

Moderators of pre-post changes in school-based mental health promotion: Psychological stress symptom decrease for adolescents with mental health problems, knowledge increase for adolescents ProHEAD Consortium. Lehner L, et al. Front Psychiatry. 2022. Aug 4;13:899185. doi: 10.3389/fpsyt.2022.899185. doi: 10.3389/fpsyt.2028.898188. doi: dataset with uniform preprocessing. Technol Health Care 31(6):2499-2511. Control 68:102756. MATH Google Scholar Acevedo CMD, Gómez JKC, Rojas CAA (2021) Academic stress detection on university students during COVID-19 outbreak by using an electronic nose and the galvanic skin response. Biomed Signal Process Control 68:102756. Scholar Al-Hatamleh MA, Hussin TM, Taib WR, Ismail I (2019) The brain-derived neurotrophic factor (BDNF) gene Val66Met (rs6265) polymorphism and stress among preclinical medical students in Malaysia. J Taibah Univ Med Sci 14(5):431-438. PubMed Central Google Scholar Ali N, Nater UM (2020) Salivary alpha-amylase as a biomarker of stress in behavioral medicine. Int J Behav Med 27:337-342. PubMed Central MATH Google Scholar Almarzouki AF (2024) Stress, working memory, and academic performance: a neuroscience perspective. Stress 27(1):2364333. associated factors of perceived stress and its consequence among undergraduate students of Salale University, Ethiopia: cross-sectional study. Psychol Health Med 26(10):1230-1240. Health Med 26(10):1230-1240. paraoxonase activity, arylesterase activity and anthropometric parameters of undergraduate students under examination stress. Eur J Inflamm 19:20587392211000884. Inder examination stress. Eur J Inflamm 19:20587392211000884. CAS PubMed Google Scholar Armario A, Labad J, Nadal R (2020) Focusing attention on biological markers of acute stressor intensity: empirical evidence and limitations. Neurosci Biobehav Rev 111:95-103. CAS PubMed Google Scholar Ballestar-Tarín ML, Ibáñez-del Valle V, Mafla-España MA, Navarro-Martínez R, Cauli O (2024) Salivary brain-derived neurotrophic factor and cortisol associated with psychological alterations in University students. Diagnostics 14(4):447. CAS PubMed PubMed Central Google Scholar Barbayannis G, Bandari M, Zheng X, Baquerizo H, Pecor KW, Ming X (2022) Academic stress and mental well-being in college students: correlations, affected groups, and COVID-19. Front Psychol 13:886344. PubMed Central Google Scholar Bedard M, Woods R, Crump C, Anisman H (2017) Loneliness in relation to depression: the moderating influence of a polymorphism of the brain derived neurotrophic factor gene on self-efficacy and coping strategies. Front Psychol 8:1224. PubMed Central Google Scholar Bedard M, Woods R, Crump C, Anisman H (2017) Loneliness in relation to depression: the moderating influence of a polymorphism of the brain derived neurotrophic factor gene on self-efficacy and coping strategies. Scholar Bedewy D, Gabriel A (2015) Examining perceptions of academic stress and its sources among university students: the Perception of Academic Stress Scale. Health Psychol Open 2(2):2055102915596714. PubMed Central Google Scholar Boell SK, Cecez-Kecmanovic D (2015) On being 'systematic'in literature reviews in IS. J Inf Technol 30(2):161-173. Coogle Scholar Borghi F, da Silva PC, Canova F, Souza AL, Arouca AB, Grassi-Kassisse DM (2021) Acute and chronic effects of exams week on cortisol production in undergraduate students. Preprint at bioRxiv NGP, Vázquez KR, Reyes BJL, Melasio DAG, Lara AR, Hernández PET (2024) Clinical practice stressors and anxiety in nursing students during COVID-19. Salud Mental 46(6):287-293. Covie Scholar Brodersen L, Lorenz R (2020) Perceived stress, physiological stress Yan J, Dong W, Deng G (2018) Attentional bias modification in reducing test anxiety vulnerability: a randomized controlled trial. BMC Psychiatry 18:1-9. PubMed Central Google Scholar Cardozo LT, Azevedo MARD, Carvalho MSM, Costa R, de Lima PO, Marcondes FK (2020) Effect of an active learning methodology combined with formative assessments on performance, test anxiety, and stress of university students. Adv Physiol Educ 44(4):744-751. PubMed Google Scholar Cardozo LT, Lima POD, Carvalho MSM, Casale KR, Bettioli AL, Azevedo MARD, Marcondes FK (2023) Active learning methodology, associated to formative assessment, improved cardiac physiology knowledge and decreased pre-test stress and anxiety. Front Physiol 14:1261199. Increased academic stress is associated with decreased plasma BDNF in Chilean college students. PeerJ 11:e16357. CAS PubMed PubMed Central Google Scholar Castillo-Navarrete J, Bustos C, Guzman-Castillo A, Vicente B (2023) Increased academic stress is associated with decreased plasma Google Scholar Castillo-Navarrete JL, Bustos C, Guzman-Castillo A, Zavala W (2024) Academic stress in college students: descriptive analyses and scoring of the SISCO-II inventory. PeerJ 12:e16980. PubMed Central Google Scholar Cipra C, Müller-Hilke B (2019) Testing anxiety in undergraduate medical students and its correlation with different learning approaches. PLoS ONE 14(3):e0210130. CAS PubMed Central Google Scholar Contoreggi C (2015) Corticotropin releasing hormone and imaging, rethinking the stress axis. Nucl Med Biol 42(4):323-339Article CAS PubMed Google Scholar Contoreggi C (2015) Corticotropin releasing hormone and imaging, rethinking the stress axis. Nucl Med Biol 42(4):323-339Article CAS PubMed Google Scholar Contoreggi C (2015) Corticotropin releasing hormone and imaging, rethinking the stress axis. Nucl Med Biol 42(4):323-339Article CAS PubMed Google Scholar Contoreggi C (2015) Corticotropin releasing hormone and imaging, rethinking the stress axis. Nucl Med Biol 42(4):323-339Article CAS PubMed Google Scholar Contoreggi C (2015) Corticotropin releasing hormone and imaging, rethinking the stress axis. Grajeda Chacón A, Sanjinés Unzueta A (2023) Academic stress as a predictor of mental health in university students. Cogent Educ 10(2):2232686. Google Scholar Cronje R, Beukes J, Masenge A, du Toit P, Bipath P (2024) Investigation of neopterin and neurophysiological measurements as biomarkers of anxiety and stress. NeuroRegulation 11(1):25-25. I Google Scholar De la Fuente J, González-Torres MC, Aznárez-Sanado M, Martínez-Vicente JM, Peralta-Sánchez FJ, Vera MM (2019) Implications, self-regulation, and external regulation. Front Psychol 10:1919. PubMed PubMed PubMed Central Google Scholar De la Fuente J, Martínez-Vicente JM (2024) Conceptual Utility Model for the Management of Stress and Psychological Wellbeing, CMMSPW<sup>™</sup> in a university environment: theoretical basis, structure and functionality. Front Psychol 14:1299224. PubMed Central Google Scholar Dou R, Brewe E, Potvin G, Zwolak JP, Hazari Z (2018) Understanding the development of interest and self-efficacy in active-learning undergraduate physics courses. Int J Sci Educ 40(13):1587-1605Article Google Scholar Dowlati MA, Shayan A, Zar A (2020) The effect of brain-derived neurotrophic factor single nucleotide polymorphism on cognitive factors. Middle East J Rehabil Health Stud. 7(3). EG, Larico-Uchamaco GR, Roman-Paredes NO, Ticona-Chayña E (2024) Coping with stress and self-efficacy as predictors of academic satisfaction in a sample of university students. Salud Cienc Tecnol 4:840-840. Coping with stress and self-efficacy as predictors of academic satisfaction in a sample of university students. Salud Cienc Tecnol 4:840-840. anxiety, self-efficacy, and the meanings that physical therapy students attribute to their experience with an objective structured clinical examination. BMC Med Educ 20:1-9. MATH Google Scholar Fitriani A, Zubaidah S, Susilo H, Al Muhdhar MHI (2020) The effects of integrated problem-based learning, predict, observe, explain on problemsolving skills and self-efficacy. Eurasian J Educ Res 20(85):45-64Article Google Scholar Fukuoka H, Shichi H, Yamamoto M, Takahashi Y (2020) The mechanisms underlying autonomous adrenocorticotropic hormone secretion in Cushing's disease. Int J Mol Sci 21(23):9132Article CAS PubMed Central Google Scholar Hall JM, Cruser D, Podawiltz A, Mummert DI, Jones H, Mummert ME (2012) Psychological stress and the cutaneous immune response: roles of the HPA axis and psoriasis. Dermatol Res Pract 2012(1):403908PubMed PubMed Central MATH Google Scholar Harb H, Gonzalez-De-La-Vara M, Thalheimer L, Klein U, Renz H, Rose M, Peters EMJ (2017) Assessment of brain derived neurotrophic factor in hair to study stress responses: a pilot investigation. Psychoneuroendocrinology 86:134-143. CAS PubMed Google Scholar Harris RB, Grunspan DZ, Pelch MA, Fernandes G, Ramirez G, Freeman S (2019) Can test anxiety interventions alleviate a gender gap in an undergraduate STEM course? CBE—Life Sci Educ 18(3):ar35. PubMed Central Google Scholar He SC, Wu S, Wang C, Du XD, Yin G, Jia Q, Zhang XY (2018) Interaction between job stress and the BDNF Val66Met polymorphism affects depressive symptoms in Chinese healthcare workers. J Affect Disord 236:157-163. CAS PubMed Google Scholar Heming M, Angerer P, Apolinário-Hagen J et al. (2023) The association between study conditions and hair cortisol in medical students in Germany—a cross-sectional study. J Occup Med Toxicol 18:7. PubMed PubMed Central Google Scholar Hermann R, Schaller A, Lay D, Bloch W, Albus C, Petrowski K (2021) Effect of acute psychosocial stress on the brain-derived neurotrophic factor in humans—a randomized cross within trial. Stress 24(4):442-449. CAS PubMed PubMe Central MATH Google Scholar Ibrahim JN, Audi L (2021) Anxiety symptoms among Lebanese health-care students: prevalence, risk factors, and relationship with vitamin D status. J Health Sci 11(1):29-36. Central NA, Leong Abdullah MFI, Hami R, Ahmad Yusof H (2020) A narrative review of brain-derived neurotrophic factor (BDNF) on cognitive performance in Alzheimer's disease. Growth Factors 38(3-4):210-225. CAS PubMed Google Scholar Jahan SS, Nerali JT, Parsa AD, Kabir R (2022) Exploring the association between
emotional intelligence and academic performance and stress factors among dental students: a scoping review. Dent J 10(4):67. Scholar Jamieson JP, Black AE, Pelaia LE, Reis HT (2021) The impact of mathematics anxiety on stress appraisals, neuroendocrine responses, and academic performance in a community college sample. J Educ Psychol 113(6):1164. HARTH Google Scholar Javaid ZK, Chen Z, Ramzan M (2024) Assessing stress causing factors and language related challenges among first year students in higher institutions in Pakistan. Acta Psychol 248:104356. In Comparison of Content of Conten Psychoneuroendocrinology 79:13-19. CAS PubMed Central Google Scholar Jiménez-Mijangos LP, Rodríguez-Arce J, Martínez-Méndez R et al. (2023) Advances and challenges in the detection of academic stress and anxiety in the classroom: a literature review and recommendations. Educ Inf Technol 28:3637-3666. MATH Google Scholar Jiménez-Mijangos LP, Rodríguez-Arce J, Martínez-Méndez R et al. (2023) Advances and challenges in the detection of academic stress and anxiety in the classroom: a literature review and recommendations. Educ Inf Technol 28:3637-3666. Scholar Kabrita CS, Hajjar-Muça TA (2016) Sex-specific sleep patterns among university students in Lebanon: impact on depression and academic performance. Nat Sci Sleep 8:189-196. PubMed Central Google Scholar Karpova NN (2014) Role of BDNF epigenetics in activity-dependent neuronal plasticity. Neuropharmacology 76(Part C):709-718. CAS PubMed MATH Google Scholar Kato-Kataoka A, Nishida K, Takada M, Kawai M, Kikuchi-Hayakawa H, Suda K, Rokutan K (2016) Fermented milk containing Lactobacillus casei strain Shirota preserves the diversity of the gut microbiota and relieves abdominal dysfunction in healthy medical students exposed to academic stress. Appl Environ Microbiol 82(12):3649-3658. ADS CAS PubMed Central Google Scholar Kokubo Y, Shoji Y (2017) Relationship between good grades and brain waves. In: Matsuo T, Fukuta N, Mori M, Hashimoto K, Hirokawa S (eds) 2017 6th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI). IEEE, Conference Publishing Services, pp. 687-690La Rovere MT, Gorini A, Schwartz PJ (2022) Stress, the autonomic nervous system, and sudden death. Auton Neurosci 237:102921. Case Scholar Lee LC, Su MT, Cho YC, Lee-Chen GJ, Yeh TK, Chang CY (2019) Multiple epigenetic biomarkers for evaluation of students' academic performance. Genes Brain Behav 18(5):e12559Article PubMed MATH Google Scholar Lightman SL, Birnie MT, Conway-Campbell BL (2020) Dynamics of ACTH and cortisol secretion and implications for disease. Endocr Rev 41(3):bnaa002. PubMed PubMed Central Google Scholar Lindau M, Almkvist O, Mohammed AH (2016) Effects of stress on learning and memory. In: Fink G (ed) Stress; concepts, cognition, emotion, and behavior. Academic Press, pp. 153–160Linz R, Puhlmann LMC, Apostolakou F, Mantzou E, Papassotiriou I, Chrousos GP, Singer T (2019) Acute psychosocial stress increases serum BDNF levels: an antagonistic relation to cortisol but no group differences after mental training. Neuropsychopharmacology 44(10):1797-1804. CAS PubMed Central Google Scholar Lipovich L, Dachet F, Cai J, Bagla S, Balan K, Jia H, Loeb JA (2012) Activity-dependent human brain coding/noncoding gene regulatory networks. Genetics 192(3):1133-1148. CAS PubMed Central Google Scholar MacCann C, Double KS, Clarke IE (2022) Lower avoidant coping mediates the relationship of emotional intelligence with well-being and ill-being. Front Psychol 13:835819. PubMed Central Google Scholar Mäkelä SM, Griffin SM, Reimari J, Evans KC, Hibberd AA, Yeung N, Patterson E (2023) Efficacy and safety of Lacticaseibacillus paracasei Lpc-37® in students facing examination stress: a randomized, triple-blind, placebo-controlled clinical trial (the ChillEx study). Brain Behav Immun-Health 32:100673. CAS PubMed Central Google Scholar Malanchini M, Rimfeld K, Wang Z, Petrill SA, Tucker-Drob EM, Plomin R, Kovas Y (2020) Genetic factors underlie the association between anxiety, attitudes and performance in mathematics. Transl Psychiatry 10(1):12. Interval Google Scholar Marlina R, Suwono H, Ibrohim I, Yuenyong C, Husamah H, Hamdani H (2024) Theoretical frameworks of self-efficacy in collaborative science learning practices: a systematic literature review. J Pendidik Biol Indones10(2):602-615 Google Scholar Márquez-Morales L, El-Kassis EG, Cavazos-Arroyo J, Rocha-Rocha V, Martínez-Gutiérrez F, Pérez-Armendáriz B (2021) Effect of the intake of a traditional Mexican beverage fermented with lactic acid bacteria on academic stress in medical students. Nutrients 13(5):1551. CAS PubMed Central Google Scholar Mayya SS, Martis M, Mayya A, Iyer VLR, Ramesh A (2022) Academic stress among pre-university students of the commerce stream: a study in Karnataka. Pertanika J Soc Sci Humanit 30(2). F, Fatemi RP, Razavipour SF, Ricciardi N, Makhmutova M, Khoury N, Faghihi MA (2021) A novel knockout mouse model of the noncoding antisense Brain-Derived Neurotrophic Factor (Bdnf) gene displays increased endogenous Bdnf protein and improved memory function following exercise. Heliyon 7(7):e07570. CAS PubMed Central Google Scholar Mujinya R, Kalange M, Ochieng JJ, Ninsiima HI, Eze ED, Afodun AM, Kasozi KI (2022) Cerebral cortical activity during academic stress amongst undergraduate medical students at Kampala International University (Uganda). Front Psychiatry 13:551508. PubMed Central Google Scholar Muntholib M, Muhdhar MHIA, Zahro SM, Abdillah RR, Astuti L, Wardhani YS, ... & Achmad R (2024) The effect of inquiry social complexity (ISC)-based adiviyata e-module on self-efficacy and environmental literacy. In: Habiddin H, Roncevic T (eds) AIP conference proceedings, vol 3106(1). AIP PublishingMunyaradzi M, Addae D (2018) Effectiveness of student psychological support services at a technical and vocational education and training college in South Africa. Community College J Res Practice 43(4):262-274. 🕏 Google Scholar Mustikasari VR, Suwono H, Farhania K (2020) Improving students' science learning outcomes through joyful-inquiry interactive demonstration assisted by game android. In: Habiddin H, Majid S, Ibnu S, Farida N, Dasna IW (eds) AIP conference proceedings, vol 2215(1). AIP PublishingMyint K, Jacobs K, Myint AM, Lam SK, Henden L, Hoe SZ, Guillemin GJ (2021) Effects of stress associated with academic examination on the kynurenine pathway profile in healthy students. PLoS ONE 16(6):e0252668Article CAS PubMed Central MATH Google Scholar Nadal R, Gabriel-Salazar M, Sanchís-Ollé M, Gagliano H, Belda X, Armario A (2021) Individual differences in the neuroendocrino eresponse of male rats to emotional stressors. Psychoneuroendocrinology 125:105127. CAS PubMed Google Scholar Nakamura H, Iwamoto M, Washida K, Sekine K, Takase M, Park BJ, Miyazaki Y (2010) Influences of casein hydrolysate ingestion on cerebral activity, autonomic nerve activity, and anxiety. J Physiol Anthropol 29(3):103-108. A, Suarez B, Salamanca-Fernandez E, Reina-Perez I, Rodriguez-Carrillo A, Mustieles V, Fernández MF (2023) Development and validation of brain-derived neurotrophic factor measurement in human urine samples as a non-invasive effect biomarker. Front Mol Neurosci 15:1075613. CAS PubMed Central Google Scholar Ouanes S, Popp J (2019) High cortisol and the risk of dementia and Alzheimer's disease: a review of the literature. Front Aging Neurosci 11:43. CAS PubMed Central MATH Google Scholar Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Moher D (2021) Updating guidance for reporting systematic reviews: development of the PRISMA 2020 statement. J Clin Epidemiol 134:103-112. PubMed Google Scholar Pascoe MC, Hetrick SE, Parker AG (2020) The impact of stress on students in secondary school and higher education. Int J Adolesc Youth 25(1):104-112. MATH Google Scholar Pati D, Lorusso LN (2018) How to write a systematic review of the literature. Health Environ Res Design J 11(1):15-30. A MATH Google Scholar Peter HL, Giglberger M, Streit F, Frank J, Kreuzpointner L, Rietschel M, Wüst S (2023) Association of polygenic scores for depression and neuroticism with perceived stress in daily life during a long-lasting stress period. Genes Brain Behav 22(6):e12872. C PubMed Central Google Scholar Pizzie RG, McDermott CL, Salem TG, Kraemer DJ (2020) Neural evidence for cognitive reappraisal as a strategy to alleviate the effects of math anxiety. Soc Cogn Affect Neurosci 15(12):1271-1287. PubMed Central Google Scholar Pizzie RG, McDermott CL, Salem TG, Kraemer DJ (2020) Neural evidence for cognitive reappraisal as a strategy to alleviate the effects of math anxiety. cross-cultural psychology. J Cross-Cult Psychol 53(7-8):847-859. Coogle Scholar Pozos-Radillo E, Preciado-Serrano L, Plascencia-Campos A, Valdez-López R, Morales-Fernández A (2016) Psychophysiological manifestations associated with stress in students of a public university in Mexico. J Child Adolesc Psychiatr Nurs 29(2):79-84. PubMed Google Scholar Pradhan G, Mendinca NL, Kar M (2014) Evaluation of examination stress and its effect on cognitive function among first year medical students. J Clin Diagn Res 8(8): BC05. PubMed Central Google Scholar Rashkova MR, Ribagin LS, Toneva NG (2012) Correlation between salivary [alpha]-amylase and stress-related anxiety. Folia Medica 54(2):46. PubMed Google Scholar Renjith VR, Pradeepkumar AP (2021) Citations of the top 100 most-cited papers of the journal Scientometrics in Web of Science and its association and correlation with Scopus and Google Scholar citations. Libr Acad 4710. K, Kovas Y, Dale PS, Plomin R (2015) Pleiotropy across academic subjects at the end of compulsory education. Sci Rep 5(1):11713. ADS PubMed PubMed Central Google Scholar Ringeisen T, Lichtenfeld S, Becker S, Minkley N (2019) Stress experience and performance during an oral exam: the role of self-efficacy, threat appraisals, anxiety, and cortisol. Anxiety Stress Coping 32(1):50-66.
PubMed Google Scholar Rodríguez-Torres ÁF, Garduño-Durán J, Carbajal-García SE, Marín-Marín JA (2024) Assessment of the perceived mastery of interdisciplinary competences of students in education degree programmes. Educ Sci 14(2):144. WATH Google Scholar Romero-Romero E, De León EG, Morán-Pinzón J, Salado-Castillo R, Castillo-Pimentel A (2023) Academic stress, hair and saliva cortisol, and their relationship with body mass index and fat percentage in first year medical students. Physiol Int 110(3):277-290. Scholar Seipäjärvi SM, Tuomola A, Juurakko J, Rottensteiner M, Rissanen APE, Kurkela JL, Wikgren J (2022) Measuring psychosocial stress with heart rate variability-based methods in different health and age groups. Physiol Meas 43(5):055002. Google Scholar Shah A, Chen C, Campanella C, Kasher N, Evans S, Reiff C, Bremner JD (2019) Brain correlates of stress-induced peripheral vasoconstriction in patients with cardiovascular disease. Psychophysiology 56(2):e13291. Comput Methods Programs Biomed 235:107521-107521. Sckolow P, Dowding D, Randell R, Favela J (2016) Using mixed methods in health informatics 2016. Ios Press, pp. 83-87Soliman F, Glatt CE, Bath KG et al. (2010) A genetic variant BDNF polymorphism alters extinction learning in both mouse and human. Science 327(5967):863-866. ADS CAS PubMed Central Google Scholar Spătaru B, Podină IR, Tulbure BT, Maricuțoiu LP (2024) A longitudinal examination of appraisal, coping, stress, and mental health in students: a cross-lagged panel network analysis. Stress Health 40:e3450. Google Scholar Špiljak B, Šimunović L, Vilibić M, Hanžek M, Crnković D, Lugović-Mihić L (2024) Perceived stress, salivary cortisol, and temperament traits among students of dental medicine: a Prospective and Interventional Study. Behav Sci 14(4):289. PubMed Central Google Scholar Špiljak B, Vilibić M, Glavina A, Crnković M, Sešerko A, Lugović-Mihić L (2022) A review of psychological stress among students and its assessment using salivary biomarkers. Behav Sci 12(10):400. 🏵 PubMed Central Google Scholar Stirparo G, Pireddu R, D'Angelo M, Bottignole D, Mazzoli R, Gambolò L (2024) Is mental health worse in medical students than in the general population? A cross-sectional study. Medicina 60(6):863. In PubMed Central Google Scholar Stoffel M, Gardini E, Ehrenthal JC, Abbruzzese E, Ditzen B (2022) Evaluation of stress management and stress prevention using epigenetic markers. Verhaltenstherapie 32(Suppl 1):5-13. Human connection with nature improves wellbeing and pro-environmental behavior: a literature review. J Pendidik Biol Indonesia 10(2):698-713MATH Google Scholar Sung G, Bhinder H, Feng T, Schneider B (2023) Stressed or engaged? Addressing the mixed significance of physiological activity during constructivist learning. Comput Educ 199. R, Yaghooti H, Daghagheleh R, Yousofi R, Rahimifar P (2017) Serum lipids and brain-derived neurotrophic factor in a cross-section of male students with symptoms of depression at a university in Iran: an observational study. Asian Biomed 11(5):413-417. CAS Google Scholar Tripathi R, Alqahtani SS, Meraya AM, Makeen HA, Tripathi P, Pancholi SS (2022) Evaluation of depression, anxiety, and stress among university healthcare students. J Appl Pharm Sci 12(10):078-087. WATH Google Scholar Unternaehrer E, Meinlschmidt G (2016) Psychosocial stress and DNA methylation. In: Spengler D, Binder E (eds) Epigenetics and neuroendocrinology. Epigenetics and human health. Springer, ChamUsichenko T, Wenzel A, Klausenitz C, Petersmann A, Hesse T, Neumann N, Hahnenkamp K (2020) Auricular stimulation vs. expressive writing for exam anxiety in medical students—a randomized crossover investigation. PLoS ONE 15(8):e0238307. M, Paisantanakij W (2021) Key steps and characteristics for successful interdisciplinary research: an analytical review. J Behav Sci 16(2):73-85. Google Scholar van den Heuvel LL, Suliman S, Bröcker E, Kilian S, Stalder T, Kirschbaum C, Seedat S (2022) The association between hair cortisol levels, inflammation and cognitive functioning in females. Psychoneuroendocrinology 136:105619Article PubMed Google Scholar Višić M (2022) Connecting puzzle pieces: systematic literature reviews: a systematic literature reviews: a systematic literature reviews: a systematic literature reviews a systematic literature reviews a systematic literature reviews a systematic literature reviews a systematic literature review method in the social sciences. literature review. Inf Softw Technol 136:106589. WATH Google Scholar Vogel S, Schwabe L (2016) Stress in the zoo: Tracking the impact of stress on memory formation over time. Psychoneuroendocrinology 71:64-72. (2016) BDNF gene polymorphisms and haplotypes in relation to cognitive performance in Polish healthy subjects. Acta Neurobiol Exp 76(1):43–52Article Google Scholar Wong CL, Chien WT, Waye MMY, Szeto MWC, Li H (2023) Nursing students' perceived anxiety and heart rate variability in mock skill competency assessment. PLoS ONE 18(10):e0293509. CAS PubMed PubMed Central Google Scholar World Health Organization (2001) International classification of functioning, disability and health. World Health Organization, Geneva, SwitzerlandWyatt T, Oswalt SB (2013) Comparing mental health issues among undergraduate and graduate students. Am J Health Educ 44(2):96 107. In MATH Google Scholar Zallocco L, Giusti L, Ronci M, Mussini A, Trerotola M, Mazzoni MR, Sebastiani L (2021) Salivary proteome changes in response to acute psychological stress due to an oral exam simulation in university students: Effect of an olfactory stimulus. Int J Mol Sci 22(9):4295. CAS PubMed Central Google Scholar Zamroni Z, Hidayah N, Ramli M, Hambali IM(2018) Prevalence of academic stress among medical and pharmaceutical students Eur J Educ Stud 4(10):256-267. Google Scholar Zhao X, Xia Q, Huang W (2020) Impact of technostress on productivity from the theoretical perspective of appraisal and coping processes. Inf Manag 57(8). 2Cronje et al. (2024)South AfricaNeuroRegulationqEEG, HRV, BP, BVP, EDA, neopterinDASS-21Stress biomarkers through neurophysiological and inflammatory parameters. Spiljak et al. (2023)BrazilFrontiers in (2023)Br PsychologyCortisol, α-amylaseState-Trait Anxiety Inventory (STAI)The effect of active learning on academic anxiety. Abromavičius et al. (2023)USTechnology and Health CareElectrodermal activity measurements (EDA), photoplethysmography, heart rate.-The effectiveness of physiological stress signals in value prediction by evaluating models and feature selection techniques.Castillo-Navarrete et al. (2023)ChilePeerJPlasma BDNF, Global DNA MethylationSISCO-II Inventory of Academic Stress, Beck Depression Inventory (BDI)Relationship between academic stress, and BDNF and G-DNA-M.Mäkelä et al. (2023)FinlandBrain, Behavior & Immunity- HealthCortisolSTAI-state; sleep quality index (PSQI); VAS; DASS-21; HADS-14; Perceived Stress in a chronic exam stress model of college students' performance and developing stress in a chronic exam stress model of stress on college students' performance and developing stress in a chronic exam stress model of stress in a chronic exam stress in a chronic exam stress model of stress in a chronic exam stress in a chro management interventions. Mujinya et al. (2022)UgandaFrontiers in PsychiatryVisual reaction time (VRT), audio reaction time (ART), dan tacticle reaction time (ART), dan tacticle reaction time (VRT), audio reaction time (VRT), audio reaction time (ART), dan tacticle reaction time (VRT), audio reaction time (VRT), audio reaction time (VRT), and TRT in the somatosensory cortex. Peter et al. (2023)GermanyGene, Brain dan BehaviorPolygenic gene NPS dan NPSR1; Cortisol Awakening Response (CAR)Hospital Anxiety and Depression Scale (HADS); Ambulatory Assessment stress scaleRelationship between chronic stress response and overall genetic variability of the neuropeptide S system (NPS), which consists of genes for NPS and its receptor (NPSR1). Tripathi et al. (2022)Saudi ArabiaJournal of Applied Pharmaceutical ScienceBody Mass IndexDASS-21Stress affects academic performance and BMI.Anjum et al. (2021)PakistanEuropean Journal of InflammationCortisol, tiroid (T3&T4), antropometri, arylesterase dan paraoxonase-Effect of academic stress on academic performance.Márquez-Morales et al. (2021)MexicoNutriensGut microbiota compositionSISCO academic stressEffect of fermented beverages in reducing stress in college studentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary proteinsState-Trait Anxiety Inventory (STAI-Y2)Salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary proteinsState-Trait Anxiety Inventory (STAI-Y2)Salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary proteinsState-Trait Anxiety Inventory (STAI-Y2)Salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary proteinsState-Trait Anxiety Inventory (STAI-Y2)Salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al.
(2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteome Biomarkers of College StudentsZallocco et al. (2021)LebanonJournal of Molecular ScienceHeart rate, salivary Proteo Health ScienceVitamin DHamilton Anxiety Rating Scale (HAM-A)Prevalence of Academic Anxiety Symptoms and Its Relationship with Vitamin D StatusJamieson et al. (2021)U.S.Journal of Educational PsychologyCortisol, testosteronAbbreviated Mathematics Anxiety Affective and Biological Responses, and Academic AchievementBrodersen and Lorenz (2020)U.S.International Journal of Nursing Education ScholarshipSalivary cortisol (sC) and salivary alpha amylase (sAA). Stressor AppraisalScale (SAS); Visual Analog Scales (VAS)Relationships Between Perceived Stress, Physiological Stress, and Final Exam PerformanceCardozo et al. (2020)BrazilAdvance in Psy EduCortisol dan alpha-amylase salivaState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety Inventory (STAI)Active Learning and Academic StressFerreira et al. (2020)BrazilBMC Medical EduSalivary cortisolState-Trait Anxiety students attribute to the experienceMalanchini et al. (2020)U.K.Translational PsychiatryGenetic similarityAbbreviated Math AnxietyScale (AMAS); Generalized Anxiety and low math self-confidence, interest, and ability and genetic factors.Pizzie et al. (2020)U.S.Social Cognitif and Afective NeurosciencefMRI (Brain activity)Math Anxiety, State-Trait Anxiety InventoryCognitive reappraisal to manage math anxiety and improve performanceUsichenko et al. (2020)GermanyPLoS ONESalivary alpha-amylase (sAA), blood pressure, heart rateState-Trait-Anxiety Inventory (STAI)Cognitive behavioral therapy and auricular stimulationCipra and Muller-Hilke (2019)GermanyPLoS ONECortisolSTAI-T, STAI-S, The Approaches and Study Skills Inventory for Students (ASSIST)Correlation between anxiety and students' learning approaches and Study Skills Inventory for Students (ASSIST)Correlation between anxiety and students' learning approaches and Study Skills Inventory for Students (ASSIST)Correlation between anxiety and students' learning approaches and Study Skills Inventory for Students (ASSIST)Correlation between anxiety and students' learning approaches and Study Skills Inventory for Students' learning approaches and Study Skills STEM studentsRingeisen et al. (2019)GermanyAnxiety; Stress & CopingCortisolState anxiety; Academic self-efficacy, anxiety, anxiet stressed college studentsBedard et al. (2017)CanadaFrontiers in PsychologyProfile BDNF geneBDI; General Self-Efficacy ScaleRelationship between BDNF gene variation and loneliness and depression Inventory (BDI)Investigating the relationship between depression, BDNF, and lipid levels that may increase the risk of cardiovascular diseaseKabrita and Hajjar-Muça (2016)LebanonNature and Science of SleepSleep qualityPittsburg Sleep Quality Index (PSQI), CES Depression Scale (CES-D)Analyzing the relationship between sleep habits, depression, and psychoacademic status of college studentsKato-Kataoka et al. (2016) JapanAplied and Environmental BiologyLeukocyte DNA microarray, gut microbiotic Lactobacillus casei strain Shirota on stress-induced abdominal dysfunction in college studentsPradhan et al. (2014)IndiaJournal of clinical and diagnostic research: JCDRPulse rate (PR), systolic-diastolic blood pressure (SBP/DBP)Student stress scaleMeasuring cardiovascular parameters, stress scaleMeasuring cardiovascular param Inventory (STAI)Effect of hydrolyzed casein beverage derived from cow's milk on relaxation and brain activity As a library, NLM provides access to scientific literature. Inclusion in an NLM database does not imply endorsement of, or agreement with, the contents by NLM or the National Institutes of Health. Learn more: PMC Disclaimer | PMC Copyright Notice . 2024 Dec 18;12:732. doi: 10.1186/s40359-024-02284-6 Students in higher education often encounter significant academic performance. The current study employs a two-wave longitudinal design to investigate the dynamic interrelationships among academic stress, academic motivation, emotional intelligence, and mindfulness. The study employed a cross-lagged panel model to investigate the temporal interactions among these four constructs and their influence on the academic experiences of doctoral students. The sample consisted of 643 individuals at Time 1 (September/October 2022), followed by a subsequent assessment involving 413 participants (July/August 2023). Notably, there was an overlap of 373 participants who were evaluated at both time points. The results indicated that elevated emotional intelligence and mindfulness levels are associated with reduced academic stress and enhancing emotional intelligence and supporting academic successity of facilitating interventions aimed at enhancing emotional intelligence and mindfulness. among students. These longitudinal insights hold significant importance within the academic literature as they elucidate the various stressors doctoral students encounter. Furthermore, this research provides practical implications for educators and policymakers in formulating targeted strategies to enhance student well-being and improve educational outcomes. Keywords: Academic stress, Academic motivation, Emotional intelligence, Mindfulness, Doctoral students, Cross-lagged panel model Academic requirements and achieving educational objectives [1]. Students' perceptions of their expectations regarding academic performance contribute to the experience of academic stress [2, 3]. Typically, students experience significant academic pressure due to the experience significant academic stress [2, 3]. of students and the educational qualifications of their parents, influence academic stress. Deb et al. (2015) [4] posited that parents' educational attainment and occupational status significantly influence their expectations regarding their children. While Huan et al. (2006) [6] posited that parents' educational attainment and occupational status significantly influence their expectations regarding their children. refuted any correlation between gender and academic stress, various other studies have indicated a prevalence of higher anxiety and academic stress among male students in contrast to female students. Recent research by Wang, Gao, and Wang (2024) [10] highlighted the interplay between engagement, self-efficacy, and anxiety in educational contexts, emphasizing how these factors collectively shape students' learning experiences. Their study, conducted among Chinese university students, provides a nuanced understanding of stress dynamics in academic environments, further underscoring the need for targeted interventions to address anxiety and enhance engagement in high-pressure academic settings. Furthermore, the demands of education contribute significantly to academic stress, particularly among students in their final year of undergraduate studies, who experience elevated stress levels [9]. The existing literature elucidated that students' perceptions of course load and difficulty, test anxiety, final grades, excessive homework assignments, and family financial hardships contribute significantly to the stress experienced by students [11-14]. Khan et al. (2013) [2] articulated that significant academic stress and the delayed identification of academic challenges impede students' capacity to study effectively and manage their time appropriately, resulting in a decline in academic performance. Empirical research has established a significant association between academic stress and various developmental outcomes, including adjustment [15], mental health [16], and academic achievement [17]. Nevertheless, there has been a paucity of research investigating the relationship between academic motivation, categorizing it into three distinct forms: intrinsic, extrinsic, and amotivation. These three types of motivation can be conceptualized as existing along a motivational continuum determined by the degree of self-determination involved [19, 20]. Intrinsic motivation is the drive that arises from the inherent satisfaction and enjoyment associated with engaging in an academic activity [21]. Extrinsic motivation is characterized by three distinct types: external
regulation, and identified regulation, and identified regulation, and identified regulation [18]. External regulation is characterized by three distinct types: external regulation are governed by introjected regulation, they engage in academic activities primarily to fulfill external expectations placed upon them [22]. Identified regulation refers to motivation influenced by the significance of students' learning behaviors. Amotivation is the absence of intention or perceived value associated with specific behaviors, which may lead to inaction or passive engagement. Previous research has shown a paucity of studies investigating the relationship between stress and academic motivation theory [19, 23]. The findings suggested that students' academic motivation significantly predicts stress levels [19, 23]. Additionally, evidence suggested that intrinsic motivation, regarded as a higher form of self-determined motivation, the study conducted by Park (2012) [19] revealed a negative correlation between external regulation and stress. Emotion is an internal phenomenon that mobilizes human behavior, prompting individuals found no correlation between introjected regulation and stress. to engage with or withdraw from their contextual environment. This response is contingent upon the hedonic tone of the emotions, which can be either positive or negative [24]. Intelligence can be conceptualized as the capacity to adapt effectively to varying contexts [25]. The integration of these concepts yields a definition of emotional intelligence as the capacity of individuals to perceive, comprehend, regulate, and adaptively articulate emotional experiences [26, 27]. Consequently, emotional intelligence can be defined as a construct that elucidates the processes by which emotions are perceived, regulated, and expressed, varying in proficiency across individuals. This understanding is further enhanced by the theoretical framework posited by Petrides's (2011) [28] trait model of emotional intelligence, which asserts that emotional intelligence has been proposed, positing that emotional intelligence is rooted in specific assessable personality traits. A trait model of emotional intelligence has been proposed, positing that emotional intelligence has been proposed, positing that emotional intelligence has been proposed. trait. This construct encompasses a constellation of self-perceptions and dispositions related to emotional intelligence can be enhanced when the design and implementation of intervention programs adhere to established quality standards [30]. For instance, a meta-analytic review underscored the importance of emotional intelligence to buffer academic stress and promote sustained motivation. Emotional intelligence has not consistently been the sole objective of social and emotional learning programs; these initiatives frequently encompass additional related aspects, such as mindfulness, examined explicitly in the present study. Over the preceding decade, mindfulness has garnered considerable attention across individual [32], academic [33], and organizational spheres [34], underscoring its significance as a foundational competency within professional environments. Mindfulness is a significance as a foundational competency within professional environments and mitigating distractions [36]. improve overall performance [37, 38]. Furthermore, research indicated that mindfulness practices can effectively mitigate stress by enhancing mental clarity and tranquility, reducing negative thoughts' prevalence, and fostering creative ideas [39, 40]. foster optimal performance and enhance the well-being of their students and employees. The prospective association between mindfulness and academic settings, yielding insights into the potential advantages of mindfulness practices for enhancing academic outcomes and overall success within the higher educational context. Numerous studies suggested that mindfulness can improve educational functioning, which can, in turn, improve education functioning, which can, in turn working memory [42], and a reduction in mind wandering [43]. Cognitive enhancements facilitate effective learning and information processing, improving academic outcomes. In addition, research indicated that mindfulness may indirectly students [44]. support academic success by helping students manage exam anxiety, develop self-awareness, and successfully handle academic problems by fostering stress reduction and building self-awareness [33]. Evidence has investigated the significant linkages between mindfulness and academic outcomes in higher education. For instance, a meta-analytic review identified a small-to-moderate positive correlation between mindfulness and academic outcomes. This conclusion was derived from synthesizing results across various studies [45]. Furthermore, a systematic review investigated the relationship between mindfulness and academic outcomes. a positive correlation between mindfulness practices and academic outcomes, such as improved grades, examination efficiency, and overall academic accomplishment [41]. Self-determination theory (SDT) provides a robust framework for understanding motivation in academic contexts, emphasizing the role of autonomy, competence, and relatedness in driving intrinsic and extrinsic motivation [21, 46]. Recent work by Wang and Wang (2024) explored SDT in the context of Chinese EFL learners' engagement with large language models, offering valuable insights into how self-determined motivation enhances learning engagement and reduces stress [47]. This perspective aligns closely with the current study, highlighting the critical role of SDT in understanding doctoral students' motivation amidst academic challenges. Although existing literature has examined the effect of psychological variables independently on academic performance, a dearth of longitudinal studies continues to analyze the dynamic interplay of these variables concerning doctoral education within the Pakistani educational system. Therefore, this research study aims to investigate the longitudinal relationship between stress in academia and critical psychological resources, a relationship that appears virtually empirically unexplored in the available literature. This investigation has gone a step further in understanding the complex interrelations among academic stress, academic motivation, emotional intelligence, and mindfulness among Pakistani doctoral candidates. In this line, the primary purpose of the current study was to examine longitudinal relationships and causal paths among the identified variables using a cross-lagged panel model. This approach captures both the within- and between-person-level dynamics that affect the academic experiences of doctoral students. The motivation for this study arises from the necessity to explore the distinctive stressors doctoral students. pressures in this context. The present study seeks to elucidate the factors that impact academic stress and motivation among doctoral students. By delineating these influences, the research aims to provide evidence-based insights that can guide the development of interventions designed to assist doctoral students in effectively managing stress and sustaining motivation throughout their academic endeavors. The unique contributions of the study are presented in Fig. 1. Consequently, this study roposed the following research questions: Study's unique contributions doctoral students in Pakistan? What are the longitudinal effects of academic stress in the context of doctoral education? How does emotional intelligence contribute to reducing academic stress across different time points in a longitudinal framework? Do the predictive strengths of academic motivation, emotional intelligence, and mindfulness differ in their impact on academic stress in Pakistani. The selection of study participants from public universities in Islamabad, Pakistani doctoral candidates? within this category was predicated on the necessity to incorporate diversity into the sample. This approach facilitates a comprehensive examination of the various experiences that students may encounter with diversifying academic fields of study. individuals from a diverse range of fields, including the sciences, humanities, social sciences, and engineering. Furthermore, the criteria established for data collection mandated that participants remain available for additional data collection mandated that participants remain available for additional data collection mandated that participants remain available for additional data collection activities one year after the initial survey. The exclusion criteria for this study encompassed students when were not enrolled full-time in their doctoral programs, individuals who transferred from another institution during the study, and participants who were concurrently engaged in other structured stress reduction programs external to this research. A two-wave longitudinal design was employed, comprising data collection at two distinct time points with a one-year interval between them. The baseline data were gathered from September-October 2022 (T1), followed by a follow-up assessment one year later, from July-August 2023 (T2). The longitudinal methodology facilitated an investigation into the temporal alterations and causal connections among academic stress, academic motivation, emotional intelligence, and mindfulness. This research design was selected to investigate the interrelationships among these constructs within a high-pressure academic year. Participants were recruited via university email distribution lists and social media platforms for academic networking. Informed consent was acquired from all participants before engaging in the study. At baseline time, participants of academic stress, academic motivation, emotional intelligence, and mindfulness. The follow-up data collection for Time 2 was conducted one year later, utilizing the same
questionnaire to evaluate alterations in the specified constructs. At the baseline period (T1), a total of 413 students completed the survey, with an overlap of 373 participants who participated at both times of survey, thereby providing a consistent sample for longitudinal analysis. Of these participants, 54.5% were females, and 45.5% were females, and 45.67% 47.34% 46.70% Female 54.33% 52.66% 53.30% Age (mean) 30.09 28.98 29.18 Academic stress: To assess academic stress, Time Management Stress, Test Stress, Results Stress, Test Stress, Stress, Stress, Stress, Test Stress, Time Management Stress, Time Management Stress, Test Stress, St and Self-inflicted Stress (Fig. 2). The instrument consisted of 34 items on a five-point Likert scale, with responses ranging from 5 (completely agree) to 1 (completely agree) to 1 (completely agree). The Cronbach's alpha coefficients for the academic stress questionnaire specifically reported at 0.90 [48]. Academic motivation: Academic motivation was assessed using the Academic Motivation Scale (AMS) developed by Vallerand et al. (1993) [46] based on self-determination. The Academic Motivation Scale (AMS) developed by Vallerand et al. (1993) [46] based on self-determination. Motivation Scale (AMS) is a self-administered 28-item measure designed to measure students' intrinsic and extrinsic motivation influence students' academic engagement and performance. Items are grouped according to the dimensions they measure. Scores for each dimension are computed by averaging from "Not at all true" (1) to "Very true" (7). the AMS has demonstrated good internal consistency, with Cronbach's alpha coefficients typically ranging from 0.70 to 0.90 for the different subscales. The scale has shown strong construct validity, with significant relationships between AMS subscales and educational intelligence: A self-reported emotional intelligence scale (EIS) developed by Schutte et al. (1998) [49] was adopted to assess the participants' emotional intelligence. The EIS comprised 33 items, with three reversed scores (Fig. 2). Participants were required to rate the extent they agree or disagree with each item on a 5-point Likert response scale (1: strongly disagree to 5: strongly agree). The final score is obtained by summing up the responses to the items, with a high value indicating higher emotional intelligence. Several empirical investigations have demonstrated good validity and reliability among healthcare professionals [50-54]. Mindfulness: This study utilized the Five Facet Mindfulness Questionnaire - Short Form (FFMQ-SF) to measure mindfulness. The FFMQ-SF is a 24-item questionnaire that comprehensively assesses mindfulness by measuring five distinct facets: Observing, Acting with Awareness, Non-Judging, and Non-Reacting (Fig. 2). These facets collectively capture the multidimensional nature of mindfulness as a construct [55]. The short form was developed by Bohlmeijer et al. (2011) [56] and has been validated for use in various populations, demonstrating good psychometric properties [57-60]. Responses to the FFMQ-SF are collected using a 5-point Likert scale, ranging from 1 ("Never or Very Rarely True") to 5 ("Very Frequently or Always True"). obtain the final average score for each facet, the scores on the FFMQ-SF indicated higher levels of mindfulness. Components of academic stress, motivation, emotional intelligence, and mindfulness All scales employed in this study were reviewed and slightly modified to reflect the unique challenges faced by postgraduate students in Pakistan. For instance, items on the Academic Stress Inventory were adapted to capture research-specific stressors, supervisory relationships, and dissertation-related pressures. Similarly, the AMS was refined to address motivations associated with professional and research goals. The EIS and the FFMO-SF were also adjusted to ensure cultural and contextual relevance while retaining their theoretical integrity. Experts in education and psychology reviewed these modifications to ensure content validity and appropriateness. To validate the modified scales, a pilot study was conducted with a subset of postgraduate students (n = 45) prior to the main study. The pilot study assessed reliability, yielding Cronbach's alpha coefficients ranging from 0.78 to 0.91 across all scales, indicating strong internal consistency. Feedback collected from participants confirmed the clarity and relevance of the modified items. To investigate the study objectives within the framework of a CLPM analysis, path models were analyzed utilizing the R programming environment [61] and the procedure of Hakanen et al. (2008) [62] (Fig. 3), which was followed by Konze et al. (2017) [63]. To enhance our comprehension of the underlying causal mechanisms and following the work of Konze et al. (2017) [63], multiple competing full-panel path models for investigating CLPM analysis The stability model exclusively incorporated autoregressive effects to account for the baseline levels of each variable. Incorporating autoregressive effects into the path models facilitates (a) an evaluation of the temporal stability and, more significantly, (b) predicting changes in academic stress over time. The proposed causal relationships were incorporated alongside the autoregressive effects in the causality model. In the reversed causation model, autoregressive effects were integrated to examine the bidirectional influence between the constructs over time. Furthermore, model fit indices were evaluated to compare the efficiency of the four models using the Comparative Fit Index (CFI ≥ 0.95), and Chi-square Error of Approximation (RMSEA ≥ 0.05), and Chi-square efficiency of the four models using the compare the efficiency of the four models using the Comparative Fit Index (CFI ≥ 0.95), and Chi-square Error of Approximation (RMSEA ≥ 0.05), and Chi-square efficiency of the four models using the comparative Fit Index (CFI ≥ 0.95), and Chi-square Error of Approximation (RMSEA ≥ 0.05), and Chi-square efficiency of the four models using the comparative Fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative Fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficiency of the four models using the comparative fit Index (CFI ≥ 0.95), and Chi-square efficience efficience efficience efficience efficience efficience efficience efficience e the initial and second data collection periods may have influenced the results, a comparative analysis was conducted between the panel group (n = 373, overlapped participants)— and the dropouts (present at baseline period T1). This was accomplished by estimating Students' t-tests employing baseline data (T1). No statistically significant differences were observed between the two groups for demographic and study variables. Consequently, it can be inferred that any systematic dropout did not significantly affect the study results. In the subsequent phase of our analysis, the overall measurement model utilizing confirmatory factor analysis (CFA) was evaluated. Following the requirement for measurement invariance, factor loadings, and intercepts were constructs into parcels were constructs into parcels were aggregated (Table 2). This procedure presents several advantages, including a reduction in parameter bias, enhanced reliability, improved normality in data distribution, increased simplicity of the model, effective management of multicollinearity, and an overall enhancement in model fit [64]. The domain-representative parceling method was employed for all four multidimensional constructs by amalgamating items from each subscale to formulate distinct parcels for each construct [65]. The CFA model that allowed all factors to be correlated over time demonstrated a good fit for the data (= 76.53, p