

INTEGRATING PSYCHOPHYSIOLOGY WITHIN CLINICAL PRACTICE: A PILOT CROSS-SECTIONAL STUDY ON PRODROMAL SYMPTOMS OF SCHIZOPHRENIA, EMOTION REGULATION, AND PERSONALITY FUNCTIONING

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Abstract

Objective: To investigate the association between prodromal symptoms of schizophrenia, autonomic activity, and personality functioning.

Method: 10 adolescents underwent semi-structured interviews assessing prodromal symptoms of schizophrenia and personality functioning. Cardiac activity was recorded at baseline, during the clinical interviews, and at recovery to assess concurrent changes in autonomic functioning.

Results: During the assessment of prodromal symptoms of schizophrenia, participants increased sympathetic activation compared to the recovery condition, and reduced vagal activation compared to the assessment of interpersonal functioning.

Conclusions: The findings highlight the importance of integrating the autonomic assessment in clinical psychiatric and psychological practice.

Key words: emotion regulation, polyvagal theory, heart rate variability, respiratory sinus arrhythmia, prodromal symptoms, dsm-5 alternative model for personality disorders

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1. Introduction

Emotion regulation is a multidimensional construct involving both the ability to recognize and express emotional experiences, as well as the capacity to accept negative emotions as part of a meaningful life and the ability to modulate negative emotions' intensity or duration using appropriate adaptive strategies (Grazt & Roemer, 2004). The critical role of emotion dysregulation as a transdiagnostic dimension common to several psychiatric and personality disorders has been increasingly recognized (Franquillo et al., 2021; Sloan et al., 2017). Besides self-report questionnaires and clinical interviews, the assessment of emotion regulation can be refined by including neurophysiological markers of emotion dysregulation, such as variations in heart rate parameters (Di Simplicio et al., 2012).

According to the Polyvagal Theory (Porges, 2007), the Autonomic Nervous System (ANS) represents the substrate of the capacity to experience, communicate, and regulate emotional states via afferent and efferent connections within the sensor and the motor system. The polyvagal system is based on three phylogenetically and ontogenetically ordered systems. The first system is the

dorsal vagal system, which promotes immobilization reactions to threats (e.g., freeze behaviors). The second system is the sympathetic vagal system, which fosters mobilization reactions (e.g., fight or flight responses). The third is the ventral vagal system, which triggers self-soothing and social engagement behaviors (e.g., emotional expression and verbal communication). It favors the body's homeostasis by inhibiting the sympathetic system and activating the Hypothalamic Pituitary Axis in response to stress (Porges, 2007).

Recently, the cardiac vagal tone has been identified as a fundamental marker of emotion dysregulation (Beauchaine, 2001). Heart Rate Variability (HRV), a well-known measure for the ANS activity and an indicator of cardiac health, is the physiological phenomenon of variation in time between heartbeats. The Low Frequency/High Frequency (LF/HF) ratio of HRV is an index of autonomic balance between the sympathetic and parasympathetic systems, whereas low-frequency HRV (LF-HRV) is an index of sympathetic cardiac control (Reyes del Paso et al., 2013). Another important index is the Respiratory Sinus Arrhythmia (RSA), which concerns periodic fluctuations in heart rate in synchrony with breathing. Accumulating

evidence suggests that high RSA and RSA suppression might be helpful indicators of emotion regulation and use of effective social regulation strategies (Porges, 2007). High RSA was associated with effective emotion regulation strategies to cope with negative emotions (Butler et al., 2006). By contrast, low RSA and poor modulation of RSA were related to social anxiety and panic disorders (Movius and Allen, 2005).

According to systematic reviews, neuroticism – a construct largely overlapping with emotional dysregulation – is one of the personality traits more consistently associated with psychosis (Franquillo et al., 2021). Neuroticism has been related to greater symptom severity, poor quality of life, and longer duration of untreated psychosis (Franquillo et al., 2021). Accumulating evidence has suggested that negative emotions such as depression and anxiety may trigger psychotic symptoms, and emotional dysregulation negatively may affect the course of psychotic disorders (Marwaha et al., 2014). Research on physiological markers of emotional dysregulation suggests that schizophrenia is consistently related to low parasympathetic activity (Guccione et al., 2019). However, only a few studies analyzed autonomic dysfunctions in people at-risk for psychosis, with most of them involving first-degree relatives of patients with psychosis (Guccione et al., 2019).

Research on premorbid personality functioning among individuals with psychosis is limited. A recent literature review on individuals at clinical high risk (CHR) for psychosis found that about 40% of youths at CHR had a comorbid personality disorder. However, the impact of specific personality disorders, such as schizotypal personality disorder or borderline personality disorder, on the transition to psychosis was not consistent (Boldrini et al., 2019). This suggested that poor personality functioning, rather than specific personality disorders, might contribute to increasing the disability and distress of individuals at risk for psychosis. According to the literature, people who will develop psychotic disorders often experience relevant impairments, both in reaching adequate educational and occupational attainment and in establishing meaningful social and intimate relationships (Velthorst et al., 2017).

This pilot study aimed to investigate the association between autonomic cardiac activity, prodromal symptoms of schizophrenia, and personality functioning in adolescents referred to a specialized psychiatry team for an assessment of prodromal symptoms of schizophrenia. We hypothesized that adolescents would show greater autonomic dysregulation while discussing their prodromal symptoms and personality dysfunctioning compared to the baseline and the recovery conditions.

2. Materials and Methods

Study participants were 10 adolescents at their first access to the Center for the Prevention and Early Intervention of Mental Health of the Department of Mental Health, Roma 1 Local Sanitary Unit. Inclusion criteria were: being at first contact to mental health services; age between 14 and 19 years; being referred by the clinical team to assess prodromal symptoms of schizophrenia based on significant social withdrawal and functional impairment. Exclusion criteria were the presence of neurological, cardio-respiratory, metabolic disease; alcohol or substance abuse; an established diagnosis of schizophrenia. Study approval was granted by the Ethical Committee Lazio 1. Written informed

consent was obtained from adolescents or their parents (when minor). The participants did not receive any compensation for participating and were free to withdraw from the study at any time.

Participants were administered semi-structured clinical interviews for prodromal symptoms of schizophrenia and personality functioning. Cardiac activity was recorded before, during, and after the clinical interviews. The Schizophrenia Proneness Instrument-Child, Adolescents Version (SPI-CY) (Schultze-Lutter & Koch, 2010) is a semi-structured interview investigating 14 basic (prodromal) symptoms of schizophrenia experienced by the individual and not necessarily noticeable by others. Symptoms were rated on a 0 (i.e., absent) to 6 (i.e., daily) scale, based on their maximum frequency during the previous three months, and a total score was calculated (Schultze-Lutter et al., 2015). The Semi-structured Clinical Interview for Diagnosis of DSM -5 Personality Disorders, Alternative Model of Personality Disorders (SCID-5-AMPD; First et al., 2017) assesses four subdomains of personality functioning: Identity and Self-direction that form the Self domain, and Empathy and Intimacy that form the Interpersonal domain. According to the Level of Personality Functioning Scale (LPFS), personality impairment in each of the four domains may vary from none (i.e., adaptive functioning, Level 0) to some (Level 1), moderate (Level 2), severe (Level 3), and extreme impairment (Level 4).

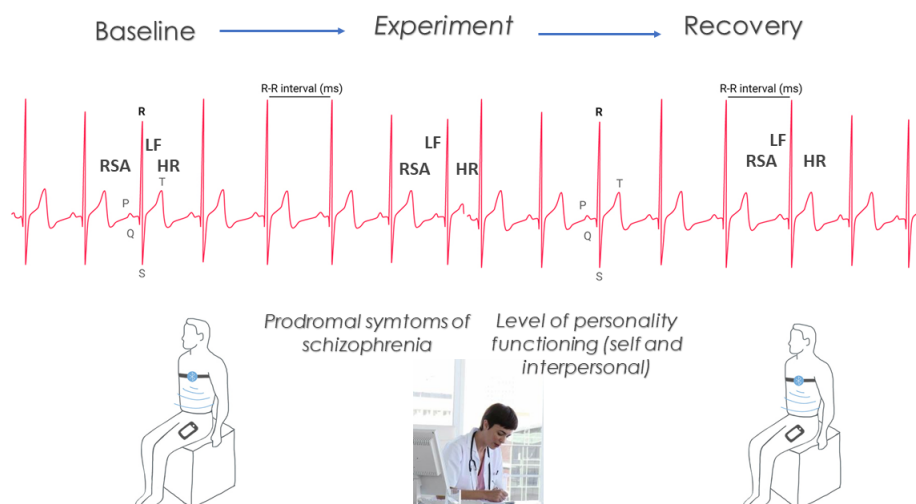
Short-Time HRV (ST-HRV) was recorded before, during, and after the interview, placing two electrodes on the participant's chest. ST-HRV was assessed using the Holter EKG Faros 360° at 5-lead configuration with a sampling rate of 1000 Hz. Heart rate (HR) data were visually inspected and edited off-line with CardioEdit software. Editing consisted of integer arithmetic (i.e., dividing intervals when detections were missed and adding intervals when spuriously invalid detections occurred) or manual insertion/deletion of missing/spurious detections based on the ECG recording. RSA, LF-HRV, and HR were calculated using CardioBatch Plus software consistent with the procedures developed by Porges (1985). Each cardiac variable was quantified during sequential 30-s epochs within each condition, and averages were used in the data analyses. Then, the RSA and LF-HRV data were transformed with a natural logarithm.

Repeated measure ANOVA with Bonferroni correction was used to compare differences in RSA, LF-HRV, and HR across baseline, experimental conditions (i.e., the semi-structured interviews about prodromal symptoms and personality functioning), and recovery. Analyses were carried out using SPSS Version 24.

3. Results

Ten participants were included in the study (80% females, mean age = 16.20, SD = 1.13 years). At the SPI-CY for prodromal symptoms, participants reported a mean total score of 15.90 (SD = 13.91). At the SCID-AMPD for personality functioning, they reported a mild impairment across the four domains (mean = 1.53, SD = 0.85). Within the four domains, the greatest although non-significant impairment ($F(3, 7) = 1.144, p < .396$) was observed in the Identity domain (mean = 1.83, SD = 1.03), the lowest in the Empathy domain (mean = 1.26, SD = 1.03), and intermediate impairment were found in the Self-direction (mean = 1.56, SD = 0.97) and the Intimacy domain (mean = 1.44, SD = 1.02).

The different experimental conditions showed

Figure 1. *Experimental Paradigm*

statistically significant changes in RSA [$F(6, 54) = 7.159, p < .0005$, partial $\eta^2 = 0.443$], LF-HRV [$F(6, 54) = 14.140, p < .0005$, partial $\eta^2 = 0.611$], and HR [$F(2.659, 23.928) = 12.861, p < .0005$, partial $\eta^2 = 0.588$]. Post-hoc analysis with a Bonferroni adjustment revealed that RSA significantly increased from SPI-CY to SCID-5-AMPD Intimacy Domain [-0.63 (95% CI = -1.19 to -0.72) $p = .023$], from SPI-CY to Empathy Domain [-0.82 (95% CI = -1.58 to -0.47), $p = .034$], and from SPI-CY to Recovery [-1.32 (95% CI = -2.22 to -0.42), $p = .004$]. LF-HRV increased from Baseline to SCID-5-AMPD Identity Domain [-0.82 (95% CI = -1.62 to -0.02) $p = .042$] and from Baseline to Self-direction Domain [-0.88 (95% CI = -1.63 to -0.13), $p = .018$].

HR decreased from SPI-CY to Recovery [13.65 (95% CI = 2.99 to 24.30) $p = .010$], from SCID-5-AMPD Identity Domain to Recovery [10.71 (95% CI = 2.75 to 18.67) $p = .007$], and from Self-direction Domain to Recovery [9.84 (95% CI = 1.36 to 18.31), $p = .019$].

4. Discussion

During the assessment of prodromal symptoms, participants showed poor autonomic regulation, as expressed by decreased vagal activation (i.e., lower RSA) compared to the assessment of the identity and the empathy personality domains. Furthermore, they showed increased sympathetic activation (i.e., higher HR) compared to the recovery condition. The findings might suggest that participants experienced difficulties in regulating their vagal tone in response to the arousal and the discomfort (e.g., embarrassment, frustration, or anxiety) evoked by talking about severe mental health symptoms. This is consistent with meta-analytic findings of a negative relationship between induction of negative emotions and decreased RSA (Beauchaine et al., 2019).

Participants showed increased sympathetic activity (i.e., LF-HRV and HR) during the assessment of the Identity and the Self-direction personality domains, compared to the baseline condition. The increased arousal associated with the two Self subdomains suggests that adolescents exhibited difficulties in talking about themselves, their feelings, ambitions,

projects, and moral standards (Fonagy & Bateman, 2005). This is consistent with Kernberg's theory of identity diffusion (Kernberg, 1998). In the presence of identity diffusion, adolescents describe themselves in a non-mentalized way with fluctuations in self-image, with a painful sense of incoherence, loss in the sense of sameness through time, and without experiencing the connection between past and present self-experiences. Thus, adolescents at risk for psychosis struggle to find meaning and self-definition in their personal experiences (Cowan et al., 2021). For these adolescents, autobiographical reflection seems to be experienced as progressively unpleasant (Cicero & Kerns, 2011), with psychotic-like experiences associated with emergent lack in self-concept clarity and increased aberrant salience (Evans et al., 2015). The increased sympathetic activity during the assessment of the Self-related domains, compared to baseline, suggests that autonomic assessment could intercept the first signals of distress in CHR adolescents before the disruption of narrative identities overwhelmingly emerges. Accordingly, a recent case-control study found that adolescents at CHR for psychosis showed more significant emotion dysregulation, with feelings of depression and anxiety, and impaired mentalization ability (Boldrini et al., 2020a). Poor mentalization was also associated with an increased likelihood of transition from an ultra-high risk status to the onset of psychosis (Boldrini et al., 2020b).

Literature suggests that impairments in the Identity and Self-direction personality domains affect interpersonal functioning and the ability to establish intimate bonds (DeFife, Goldberg, & Westen, 2015). Vulnerable teenagers may experience greater difficulties in integrating contrasting representations of the self and the others and in coming across the separation-individuation process, balancing their wishes for independence with their attachment to parents (Rivnyák et al., 2021). This may affect the development of a positive, coherent, and consistent self-representation and trigger the emergence of severe psychopathological symptoms, such as delusions and hallucinations (Debbané et al., 2016).

Our study highlights the importance of integrating the autonomic assessment of emotional dysregulation in clinical psychiatric and psychological practice. Accumulating evidence suggests that a comprehensive autonomic assessment should include measures of

parasympathetic and sympathetic cardiovascular functions, assessing heart rate and blood pressure changes in response to emotional triggers (heart rate or blood pressure variability), different types of breathing (breathing tests), or different postures and positions (tilt or pressor test) (Freeman & Chapleau, 2013; Ziemssen & Siepmann, 2019). The latter assumes an important role in evaluating the predisposition to neurally mediated (vasovagal) syncope (Carette et al., submitted; Freeman & Chapleau, 2013). The combination of semi-structured interviews with autonomic assessment can provide information about symptoms or personality domains associated with the highest physiological activation. This assessment can also contribute to a better understanding of patients' emotion regulation abilities and overall personality functioning, supporting clinicians in differential diagnosis and early targeted interventions.

Consistent evidence has demonstrated the efficacy of psychological interventions to improve emotion regulation abilities (Porges & Dana, 2018). Adolescents at risk for psychosis might particularly benefit from interventions promoting emotion modulation as a mean to cope with painful emerging fragmentation in self-experience, adverse events of the past, and negative emotions and daily life stress. As suggested by Dana (2018), therapeutic relationships focused on co-regulation, mirroring, attunement, and reciprocity would push the patient's autonomic nervous system toward a sense of safety. This approach might help CHR adolescents to modulate their autonomic dysregulation in the context of a therapeutic relationship that fosters making sense of their distress, creating embodied and meaningful narratives (Cowan et al., 2021).

The main strength of this study is to provide initial findings on the relationship between autonomic cardiac markers of emotion regulation, personality functioning, and prodromal symptoms of schizophrenia. In addition, to our knowledge, no study has yet employed the Alternative Model of Personality Disorders to assess personality functioning among youths at risk for psychosis. However, this study should be interpreted considering some limitations. First, the small sample size, which limited the generalizability of the findings. Second, the potential confounding effect of gender and other somatic or psychological variables. Third, the lack of a control group. These points will be assessed in a further stage of the study.

5. Conclusions

This pilot study underscores the relevance of integrating an autonomic assessment into clinical practice to achieve a global perspective of patients. In particular, this approach could identify signals of emotion dysregulation in CHR adolescents evoked by talking about their symptoms and their self and interpersonal functioning. The autonomic assessment would also support interventions targeted to improve emotional regulation in youth with severe mental disorders.

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Author Contributions

All the authors made substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of data, or the draft of the present study. All the authors critically revised and approved the submitted version.

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