family history of mental illness					
Yes	20	10.4%	68	25.7%	< **0.001**
No	172	89.6%	188	74.3%	
Satisfaction from family relations	8.4	1.87	7.6	2.40	< **0.001**
Schizotypy traits questionnaire					
Total	14.5	6.95	17.1	6.22	< **0.001**
Magical thinking	4.1	2.68	5.1	2.40	< **0.001**
Paranoid Ideation	5.7	3.28	6.7	2.98	**0.001**
Unusual perceptual experiences	4.8	2.43	5.3	2.27	**0.010**

2.2. Questionnaires

The main outcome of the study was schizotypal personality traits as measured with the Schizotypal Traits Questionnaire (STQ) [18]. This is a 37-item self-report questionnaire derived from the criteria for schizotypal personality disorder in the diagnostic and statistical manual of mental disorders (DSM-IV). It has been extensively used in adult, adolescent and children populations, with excellent face and predictive validity and test-retest reliability [19] and is thought to provide the best measure of the underlying positive schizotypy dimension. Responses to each item have a dichotomous (yes/no) format. A total schizotypy and three subscale scores ["magical thinking", "paranoid ideation" and "unusual perceptual experiences"] are derived by adding the positive answers. Higher scores indicate higher positive schizotypy.

Participants also completed the following personality questionnaires: Revised Eysenck Personality Questionnaire (EPQ-R) [20], Cloninger's Temperament and Character Inventory (TCI) [21], Spielberger's State-Trait Anxiety Inventory—Trait Scale (STAI-T) [22] and Carver and White's Behavioural Inhibition/Behavioural Activation System (BIS/BAS) questionnaire [23]. Additionally, participants completed a modified version of the Health Behavior in School-aged Children (HBSC) [24] World Health Organization questionnaire which refers anonymously to their socio-demographic characteristics, health habits, and other important lifestyle parameters, family and school circumstances. A detailed description of all the above scales is included in the Supplementary Data.

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