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ORIGINAL RESEARCH

Oxidative Imbalance in Conversion Disorder: Evidence from Thiol-Disulphide Homeostasis Disruption

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Purpose: Conversion Disorder (CD) is a complex neuropsychiatric condition in which stress-related biological changes are thought to play a role. The present study sought to assess oxidative imbalance and inflammation in patients with conversion disorder by examining thiol/disulfide homeostasis and CRP levels as potential biomarkers.

Patients and Methods: Ninety-six patients diagnosed with Conversion Disorder according to DSM-5 criteria and ninety-six age- and sex-matched healthy controls were included. Psychiatric symptom severity was assessed using the Beck Depression Inventory (BDI) and Beck Anxiety Inventory (BAI). Native thiol (SH), total thiol, disulphide levels, and ratios were measured spectrophotometrically. CRP levels were determined by immunoturbidimetry. Mann–Whitney *U*-test was applied as appropriate. Effect size calculations were performed and a post-hoc observed power analysis was conducted.

Results: Native thiol and total thiol levels were significantly lower in CD patients compared with controls whereas disulphide levels and disulphide/thiol ratios were significantly higher (all $p < 0.001$). Effect sizes were large (Native thiol: $d = 0.97$), and post-hoc power was adequate (>0.95). No differences were observed in demographic parameters between groups. CRP levels were elevated in the CD group (2.61 ± 0.276 vs 1.34 ± 0.227 mg/L, $p<0.001$).

Conclusion: Our findings indicate that patients with Conversion Disorder may show oxidative imbalance together with elevated CRP levels, supporting the notion that redox and inflammatory pathways could be involved in the disorder's pathophysiology. Thiol/disulfide homeostasis and CRP might therefore represent peripheral biomarkers of interest, although the cross-sectional, single-center design and the restricted set of biomarkers assessed call for cautious interpretation of these results. This is the first study to concurrently evaluate TDH and CRP in CD.

Keywords: conversion disorder, thiol-disulphide homeostasis, oxidative stress, redox imbalance, functional neurological disorder, biomarkers

Introduction

Conversion disorder (CD) – also termed functional neurological symptom disorder (FND) in DSM-5 – is characterized by neurological symptoms such as motor or sensory deficits and non-epileptic seizures that cannot be explained by an underlying neurological disease.[1] Despite the absence of identifiable structural lesions, CD causes significant functional impairment and distress.[1–3] It is commonly encountered in clinical practice, accounting for a substantial proportion of neurology referrals and hospital admissions for neurologic symptoms.[2]

The etiopathogenesis of CD remains poorly understood and is multifactorial. While psychological stressors, trauma, and adverse childhood experiences often precede symptom onset, recent perspectives emphasize a biopsychosocial model

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that includes neurobiological contributions.[4,5] Neuroimaging and neurometabolic studies suggest that patients with CD exhibit disrupted neural energetics and heightened vulnerability to oxidative stress.[6]

Systemic inflammation and oxidative stress have emerged as potential biological underpinnings of CD. CRP, a well-established inflammatory marker, has been proposed as a transdiagnostic biomarker across psychiatric disorders.[7] Elevated CRP levels are commonly observed in mood, anxiety, and stress-related disorders, particularly in more severe or chronic presentations.[8] In pediatric FND, inflammation has been detected in two-thirds of cases even after excluding infectious or other medical causes.[9] Similar findings have been reported in adults, with CRP correlating with specific symptom subtypes.[10] These data suggest that inflammation may link psychosocial stress to physiological dysfunction.

Oxidative stress – the imbalance between reactive oxygen species and antioxidant defenses – is implicated in many neuropsychiatric disorders.[11] Recent meta-analyses and reviews highlight its role in conditions such as depression, anxiety, bipolar disorder, and schizophrenia.[12,13] Similarly, evidence suggesting impaired oxidative balance has also been reported in CD.[14] Though research specifically on CD is limited, studies in functional movement disorders report alterations in redox-related metabolites, suggesting oxidative processes may directly influence symptom onset and persistence.[6]

In this context, thiol-disulphide homeostasis (TDH) emerges as a promising biomarker of oxidative balance. TDH reflects the dynamic equilibrium between thiol antioxidants and their oxidized disulphide forms. Unlike static markers such as total antioxidant status or total oxidant status TDH captures the reversible and dynamic nature of oxidative stress.[15] Disruption of TDH (eg, increased disulphide with decreased free thiols) has been documented in psychiatric and neurological disorders (Figure 1).Importantly, foundational biochemical insights into thiol redox dynamics in the brain stem from McBean's work, which elucidates thiol redox homeostasis in neurodegenerative disease models.[16]

Given the converging evidence on inflammation and oxidative stress in CD, investigating TDH may reveal a biological link between psychosocial stress and neurological manifestations (Figure 1). Therefore, our study aimed to assess serum thiol, disulphide, and their ratios (indices of TDH) in patients with CD versus healthy controls, alongside CRP measurement.

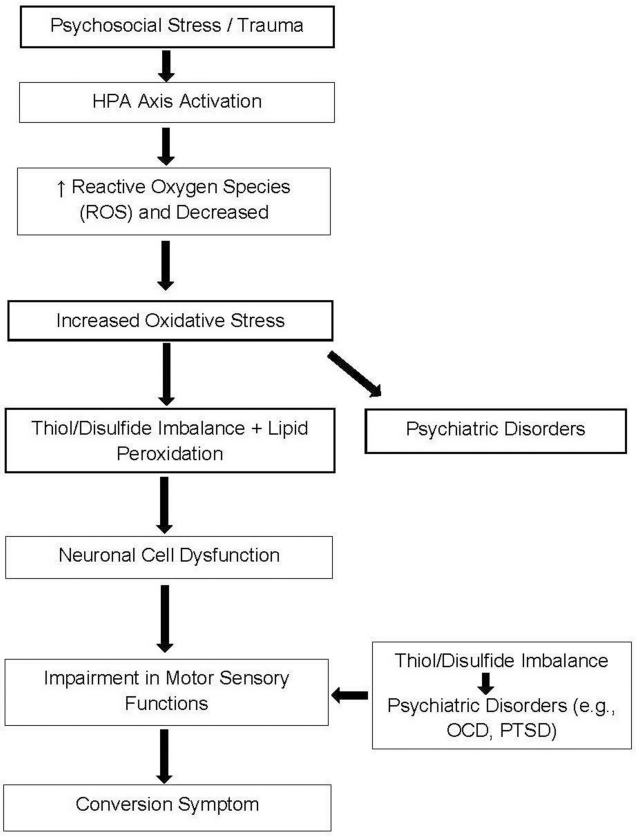

Figure 1 Oxidative Mechanisms in the Oxidative Stress Hypothesis of Conversion Disorder.

Demonstrating disrupted TDH in CD would support a role for oxidative stress in its pathophysiology and suggest novel biomarkers for diagnosis and treatment—thus helping to bridge the "mind–body" gap in this functional neurological disorder.

Materials and Methods

Sample and Study Design

This cross-sectional study was conducted in the Emergency Department of Harran University Hospital (Şanlıurfa, Turkey). The study population consisted of individuals aged 18–65 years who presented to the emergency department and were subsequently referred for psychiatric evaluation. Inclusion required the absence of focal neurological signs on detailed physical and neurological examinations. Patients exhibiting such signs were excluded. When clinically indicated, additional diagnostic investigations—including brain computed tomography magnetic resonance imaging, complete blood count, routine biochemical analyses, electrocardiography, and cardiac enzyme testing—were performed.[17] Referrals to neurology, ophthalmology, or other relevant specialties were made where appropriate. Only those without evidence of neurological, ophthalmological, or metabolic disease were eligible.

The final diagnosis of CD was established by a psychiatrist in accordance with the DSM-5 criteria. Patients were excluded if they had a history or signs suggestive of neurological, ophthalmological, or metabolic disorders; comorbidities such as intellectual disability, dementia, epilepsy, migraine, Parkinson's disease, multiple sclerosis, or schizophrenia spectrum disorders; or current/past use of psychotropic or systemic agents (including anti-inflammatory drugs, antioxidants, vitamins,). Additional exclusion criteria included acute/chronic infections, inflammatory diseases, trauma, surgery, or neurological illness in the past three months; use of tobacco, alcohol, or illicit drugs; pregnancy or lactation; and inability to cooperate with study procedures. During participant selection, individuals with a history of intellectual disability, cognitive impairment, or developmental delay were excluded. This exclusion was based on detailed clinical history and comprehensive psychiatric evaluations conducted by experienced psychiatrists.

The healthy control group (n = 96) was recruited from hospital staff and community volunteers aged 18–62 years, matched in number to the CD group. Controls had no acute illness within the past three months, no history of chronic physical or psychiatric disorders, and no regular medication use. The same exclusion criteria applied to both groups, except for the diagnosis of CD. A structured psychiatric interview was performed to exclude current psychiatric disorders. The recruitment process and eligibility criteria are illustrated in the consort flow diagram (Figure 2).

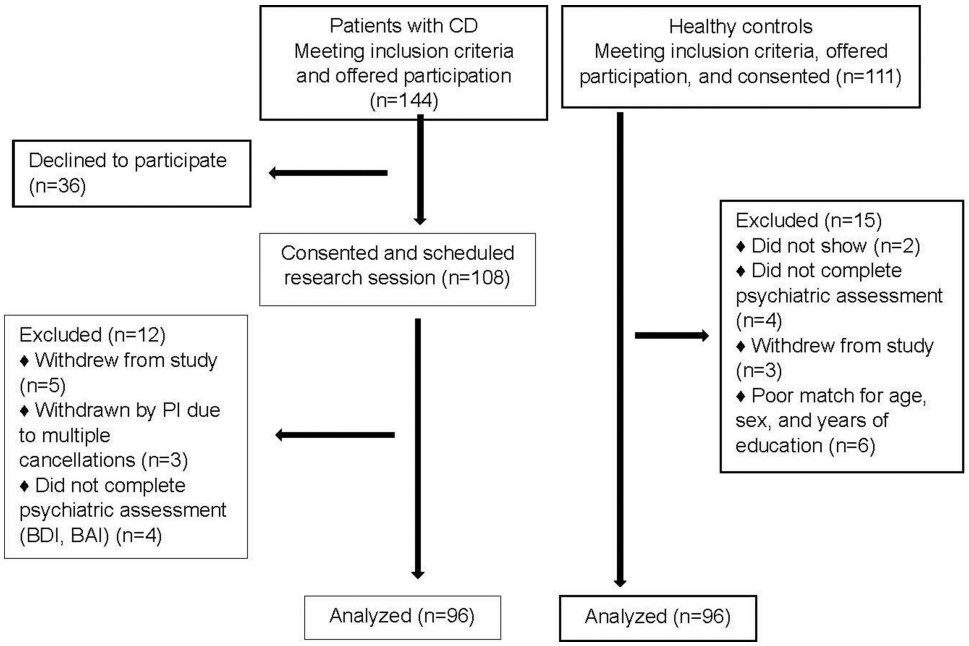

Figure 2 CONSORT flow diagram illustrating recruitment, exclusion, and analysis of patients with conversion disorder (CD) and healthy controls.

Sociodemographic variables (age, sex, marital status, education) were recorded via structured questionnaire. Psychiatric symptom severity was assessed with the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI) and administered by a trained clinician in a quiet observation area once patients were clinically stable.

The study protocol was approved by the Ethics Committee of Harran University Faculty of Medicine and was conducted in accordance with the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from all participants prior to enrollment.

Measures

Beck Anxiety Inventory

The BAI is a 21-item self-report instrument designed to measure the severity of anxiety symptoms. Each item is rated on a 4-point Likert scale, with higher scores reflecting greater anxiety severity. The Turkish validity and reliability study was conducted by Ulusoy et al.[18]

Beck Depression Inventory

BDI consists of 21 items evaluating depressive symptoms across emotional, cognitive, behavioral, somatic, and interpersonal domains. Total scores range from 0 to 63, with established severity cut-offs. The Turkish adaptation was validated by Hisli.[19]

Blood Collection

After a 12-hour overnight fast, venous blood samples were collected from all participants for thiol-disulphide homeostasis parameters and CRP measurement. Samples were processed within six hours and kept on ice during transport. Serum was obtained by centrifugation at 3000 rpm for 10 minutes and stored at –80 °C until analysis.

Assessment of Thiol-Disulphide Homeostasis

Thiol-disulphide homeostasis was determined using the fully automated spectrophotometric method described by Erel and Neselioglu.[19] In this method, disulphide bonds are reduced to free thiols with sodium borohydride. Excess reductant is removed by formaldehyde, and native thiol levels are measured with 5, 5′-dithiobis-(2-nitrobenzoic) acid. Total thiol is measured after reduction, and disulphide concentration is calculated as (total thiol – native thiol) / 2. Ratios calculated included disulphide/native thiol (%), disulphide/total thiol (%), and native thiol/total thiol (%). CRP was measured by immunoturbidimetric assay. All analyses were performed on a Cobas c501 analyzer (Roche Diagnostics, Mannheim, Germany).

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed with the Kolmogorov–Smirnov test. As most biochemical and psychometric parameters were non-normally distributed, comparisons between the CD and control groups were conducted using the Mann–Whitney *U*-test for continuous variables. Data were expressed as median (interquartile range, IQR).

Categorical variables were compared using the Chi-square test and presented as counts (percentages). Effect sizes for Mann–Whitney *U*-tests were reported using the rank biserial correlation coefficient.

Correlations between psychometric scores (BDI, BAI) and thiol-disulphide parameters were analyzed using Spearman's rank correlation. Correlation coefficients (rho) and two-tailed p-values were reported.

Diagnostic performance of significant variables was evaluated via receiver operating characteristic (ROC) curve analysis, with area under the curve (AUC), sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and Youden's index calculated for optimal cut-points. Separate ROC analyses were conducted for markers positively and negatively associated with CD. Statistical significance was set at $p < 0.05$.

We conducted post-hoc power analyses for our study. With groups of n=96 patients and n=96 controls, the calculated effect sizes (Cohen's d) were considerably large. Specifically, Cohen's d values were 7.25 for BAI, 2.58 for BDI, 0.97 for

native thiol, and 0.72 for disulphide. Based on these effect sizes, the corresponding post-hoc power values were approximately 100%, 100%, 99.9%, and >95%, respectively. Thus, our sample size was more than adequate to detect the observed differences with very high statistical power.

Results

Demographic and Clinical Characteristics

The study included 192 participants, comprising 96 patients with CD and 96 healthy controls. The median age did not differ significantly between groups (p = 0.953) (Table 1). In terms of symptom subtypes, the majority of patients presented with attacks or seizures (n=67, 69.8%). Anesthesia or sensory loss was observed in 19 patients (19.8%), while weakness or paralysis was present in 6 patients (6.3%). Speech symptoms were the least common, observed in 4 patients (4.2%) (Table 2). Sex distribution, marital status, and educational level were comparable between the groups (Table 2).

Table 1 Comparison of Demographic, Clinical, and Oxidative Stress Parameters Between Conversion Disorder Patients and Control Groups

Parameter	Unit	Conversion Group Median (IQR)	Control Group Median (IQR)	Total Median (IQR)	Effect Size (Rank Biserial Correlation)	p-value
Total N (%)		96 (50.0)	96 (50.0)	192		
Age	Year	32.5 (23.8–48.0)	31.5 (24.0–47.0)	32.0 (24.0–48.0)	−0.00488	0.953
Sex - Male		41 (42.7)	48 (50.0)	89 (46.4)	−0.07292	0.385
Sex - Female		55 (57.3)	48 (50.0)	103 (53.6)		
BMI	kg/m²	23.9 (23.6–24.4)	23.8 (23.6–24.3)	23.9 (23.6–24.3)	−0.07856	0.346
C-reactive protein	mg/L	2.6 (2.4–2.8)	1.4 (1.2–1.5)	1.9 (1.4–2.6)	−1.0000	<0.001
BAI	-	25.0 (24.0–26.0)	4.0 (3.0–4.2)	6.0 (4.0–25.0)	−0.95833	<0.001
BDI	-	9.0 (8.0–10.0)	6.0 (5.0–7.0)	7.5 (6.0–9.0)	−0.91884	<0.001
Native thiol (SH)	µmol/L	321.1 (282.2–384.0)	406.1 (341.6–466.5)	361.5 (301.2–425.4)	0.48394	<0.001
Total thiol	µmol/L	381.3 (327.8–439.1)	451.2 (385.4–523.0)	407.6 (345.5–478.1)	0.38802	<0.001
Disulphide (SS)	µmol/L	24.9 (20.9–30.1)	19.4 (12.9–27.2)	23.2 (16.3–28.9)	−0.35786	<0.001
Disulphide/Native thiol	%	8.0 (6.2–10.1)	5.1 (3.0–7.0)	6.4 (4.0–8.2)	−0.58832	<0.001
Disulphide/Total thiol	%	6.9 (5.5–8.4)	4.6 (2.8–6.1)	5.7 (3.7–7.1)	−0.58811	<0.001
Native thiol/Total thiol	%	86.2 (83.2–89.0)	90.8 (87.7–94.4)	88.6 (85.8–92.6)	0.58876	<0.001

Abbreviations: BMI, body mass index; BDI, Beck depression Inventory; BAI, Beck Anxiety Inventory.

Table 2 Comparison of Demographic and Clinical Characteristics Between Conversion Disorder Patients and Controls (n=96 per Group)

Parameter	Category	Conversion Group n (%)	Control Group n (%)	p-value
Sex	Male	41 (42.7%)	48 (50.0%)	0.385
	Female	55 (57.3%)	48 (50.0%)	
Marital status	Single	37 (38.5%)	35 (36.5%)	0.880
	Married	59 (61.5%)	61 (63.5%)	

(*Continued*)

Table 2 (Continued).

Parameter	Category	Conversion Group n (%)	Control Group n (%)	p-value
Education	Illiterate	24 (25.0%)	15 (15.6%)	0.400
	Elementary	35 (36.5%)	40 (41.7%)	
	High school	32 (33.3%)	37 (38.5%)	
	College or higher	5 (5.2%)	4 (4.2%)	
Symptoms	Attacks or seizures	67 (69.79%)		
	Anesthesia or sensory loss	19 (19.79%)		
	Weakness or paralysis	6 (6.25%)		
	Speech symptoms	4 (4.16%)		
Distress factors	Yes	47 (48.96%)		
	No	49 (51.04%)		
Onset of symptoms	<6 months	50 (52.08%)		
	6–12 months	13 (13.54%)		
	13–60 months	33 (34.38%)		

Psychometric Scores

Patients with CD exhibited markedly higher BAI and BDI scores compared to controls (both $p < 0.001$). The median BAI score in the CD group was 25.0 (IQR: 24.0–26.0) versus 4.0 (IQR: 3.0–4.2) in controls, while the median BDI score was 9.0 (IQR: 8.0–10.0) versus 6.0 (IQR: 5.0–7.0).

Oxidative Stress Parameters

CRP levels were significantly higher in the CD group ($p < 0.001$). Native thiol (SH) and total thiol concentrations were significantly lower in the CD group, whereas disulphide (SS) levels and the disulphide/native thiol and disulphide/total thiol ratios were significantly higher (all $p < 0.001$). The native thiol/total thiol ratio was significantly reduced in the CD group ($p<0.001$) (Table 1).

Correlation Analyses

Spearman's rank correlation analysis revealed that both BAI and BDI scores were negatively correlated with native thiol and total thiol levels and positively correlated with disulphide concentrations. The strongest positive correlation was observed between BAI and BDI scores (rho = 0.687, $p < 0.001$) (Table 3).

Table 3 Spearman Correlation Matrix Between Clinical Scores (BDI/BAI) and Thiol-Disulphide Parameters

	BAI	BDI	Native Thiol (SH)	Total Thiol
BDI	Spearman's rho = 0.687 p < 0.001	—		

(*Continued*)

Table 3 (Continued).

	BAI	BDI	Native Thiol (SH)	Total Thiol
Native Thiol (SH)	Spearman's rho = −0.333 p < 0.001	Spearman's rho = −0.326 p < 0.001	—	
Total Thiol	Spearman's rho = −0.270 p < 0.001	Spearman's rho = −0.258 p < 0.001	Spearman's rho = 0.973 p < 0.001	—
Disulphide (SS)	Spearman's rho = 0.197 p = 0.006	Spearman's rho = 0.246 p < 0.001	Spearman's rho = −0.043 p = 0.550	Spearman's rho = 0.154 p = 0.033

Notes: Spearman's rho coefficients shown with two-tailed p-values; *df* = 190.
Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory.

Table 4 Positively Associated Predictors of Conversion Disorder

Scale	Cut point	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden's Index	AUC	Metric Score
BAI	20	97.92	100.00	100.00	97.96	0.979	0.979	1.98
BDI	8	89.58	89.58	89.58	89.58	0.792	0.959	1.79
Disulphide (SS)	21.7	72.92	58.33	63.64	68.29	0.313	0.679	1.31
Disulphide / Native thiol (%)	5.7	86.46	59.38	68.03	81.43	0.458	0.794	1.46
Disulphide / Total thiol (%)	5.1	86.46	58.33	67.48	81.16	0.448	0.794	1.45

Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; PPV, Positive Predictive Value; NPV, Negative Predictive Value; AUC, Area Under the Curve.

Diagnostic Performance of Psychometric and Biochemical Parameters

ROC curve analysis identified BAI and BDI as the strongest positive predictors of CD, with AUC values of 0.979 and 0.959, respectively. Among oxidative stress markers, disulphide levels and both disulphide-based ratios demonstrated moderate predictive accuracy (AUC = 0.679–0.794) (Table 4 and Figure 3).

In the negative direction, lower native thiol, total thiol, and native thiol/total thiol ratios were associated with increased likelihood of CD. Native thiol/total thiol ratio showed the highest discriminative ability among negative markers (AUC = 0.794) (Table 5 and Figure 4).

Discussion

This study examined sociodemographic variables, psychopathological symptoms (depression and anxiety), inflammatory markers (CRP), and TDH, an indicator of oxidative stress, in individuals with conversion disorder compared to matched healthy controls. According to our findings, while there was no significant difference between the groups in terms of age, gender and BMI, the literature showed a higher prevalence especially in women, young adults and those with low education/socioeconomic status.[20,21] Supporting the literature, although no significant difference was found in those who were married and had a lower level of education, a proportionally higher rate of CD was detected.[22]

In this study, we evaluated serum thiol-disulphide homeostasis parameters and CRP levels in patients with CD compared to matched healthy controls. Our results demonstrated significantly lower native and total thiol levels, higher disulphide concentrations, and increased disulphide/native–total thiol ratios in the CD group. Additionally, the native/total thiol ratio was significantly reduced. CRP levels were also elevated in patients, indicating the presence of a systemic inflammatory process. These findings suggest that conversion disorder may also be associated with inflammatory and oxidative stress processes. Supporting both our previous work and other reports, CD was found to be linked to disruption

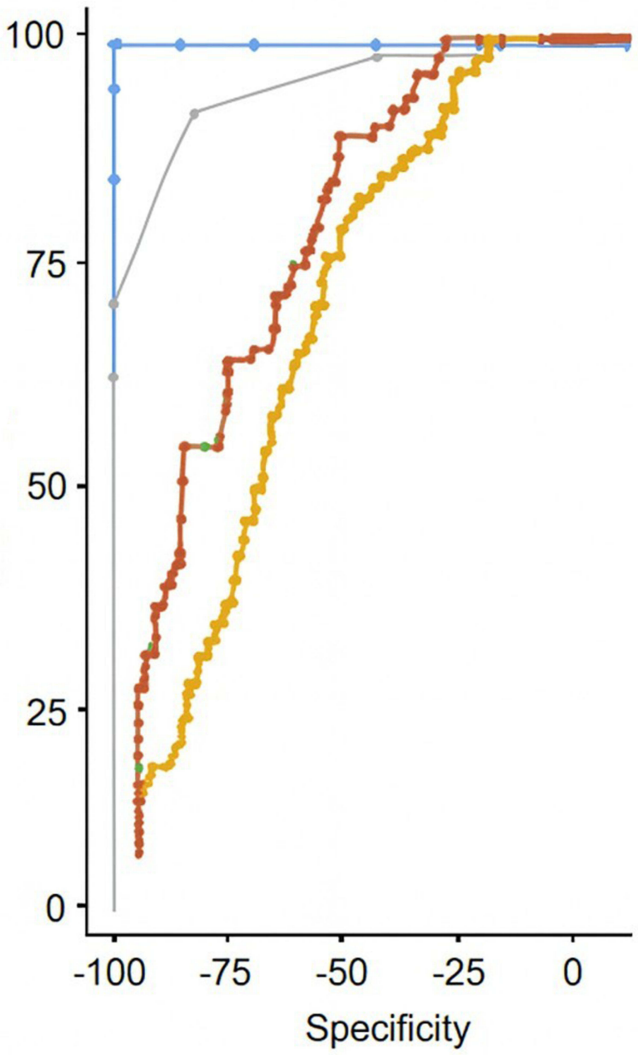

Figure 3 ROC Curves of Psychometric and Biochemical Parameters for Predicting Conversion Disorder.
Notes: Blue line → BAI (Beck Anxiety Inventory); Gray line → BDI (Beck Depression Inventory); Yellow line → Disulphide (SS) (μmol/L); Green line → Disulphide / Native thiol (%); Red line → Disulphide / Total thiol (%).
Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory.

of oxidative metabolism.[14] To our knowledge, this is the first study to assess TDH and CRP concurrently in CD, addressing a gap in the literature. Our results emphasize that thiol-disulphide homeostasis should be considered as a potential marker in the early diagnosis and treatment of CD.

The brain's high oxygen consumption and lipid-rich composition render it particularly susceptible to oxidative injury.[6] Under physiological conditions, a dynamic balance exists between reactive oxygen species and antioxidant

Table 5 Negatively Associated Predictors of Conversion Disorder

Scale	Cut point	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden's Index	AUC	Metric Score
Native thiol (SH)	371.8	65.62	71.88	70.00	67.65	0.375	0.742	1.38
Total thiol	494.8	32.29	97.92	93.94	59.12	0.302	0.694	1.30
Native thiol / Total thiol (%)	89.9	59.38	86.46	81.43	68.03	0.458	0.794	1.46

Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; PPV, Positive Predictive Value; NPV, Negative Predictive Value; AUC, Area Under the Curve.

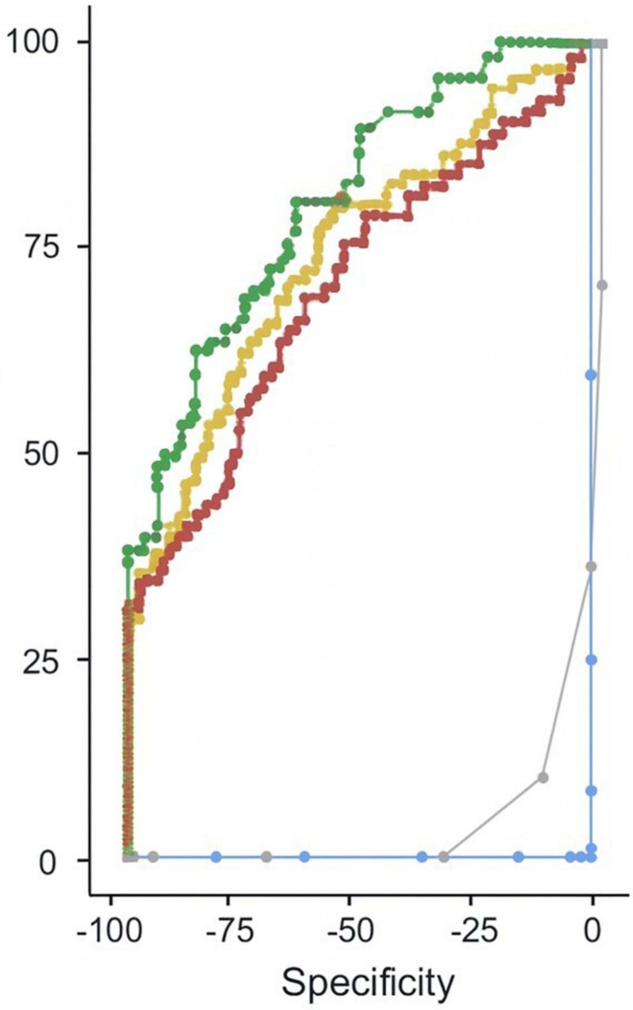

Figure 4 ROC Curves of Psychometric Scales and Negatively Associated Thiol-Based Markers for Predicting Conversion Disorder.
Notes: Blue line → BAI (Beck Anxiety Inventory), Gray line → BDI (Beck Depression Inventory), Yellow line → Native thiol (SH) (μmol/L), Green line → Native thiol / Total thiol (%), Red line → Total thiol (μmol/L).
Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory.

defenses; disruption of this balance leads to oxidative stress, which has been implicated in various psychiatric disorders.[23–25] Evidence of impaired oxidative balance has also been reported in CD.[14] In our study, the significantly reduced thiol levels observed in the CD group indicate diminished antioxidant capacity, a finding that aligns with previous reports in generalized anxiety disorder and panic disorder, where oxidative imbalance has similarly been linked to symptom severity.[26] This convergence across disorders supports the biological plausibility of our observations.

The increased disulphide/native-total thiol ratios we observed are in line with studies in generalized anxiety disorder, panic disorder, and Parkinson's disease, indicating that a shift toward an oxidative state may be a shared feature of stress-related and neurodegenerative disorders.[23,25,26] Furthermore, similar patterns of TDH disruption have been described in obsessive–compulsive disorder and post-traumatic stress disorder, suggesting the presence of transdiagnostic redox dysregulation mechanisms.[27,28] These disturbances may hold biological relevance, as they have the potential to influence neurotransmission, apoptotic regulation, and neuroinflammatory signaling—mechanisms widely implicated in the pathophysiology of CD.

In this study, patients with CD were found to have markedly higher CRP levels. CRP is a well-known acute-phase reactant and an established marker of systemic inflammation.[29] Elevated CRP has also been described in depression, anxiety, and somatoform disorders.[30,31] In line with our results, increased CRP levels have similarly been reported in both pediatric and adult FND populations.[9,10] Previous research has further shown inflammatory changes in peripheral

blood indices such as mean platelet volume, red cell distribution width, and neutrophil-to-lymphocyte ratio in patients with CD, supporting the idea that systemic inflammation is a central feature of the disorder.[32] Overall, these findings suggest that systemic inflammation may contribute to both the onset and persistence of CD symptoms, possibly through mechanisms linked to oxidative stress.

Correlation analyses revealed that higher BDI scores were associated with lower native thiol levels, and higher BAI scores were associated with lower total thiol levels. These associations are consistent with previous findings linking oxidative stress markers to the severity of affective symptoms in psychiatric disorders.[25,26] This supports the hypothesis that oxidative imbalance can play role as a biological linking between emotional dysregulation and functional neurological symptoms.[33]

From a clinical perspective, our findings reinforce the concept that CD shares biological features with other stress-related psychiatric conditions, particularly with respect to redox and inflammatory dysregulation. This highlights the potential utility of incorporating peripheral biomarkers such as TDH and CRP into diagnostic frameworks and opens possibilities for therapeutic approaches targeting oxidative and inflammatory pathways. Antioxidant interventions (eg, N-acetylcysteine) and anti-inflammatory strategies can be research as potential treatments for CD.

Limitations

This study has limitations. First, its cross-sectional design precludes causal inference between oxidative imbalance, inflammation, and CD. Second, data were obtained from a single center, which may limit generalizability. Third, lifestyle factors influencing oxidative status (eg, diet, physical activity, sleep) were not controlled. Fourth, neuroimaging and broader biomarker panels were not employed, which could have provided deeper mechanistic insight. Finally, oxidative and inflammatory status were assessed using only TDH parameters and CRP, respectively; inclusion of additional markers (eg, cytokines, lipid peroxidation products) could yield a more comprehensive evaluation.

Conclusion

This is the first study to demonstrate concurrent alterations in TDH and CRP levels in CD, indicating that both oxidative stress and inflammation may contribute to its biological basis. These findings support the inclusion of redox and inflammatory biomarkers in the assessment of CD and provide a rationale for exploring targeted antioxidant and anti-inflammatory interventions. We speculate that antioxidant (eg, N-acetylcysteine) and anti-inflammatory interventions may be a rational approach to the prevention and treatment of CD. Further large-scale, longitudinal studies are needed to clarify these associations and evaluate their therapeutic implications.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Espay AJ, Aybek S, Carson A, et al. Current concepts in diagnosis and treatment of functional neurological disorders. *JAMA Neurol*. 2018;75(9):1132–1141. doi:10.1001/jamaneurol.2018.1264
2. Stone J, Carson A, Duncan R, Roberts R, Warlow C, Hibberd C. Who is referred to neurology clinics? The diagnoses made in 3781 new patients. *Clin Neurol Neurosurg*. 2010;112(9):747–751. doi:10.1016/j.clineuro.2010.05.011
3. Mark VW. Biomarkers and rehabilitation for functional neurological disorder. *J Pers Med*. 2024;14(9):948. doi:10.3390/jpm14090948
4. Ratcliff J, van der Feltz-Cornelis C. Conversion disorder/functional neurological disorder—a narrative review on current research into its pathological mechanism. *Eur J Psychiatry*. 2020;34(3):143–152. doi:10.1016/j.ejpsy.2020.04.002
5. Lu Z, Yang Y, Zhao G, et al. The association of redox regulatory drug target genes with psychiatric disorders: a Mendelian randomization study. *Antioxid*. 2024;13(4):398. doi:10.3390/antiox13040398
6. Ng F, Berk M, Dean O, Bush AI. Oxidative stress in psychiatric disorders: evidence base and therapeutic implications. *Int J Neuropsychopharmacol*. 2008;11(6):851–876. doi:10.1017/S1461145707008401

7. Correia AS, Cardoso A, Vale N. Oxidative stress in depression: the link with the stress response, neuroinflammation, serotonin, neurogenesis and synaptic plasticity. *Antioxid*. 2023;12(2):470. doi:10.3390/antiox12020470
8. Anderson G, Maes M. Oxidative/nitrosative stress and immuno-inflammatory pathways in depression: treatment implications. *Curr Pharm Des*. 2014;20(23):3812–3847. doi:10.2174/13816128113196660738
9. Kozlowska K, Chung J, Cruickshank B, McLean L, Scher S, Dale RC. Blood CRP levels are elevated in children and adolescents with functional neurological symptom disorder. *Eur Child Adolesc Psychiatry*. 2019;28(4):491–504. doi:10.1007/s00787-018-1211-5
10. Van der Feltz-Cornelis C, Brabyn S, Ratcliff J, et al. Assessment of cytokines, microRNA and patient related outcome measures in conversion disorder/functional neurological disorder (CD/FND): the CANDO clinical feasibility study. *Brain Behav Immun Health*. 2021;13:100228. doi:10.1016/j.bbih.2021.100228
11. Sies H. Oxidative stress: concept and some practical aspects. *Antioxid*. 2020;9(9):852. doi:10.3390/antiox9090852
12. Smaga I, Niedzielska E, Gawlik M, et al. Oxidative stress as an etiological factor and a potential treatment target of psychiatric disorders. Part 2. Depression, anxiety, schizophrenia and autism. *Pharmacol Rep*. 2015;67(3):569–580. doi:10.1016/j.pharep.2014.12.015
13. Bhatt S, Nagappa AN, Patil CR. Role of oxidative stress in depression. *Drug Discov Today*. 2020;25(7):1270–1276. doi:10.1016/j.drudis.2020.04.008
14. Büyükaslan H, Kandemir SB, Asoğlu M, et al. Evaluation of oxidant, antioxidant, and S100B levels in patients with conversion disorder. *Neuropsychiatr Dis Treat*. 2016;12:1725–1729. doi:10.2147/NDT.S109174
15. Erel O, Neşelioğlu S. A novel and automated assay for thiol/disulphide homeostasis. *Clin Biochem*. 2014;47(18):326–332. doi:10.1016/j.clinbiochem.2014.09.026
16. McBean GJ, Aslan M, Griffiths HR, Torrão RC. Thiol redox homeostasis in neurodegenerative disease. *Redox Biol*. 2015;5:186–194. doi:10.1016/j.redox.2015.04.004
17. Evrin T, Kaykısız EK. Assessment of the patients diagnosed with conversion disorder in the emergency department. *Ortadogu Med J*. 2018;10(3):348–355.
18. Ulusoy M, Şahin N H, Erkmen H. Turkish version of the beck anxiety inventory: psychometric properties. *J Cogn Psychother*. 1998;12(2):163–172.
19. Hisli N. A study on the validity of the beck depression inventory. *Turk J Psychol*. 1998;6:118–123.
20. Ram D, Mathew A. A scoping review of studies on dissociative and conversion disorders in India. *Indian J Psychiatry*. 2025;67(6):574–590. doi:10.4103/indianjpsychiatry
21. Bammidi R, Ravipati LP, Bashar MA, Kumar KS. Clinical, sociodemographic profile and stressors in patients with conversion disorders: an exploratory study from southern India. *Ind Psychiatry J*. 2020;29(2):222–227. doi:10.4103/ipj.ipj_73_20
22. Morsy S, Kamal A, Hassan M, Abdel-Fadeel N, Kanaan R. Demographic data and clinical characteristics of patients with functional neurological (conversion) disorder. *Minia J Med Res*. 2022;33(4):166–170. doi:10.21608/mjmr.2022.271023
23. Korkmaz ŞA, Kaymak SU, Neşelioğlu S, Erel Ö. Thiol-disulphide homeostasis in patients with schizophrenia: the potential biomarkers of oxidative stress in acute exacerbation of schizophrenia. *Clin Psychopharmacol Neurosci*. 2024;22(1):139–150. doi:10.9758/cpn.2024.22.1.139
24. Beğinoğlu Ö, Asoğlu M, Sabuncu E, Çelik H. Evaluation of thiol/disulfide interrelation in major depressive disorder. *Alpha Psychiatry*. 2023;24(6):283–287. doi:10.5455/apd.115885
25. Şahin EK, Turan G, Neşelioğlu S, et al. Thiol-disulphide homeostasis in patients with general anxiety disorder and panic disorder. *Dusunen Adam*. 2019;32:289–294. doi:10.14744/DAJPNS.2019.00038
26. Tuncay ME, Atagun MI, Ö E. Thiol-disulphide homeostasis in psychiatric disorders: a comprehensive review. *Prog Neuropsychopharmacol Biol Psychiatry*. 2023;123:110719. doi:10.1016/j.pnpbp.2023.110719
27. Kurhan F, Alp HH. Investigation of thiol/disulfide balance and oxidative DNA damage in patients experiencing avalanche disaster and with a diagnosis of post-traumatic stress disorder. *Alpha Psychiatry*. 2021;22(3):123–129. doi:10.5455/apd.66185
28. Kurhan F, Alp HH, Işık M, Atan YS. The evaluation of thiol/disulphide homeostasis and oxidative DNA damage in patients with obsessive compulsive disorder. *Clin Psychopharmacol Neurosci*. 2022;20(2):240–247. doi:10.9758/cpn.2022.20.2.240
29. Sproston NR, Ashworth JJ. Role of C-reactive protein at sites of inflammation and infection. *Front Immunol*. 2018;9:754. doi:10.3389/fimmu.2018.00754
30. Mac Giollabhui N, Slaney C, Hemani G, et al. Role of inflammation in depressive and anxiety disorders, affect, and cognition: genetic and non-genetic findings in the lifelines cohort study. *Transl Psychiatry*. 2025;15(1):164. doi:10.1038/s41398-025-03264-8
31. Wang D, Xu J, Liang N, et al. Network analysis of depressive symptoms and C-reactive protein levels in major depressive disorder. *J Affect Disord*. 2024;367:788–794. doi:10.1016/j.jad.2024.04.052
32. Büyükaslan H, Asoğlu M. Evaluation of mean platelet volume, red cell distribution width and neutrophil to lymphocyte ratio in conversion disorder. *Neuropsychiatr Dis Treat*. 2019;15:2879–2884. doi:10.2147/NDT.S214392
33. Jomova K, Raptova R, Alomar SY, et al. Reactive oxygen species, toxicity, oxidative stress, and antioxidants: chronic diseases and aging. *Arch Toxicol*. 2023;97(10):2499–2514. doi:10.1007/s00204-023-03582-y