ISSN 2220-3206 (online)

World Journal of *Psychiatry*

Monthly Volume 16 Number 3 March 19, 2026

Published by Baishideng Publishing Group Inc

World Journal of

Psychiatry

Editorial Board

2026-2029

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
https://www.wjgnet.com

The *World Journal of Psychiatry* Editorial Board Members are composed of 56 distinguished experts active in the relevant field, distributed in 26 countries/regions, including China (21), Italy (4), United States (3), Canada (2), South Korea (2), India (2), Mexico (2), Brazil (2), Bulgaria (1), Australia (1), Austria (1), Czech Republic (1), Germany (1), Hungary (1), Nepal (1), Norway (1), Palestine (1), Poland (1), Serbia (1), Singapore (1), Israel (1), Japan (1), Lebanon (1), Taiwan (1), Türkiye (1), and United Kingdom (1).

Editor-in-Chief

Paolo Girardi, MD, Professor, (E-mail: paolo.girardi@uniroma1.it) Department of Dynamic and Clinical Psychology, and Health Studies, Faculty of Medicine and Psychology, Sapienza University of Rome, Rome 00100, Italy

Marianna Mazza, MD, PhD, Assistant Professor, (E-mail: marianna.mazza@policlinicogemelli.it) Department of Neurosciences, Catholic University of Sacred Heart, Rome 00168, Italy

Editorial Board

Saeed Ahmed, MD, Director, Senior Researcher, Senior Scientist, Department of Psychiatry, Rutland Regional Medical Center, Rutland, VT 05701, United States

Cengiz Akkaya, MD, Professor, Department of Psychiatry, Uludag University Medical Faculty, Bursa 16059, Türkiye

Samah W Al-Jabi, PhD, Associate Professor, Department of Clinical and Community Pharmacy, College of Medicine and Health Sciences, An-Najah National University, Nablus, West Bank 44839, Palestine

Fares Al-Shargie, PhD, Department of Rehabilitation and Movement Sciences, Rutgers University, Newark, NJ 07107, United States

Leandro Bueno Bergantin, MD, PhD, Research Fellow, INTI International University, Persiaran Perdana BBN, Nilai 71800, Malaysia

Rami Bou Khalil, MD, Assistant Professor, Department of Psychiatry, Hotel Dieu de France Hospital-Saint Joseph University, Beirut 16-6830, Lebanon

Haewon Byeon, PhD, Professor, Department of Further Technology, Medical Information Lab, Korea University of Technology and Education, Cheonan 31253, South Korea

Subho Chakrabarti, MD, Professor, Department of Psychiatry, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India

Ji-Kang Chen, PhD, Associate Professor, Department of Social Work, The Chinese University of Hong Kong, Hong Kong 999077, China

I-Hua Chen, PhD, Full Professor, Professor, Qufu Normal University, Chinese Academy of Education Big Data, Qufu 273100, Shandong Province, China

Jia Cheng, MD, PhD, Senior Scientist, Zhongshan Hospital of Xiamen University, School of Medicine, Xiamen University, Xiamen 361004, Fujian Province, China

Carlos M Contreras, MD, PhD, Senior Researcher, Unidad Periférica Xalapa, Instituto de Investigaciones Biomédicas, UNAM, Instituto de Neuroetología, Universidad Veracruzana, Martin Torres 204, Obrero Campesina, Xalapa, Veracruz 91020, Mexico

Gábor Gazdag, PhD, MD, Professor, Department of Psychiatry and Psychiatric Rehabilitation, Jahn Ferenc South Pest Hospital, Budapest 1204, Hungary

Sari Goldstein Ferber, PhD, Additional Professor, Department of Psychology and Gonda Brain Studies Center, Bar Ilan University, Ramat Gan 5317000, Israel

Hong Gong, PhD, MD, Associate Professor, Department of Military Cognitive Psychology, School of Psychology, Third Military Medical University (Army Medical University), Chongqing 40038, China

Ladislav Hosak, MD, PhD, Professor, Department of Psychiatry, University Hospital, Sokolska 581, Hradec Kralove 500 05, Czech Republic

Rong-Rong Huang, PhD, Assistant Professor, Clinical Research Center, Nantong Research Institute of Traditional Chinese Medicine, Nantong Hospital of Traditional Chinese Medicine, Nantong Hospital Affiliated to Nanjing University of Chinese Medicine, Nantong 226001, Jiangsu Province, China

Marek Michal Jarema, PsyD, Academic Fellow, Professor, III Department of Psychiatry, Institute of Psychiatry and Neurology, Warsaw 02-957, Poland

Russell Kabir, PhD, Associate Professor, School of Allied Health, Faculty of Health, Medicine and Social Care, Anglia Ruskin University, Essex, Chelmsford CM1 1SQ, United Kingdom

Sujita Kumar Kar, MD, Additional Professor, Department of Psychiatry, King George's Medical University, Lucknow 226003, Uttar Pradesh, India

Yuliya Knyahnytska, MD, PhD, Assistant Professor, Faculty of Medicine, Department of Psychiatry, University of Toronto, Toronto, ON M6J1H4, Canada

Jian-Bo Lai, Associate Chief Physician, MD, Researcher, Department of Psychiatry, The First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou 310003, Zhejiang Province, China; Zhejiang Key Laboratory of Precision Psychiatry, Hangzhou 310003, Zhejiang Province, China

Hsien-Yuan Lane, MD, PhD, Department of Psychiatry, China Medical University Hospital, Taichung 404, Taiwan

Bing Lang, Professor, MD, PhD, Department of Psychiatry, National Clinical Research Center for Mental Disorders and National Center for Mental Disorders, The Second Xiangya Hospital, Central South University, Changsha 410011, Hunan Province, China

Ze-Zhi Li, MD, PhD, Director, Professor, Department of Psychiatry, The Affiliated Brain Hospital of Guangzhou Medical University, Guangzhou 510370, Guangdong Province, China

Wei-Na Liu, PhD, Professor, College of Physical Education and Health, Key Laboratory of Adolescent Health Assessment and Exercise Intervention of Ministry of Education, East China Normal University, Shanghai 200241, China

Xin-Qiao Liu, PhD, Full Professor, School of Education, Tianjin University, Tianjin 300350, China

Henriette Löffler-Stastka, MD, Professor, Department of Psychoanalysis and Psychotherapy, and Postgraduate Unit/Teaching Center, Medical University of Vienna/General Hospital of Vienna, Wien, Österreich 1090, Austria

Rosaria Nardello, MD, Assistant Professor, Department of Health Promotion, Mother and Child Care, Internal Medicine and Medical, Specialities "G. D'Alessandro", University of Palermo, Palermo 90127, Italy

Qin Xiang Ng, Researcher, Institute of Mental Health, Buangkok Green Medical Park, Singapore 329506, Singapore

Trevor Ronald Norman, PhD, Associate Professor, Honorary Research Fellow, Department of Psychiatry, University Melbourne, Austin Hospital, Heidelberg 3084, Victoria, Australia

Seon-Cheol Park, MD, PhD, Professor, Department of Psychiatry, Hanyang University Guri Hospital, Guri 11923, South Korea; Department of Psychiatry, Hanyang Institute of Bioscience and Biotechnology, Hanyang University College of Medicine, Seoul 04763, South Korea

Massimo Pasquini, MD, PhD, Full Professor, Department of Human Neurosciences, Sapienza University, Rome 00185, Italy

Lenin Pavón, PhD, Professor, Laboratory of Psychoimmunology, National Institute of Psychiatry, "Ramón de la Fuente", Mexico City 14070, Mexico

Zheng-Wu Peng, PhD, Associate Professor, Department of Psychiatry, Xijing Hospital, Fourth Military Medical University, Xi'an 710032, Shaanxi Province, China

Jia-Xi Peng, Professor, Mental Health Education Center, Chengdu University, Chengdu 610106, Sichuan Province, China

Wei-Dan Pu, MD, PhD, Chief Physician, Associate Professor, Director, Department of Clinical Psychology, The Third Xiangya Hospital of Central South University, No. 138 Tongzipo Road, Changsha 410013, Hunan Province, China

Mary V Seeman, FRCP (C), MD, Emeritus Professor, Professor Emerita, Department of Psychiatry, University of Toronto, Toronto ON M5P 3L6, Canada

Akihiro Shiina, MD, PhD, Associate Professor, Division of Medical Treatment and Rehabilitation, Chiba University Center for Forensic Mental Health, Chiba 2608670, Japan

Rakesh Singh, Assistant Professor, Senior Researcher, Department of Community Medicine and Public Health, Department of Research, Transcultural Psychosocial Organization Nepal and KIST Medical College, Kathmandu 00977, Nepal

Thomas Sobanski, MD, Senior Research Fellow, Department of Psychiatry, Psychotherapy, and Psychosomatic Medicine, Thueringen-Kliniken GmbH, Saalfeld D-07318, Germany

Drozdstoy Stoyanov, MD, PhD, Professor, Research Institute, Medical University, Plovdiv 4002, Bulgaria

Xue-Li Sun, Professor, Mental Health Center, West China Hospital, Sichuan University, Chengdu 610041, Sichuan Province, China

Oleg V Tcheremissine, MD, Academic Fellow, Full Professor, Professor, Department of Psychiatry, Atrium Health (Formerly Carolinas HealthCare System), Charlotte, NC 28211, United States

Isidora S Vujčić, PhD, Associate Professor, Institute of Epidemiology, Faculty of Medicine, University of Belgrade, Visegradska 26a, Belgrade 11000, Serbia

Yuan-Pang Wang, MD, PhD, Associate Research Scientist, Senior Scientist, Department of Psychiatry, School of Medicine, University of São Paulo, Sao Paulo, Sao Paulo 01060-970, Brazil

Wei Wang, Full Professor, Department of Psychology, Norwegian University of Science and Technology, Trondheim 7491, Norway

Shu Wang, MD, Assistant Professor, Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing 100070, China

Guo-Rong Wu, Full Professor, Key Laboratory of Cognition and Personality, Faculty of Psychology, Southwest University, Chongqing 400715, China; Faculty of Medicine and Health Sciences, Department of Head and Skin, Ghent Experimental Psychiatry (GHEP) Lab, Ghent University, Ghent 9000, Belgium

Guo-Gang Xing, MD, PhD, Professor, Department of Neurobiology, School of Basic Medical Sciences, Peking University Health Science Center, Neuroscience Research Institute, Peking University, Beijing 100191, China

Hai-Yun Xu, MD, PhD, Professor, School of Mental Health, Zhejiang Provincial Clinical Research Center for Mental Illness, Affiliated Kangning Hospital, Wenzhou Medical University, Wenzhou 325035, Zhejiang Province, China

Luo-Dan Yang, Professor, PhD, Laboratory of Exercise and Neurobiology, School of Physical Education and Sports Science, South China Normal University, Guangzhou 510006, Guangdong Province, China

Xiao-Bin Zhang, PhD, Professor, Institute of Mental Health, Suzhou Psychiatric Hospital, The Affiliated Guangji Hospital of Soochow University, No. 11 Guangqian Road, Suzhou 215137, Jiangsu Province, China

Zhen-He Zhou, Chief Physician, PhD, Professor, Senior Scientist, President, The Affiliated Mental Health Center of Jiangnan University, Wuxi Central Rehabilitation Hospital, Wuxi 214151, Jiangsu Province, China

World Journal of Psychiatry

Contents

Monthly Volume 16 Number 3 March 19, 2026

EDITORIAL

Karmakar R, Kandalkar A, Wang HC, Mukundan A. Redefining pain and mental health management in cervical spondylosis: Electroacupuncture as a neuroinflammatory modulator and multimodal therapeutic innovation. *World J Psychiatry* 2026; 16(3): 114009 [DOI: 10.5498/wjp.v16.i3.114009]

Xue GC, Zhang LW, Ma CY. Confronting childhood maltreatment and promoting trauma-informed care: Safeguarding the mental health of young and middle-aged adults. *World J Psychiatry* 2026; 16(3): 114110 [DOI: 10.5498/wjp.v16.i3.114110]

Qiu MQ, Yang WJ, Qiu WS, Chen MM. Integrating traditional Chinese medicine and modern technology: A new approach to understanding Changmaxifeng granules for tic disorders. *World J Psychiatry* 2026; 16(3): 114342 [DOI: 10.5498/wjp.v16.i3.114342]

OPINION REVIEW

Huang M, Bellon A. Prescribing antibiotics to acutely ill psychiatric patients with urine analysis indicative of infection. *World J Psychiatry* 2026; 16(3): 114529 [DOI: 10.5498/wjp.v16.i3.114529]

REVIEW

Ma YL, Fu X, Chen Y, Zeng SX. Contemporary adolescent depression: Multidimensional analysis from neurobiological, psychological, and social integrative perspectives. *World J Psychiatry* 2026; 16(3): 113125 [DOI: 10.5498/wjp.v16.i3.113125]

Liu Y, Zhu LY, Xiao Q, Zeng HM, Zhan YX, Yang RH, Lin FZ, Liu DL, Zeng XX, Chen BF. Circadian rhythm disruption in bipolar disorder: Mechanisms, clinical significance, and rhythm-oriented interventions. *World J Psychiatry* 2026; 16(3): 114301 [DOI: 10.5498/wjp.v16.i3.114301]

MINIREVIEWS

Li WT, Wan YM, Miao W, Zhong R, Gao Q, Wang QX, Zheng YS. Innovations and approaches in depression detection *via* functional near-infrared spectroscopy. *World J Psychiatry* 2026; 16(3): 112056 [DOI: 10.5498/wjp.v16.i3.112056]

Matos Padilla F, Lingamchetty T, Waxmonsky JG, Baweja R. Predictors of readmission in child and adolescent psychiatry. *World J Psychiatry* 2026; 16(3): 113468 [DOI: 10.5498/wjp.v16.i3.113468]

Gu Y, Wang YX, Xia WJ, Wang J. Emotion-cognition dysregulation in major depression: Multidimensional biases, neural circuit imbalance, and translational opportunities. *World J Psychiatry* 2026; 16(3): 114153 [DOI: 10.5498/wjp.v16.i3.114153]

ORIGINAL ARTICLE

Case Control Study

Chen LB, Xu XQ, Chen YH. Serum folate and brain-derived neurotrophic factor in pediatric autism spectrum disorder and their predictive role in illness severity. *World J Psychiatry* 2026; 16(3): 112418 [DOI: 10.5498/wjp.v16.i3.112418]

Xu L, Zhang XB, Luan LS, Yang M, Zhang J, Yang HD, Tang XW. Electroconvulsive therapy alters serum cytokine levels and correlates with symptom improvement in patients with acute schizophrenia. *World J Psychiatry* 2026; 16(3): 115163 [DOI: 10.5498/wjp.v16.i3.115163]

Gu AM, Liu C, Chen JH, Guo RY, Liang C, Chen XS. Clinical study of repetitive transcranial magnetic stimulation in the rehabilitation of post-stroke depression: A Quantitative Insomnia Sleep Inventory monitoring evaluation. *World J Psychiatry* 2026; 16(3): 116094 [DOI: 10.5498/wjp.v16.i3.116094]

Retrospective Cohort Study

Shang S, Hu Y, Wang H, Rao RQ, Zhang F. Preoperative anxiety and psychological determinants of functional recovery after total knee arthroplasty: A retrospective cohort study. *World J Psychiatry* 2026; 16(3): 113625 [DOI: 10.5498/wjp.v16.i3.113625]

Retrospective Study

Du WL, Chen S, Zhan SS. Analysis of risk factors for postoperative depressive disorders in patients with intrauterine adhesions. *World J Psychiatry* 2026; 16(3): 112649 [DOI: 10.5498/wjp.v16.i3.112649]

Atas Y, Kırık S, Yıldırım K, Tasci B, Barua PD, Balgetir F, Dogan S, Tuncer T, Tan RS, Palmer E, Devi A, Acharya UR. Explainable electroencephalography-based attention-deficit/hyperactivity disorder detection model with a combination of ternary pattern and twin wavelet transform. *World J Psychiatry* 2026; 16(3): 112962 [DOI: 10.5498/wjp.v16.i3.112962]

Yang JJ, Yu YH. Non-pharmacological psychiatric nursing interventions for auditory hallucinations in patients undergoing mechanical ventilation. *World J Psychiatry* 2026; 16(3): 113594 [DOI: 10.5498/wjp.v16.i3.113594]

Holzweber C, Hennenberg B, Stastka L, Kob M, Löffler-Stastka H. Voice as the sound of the psyche: Changes in prosodic characteristics in depressive patients in long-term therapy. *World J Psychiatry* 2026; 16(3): 113646 [DOI: 10.5498/wjp.v16.i3.113646]

Ao C, Zhan L, Mou YL, Hu S, Huang YH. Influence of aerobic exercise on the cognitive and social functions of elderly patients with schizophrenia. *World J Psychiatry* 2026; 16(3): 113765 [DOI: 10.5498/wjp.v16.i3.113765]

Li W, Su YX, Wang C, Wang YL, Gao SX, Bao J, Zhu QW. Age-related and sex-related disparities in psychological distress among thyroid cancer patients: A retrospective study. *World J Psychiatry* 2026; 16(3): 114348 [DOI: 10.5498/wjp.v16.i3.114348]

Deng J, Xiao YX, Wang L, Bao AZ. Impact of stress management and resilience training-clinical program on stress adjustment in clinical graded psychological nursing nurses. *World J Psychiatry* 2026; 16(3): 116166 [DOI: 10.5498/wjp.v16.i3.116166]

Wu SJ, Wang JX, Kang HX, Li P. Effect of anxiety and depression symptoms in pregnancy on Apgar score and birth weight of newborns. *World J Psychiatry* 2026; 16(3): 116848 [DOI: 10.5498/wjp.v16.i3.116848]

Observational Study

Luo DW, Du HL. Anxiety and depression in relation to resilience and quality of life in patients with kidney calculi. *World J Psychiatry* 2026; 16(3): 111821 [DOI: 10.5498/wjp.v16.i3.111821]

Shen N, Wu HK, Huang XM. Resilience levels, associated factors, and their correlation with serum neurotransmitter levels in patients with gastric cancer. *World J Psychiatry* 2026; 16(3): 111988 [DOI: 10.5498/wjp.v16.i3.111988]

Javaid ZK, Ramzan M. Emotions deteriorate gastrointestinal health: Diagnosing problems through artificial intelligence and psychometric and psycholinguistic techniques. *World J Psychiatry* 2026; 16(3): 112543 [DOI: 10.5498/wjp.v16.i3.112543]

Pandey S, Gupta PK, Kar SK. Perceived social support, subjective well-being, coping styles, personality traits, and social media addiction among patients with depression. *World J Psychiatry* 2026; 16(3): 112604 [DOI: 10.5498/wjp.v16.i3.112604]

Zhang XY, Shi Y, Lu YT, Zhong YJ, Wu JX, Wang XQ. Constructing a predictive model for postpartum anxiety in patients with preeclampsia based on multidimensional indicators and its application. *World J Psychiatry* 2026; 16(3): 113273 [DOI: 10.5498/wjp.v16.i3.113273]

Hou L, Chen R, Huang CB, Shi WJ, Wu LL. Clinical symptom improvement following modified electroconvulsive therapy is associated with modulation of peripheral inflammatory markers in schizophrenia. *World J Psychiatry* 2026; 16(3): 114036 [DOI: 10.5498/wjp.v16.i3.114036]

Salem N, Farhat A, Hochaimi D, El Hage Ali J, Ammar L, Hamze L, El Irani M, Habib M, Hijazi M, Kaddoura H. Imposter phenomenon and resilience in Lebanese university students: A cross-sectional study. *World J Psychiatry* 2026; 16(3): 114371 [DOI: 10.5498/wjp.v16.i3.114371]

Chen MJ, Lei W, Zhou J, Chen LX, Hui T, Lu X. Fear of disease progression and psychological factors in postoperative lung cancer patients. *World J Psychiatry* 2026; 16(3): 114588 [DOI: 10.5498/wjp.v16.i3.114588]

Liu X, Liu C, Pu YZ, Liu D, Liu HS, Xiang DF, Zhang XY, Wang XY, Yang QX, Jin R, Yu RQ. Significance of arterial spin labeling in relation to sertraline treatment response in adolescents with major depressive disorder. *World J Psychiatry* 2026; 16(3): 114719 [DOI: 10.5498/wjp.v16.i3.114719]

Prospective Study

Laoudi E, Papalouka D, Kokkotis G, Gkizis M, Mantzou A, Lyrakos G, Markopoulos P, Prapa P, Voulgaris T, Vlachogiannakos J, Papaconstantinou I, Bamias G. Hypothalamic-pituitary-adrenal dysregulation and psychological distress in Crohn's disease: Insights from acute and chronic stress responses. *World J Psychiatry* 2026; 16(3): 111523 [DOI: 10.5498/wjp.v16.i3.111523]

Randomized Controlled Trial

Li DX, Gu Y, Xia WJ, Sun YF, Hou L, Zhu WX, Wang J. *Pediococcus acidilactici* CCFM6432 alleviates anhedonia in major depression through immune-inflammatory modulation: An extended trial analysis. *World J Psychiatry* 2026; 16(3): 114446 [DOI: 10.5498/wjp.v16.i3.114446]

SYSTEMATIC REVIEWS

Jiang YL, Samah NA, Xiao ZS. Forever chemicals and mental health: A systematic review of per- and polyfluoroalkyl substances-related psychiatric outcomes and mechanistic insights. *World J Psychiatry* 2026; 16(3): 112022 [DOI: 10.5498/wjp.v16.i3.112022]

Ahsan M, Ahmed S, Shaik RA, Ahmad MS, Nurani KM, A P. Efficacy of hyperbaric oxygen therapy in the treatment of depression. *World J Psychiatry* 2026; 16(3): 113572 [DOI: 10.5498/wjp.v16.i3.113572]

Ji YJ, Chen XC, Zheng Q, Liu Q, Zhang CY, Zhang TT, Li LJ. Implicit cognition tests for the prediction of suicide risk of non-suicidal self-injury in individuals: A systematic review. *World J Psychiatry* 2026; 16(3): 113825 [DOI: 10.5498/wjp.v16.i3.113825]

LETTER TO THE EDITOR

Byeon H. Decoding auditory hallucinations with brain blood flow patterns? *World J Psychiatry* 2026; 16(3): 113487 [DOI: 10.5498/wjp.v16.i3.113487]

Xing HY, Yan J. Critical commentary on initial lurasidone dosing strategies in acute schizophrenia. *World J Psychiatry* 2026; 16(3): 114882 [DOI: 10.5498/wjp.v16.i3.114882]

Deniz R, Atay ME, Çiftçi B. Electromyographic biofeedback in stroke rehabilitation: A pathway to motor recovery and psychological resilience. *World J Psychiatry* 2026; 16(3): 115093 [DOI: 10.5498/wjp.v16.i3.115093]

Nayak S. When East meets West: Accelerated depression recovery with Shugan Jieyu plus sertraline in alcohol-dependent patients. *World J Psychiatry* 2026; 16(3): 115889 [DOI: 10.5498/wjp.v16.i3.115889]

ABOUT COVER

Peer Reviewer of *World Journal of Psychiatry*, Bahar Çiftçi, PhD, Associate Professor, Faculty of Nursing, Atatürk University, 25000 Erzurum, Türkiye. bahar.ciftci@atauni.edu.tr

AIMS AND SCOPE

The primary aim of *World Journal of Psychiatry* (*WJP*, *World J Psychiatry*) is to provide scholars and readers from various fields of psychiatry with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJP mainly publishes articles reporting research results and findings obtained in the field of psychiatry and covering a wide range of topics including adolescent psychiatry, biological psychiatry, child psychiatry, community psychiatry, ethnopsychology, psychoanalysis, psychosomatic medicine, *etc.*

INDEXING/ABSTRACTING

The *WJP* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports/Science Edition, PubMed, PubMed Central, Reference Citation Analysis, China Science and Technology Journal Database, and Superstar Journals Database. The 2025 Edition of Journal Citation Reports® cites the 2024 journal impact factor (JIF) for *WJP* as 3.4; JIF without journal self cites: 3.2; 5-year JIF: 4.0; JIF Rank: 79/288 in psychiatry; JIF Quartile: Q2; and 5-year JIF Quartile: Q2.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Yan-Liang Zhang*; **Production Department Director:** *Xiao-Mei Zheng*; **Cover Editor:** *Jia-Ping Yan.*

NAME OF JOURNAL
World Journal of Psychiatry

ISSN
ISSN 2220-3206 (online)

LAUNCH DATE
December 31, 2011

FREQUENCY
Monthly

EDITORS-IN-CHIEF
Marianna Mazza, Paolo Girardi

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/2220-3206/editorialboard.htm

PUBLICATION DATE
March 19, 2026

COPYRIGHT
© 2026 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

© 2026 Baishideng Publishing Group Inc. All rights reserved. 7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
E-mail: office@baishideng.com https://www.wjgnet.com

World Journal of Psychiatry

Submit a Manuscript: https://www.f6publishing.com

World J Psychiatry 2026 March 19; 16(3): 112056

DOI: 10.5498/wjp.v16.i3.112056

ISSN 2220-3206 (online)

MINIREVIEWS

Innovations and approaches in depression detection *via* functional near-infrared spectroscopy

Wen-Tao Li, Yu-Mei Wan, Wei Miao, Rui Zhong, Qian Gao, Qing-Xiang Wang, Yun-Shao Zheng

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's classification

Scientific Quality: Grade B, Grade B, Grade B

Novelty: Grade B, Grade B, Grade C

Creativity or Innovation: Grade C, Grade C, Grade C

Scientific Significance: Grade B, Grade B, Grade C

P-Reviewer: Li Y, PhD, Researcher, China; Xin YJ, PhD, Assistant Professor, China

Received: July 17, 2025

Revised: August 27, 2025

Accepted: December 10, 2025

Published online: March 19, 2026

Processing time: 226 Days and 15.8 Hours

©Author(s) (or their employer(s)) 2026. No commercial re-use. See Permissions. Published by Baishideng Publishing Group Inc.

Wen-Tao Li, Yu-Mei Wan, Wei Miao, Rui Zhong, Qing-Xiang Wang, Yun-Shao Zheng, Shandong Mental Health Center, Shandong University, Jinan 250014, Shandong Province, China

Qian Gao, Faculty of Computer Science and Technology, Qilu University of Technology (Shandong Academy of Sciences), Jinan 250300, Shandong Province, China

ORCID number: Qing-Xiang Wang 0000-0002-8159-7739.

Co-first authors: Wen-Tao Li and Yu-Mei Wan.

Co-corresponding authors: Qing-Xiang Wang and Yun-Shao Zheng.

Corresponding author: Qing-Xiang Wang, Shandong Mental Health Center, Shandong University, No. 49 Wenhua East Road, Jinan 250014, Shandong Province, China. wangqx@qlu.edu.cn

Abstract

Depression, a leading contributor to global disability, lacks objective diagnostic biomarkers. This review evaluates functional near-infrared spectroscopy (fNIRS) as a portable neuroimaging tool for depression detection, highlighting its algorithmic innovations and clinical translation potential. Machine learning techniques effectively decode hemodynamic patterns of the prefrontal cortex during emotional or cognitive tasks to achieve high classification accuracy in controlled studies. Clinically, fNIRS identifies prefrontal cortex hypoactivation as correlated with symptom severity and tracks neuroplasticity during psychotherapy. However, heterogeneity across symptom subtypes, cultural backgrounds, and age groups limits the generalizability of the model. Technical challenges include signal noise from motion artifacts and interference from superficial tissues. Future research should prioritize standardized multicenter trials, multimodal integration to enhance biomarker specificity, and interpretable artificial intelligence frameworks for clinical translation. fNIRS demonstrates unique advantages for scalable, noninvasive depression screening but necessitates rigorous validation to transition from research to point-of-care applications. This review provides insights into the optimization of fNIRS-based tools for precision psychiatry.

Key Words: Depression; Functional near-infrared spectroscopy; Machine learning; Cognitive tasks; Verbal fluency tasks

Core Tip: Functional near-infrared spectroscopy shows great potential in depression research: It captures prefrontal oxygenation deficits at rest and emotional/cognitive activation abnormalities during tasks, offering quantifiable biomarkers for diagnosis, differentiation, and severity assessment. Despite challenges like limited spatial resolution and unstandardized tasks, combining with advanced algorithms and large samples may enable its key role in early screening, mechanism analysis, and precise treatment, advancing objective, quantitative diagnosis.

Citation: Li WT, Wan YM, Miao W, Zhong R, Gao Q, Wang QX, Zheng YS. Innovations and approaches in depression detection *via* functional near-infrared spectroscopy. *World J Psychiatry* 2026; 16(3): 112056
URL: https://www.wjgnet.com/2220-3206/full/v16/i3/112056.htm
DOI: https://dx.doi.org/10.5498/wjp.v16.i3.112056

INTRODUCTION

Depression, particularly major depressive disorder (MDD), has evolved into a global mental health crisis with a wide range of impacts[1]. According to the World Health Organization, approximately 350 million people worldwide are affected by depression, and this number is projected to grow exponentially in the future[2,3]. Symptoms of depression are diverse, and in severe cases, psychotic symptoms and suicidal thoughts may occur, significantly increasing the risk of unnatural death[4,5]. The diagnosis of MDD relies primarily on clinicians' reference to classification systems, such as the International Classification of Diseases and Related Health Problems, 10th Revision, or the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition[6,7]. The diagnosis often depends on the clinician's subjective assessment and clinical experience[8]. Mental symptoms are polymorphic and often overlap in various diseases, making accurate diagnosis extremely difficult[9]. Moreover, owing to the limitations of diagnostic tools, erroneous or ineffective results are often given to people with cognitive impairments[10].

Functional near-infrared spectroscopy (fNIRS) has emerged as a promising technology in neuroscience and mental health research[11,12]. The principle of fNIRS is that when specific regions of the brain are activated, changes occur in the cerebral blood flow, volume, and oxygenation[13]. By measuring the absorption of near-infrared light by hemoglobin in the brain tissue, fNIRS can detect changes in oxygenated (HbO), deoxygenated (HbR), and total hemoglobin, thereby providing insights into brain function[14]. It is a noninvasive, portable, and relatively inexpensive technology, making it suitable for various scenarios, including clinical settings and large-scale population studies[12-15]. The core pathological mechanism of depression involves functional abnormalities in multiple brain regions, and fNIRS can be used to monitor key regions[16,17]. The dorsolateral and ventromedial prefrontal cortices are brain regions associated with emotional regulation and cognitive control[18]. Patients with depression typically exhibit decreased blood oxygen levels in the prefrontal cortex (PFC), indicating reduced activity of neural circuits responsible for emotional regulation[19]. The default mode network, which includes the posterior cingulate cortex, precuneus, and related regions, shows excessive activity at rest[20]. Current research indicates that there is dysregulation in neural processing during self-referential cognition[21], the amygdala shows excessive activity in emotional processing, and the regulatory control of the PFC over the amygdala is weakened[22]. This imbalance may disrupt emotional homeostasis, contributing to depressive symptoms[23,24]. Several existing studies have analyzed the principles of depression and brain mechanisms using statistical correlation analysis[25].

DEPRESSION DETECTION *VIA* FNIRS

Applications of fNIRS in depression research

Research on the use of fNIRS for depression detection involves multilevel explorations from basic research to clinical practice[26]. In addition to resting and task states, fNIRS applications in depression detection also include natural contexts and mixed states. fNIRS has unique advantages compared to traditional technologies such as functional magnetic resonance imaging and electroencephalography, making it suitable for the long-term monitoring of natural environments[27,28]. As a chronic mental illness[29], depression can be monitored using fNIRS in natural settings, such as clinical consulting rooms, laboratories, and homes[30].

Studies have demonstrated that, based on the detection of abnormal resting-state brain function, low oxygenation levels in the PFC of patients at rest are positively correlated with the severity of depression, which can serve as a potential marker for distinguishing patients with depression from healthy individuals[31]. Regarding abnormal emotional and cognitive responses in task states, the brain region activation patterns of patients with depression differed significantly from those of healthy individuals[32]. During executive function tasks, the amplitude of blood oxygen changes in the PFC of patients is significantly lower than that observed in healthy individuals. The degree of such abnormalities is correlated with the degree of cognitive impairment, which can be used as a supplementary indicator for diagnosis. For the dynamic monitoring of treatment effects and prediction of therapeutic efficacy, fNIRS can track changes in brain activity in patients with depression during drug therapy, psychotherapy, or physical therapy, providing an important basis for efficacy evaluation and the adjustment of individualized treatment plans[33].

In research on depression in special populations, by monitoring the prefrontal activity of adolescents during social interaction tasks using fNIRS, it was found that the activation of the ventrolateral PFC in patients was significantly reduced when facing peer evaluation, revealing the neural basis behind social anxiety and providing targets for early intervention[34]. fNIRS can monitor brain activity in elderly patients at the bedside. Studies have found that the reduction in blood oxygen levels in their PFC is closely related to cognitive decline, providing evidence for the comorbidity mechanism of geriatric depression with cognitive impairment[35]. For treatment-resistant depression, fNIRS can identify unique brain activity patterns in patients who are unresponsive to conventional treatments, thus providing a basis for personalized treatment.

fNIRS is also often used in combination with other technologies such as scale assessment, electroencephalography, and behavioral tasks. The specific applications of fNIRS in depression research, from the exploration of objective diagnostic markers to the dynamic monitoring of treatment effects and the analysis of neural mechanisms of core symptoms to targeted research on special populations, all reflect its unique value[36]. fNIRS is an ideal tool for depression detection due to its low cost and high portability, its ability to process high-dimensional data in combination with technologies like machine learning, its contribution to objective diagnosis, treatment effect monitoring, and mechanism research of depression, as well as its compatibility with various other technologies.

Resting-state depression detection

The resting state refers to the brain activity state of the subjects without specific tasks. Analysis of blood oxygen signals in regions such as the PFC and default network revealed baseline functional abnormalities in patients with depression. Xu *et al*[37] conducted a study of 34 patients with MDD and 30 healthy controls using fNIRS. During a 10-minute resting-state detection, they found that patients with MDD exhibited stronger brain network integration and lower local efficiency of occipital hub nodes. Zhu *et al*[38] used fNIRS to detect the resting-state activity in the PFC of 28 patients with adjustment disorder (AD) and 30 healthy controls. They found that connectivity within the PFC and between symmetric hemispheres was reduced in AD patients, and that connection strength was negatively correlated with depressive symptoms, indicating that fNIRS can characterize AD neuropathology[38]. Wong *et al*[39] used fNIRS to measure the dorsolateral PFC in 70 subjects and found that patients with depression receiving combined acupuncture and antidepressant therapy exhibited improved depressive symptoms and stronger resting-state functional connectivity in the dorsolateral PFC compared with those treated with antidepressants alone. Lin *et al*[40] recruited 37 patients and 49 healthy controls to investigate the association between the resting-state prefrontal network and cognitive function in patients with depression and insomnia using fNIRS. They found that these patients exhibited impaired prefrontal cortical functional connectivity, which is closely linked to cognitive function[40].

Task-state of depression detection

Compared with resting-state detection, task-state detection induces specific brain region activities through designed standardized tasks and detects neural abnormalities in dimensions such as emotion, cognition, and social function, which is the mainstream form of current research. Gao *et al*[41] studied 27 patients with MDD and 24 healthy controls during facial emotion recognition tasks. They found that the hemodynamic changes in the left PFC and between bilateral prefrontal cortices detected by fNIRS can provide reliable predictive indicators for the clinical diagnosis of depression [41]. Manelis *et al*[42] observed 33 patients with depression and 20 healthy controls during an emotional intensity rating task. They found that compared with healthy controls, depressed patients demonstrated lower activation in the right PFC when identifying happy facial expressions. Wan *et al*[43] recruited 37 patients with MDD and 34 healthy controls to participate in three groups of emotion recognition cognitive tasks. They found that patients with MDD had lower accuracy in distinguishing sad emotional cues from neutral and happy ones. Lee *et al*[44] compared the functional activity in the prefrontal region measured by fNIRS in 28 patients with seasonal affective disorder and 27 healthy controls during cognitive tasks. The results indicated that the reduction in right frontopolar PFC activity in the healthy control group was greater than that in the seasonal affective disorder group; there were also significant differences in orbitofrontal cortex activity[44].

Lyu *et al*[45] recruited 110 MDD patients and 106 healthy controls to perform verbal fluency tasks. They found that compared to healthy controls, MDD patients had significantly reduced changes in the right inferior frontal gyrus, and the functional language lateralization to the left in the inferior frontal gyrus was significantly increased. Mao *et al*[46] recorded fNIRS data from 289 patients with MDD and 178 healthy controls who performed verbal fluency tasks to assess cognitive deficits and conduct early screening for MDD. Yang *et al*[47] used fNIRS to detect brain functional activity in recurrent MDD and healthy control groups, and found that the average activation in the frontal and temporal lobes of the MDD group was lower. Yang *et al*[48] studied 50 patients with MDD and 20 healthy controls, and collected fNIRS data during four tasks (emotional pictures, verbal fluency, finger movement, and negative emotional picture description). They found that differences in activation patterns and functional connectivity characteristics between patients with MDD and healthy controls were closely related to the selected tasks.

Machine learning based detection methods

The data processing stage involves preprocessing raw fNIRS signals to eliminate noise and artifacts, which includes applying bandpass filtering to eliminate physiological interference, motion correction techniques to address head movement artifacts, and normalization to ensure consistency across subjects. This was followed by segmentation of the time-series data into epochs corresponding to specific experimental conditions or resting-state periods. For feature extraction, both temporal and spatial characteristics of the fNIRS signals were analyzed, where temporal features such as mean, variance, and skewness of HbO and HbR hemoglobin concentrations were computed. Spatial features were

derived from connectivity patterns between different brain regions using correlation or coherence measures, and dimensionality reduction techniques such as principal component analysis were applied to identify the most discriminative features for depression classification. The data processing stage involves preprocessing raw fNIRS signals to eliminate noise and artifacts, which includes applying bandpass filtering to eliminate physiological interference, motion correction techniques to address head movement artifacts, and normalization to ensure consistency across subjects. This was followed by segmentation of the time-series data into epochs corresponding to specific experimental conditions or resting-state periods.

For feature extraction, both temporal and spatial characteristics of fNIRS signals were analyzed, and temporal features such as the mean, variance, and skewness of HbO and HbR hemoglobin concentrations were computed. Spatial features were derived from connectivity patterns between different brain regions using correlation or coherence measures. Dimensionality reduction techniques, such as principal component analysis, were applied to identify the most discriminative features for depression classification. In model construction, machine learning algorithms or deep learning models are trained on the extracted features for classification, with performance evaluated through cross-validation and metrics such as accuracy, sensitivity, and specificity[49]. Interpretability techniques, such as SHapley Additive exPlanation values or feature importance analysis, were employed to identify brain regions and functional connectivity patterns that were most predictive of depression, thereby enhancing the clinical applicability of the approach. All articles are summarized in Table 1[27,50-56].

Yu *et al*[50] proposed a graph neural network-based method using fNIRS data from 96 subjects. They combined the temporal and spatial features of fNIRS data for automatic depression recognition, achieving good performance in depression identification. Shao *et al*[51] proposed a cross-modal data augmentation-based fNIRS-driven depression recognition architecture that converted fNIRS data into pseudo-sequential activation images using a stimulus task-driven data pseudo-sequential method, achieving a binary classification accuracy of 0.905. Huang *et al*[52] collected fNIRS data from 140 subjects and applied a combined denoising method using complete ensemble empirical mode decomposition and adaptive noise wavelet thresholding. The proposed model effectively distinguished between mild and severe depression with an accuracy of 92.8%. Kim *et al*[53] conducted a study on 30 adolescents with MDD aged 13-19 years to explore the relationship between their fNIRS data during the Stroop test and suicide risk. Wang *et al*[54] conducted research on fNIRS in depression and proposed time and frequency domain feature extraction and deep neural network recognition methods. They found that patients with depression exhibited weaker brain connectivity and lower prefrontal activation levels.

DISCUSSION

The application of fNIRS in depression research provides a novel perspective for addressing core challenges in current depression diagnosis and treatment. Existing studies have shown that by detecting changes in cerebral regional blood oxygen dynamics, fNIRS can capture specific neural activity patterns in patients with depression during the resting and task states, providing potential biomarkers for objective diagnosis, treatment monitoring, and mechanism analysis of depression. Machine learning is revolutionizing depression research with fNIRS. Algorithms ingest multichannel prefrontal hemodynamic responses during verbal fluency or emotional tasks, learning subtle hypo-or hyper-activation patterns to classify patients *vs* controls with acceptable accuracy. Feature selection and deep networks handle high-dimensional, noisy fNIRS data, identifying biomarkers tied to pathophysiology. Regression models further predict symptom severity and treatment response, supporting personalized care. The low cost and portability of fNIRS enable large, ecologically valid datasets.

The rapid development of machine learning technology has injected strong impetus into fNIRS-based depression recognition. By deeply mining the temporal dynamic laws of cerebral blood oxygen changes and the spatial distribution characteristics of brain region activation contained in fNIRS data, high-precision automatic recognition of depression can be realized to significantly improve diagnostic efficiency and objectivity. The integrated analysis of time-series patterns and spatial topological structures of fNIRS data using machine learning algorithms can accurately locate abnormal brain function regions in patients with depression and effectively distinguish brain function differences between patients and healthy individuals by constructing multidimensional feature classification models, providing data support for the study of the pathological mechanism of depression. This opens new avenues for early screening, accurate diagnosis, and personalized treatment plan formulations for depression.

LIMITATIONS

Despite the promising advances, several limitations must be acknowledged. First, the spatial resolution of fNIRS remains inferior to that of fMRI, restricting its capacity to probe subcortical structures critically involved in depression, such as the amygdala or hippocampus. Second, variability in experimental protocols (*e.g.*, task design, duration, and channel configurations) undermines the comparability and reproducibility of cross-study findings. Third, most existing models are trained on relatively small, homogeneous samples, limiting their generalizability across diverse populations, ethnicities, and clinical subtypes. Additionally, fNIRS signals are susceptible to motion artifacts, physiological noise, and systemic variations, which can confound the interpretation of hemodynamic responses. The interpretability of machine learning models also remains a challenge; while they achieve high accuracy, the clinical translation of these "black-box" systems requires clearer neurobiological correlates. Finally, longitudinal studies are scarce, and the utility of fNIRS in tracking

Table 1 Summary of machine learning-based detection methods

Ref.	Method	Task	Sample size	Number of channels	Evaluation criterion
Enneking *et al*[27], 2022	SVR	Resting	64 (34 P + 30 HC)	53	-
Yu *et al*[50], 2022	GNN	VFT	96	53	ACC (0.8775)
Shao *et al*[51], 2024	2D-CNN	Vision	96 (17 HC + 79 P)	53	ACC (0.905)
Huang *et al*[52], 2024	SVM	VFT	140	52	ACC (0.928)
Kim *et al*[53], 2023	SVM	Stroop	34	15	ACC (0.703)
Wang *et al*[54], 2021	AlexNet	Vison	96 (17 HC + 79 P)	53	ACC (0.90)
Lin *et al*[55], 2025	RF	VFT	143 (73 HC + 70 P)	44	ACC (0.77)
Mou *et al*[56], 2025	1D-CNN	VFT	172 (132 P + 40 HC)	22	ACC (0.7957)

P: Patients; HC: Healthy control; ACC: Accuracy; SVR: Support vector regression; GNN: Graph neural network; 2D-CNN: 2-dimensional convolution neural network; SVM: Support vector machine; RF: Random forest; 1D-CNN: 1-dimensional convolutional neural network; VFT: Verbal fluency tasks.

long-term treatment outcomes or predicting relapse has yet to be fully established. Addressing these limitations through standardized protocols, multimodal validation, and larger multi-center cohorts will be essential for translating fNIRS into a reliable clinical tool.

CONCLUSION

fNIRS has demonstrated significant potential for application in depression research. It can capture the low oxygenation characteristics of the PFC in depressed patients at rest and activation abnormalities in brain regions related to emotional processing and cognitive function during task states, providing quantifiable biomarkers for the objective diagnosis of depression, which helps distinguish patients from healthy individuals and evaluate disease severity and cognitive deficits. Although there are current challenges, such as limited spatial resolution and insufficient standardization of task paradigms, combined with advanced algorithms and large-sample studies, fNIRS is expected to play a crucial clinical role in early screening, mechanism analysis, and precise treatment of depression, promoting the transformation of depression diagnosis from subjective to objective and quantitative assessment.

REFERENCES

1 **Kessler RC**, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, Rush AJ, Walters EE, Wang PS; National Comorbidity Survey Replication. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA* 2003; **289**: 3095-3105 [*RCA*] [PMID: 12813115 DOI: 10.1001/jama.289.23.3095] [FullText]

2 **Smith K**. Mental health: a world of depression. *Nature* 2014; **515**: 181 [*RCA*] [PMID: 25391942 DOI: 10.1038/515180a] [FullText]

3 **Freeman M**. The World Mental Health Report: transforming mental health for all. *World Psychiatry* 2022; **21**: 391-392 [*RCA*] [PMID: 36073688 DOI: 10.1002/wps.21018] [FullText]

4 **Katon WJ**. Clinical and health services relationships between major depression, depressive symptoms, and general medical illness. *Biol Psychiatry* 2003; **54**: 216-226 [*RCA*] [PMID: 12893098 DOI: 10.1016/s0006-3223(03)00273-7] [FullText]

5 **Kalin NH**. Anxiety, Depression, and Suicide in Youth. *Am J Psychiatry* 2021; **178**: 275-279 [*RCA*] [PMID: 33789454 DOI: 10.1176/appi.ajp.2020.21020186] [FullText]

6 **Nimgampalle M**, Chakravarthy H, Sharma S, Shree S, Bhat AR, Pradeepkiran JA, Devanathan V. Neurotransmitter systems in the etiology of major neurological disorders: Emerging insights and therapeutic implications. *Ageing Res Rev* 2023; **89**: 101994 [*RCA*] [PMID: 37385351 DOI: 10.1016/j.arr.2023.101994] [FullText]

7 **Di Vincenzo M**. New research on validity and clinical utility of ICD-11 vs. ICD-10 and DSM-5 diagnostic categories. *World Psychiatry* 2023; **22**: 171-172 [*RCA*] [PMID: 36640408 DOI: 10.1002/wps.21053] [FullText]

8 **Levis B**, Yan XW, He C, Sun Y, Benedetti A, Thombs BD. Comparison of depression prevalence estimates in meta-analyses based on screening tools and rating scales versus diagnostic interviews: a meta-research review. *BMC Med* 2019; **17**: 65 [*RCA*] [PMID: 30894161 DOI: 10.1186/s12916-019-1297-6] [FullText] [Full Text(PDF)]

9 **Dubovsky SL**, Ghosh BM, Serotte JC, Cranwell V. Psychotic Depression: Diagnosis, Differential Diagnosis, and Treatment. *Psychother Psychosom* 2021; **90**: 160-177 [*RCA*] [PMID: 33166960 DOI: 10.1159/000511348] [FullText]

10 **Perini G**, Cotta Ramusino M, Sinforiani E, Bernini S, Petrachi R, Costa A. Cognitive impairment in depression: recent advances and novel treatments. *Neuropsychiatr Dis Treat* 2019; **15**: 1249-1258 [*RCA*] [PMID: 31190831 DOI: 10.2147/NDT.S199746] [FullText] [Full Text (PDF)]

11 **Ho CSH**, Lim LJH, Lim AQ, Chan NHC, Tan RS, Lee SH, Ho RCM. Diagnostic and Predictive Applications of Functional Near-Infrared Spectroscopy for Major Depressive Disorder: A Systematic Review. *Front Psychiatry* 2020; **11**: 378 [*RCA*] [PMID: 32477179 DOI: 10.3389/fpsyt.2020.00378] [FullText] [Full Text(PDF)]

12 **Rahman MA**, Siddik AB, Ghosh TK, Khanam F, Ahmad M. A Narrative Review on Clinical Applications of fNIRS. *J Digit Imaging* 2020; **33**: 1167-1184 [*RCA*] [PMID: 32989620 DOI: 10.1007/s10278-020-00387-1] [FullText]

13 **Pinti P**, Tachtsidis I, Hamilton A, Hirsch J, Aichelburg C, Gilbert S, Burgess PW. The present and future use of functional near-infrared spectroscopy (fNIRS) for cognitive neuroscience. *Ann N Y Acad Sci* 2020; **1464**: 5-29 [*RCA*] [PMID: 30085354 DOI: 10.1111/nyas.13948] [FullText] [Full Text(PDF)]

14 **Peng C**, Hou X. Applications of functional near-infrared spectroscopy (fNIRS) in neonates. *Neurosci Res* 2021; **170**: 18-23 [*RCA*] [PMID: 33347910 DOI: 10.1016/j.neures.2020.11.003] [FullText]

15 **Mauri M**, Crippa A, Bacchetta A, Grazioli S, Rosi E, Gazzola E, Gallace A, Nobile M. The utility of NIRS technology for exploring emotional processing in children. *J Affect Disord* 2020; **274**: 819-824 [*RCA*] [PMID: 32664020 DOI: 10.1016/j.jad.2020.06.004] [FullText]

16 **Li R**, Hosseini H, Saggar M, Balters SC, Reiss AL. Current opinions on the present and future use of functional near-infrared spectroscopy in psychiatry. *Neurophotonics* 2023; **10**: 013505 [*RCA*] [PMID: 36777700 DOI: 10.1117/1.NPh.10.1.013505] [FullText] [Full Text(PDF)]

17 **Băcilă CI**, Marcu GM, Vintilă BI, Anghel CE, Lomnasan A, Cornea M, Grama AM. Applications of Functional Near-Infrared Spectroscopy (fNIRS) in Monitoring Treatment Response in Psychiatry: A Scoping Review. *J Clin Med* 2025; **14**: 5197 [*RCA*] [PMID: 40806818 DOI: 10.3390/jcm14155197] [FullText] [Full Text(PDF)]

18 **Nejati V**, Majdi R, Salehinejad MA, Nitsche MA. The role of dorsolateral and ventromedial prefrontal cortex in the processing of emotional dimensions. *Sci Rep* 2021; **11**: 1971 [*RCA*] [PMID: 33479323 DOI: 10.1038/s41598-021-81454-7] [FullText] [Full Text(PDF)]

19 **Pizzagalli DA**, Roberts AC. Prefrontal cortex and depression. *Neuropsychopharmacology* 2022; **47**: 225-246 [*RCA*] [PMID: 34341498 DOI: 10.1038/s41386-021-01101-7] [FullText]

20 **Ho TC**, Connolly CG, Henje Blom E, LeWinn KZ, Strigo IA, Paulus MP, Frank G, Max JE, Wu J, Chan M, Tapert SF, Simmons AN, Yang TT. Emotion-Dependent Functional Connectivity of the Default Mode Network in Adolescent Depression. *Biol Psychiatry* 2015; **78**: 635-646 [*RCA*] [PMID: 25483399 DOI: 10.1016/j.biopsych.2014.09.002] [FullText]

21 **Lemogne C**, Mayberg H, Bergouignan L, Volle E, Delaveau P, Lehéricy S, Allilaire JF, Fossati P. Self-referential processing and the prefrontal cortex over the course of depression: a pilot study. *J Affect Disord* 2010; **124**: 196-201 [*RCA*] [PMID: 19945172 DOI: 10.1016/j.jad.2009.11.003] [FullText]

22 **Klug M**, Enneking V, Borgers T, Jacobs CM, Dohm K, Kraus A, Grotegerd D, Opel N, Repple J, Suslow T, Meinert S, Lemke H, Leehr EJ, Bauer J, Dannlowski U, Redlich R. Persistence of amygdala hyperactivity to subliminal negative emotion processing in the long-term course of depression. *Mol Psychiatry* 2024; **29**: 1501-1509 [*RCA*] [PMID: 38278993 DOI: 10.1038/s41380-024-02429-4] [FullText] [Full Text(PDF)]

23 **Wang B**, He T, Qiu G, Li C, Xue S, Zheng Y, Wang T, Xia Y, Yao L, Yan J, Chen Y. Altered synaptic homeostasis: a key factor in the pathophysiology of depression. *Cell Biosci* 2025; **15**: 29 [*RCA*] [PMID: 40001206 DOI: 10.1186/s13578-025-01369-y] [FullText] [Full Text (PDF)]

24 **Shaffer C**, Westlin C, Quigley KS, Whitfield-Gabrieli S, Barrett LF. Allostasis, Action, and Affect in Depression: Insights from the Theory of Constructed Emotion. *Annu Rev Clin Psychol* 2022; **18**: 553-580 [*RCA*] [PMID: 35534123 DOI: 10.1146/annurev-clinpsy-081219-115627] [FullText]

25 **Chao J**, Zheng S, Wu H, Wang D, Zhang X, Peng H, Hu B. fNIRS Evidence for Distinguishing Patients With Major Depression and Healthy Controls. *IEEE Trans Neural Syst Rehabil Eng* 2021; **29**: 2211-2221 [*RCA*] [PMID: 34554917 DOI: 10.1109/TNSRE.2021.3115266] [Full Text]

26 **Wen D**, Lang X, Zhang H, Li Q, Yin Q, Chen Y, Xu Y. Task and Non-task Brain Activation Differences for Assessment of Depression and Anxiety by fNIRS. *Front Psychiatry* 2021; **12**: 758092 [*RCA*] [PMID: 34803768 DOI: 10.3389/fpsyt.2021.758092] [FullText] [Full Text (PDF)]

27 **Zhao JL**, Jiang WT, Wang X, Cai ZD, Liu ZH, Liu GR. Exercise, brain plasticity, and depression. *CNS Neurosci Ther* 2020; **26**: 885-895 [*RCA*] [PMID: 32491278 DOI: 10.1111/cns.13385] [FullText] [Full Text(PDF)]

28 **Enneking V**, Klug M, Borgers T, Dohm K, Grotegerd D, Frankenberger LM, Hülsmann C, Lemke H, Meinert S, Leehr EJ, Opel N, Goltermann J, Richter M, Waltemate L, Böhnlein J, Sindermann L, Repple J, Bauer J, Thomas M, Dannlowski U, Redlich R. Changes in brain function during negative emotion processing in the long-term course of depression. *Br J Psychiatry* 2022; **221**: 476-484 [*RCA*] [PMID: 35082002 DOI: 10.1192/bjp.2021.223] [FullText]

29 **Alagapan S**, Choi KS, Heisig S, Riva-Posse P, Crowell A, Tiruvadi V, Obatusin M, Veerakumar A, Waters AC, Gross RE, Quinn S, Denison L, O'Shaughnessy M, Connor M, Canal G, Cha J, Hershenberg R, Nauvel T, Isbaine F, Afzal MF, Figee M, Kopell BH, Butera R, Mayberg HS, Rozell CJ. Cingulate dynamics track depression recovery with deep brain stimulation. *Nature* 2023; **622**: 130-138 [*RCA*] [PMID: 37730990 DOI: 10.1038/s41586-023-06541-3] [FullText] [Full Text(PDF)]

30 **Flanagan K**, Saikia MJ. Consumer-Grade Electroencephalogram and Functional Near-Infrared Spectroscopy Neurofeedback Technologies for Mental Health and Wellbeing. *Sensors (Basel)* 2023; **23**: 8482 [*RCA*] [PMID: 37896575 DOI: 10.3390/s23208482] [FullText]

31 **Bruder GE**, Stewart JW, McGrath PJ. Right brain, left brain in depressive disorders: Clinical and theoretical implications of behavioral, electrophysiological and neuroimaging findings. *Neurosci Biobehav Rev* 2017; **78**: 178-191 [*RCA*] [PMID: 28445740 DOI: 10.1016/j.neubiorev.2017.04.021] [FullText]

32 **Wu H**, Lu B, Xiang N, Qiu M, Da H, Xiao Q, Zhang Y, Shi H. Different activation in dorsolateral prefrontal cortex between anxious depression and non-anxious depression during an autobiographical memory task: A fNIRS study. *J Affect Disord* 2024; **362**: 585-594 [*RCA*] [PMID: 39019227 DOI: 10.1016/j.jad.2024.07.031] [FullText]

33 **Wu Y**, Qiao S, Zhong J, Zhang L, Wang J, Hu B, Peng H. FNIRS-Based Energy Landscape Analysis to Signify Brain Activity Dynamics of Individuals With Depression. *CNS Neurosci Ther* 2024; **30**: e70139 [*RCA*] [PMID: 39618052 DOI: 10.1111/cns.70139] [FullText] [Full Text (PDF)]

34 **Shin JE**, Lee YS, Park SY, Jeong MY, Choi JK, Cha JH, Lee YJ. The Relationship between Depression Severity and Prefrontal Hemodynamic Changes in Adolescents with Major Depression Disorder: A Functional Near-infrared Spectroscopy Study. *Clin Psychopharmacol Neurosci* 2024; **22**: 118-128 [*RCA*] [PMID: 38247418 DOI: 10.9758/cpn.23.1073] [FullText]

35 **Kang MJ**, Cho SY, Choi JK, Yang YS. fNIRS Assessment during Cognitive Tasks in Elderly Patients with Depressive Symptoms. *Brain Sci* 2023; **13**: 1054 [*RCA*] [PMID: 37508986 DOI: 10.3390/brainsci13071054] [FullText]

36 **Kawabata Y**, Imazu SI, Matsumoto K, Toyoda K, Kawano M, Kubo Y, Kinoshita S, Nishizawa Y, Kanazawa T. rTMS Therapy Reduces Hypofrontality in Patients With Depression as Measured by fNIRS. *Front Psychiatry* 2022; **13**: 814611 [*RCA*] [PMID: 35815029 DOI: 10.3389/fpsyt.2022.814611] [FullText] [Full Text(PDF)]

37 **Xu Y**, Wang Y, Hu N, Yang L, Yu Z, Han L, Xu Q, Zhou J, Chen J, Mao H, Pan Y. Intrinsic Organization of Occipital Hubs Predicts

Depression: A Resting-State fNIRS Study. *Brain Sci* 2022; **12**: 1562 [*RCA*] [PMID: 36421888 DOI: 10.3390/brainsci12111562] [FullText] [Full Text(PDF)]

38 **Zhu H**, Xu J, Li J, Peng H, Cai T, Li X, Wu S, Cao W, He S. Decreased functional connectivity and disrupted neural network in the prefrontal cortex of affective disorders: A resting-state fNIRS study. *J Affect Disord* 2017; **221**: 132-144 [*RCA*] [PMID: 28645025 DOI: 10.1016/j.jad.2017.06.024] [FullText]

39 **Wong YK**, Wu JM, Zhou G, Zhu F, Zhang Q, Yang XJ, Qin Z, Zhao N, Chen H, Zhang ZJ. Antidepressant Monotherapy and Combination Therapy with Acupuncture in Depressed Patients: A Resting-State Functional Near-Infrared Spectroscopy (fNIRS) Study. *Neurotherapeutics* 2021; **18**: 2651-2663 [*RCA*] [PMID: 34431029 DOI: 10.1007/s13311-021-01098-3] [FullText]

40 **Lin X**, Ji S, Shan Z, Wang L, He X, Xue R, Jia X, Liu X, Yu H. The association between resting-state prefrontal network and cognitive function in depressed patients with insomnia. *Neuroscience* 2025; **581**: 208-214 [*RCA*] [PMID: 40645325 DOI: 10.1016/j.neuroscience.2025.07.012] [FullText]

41 **Gao L**, Cai Y, Wang H, Wang G, Zhang Q, Yan X. Probing prefrontal cortex hemodynamic alterations during facial emotion recognition for major depression disorder through functional near-infrared spectroscopy. *J Neural Eng* 2019; **16**: 026026 [*RCA*] [PMID: 30669122 DOI: 10.1088/1741-2552/ab0093] [FullText]

42 **Manelis A**, Huppert TJ, Rodgers E, Swartz HA, Phillips ML. The role of the right prefrontal cortex in recognition of facial emotional expressions in depressed individuals: fNIRS study. *J Affect Disord* 2019; **258**: 151-158 [*RCA*] [PMID: 31404763 DOI: 10.1016/j.jad.2019.08.006] [FullText]

43 **Wan X**, Wu Y, Jiang W, Lu X, Tang Y, Yuan X, Huang L, Hu M. Cortical functional mechanisms in emotional cognitive tasks in first-episode, drug-naïve with major depressive disorder: A fNIRS study. *J Affect Disord* 2024; **362**: 698-705 [*RCA*] [PMID: 39029670 DOI: 10.1016/j.jad.2024.07.113] [FullText]

44 **Lee H**, Choi J, Jung D, Hur JW, Cho CH. The Effects of Virtual Reality Treatment on Prefrontal Cortex Activity in Patients With Social Anxiety Disorder: Participatory and Interactive Virtual Reality Treatment Study. *J Med Internet Res* 2021; **23**: e31844 [*RCA*] [PMID: 34801979 DOI: 10.2196/31844] [FullText]

45 **Lyu H**, Zhao M, Xu P, Li Y, Jiang C, Zhao H, Shen W, Hu X, Wang K, Xu Y, Huang M. Gender differences in brain region activation during verbal fluency task as detected by fNIRS in patients with depression. *World J Biol Psychiatry* 2024; **25**: 141-150 [*RCA*] [PMID: 37998167 DOI: 10.1080/15622975.2023.2287735] [FullText]

46 **Mao L**, Hong X, Hu M. Identifying neuroimaging biomarkers in major depressive disorder using machine learning algorithms and functional near-infrared spectroscopy (fNIRS) during verbal fluency task. *J Affect Disord* 2024; **365**: 9-20 [*RCA*] [PMID: 39151759 DOI: 10.1016/j.jad.2024.08.082] [FullText]

47 **Yang T**, Wang H, Dai H, Hui J, Zhang J, Li J, Cui G, Wang J, Mu J, Zhang Z. The fNIRS evaluation of frontal and temporal lobe cortical activation in Chinese first-episode medication-naïve and recurrent depression during a verbal fluency task. *Front Psychiatry* 2023; **14**: 1132666 [*RCA*] [PMID: 37113544 DOI: 10.3389/fpsyt.2023.1132666] [FullText]

48 **Yang J**, Fan J, Cheng A, Zhao W, Wu D, Cui W, Zhang Y, Liu X. Hemodynamic analysis of the frontal cortex using multi-task fNIRS in major depressive disorder. *J Affect Disord* 2022; **315**: 206-212 [*RCA*] [PMID: 35932939 DOI: 10.1016/j.jad.2022.08.001] [FullText]

49 **Eastmond C**, Subedi A, De S, Intes X. Deep learning in fNIRS: a review. *Neurophotonics* 2022; **9**: 041411 [*RCA*] [PMID: 35874933 DOI: 10.1117/1.NPh.9.4.041411] [FullText] [Full Text(PDF)]

50 **Yu Q**, Wang R, Liu J, Hu L, Chen M, Liu Z. GNN-Based Depression Recognition Using Spatio-Temporal Information: A fNIRS Study. *IEEE J Biomed Health Inform* 2022; **26**: 4925-4935 [*RCA*] [PMID: 35905061 DOI: 10.1109/JBHI.2022.3195066] [FullText]

51 **Shao K**, Liu Y, Mo Y, Yang Q, Hao Y, Chen M. fNIRS-Driven Depression Recognition Based on Cross-Modal Data Augmentation. *IEEE Trans Neural Syst Rehabil Eng* 2024; **32**: 2688-2698 [*RCA*] [PMID: 39012734 DOI: 10.1109/TNSRE.2024.3429337] [FullText]

52 **Huang Z**, Liu M, Yang H, Wang M, Zhao Y, Han X, Chen H, Feng Y. Functional near-infrared spectroscopy-based diagnosis support system for distinguishing between mild and severe depression using machine learning approaches. *Neurophotonics* 2024; **11**: 025001 [*RCA*] [PMID: 38660382 DOI: 10.1117/1.NPh.11.2.025001] [FullText]

53 **Kim S**, Yoon H, Shin J, Yang CM. Classification of fNIRS signals from adolescents with MDD in suicide high- and low-risk groups using machine learning. *J Affect Disord* 2023; **340**: 379-386 [*RCA*] [PMID: 37536425 DOI: 10.1016/j.jad.2023.07.118] [FullText]

54 **Wang R**, Hao Y, Yu Q, Chen M, Humar I, Fortino G. Depression Analysis and Recognition Based on Functional Near-Infrared Spectroscopy. *IEEE J Biomed Health Inform* 2021; **25**: 4289-4299 [*RCA*] [PMID: 33929968 DOI: 10.1109/JBHI.2021.3076762] [FullText]

55 **Li L**, Liu JX, Zheng YF, Shi CC, Bai WT. Identification of Subthreshold Depression Based on fNIRS–VFT Functional Connectivity: A Machine Learning Approach. *Depress Anxiety* 2025; **2025**: 7645625 [DOI: 10.1155/da/7645625] [FullText]

56 **Mou L**, Shen Y, Wu B, Zhang C, Zhu J, Tan Q, Zhang X, Wang Z, Shen Z. Different prefrontal cortex activity patterns in bipolar and unipolar depression during verbal fluency tasks based on functional near infrared spectroscopy study. *Sci Rep* 2025; **15**: 21257 [*RCA*] [PMID: 40593067 DOI: 10.1038/s41598-025-05896-z] [FullText] [Full Text(PDF)]

FOOTNOTES

Specialty type: Psychiatry

Country of origin: China

Author contributions: Li WT and Wan YM contributed equally to this manuscript and are co-first authors. Wang QX and Zheng YS contributed equally to this manuscript and are co-corresponding authors. Li WT, Wan YM, Wang QX, and Zheng YS designed the research study; Zhong R, Miao W, and Gao Q conducted literature retrieval; Li WT and Wan YM summarized and analyzed relevant literature; Zheng YS, Wan YM, and Miao W provided medical knowledge; Li WT and Wan YM were responsible for writing and revising the manuscript; Wang QX and Zheng YS reviewed the manuscript and approved its publication. All authors have read and approved the final manuscript.

Supported by Shandong Provincial Medical and Health Science and Technology, No. 202303090824; Science and Technology

Development Plan of Jinan (Clinical Medicine Science and Technology Innovation Plan), No. 202225054; Shandong Provincial Medical and Health Science and Technology, No. 202203090935; and Shandong Provincial Natural Science Foundation, No. ZR2022MF333.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Open Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: https://creativecommons.org/Licenses/by-nc/4.0/

S-Editor: Bai SR
L-Editor: A
P-Editor: Wang WB

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: office@baishideng.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com

© 2026 Baishideng Publishing Group Inc. All rights reserved.