

Anomalous self-experiences and neurocognitive functioning in adolescents at risk for psychosis: Still no significant associations found between these two vulnerability markers

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ABSTRACT

Background: Anomalous self-experiences (ASEs) and neurocognitive impairments are considered essential domains of vulnerability for developing psychotic disorders. However, little research exists of possible associations between ASEs and neurocognitive functions in individuals at-risk for psychosis. The interconnections between ASEs and neurocognitive impairments should therefore be clarified as much as possible, especially in young individuals at risk. No previous studies have investigated these two fundamental domains in non-help-seeking adolescents at risk for developing psychosis.

Methods: This study is based on the Norwegian Mother, Father and Child Cohort Study (MoBa). Adolescents ($N = 48$, 94% females, mean age = 15.3) were invited to participate after completing a 14-year-old survey distributed by MoBa. At-risk adolescents were selected based on the 0.4% highest scores on 19 items assessing both psychotic-like experiences and ASEs. Five specifically selected and formulated items measuring ASEs were computed to an ASEs total score. Neurocognitive functioning was assessed using the MATRICS Consensus Cognitive Battery.

Results: Regression analyses revealed no significant relationships between ASEs and any neurocognitive domain. **Conclusions:** We did not find any significant associations between ASEs and neurocognitive functions in non-help-seeking adolescents at risk for psychotic disorders, which is in line with reports from other types of cohorts. Thus, ASEs and neurocognitive functions may be understood as two relatively separate domains that co-exist in at-risk states. These results underline the need for a wider scope when making predictions about future trajectories, e.g. the development of psychotic disorders. Including both ASEs and neurocognitive functioning in at-risk populations may increase the specificity of vulnerability criteria in this population and enhance our understanding of early psychosis psychopathology.

1. Introduction

Psychotic disorders exhibit protracted periods of initial development, where subtle impairments in cognitive and emotional function and experiences start in childhood and develop in a way that indicates deviant maturation of the nervous system [1,2]. Consequently, there has been a great scientific interest in the prodromal phase, i.e., the high-risk state predating psychotic disorders. The goal of this research is to

explore specific core features associated with risk of psychosis, to increase the understanding of early psychopathology, and to develop targeted interventions [3].

Studies have found that anomalous self-experiences (ASEs), also called basic self-disturbance or self-disorders, are an essential component of vulnerability to psychotic disorders [4–7]. ASEs comprise a broad ‘Gestalt’ of several overlapping phenomena, particularly two core aspects; (1) a diminished sense of basic self-presence or being a vital

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subject or agent of action, and (2) exaggerated self-consciousness and heightened self-monitoring and awareness of aspects of experience that are normally implicit [4,8]. ASEs are frequent in samples considered at risk for psychosis [9–11], and significantly correlated to transition to psychosis from an at-risk state [11,12]. It has been argued that ASEs are trait-like markers that predict schizophrenia spectrum disorders specifically, and particularly early on during the development of this illness. Subthreshold or attenuated, conventional psychotic symptoms, however, may be markers of psychotic disorders in general, also appearing closer to psychosis breakthrough [13].

Another domain of vulnerability in the pre-psychotic phase is neurocognitive impairment. A main finding has been that individuals at risk for psychosis perform worse on tests of neurocognitive function when compared to individuals who are not at risk [14,15]. Transition from an at-risk state to psychotic disorder is associated with worse neurocognitive performance compared to healthy controls, particularly on tests of processing speed, attention, verbal learning, visual memory and general intelligence (IQ) [16]. Also, performance on tests of neurocognitive functioning in adolescents has been found to be significantly lower in those at high risk for emotional difficulties compared to controls [17]. The same has been found in neurocognitive domains such as social cognition, in adolescents at-risk for suicidal behavior [18]. Both emotional difficulties and suicidal behavior are common in populations at-risk for psychosis [19,20], stressing the importance of expanding our knowledge of neurocognitive functions and its associations in at-risk populations.

To summarize, both ASEs and neurocognitive impairments can be considered essential domains of vulnerability for developing psychotic disorders. However, very few studies have explored possible associations between ASEs and neurocognitive functions in groups at risk for psychotic disorders and in established psychotic disorder. Examining possible relationships between ASEs and neurocognitive functions may help inform early clinical interventions and enrich our theories and understanding of what constitutes vulnerability for developing psychotic disorders.

To date, two studies of established psychotic disorders [21,22] have found relationships between psychotic-like ASEs as measured by the Inventory of Psychotic-Like Anomalous Self-Experiences (IPASE) [23] and neurocognitive functions, including impaired motor speed, visual learning, reasoning and working memory. However, samples sizes were relatively small, and, not least, consisted of individuals who had been experiencing psychotic illness over long periods of time (mean duration of illness 14.1 years in Hernández-García et al., 2021, mean duration of illness not reported in Trask et al., 2021, but assumed to be similar). Consequently, results are not generalizable to an at-risk population. In a study of first-episode psychosis [24], only a single relationship between ASEs as measured by the full Examination of Anomalous Self Experiences scale (EASE) [25] and verbal memory was found, but the main finding was a general lack of associations between ASEs and impairment in other neurocognitive domains [24]. Another first-episode study found no associations between ASEs as measured by the EASE and performance on neurocognitive tests [26]. Consequently, the relationship between ASEs and neurocognitive functions both early and later in psychotic illness is still unsettled.

To the best of our knowledge, only two previous studies have investigated the relationship between ASEs and neurocognitive functions in a high-risk sample [27,28]. One of these studies [27] found no significant relationship between ASEs as measured by the full EASE and any neurocognitive domain as measured by the MATRICS Consensus Cognitive Battery (MCCB) [29]. Similarly, a study by Nelson, Lavoie, Gaweda et al. (2020) [28] did not find a significant association between the full EASE and other measures of basic neurocognitive functions. Neither study recruited adolescents (mean age was 21.0 and 18.8 years, respectively), and both exclusively included help-seeking individuals. Only one study has investigated this relationship in younger adolescents (mean age 15.8 years) [7], and again, only weak to no associations

between neurocognitive functions and ASEs were observed. However, this study did not use a comprehensive neurocognitive battery but rather used a novel metacognitive approach to measuring neurocognition. Furthermore, like the two other studies, only help-seeking individuals were included as participants. Hence, the generalizability to adolescents at risk who are not help-seeking is still unsettled. Only about 25% of those characterized as clinical high-risk, as reported in these studies, develop a psychotic disorder within three years [30]. Thus, there is a potential to identify other individuals at risk, outside this definition, and at a younger age.

Both ASEs and neurocognitive functions are fundamental domains of psychosis risk and psychopathology, and highly promising in the early identification endeavor, but the evidence so far indicates few, weak or no associations between the two. To promote knowledge and new perspectives on early clinical intervention, their interconnections and relative contributions should be clarified as much as possible. ASEs are quite recently re-discovered as markers of vulnerability in at-risk populations [4,5,31], and can provide a means of enhancing the specificity of at-risk criteria, i.e., who are at the highest risk of developing psychotic disorders [11,27], or markers of non-remission of at-risk status [32]. Recently, a study from our research group found that the adolescents at risk for psychosis in the current sample exhibited significantly poorer neurocognitive performance compared to age- and gender matched controls [33]. This may indicate that the development of neurocognitive impairment commence early in adolescence or before symptoms are severe or before help is sought. However, the existing studies do not include empirical data concerning the relationship between ASEs and neurocognitive functions in younger adolescents at defined risk, nor in non-help-seeking individuals at risk.

We examine the relationship between ASEs and neurocognitive functions in non-help-seeking adolescents with a presumed enhanced risk of psychosis. Data has been collected from a large-scale nation-wide population survey, the Norwegian Mother, Father and Child Study [34]. Thus, on the basis of previous research, we pose this main question: Is there a relationship between neurocognitive functioning and anomalous self-experience in non-help-seeking adolescents at presumed enhanced risk of psychosis?

2. Methods

This investigation is a sub-study of the Norwegian Mother, Father, and Child study (MoBa). Parts of the current sample were included in a previously published article where the adolescents at-risk for psychosis and gender- and age matched controls were compared on measures of neurocognitive function [33]. Consequently, materials and methods have also been elaborated and reported there and the current section will include much of the same information, though elaborated on to clarify the methods that are the focus of the current study.

2.1. The Norwegian Mother, Father and Child Study (MoBa)

The following paragraph is a mandatory requirement for all MoBa related studies [34,35].

The MoBa study is a population-based pregnancy cohort study conducted by the Norwegian Institute of Public Health. Participants were recruited from all over Norway from 1999 to 2008. The cohort includes approximately 114.500 children, 95.200 mothers and 75.200 fathers, and 41% of all eligible pregnant women agreed to participate. The current study is based on MoBa data files released for research in March–October of 2022. The establishment of MoBa and initial data collection was based on a license from the Norwegian Data Protection Agency and approval from The Regional Committees for Medical and Health Research Ethics. The MoBa cohort is currently regulated by the Norwegian Health Registry Act. The present study was approved by The Regional Committees for Medical and Health Research Ethics (ref. 2017/342) and was conducted at Vestre Viken Hospital Trust in

Norway.

2.2. Participants and inclusion procedure

The inclusion procedure is identical to that of our previous study [33]. To ease understanding for the reader, we have included it here. Adolescents participating in the MoBa study are invited to complete a survey consisting of about 200 items asking about a wide variety of well-being and mental health issues at age 14. As of December 2022, this MoBa 14-year survey has been distributed to approximately 72,000 adolescents, of which about 33% have responded. Nineteen items included in the MoBa survey concern near-psychotic or psychotic-like experiences and ASEs. The items included were deemed the most sensitive and applicable at identifying non-help-seeking adolescents at-risk for psychosis prospectively, in a population survey. Sixteen items were selected from the Community Assessment of Psychic Experiences (CAPE) [36,37], and three compound items were based on the EASE [25], i.e., several closely related EASE phenomena combined into three broader questions. These items were further reinforced through requirements for significant discomfort and functional impact. To increase the probability of selecting adolescents at true risk for psychosis and to reduce the rate of false positives as much as possible, a very high cut-off of 4% was chosen in cooperation with the Regional Committee for Medical and Health Research (REK). The selection process is presented visually in Fig. 1.

When selected for participation, both adolescents and their parents

were sent a letter of invitation by mail. Written consent was provided by the parents. Informed consent was provided from the adolescent at the time of testing, and they received monetary compensation for participating. The at-risk group consisted of the 4% who had the highest sum score on the 19 items asking about near-psychotic/psychotic-like experiences and ASEs, resulting in 50 participants at the present time who have completed neuropsychological testing, and 48 who have complete ASE scores. Out of these 48 participants, 45 were female (94%), the mean age was 15.3 (SD = 0.5), they had an average of 9.8 years of education (SD = 0.5) and the estimated average intelligence was 99.4 (SD = 10.0). As in our previous study [33], we define this group as “at-risk for psychosis” due to the utilization of clearly psychosis-associated items. It is however not an ultra-high risk (UHR) or clinical high risk (CHR) group, as the clinical interviews Comprehensive Assessment of At-Risk Mental States and the Structured Interview for Prodromal Syndromes were not used in the present study. This would also be impossible in the present survey.

2.3. Measures of neurocognitive functions

Neurocognitive domains were assessed using the MATRICS Consensus Cognitive Battery (MCCB) [29]. The MCCB includes 10 tests that cover seven core neurocognitive functions, including processing speed, attention/vigilance, working memory, verbal learning, visual learning, reasoning and problem solving, and social cognition. The Composite score of the MCCB is calculated based on these seven

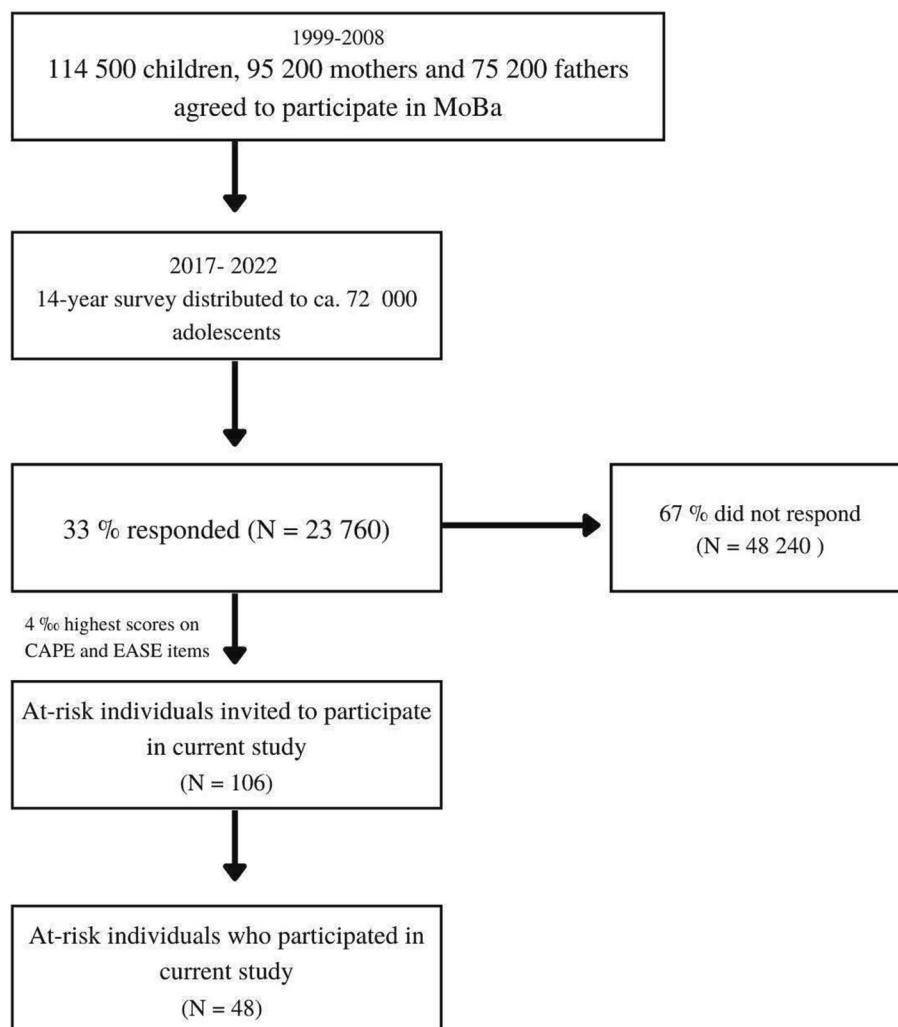


Fig. 1. Flowchart of inclusion.

cognitive domains, and is considered as a measure of global cognitive functioning. In addition to assessment of neurocognitive functioning, participants were screened for symptoms of psychiatric conditions using the Mini International Neuropsychiatric Interview (MINI) [38].

2.4. Measures of anomalous self-experiences

Three compound ASE items included in this nation-wide survey were compiled and formulated specifically for this project by one of the main authors of the full clinical interview EASE (PM) [4,25]. Each of these EASE-based questions contains two parts: the first part asks if the participants had experienced the particular kind(s) of ASE(s), the next part further adding specifically that this ASE feature, to be endorsed, should also be experienced as very distressful and with a significantly negative functional impact on the person. The alternative responses to these additional questions were “Not, Sometimes, or Very true”. The selection of ASEs for this study was based on empirical findings that these particular experiences are highly characteristic and common ASEs in pre-psychotic conditions, and in established illness [4,10,11,39–41]. To be noted, we also included in the analyses, as ASEs, two items from the CAPE, as they are fully synonymous to two items of the original EASE, namely, ‘primary self-reference’ and ‘loss of thought ipseity’. For these two CAPE items, if confirmed (i.e., “Sometimes, Often, or Nearly always”), the participants were asked to assess the degree of distress, as “Not/ A bit/ Quite/ or Very distressed”. The respective scores on these five ASE items were summarized into a total ASE score. The five items are presented in Table 1.

2.5. Statistical analysis

All analyses were performed with the SPSS version 28. A series of stepwise linear regression analyses were performed with ASEs total as the dependent variable, and one neurocognitive domain as the independent variable. Even though we would expect the distribution in the population to be skewed due to the selection process, the ASE variable was normally distributed in the current sample. Consequently, and per the central limit theorem, we have not transformed this variable. The mean score on the ASE composite variable was 13.54 (SD = 1.50, range = 10–17). Although not included in the current analyses the mean score on the ASE composite variable for a gender- and age matched control group drawn from the same population was 7.43 (SD = 2.28, range = 5–14). The scores in the control sample were skewed, but this has no bearing on the analyses in the present study. Due to multiple comparisons in a relatively small sample, all *p*-values were corrected using the

Table 1
Specially formulated compound items measuring anomalous self-experiences.*

ASE item 1^a: I ruminate so much and intensely about myself and the world around me, that it is very distressing and detrimental for me. <i>This item corresponds to the (full) EASE items 1.6 and 2.6. (highest severity)</i>
ASE item 2: Myself, or the world around me, feels so alienated and unreal that it is very distressing and detrimental for me. <i>This item corresponds to the (full) EASE items 2.1, 2.2, 2.5 and 5.5. (partly 1.2) (highest severity)</i>
ASE item 3: Suddenly, out of the blue, thoughts appear in my head that are so alien, strange and disturbing that it is very distressing and detrimental for me. <i>This item corresponds to the (full) EASE item 1.1 (partly 1.2 and 2.2) (highest severity)</i>
CAPE item 1^b (overlaps completely with the original EASE item 5.1): Have you ever felt as if things being written in magazines, newspapers or being said on TV, is about you in particular? <i>This item corresponds to the (full) EASE item 5.1. (highest severity)</i>
CAPE item 5 (overlaps completely with the original EASE item 1.2): Have you ever had the feeling that thoughts in your head are not your own? <i>This item corresponds to the (full) EASE item 1.2 (highest severity)</i>

^a ASE items 1, 2 and 3 can be scored from 0 to 3.

^b CAPE items 1 and 5 can be scored from 0 to 4.

* Max total score for ASE total is 17.

Benjamini-Hochberg procedure. The level of significance was set at *p* = .05. There was a skewness –1.45 for the visual learning domain and –1.58 for the reasoning domain in the at-risk group. This skewness did not affect the results.

3. Results

In this study, the regression analyses revealed no significant relationships between ASEs total score and any neurocognitive domain, including the Composite score of the MCCB (Table 2). Mean CAPE total score for the cohort was 52.9 (SD = 4.4, range = 48–67) (max 128), and mean ASE total score was 13.5 (SD = 1.5, range = 10–17) (max 17).

4. Discussion

This is the first population-based study of young adolescents at-risk for psychosis based on self-reported symptoms of attenuated psychosis and ASEs that have been assessed using a comprehensive neurocognitive test battery. In the present study, when examining a possible relationship between neurocognitive functions and ASEs, we found no relationship between these two vulnerability markers. Our findings largely confirm and expand upon earlier research that found weak or no significant associations between ASEs and poorer performance on neurocognitive tests in both at-risk and first-episode samples [7,24,26–28].

Adolescence is a time in life that may be particularly important and vulnerable for the development of severe mental illness, such as psychotic disorders. For adolescents who are considered at-risk for psychosis, there is now considerable evidence for the presence of ASEs [27,40,42,43]. It has also been persistently demonstrated that lower performance on neurocognitive tests in children, adolescents and young adults is associated with later psychotic disorders [16,44].

In the present sample, the adolescents reported ASEs that cause considerable distress and dysfunction and they perform significantly below controls on the Composite score of the MCCB [33]. However, in the current study we found no associations between ASEs and neurocognition, suggesting that these two central drivers of psychosis development are unrelated among non-help-seeking adolescents at-risk for psychosis. Both of the screening scores (CAPE and ASE) reflect fairly high mean values, which makes it likely that the individuals in this cohort have a real increased risk of psychosis. The mean CAPE score was about 40% of the maximum, and the mean ASE score was about 80% of the maximum. This is in line with the expected, in that the CAPE items are clearly more near-psychotic than the EASE items, and therefore scored relatively lower.

Our findings may have different implications. Firstly, ASEs can be described as ‘primary’ experiences, i.e., not further reducible on a phenotypical level. Neurocognitive functions, on the other hand, are

Table 2
Regression coefficients of anomalous-self experiences (ASE) and cognitive domains in adolescents at-risk for psychosis.

Source	B	SE B	β	t	p	Adjusted R squared
MCCB						
Processing speed	0.008	0.031	0.039	0.261	0.200	–0.020
Attention	0.049	0.019	0.367	2.616	0.054	0.115
Working memory	0.032	0.023	0.205	1.424	0.127	0.021
Verbal learning	0.018	0.019	0.138	0.942	0.163	–0.002
Visual learning	0.037	0.018	0.291	2.061	0.090	0.065
Reasoning	0.010	0.020	0.072	0.492	0.181	–0.016
Social cognition	0.025	0.022	0.164	1.117	0.145	0.005
Composite	0.067	0.037	0.268	1.821	0.109	0.050

ASEs total as dependent variable. All *p*-values have been Benjamini-Hochberg corrected.

operationalized through neuropsychological testing in an attempt to capture discrete but still interrelated neurocognitive processes. These differences are of course essential and may entail that these two central domains, underlying risk of developing psychotic disorders, are not overtly related, even if they both reflect closely related psychological processes that underlie vulnerability for developing psychotic disorders. It has also been suggested that traditional methods of basic neurocognitive functions lack specificity to the disturbances central in ASEs [28].

Secondly, our results may have implications for how to identify and assess young individuals at risk, and ultimately how to follow-up clinically. The most widespread research paradigm is based on ultra high-risk criteria, defining three different groups of at-risk syndromes. These include either 1) an experience of subthreshold psychotic symptoms, 2) transient psychotic symptoms, or 3) onset of poor functioning combined with a family history of psychotic disorders [19]. Ultra high-risk research often entails some form of neurocognitive testing, as cognitive impairment is widely accepted as an important and central feature of being at-risk for psychosis. By also including assessment of ASEs in early intervention endeavors, we may significantly enrich our understanding of at-risk conditions. This procedure may also increase specificity of at-risk criteria, and reduce the high level of “false positives” in ultra- or clinical high-risk groups (70–75%) who do not develop a psychotic disorder [30].

Thirdly, the unrelatedness have possible implications for early clinical interventions. If these two domains are unrelated in at-risk groups, they will most likely need to be targeted by different interventions. Cognitive impairment can be targeted through cognitive remediation programs. ASEs represent detailed descriptions of self-transformations, that by their very nature points to central therapeutic issues [45]. Based on the existing knowledge, little to no transfer effects should be expected between the different types of therapeutic interventions.

Other studies of the associations between ASEs and neurocognitive functioning have, in addition to measurements of neurocognitive function, also included measures of metacognitive functions [7,28]. These studies are particularly focused on the metacognitive functions of source monitoring, i.e. difficulties in making correct attributions about the origins of mental experiences, and aberrant salience, i.e. reduced ability to suppress attention to irrelevant or familiar information or stimuli [7]. Whether or not metacognitive functions can be considered neurocognition is debatable. However, some links between ASEs, neurocognition and metacognition have been found. Koren, Scheyer, Reznik et al. (2019) [7] found low to modest correlations between ASEs and metacognition. They argue that the results might be a consequence of the low-stress environment in which neurocognitive and metacognitive functioning is assessed, referencing research that highlights how stress or emotional arousal may worsen or trigger bouts of ASEs (e.g. [46]). As neurocognitive testing is rigorously performed, this may also contribute to the seemingly small to non-existent associations between these two vulnerability markers.

Nelson et al. (2020) [28] found that source monitoring problems explained almost 40% of the variance in EASE scores, while aberrant salience was more strongly linked to positive psychotic symptoms. They point out that several neuro-variables, including neurocognition, are relevant to ASEs, given its complexity and fundamental nature. A network analysis, looking at both psychotic symptoms, neurocognition, social cognition and metacognition [47], found support for the notion that these central constructs are related but separate phenomena. Following neurocognition, metacognition also had strong connections to other variables in the network, indicating the relevance of ASEs, and particularly self-reflectivity, in psychotic disorders. As a whole, the literature, including the current study, underlines the importance of assessing both neurocognitive functioning, ASEs and metacognitive integration at an early point in the development of psychotic disorder. It could also be valuable to expand on the research of both Nelson et al. (2020) and Koren et al. (2019) and include measures of metacognitive

function as well to further test whether or how metacognitive processes such as source monitoring relates to both ASEs and more basic neurocognitive functions.

Furthermore, this is a first pilot attempt at capturing ASEs, at a first-step survey level, by using a small cluster of self-reported specially adapted ASE items. It has been pointed out that certain aspects of ASEs may partly overlap with having an intense introspective orientation in general, albeit with decisive differences in experiential distress and negative impact between healthy populations and pre-psychotic or psychotic populations [48]. Using compound items in a large survey may result in capturing a wider phenomenon of introspection and ASEs, and perhaps too wide. This may be worked around by including that these experiences are very distressful and have significant negative functional impact. Thus, this piloting new way of capturing ASEs, as a first-line measure, may open an opportunity to identify this central aspect of the pre-psychotic phase in larger at-risk samples, in a time saving way. In other words, there is a need for research investigating the reliability and validity of possible short- and survey versions of instruments identifying ASEs. Future studies should also facilitate a direct validating comparison of short and full versions of the EASE, in the same individual. An initial attempt to shed light on this is built into a study by Baklund, Røssberg and Møller (2023) [43], where both the full EASE and a deeper description of individual items of the EASE are analyzed in context. In any case, it is an advantage that the ASEs all together represent a one-factor structure, so that the finding of just a few reliable ASE phenomena will often justify further assessment and treatment directed at self-disturbances.

5. Strengths and limitations

A key strength of this study is the use of data from a large-scale, nation-wide cohort. There is previously no such population-based prospective cohort study, investigating anomalous self-experiences as possible antecedents of future psychosis, and in non-help-seeking at-risk individuals, neither adolescents nor adults. Furthermore, this is thus the first population cohort study where (1) 14–15-year-olds have been identified as being at risk for psychosis through population survey items, and where (2) participants have been assessed using a validated test battery that spans core neurocognitive domains. A limitation of our study is the relatively small sample, but they in turn represent those with the very highest risk. Another possible limitation is the significant overrepresentation of female adolescents, making up 94% of the at-risk group. This raises the question of generalizability to male adolescents at risk for psychosis. On the other hand, there is a consistent experience with far more girls than boys in both clinical and research contexts within mental health services for children and adolescents. A possible explanation for the high percentage of female participants is that female adolescents may have perceived the questions differently compared to adolescent males. Evidence points to no gender differences in performance on tests of neurocognition in adolescence [49]. Differences in range on the ASE variable in the at-risk and control groups, could indicate the existence of subgroups in the at-risk population. However, subgroup analyses are not appropriate due to low N. It is of course an overall problem and thus an inevitable potential weakness of the study that a limited number of ASEs were examined, and that this was done via self-report. A wider selection of ASEs was however not feasible in this comprehensive population-based survey. To counteract this weakness, the ASE questions have been reinforced through requirements for significant discomfort and functional impact, and by selecting the potentially most relevant and clear-cut phenomena. It is in any case of empirical value to pilot test the applicability of this method, and our results seem to be in line with other findings.

6. Conclusions

Our results support and expand upon previous studies suggesting

that ASE levels and neurocognitive test results are generally uncorrelated, this time in non-help-seeking adolescents at risk for psychotic disorders. ASEs and neurocognitive functioning can be understood as two fundamentally different and generally unrelated domains that still co-exist in at-risk conditions. These results underline the need for a wider scope when making predictions about future trajectories (e.g., transition to full-blown psychosis) among individuals at risk for psychotic disorders. Including both ASEs and neurocognitive functioning may increase the specificity of vulnerability criteria in this population and enhance our understanding of early psychosis psychopathology. Finally, more research of this kind is needed, where both subjective, experiential domains and test-based, observable domains are mapped, in the same sample. There is a need for further replication of results concerning the relationship between ASEs and neurocognitive function, both in adolescent and adult at-risk samples.

Declaration of Competing Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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