THE MIND Bulletin on Mind-Body Medicine Research

Mind-Body Medicine Research Council

Editorial I

The Physiological Basis of Mind-Body Medicine

by Maja Figura[1] and Tobias Esch[2]

[1]Technische Universität Dresden, Faculty of Medicine Carl Gustav Carus, Institute and Polyclinic of Occupational and Social Medicine, Health Sciences/Public Health, 01069 Dresden, Germany
[2]Institute for Integrative Health Care and Health Promotion, School of Medicine, Witten/Herdecke University, 58455 Witten, Germany

Mind-body medicine (MBM) is a modern form of stress medicine (Esch & Stefano, 2010; Esch & Stefano, 2022). It was developed by the American cardiologist and professor of medicine at Harvard Medical School, Herbert Benson (M.D.). As a counterpart to Walter B. Cannon's discovery of the body's "fight or flight" response (Cannon, 1915), Benson coined the term relaxation response (RR), a physiological response reaction of the body to stress (Cannon, 1915). Techniques that elicit a RR are the basis of virtually all MBM interventions (MBI) (Esch et al., 2018). Together with Integrative Medicine, MBM forms Complementary and Integrative Health (Esch & Brinkhaus, 2020). According to the approach of salutogenesis, the self-healing potential is used to build up and facilitate individual resources (Esch, 2020). Thus, MBM offers the opportunity to make an important contribution to individual health care by helping people to help themselves (Dineen-Griffin et al., 2019).

Based on the idea that thoughts and emotions have an impact on health, MBM effects manifest, e.g., at the psychoneuroimmunological level (Magan & Yadav, 2022). Psychoneuroimmunology is an interdisciplinary field of research that focuses on the role of neuro-immune interactions in coping with stressors (Ader, 2007; Godoy et al., 2018). Stress results from an interplay of biological and adaptive processes (Godoy et al., 2020). These processes involve a variety of different brain areas that can interpret events as real or potential threats. This is followed by a rapid activation of the autonomic nervous system via the sympathetic-adreno-medullary (SAM) axis and the hypothalamic-pituitary-adrenal (HPA) axis (Figure 1) (Stefano et al., 2005).

In addition to the classical stress mediators cortisol and (nor-) adrenaline, a wide range of neuroendocrine signaling molecules are involved. These lead to an adaptation of the cardiovascular system such as increased heart rate, blood pressure and immune response. Short-term stress seems to increase the ability to perform. Problems arise when permanent and/or excessive stress occurs (Chrousos & Gold, 1992; Esch et al., 2002; Esch & Stefano,

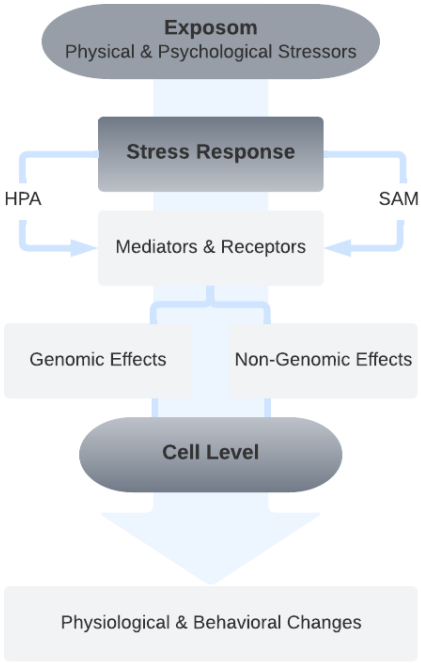

Figure 1. The stress response simplification based on Godoy et al. (2018).

SAM = sympathetic-adreno-medullary axis,
HPA = hypothalamic-pituitary-adrenal axis

2010). Chronic stress can lead to suppression of protective immune responses and exacerbation of pathological immune responses (Dhabhar, 2014). The balance between type 1 and type 2 cytokines changes and chronic inflammation is induced. The number, transport, and function of immune protective cells increases. By suppressing type 1 cytokines and protective T cells and increasing function of defensive T cells, susceptibility to certain cancers may increase (Esch et al., 2002). The body's physiological stress response is also suspected to have negative effects on the disease progression of viral infections such as SARS-CoV-2 (Peters et al., 2021).

How the effects of chronic stress can drive aging processes is evident at the molecular genetic level, as seen, e.g., in our chromosomes (Dobos & Paul, 2019). In a study by Mathur et al. (2016), a minimal association was found between perceived psychological stress and a decrease in telomere length. Telomeres are regions of repetitive nucleotide sequences associated with specialized proteins at the ends of linear chromosomes. They protect the end regions of chromosomal DNA from progressive degradation and ensure the integrity of linear chromosomes via preventing DNA repair systems from confusing the outermost ends of the DNA strand with a double-strand break (Jacobs, 2013). Hence, telomeres are non-coding DNA segments that serve a protective role during DNA transcription: A small number of base pairs at the ends of a chromosome are lost during each transcription, resulting in an overall shortening of the chromosome after many duplications. Telomeres thus have a function as a bumper that prevents functional coding segments from being truncated during duplication. This buffer grows shorter during the lifetime of a cell, and its cycles of transcription and replication. Hence, although telomeres are routinely replenished by telomerase, their gradual attrition over the lifespan may contribute to aging and disease (Esch et al., 2018; Mathur et al, 2016). Thus, short-term, and chronic stress can have an impact on cell aging and chromosomal integrity. At the cellular level, this may favor age-related diseases such as Alzheimer's, cardiovascular disease, type II diabetes or even general muscular atrophy (Esch et al., 2018; Ludlow et al., 2013; Stefano et al., 2005).

It has been shown that telomere length is influenced not only by individual genetic predisposition, harmful noxae, and oxidative or psychological stress, but also by the individual's own health behavior (Bär & Blasco, 2016). At the same time, the probability of the occurrence of mental and somatic illnesses is increased (Esch, 2003). Especially the use of MBIs has proven to be particularly effective in stress reduction in this context (Bhasin et al., 2013; Black et al., 2013; Esch, 2020; Esch & Stefano, 2022; Niles et al., 2014).

MBIs contribute to the restoration of the balance between sympathetic and parasympathetic nervous system. In the process, the catecholamine and cortisol hormone equilibrium is adjusted. While psychological stress declines and a positive state of mind is re-established, both conditions, as described, are associated with an effect on telomeres (Epel et al., 2004). The length of telomeres appears positively changed already over short periods of time (Ornish et al., 2013; Puterman et al., 2015). Moreover, recent study results suggest that lifestyle interventions also have a positive effect on mitochondrial bioenergetics, insulin secretion, and a reduction in inflammatory processes (Stefano at al., 2019). Dysfunctional mitochondrial processes thus lead to impaired energy translocation in the brain and neuropsychiatric symptoms (Büttiker et al., 2022). Therefore, lifestyle interventions and MBIs include RR as a parameter of metabolic "correction", thus also causing cognitive and mental "awareness" (Stefano at al., 2019).

Taken together, the mind affects the body – and this may happen even on cellular, chromosomal, and mitochondrial levels.

References

Ader, R. (2007). *Psychoneuroimmunology* (4 ed.). Elsevier Academic Press.

Bär, C., & Blasco, M. A. (2016). Telomeres and telomerase as therapeutic targets to prevent and treat age-related diseases. *F1000Res, 5*. https://doi.org/10.12688/f1000research.7020.1

Bhasin, M. K., Dusek, J. A., Chang, B. H., Joseph, M. G., Denninger, J. W., Fricchione, G. L., Benson, H., & Libermann, T. A. (2013). Relaxation response induces temporal transcriptome changes in energy metabolism, insulin secretion and inflammatory pathways. *PLoS One*, *8*(5), e62817. https://doi.org/10.1371/journal.pone.0062817

Black, D. S., Cole, S. W., Irwin, M. R., Breen, E., St Cyr, N. M., Nazarian, N., Khalsa, D. S., & Lavretsky, H. (2013). Yogic meditation reverses NF-κB and IRF-related transcriptome dynamics in leukocytes of family dementia caregivers in a randomized controlled trial. *Psychoneuroendocrinology*, *38*(3), 348-355. https://doi.org/10.1016/j.psyneuen.2012.06.011

Büttiker, P., Weissenberger, S., Esch, T., Anders, M., Raboch, J., Ptacek, R., Kream, R. M., & Stefano, G. B. (2022). Dysfunctional mitochondrial processes contribute to energy perturbations in the brain and neuropsychiatric symptoms. *Front Pharmacol*, *13*, Article 1095923. https://doi.org/10.3389/fphar.2022.1095923

Cannon, W. B. (1915). *Bodily changes in pain, hunger, fear, and rage: An Account of Recent Researches into the Function of Emotional Excitement*. D Appleton & Company.

Chrousos, G. P., & Gold, P. W. (1992). The concepts of stress and stress system disorders. Overview of physical and behavioral homeostasis. *JAMA*, *267*(9), 1244-1252.

Dhabhar, F. S. (2014). Effects of stress on immune function: the good, the bad, and the beautiful. *Immunologic Research*, *58*(2), 193-210. https://doi.org/10.1007/s12026-014-8517-0

Dineen-Griffin, S., Garcia-Cardenas, V., Williams, K., & Benrimoj, S. I. (2019). Helping patients help themselves: A systematic review of self-management support strategies in primary health care practice. *PLoS One*, *14*(8), Article e0220116. https://doi.org/10.1371/journal.pone.0220116

Dobos, G., & Paul, A. (2019). *Mind-Body-Medizin: Integrative Konzepte zur Ressourcenstärkung und Lebensstilveränderung* (2 ed.). Urban & Fischer.

Epel, E. S., Blackburn, E. H., Lin, J., Dhabhar, F. S., Adler, N. E., Morrow, J. D., & Cawthon, R. M. (2004). Accelerated telomere shortening in response to life stress. *Proc Natl Acad Sci USA*, *101*(49), 17312-17315. https://doi.org/10.1073/pnas.0407162101

Esch, T. (2003). Die Bedeutung von Stress für das Herz-Kreislauf-System: Stress-assoziierte kardiovaskuläre Erkrankungen und nicht-medikamentöse Therapieverfahren. *Apothekenmagazin*, *21*, 8-15.

Esch, T. (2020). Self-healing in health-care: Using the example of mind-body medicine. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*, *63*(5), 577-585. https://doi.org/10.1007/s00103-020-03133-8

Esch, T., & Brinkhaus, B. (2020). Neue Definitionen der Integrativen Medizin: Alter Wein in neuen Schläuchen? *Complement Med Res*, *27*(2), 67-69. https://doi.org/10.1159/000506224

Esch, T., & Stefano, G. B. (2010). The neurobiology of stress management. *Neuro Endocrinol Lett*, *31*(1), 19-39.

Esch, T., & Stefano, G. B. (2022). The BERN framework of Mind-Body Medicine: Integrating self-care, health promotion, resilience, and applied neuroscience. *Front Integr Neurosci*, *16*, Article 913573. https://doi.org/10.3389/fnint.2022.913573

Esch, T., Benson, H., Fricchione, G., & Stefano, G. (2002). An overview of stress and its impact on immunological disease. *Modern Aspects of Immunobiology*, *2*, 187-192.

Esch, T., Kream, R. M., & Stefano, G. B. (2018). Chromosomal processes in Mind-Body Medicine: Chronic stress, cell aging, and telomere length. *Med Sci Monit Basic Res*, *24*, 134-140. https://doi.org/10.12659/msmbr.911786

Godoy, L. D., Rossignoli, M. T., Delfino-Pereira, P., Garcia-Cairasco, N., & de Lima Umeoka, E. H. (2018). A Comprehensive overview on stress neurobiology: Basic concepts and clinical implications. *Front Behav Neurosci*, *12*, Article 127. https://doi.org/10.3389/fnbeh.2018.00127

Jacobs, J. J. (2013). Loss of telomere protection: consequences and opportunities. *Front Oncol*, *3*, 88. https://doi.org/10.3389/fonc.2013.00088

Ludlow, A. T., Ludlow, L. W., & Roth, S. M. (2013). Do telomeres adapt to physiological stress? Exploring the effect of exercise on telomere length and telomere-related proteins. *Biomed Res Int*, Article 601368. https://doi.org/10.1155/2013/601368

Magan, D., & Yadav, R. K. (2022). Psychoneuroimmunology of meditation. *Ann Neurosci*, *29*(2-3), 170-176. https://doi.org/10.1177/09727531221109117

Mathur, M. B., Epel, E., Kind, S., Desai, M., Parks, C. G., Sandler, D. P., & Khazeni, N. (2016). Perceived stress and telomere length: A systematic review, meta-analysis, and methodologic considerations for advancing the field. *Brain Behav Immun*, *54*, 158-169. https://doi.org/10.1016/j.bbi.2016.02.002

Niles, H., Mehta, D. H., Corrigan, A. A., Bhasin, M. K., & Denninger, J. W. (2014). Functional genomics in the study of mind-body therapies. *Ochsner J*, *14*(4), 681-695.

Ornish, D., Lin, J., Chan, J. M., Epel, E., Kemp, C., Weidner, G., Marlin, R., Frenda, S. J., Magbanua, M. J. M., Daubenmier, J., Estay, I., Hills, N. K., Chainani-Wu, N., Carroll, P. R., & Blackburn, E. H. (2013). Effect of comprehensive lifestyle changes on telomerase activity and telomere length in men with biopsy-proven low-risk prostate cancer: 5-year follow-up of a descriptive pilot study. *Lancet Oncol*, *14*(11), 1112-1120. https://doi.org/10.1016/s1470-2045(13)70366-8

Peters, E. M. J., Schedlowski, M., Watzl, C., & Gimsa, U. (2021). To stress or not to stress: Brain-behavior-immune interaction may weaken or promote the immune response to SARS-CoV-2. *Neurobiol Stress*, *14*, Article 100296. https://doi.org/10.1016/j.ynstr.2021.100296

Puterman, E., Lin, J., Krauss, J., Blackburn, E. H., & Epel, E. S. (2015). Determinants of telomere attrition over 1 year in healthy older women: stress and health behaviors matter. *Mol Psychiatry*, *20*(4), 529-535. https://doi.org/10.1038/mp.2014.70

Stefano, G. B., Esch, T., & Kream, R. M. (2019). Behaviorally-mediated entrainment of whole-body metabolic processes: Conservation and evolutionary development of mitochondrial respiratory complexes. *Med Sci Monit*, *25*, 9306-9309. https://doi.org/10.12659/msm.920174

Stefano, G., Benson, H., Fricchione, G., & Esch, T. (2005). *The Stress Response - Always Good And When It Is Bad*. International Scientific Literature. ISBN: 8390923157