Review Article

PHYSIOLOGICAL EFFECTS OF MUSIC IN HUMAN BEINGS

Muhammad Jabran Javaid Sidhu, Muhammad Sohail Aslam

ABSTRACT
Music and ancient art are being used as a mode of entertainment. There is evidence of its effectiveness as a therapy for different diseases. Listening to rock music (440 Hz) results in increased cortisol levels appetite, blood glucose, lipids and body weight. Whereas listening to classical music (432 Hz) leads to a significant lowering of cortisol level due to its soothing effect. It also decreases blood glucose, lipids, appetite, and body weight. Classical music exposure helps to control anxiety.
Conclusion: Listening to classical music helps to relieve anxiety and reduces blood glucose, lipids, and body weight.

Key Words: Music, Human body, Anxiety

doi: https://doi.org/10.51127/JAMDCV4I3RA01

How to cite this:
Sidhu MJJ, Aslam MS. Physiological effects of music in human beings.
JAMDC. 2022;4(3): 140-144
doi: https://doi.org/10.51127/JAMDCV4I3RA01

Effect of music on the human body

Music is an ancient art. It is being used as a treatment for many diseases.[1] Research is being carried out in different parts of the world to see the effect of music on the human body and mind.[2,3] Music is used as a mode of entertainment and a tool for relaxation.[4]

Music history:

There are two types of music

Classical music: Originated in the early Vedic period (C1500 – 500 BCE) and the instruments include tempura, bansuri, sarangi, and tabla.[5]

Rock: Music originated in the 1950s.[6] It uses electric guitar, amplifier, digital synthesizers, keyboard, drum, electric organ, and bass guitar as instruments.[7] Rock music has two components, rhythm, and composition.[8] It produces more dissonant sounds.[9]

Classical music has no separate identifiable rhythm. Its composition and rhythm are synchronized. It produces more consonant sounds.[9]

[1]Assisstant Professor Physiology,
[2]Associate Professor Physiology, Akhtar Saeed Medical & Dental College, Lahore.

Areas of the brain affected by the music

When music is produced by an instrument, the sound waves produced to strike the tympanic membrane to produce its vibration. Through the bones of the middle ear, these vibrations are transferred to the inner ear to produce vibration of the basilar membrane. The specific frequency of music causes a specific part of the basilar membrane to vibrate. The basilar membrane converts these mechanical signals into electrical signals and these action potentials are transmitted in the auditory nerve. The action potentials reach the auditory cortex in the temporal lobe.

The Pitch and timbre of the sound are processed in the right temporal lobe.[10]

The amygdala after receiving classical music sound signals sends inhibiting signals to the hypothalamus which reduces the production of ACTH and hence cortisol secretion. Upon stimulation by rock music, the amygdala sends excitatory signals to the hypothalamus leading to increased production of ACTH and hence increases cortisol level.[11]

Correlation between cortisol and oxidative stress

Prolonged stress can produce a bad effect on health[12,13] and causes a large financial burden

on the patient.[14] Music has a beneficial effect on stress-related physiology.[15] Stress through the hypothalamic-pituitary axis (HPA) affects the secretion of cortisol, the stress hormone.[16,17]

Patients undergoing medical procedures have raised stress hormone levels. Music therapy showed positive effects on these patients before and during the procedure,[18-20,] and also after the procedure.[21,22]

Stress leads to anxiety that itself is the cause of stress and thus it makes a vicious cycle. Music affects parts of the brain related to emotional processing.[23] Anxiety levels are decreased in individuals exposed to soothing classical music.[24,25] McCraty et al. showed that exposure to rock music resulted in increased cortisol levels.[16]

A study conducted by Joseph and Alice negated this effect.[3] Oxidative stress means an imbalance between oxidants and antioxidants in the body. Oxidants act as free radicals. Antioxidants react with these free radicals to stabilize these.[18] Oxidants react with polyunsaturated lipids to form products like malondialdehyde which is used as a marker to measure oxidative stress in the body.[17] Reactive oxygen species are increased in a state of psychological stress.[26] Undo et al studied mothers having seriously ill kids. Their cortisol, oxidation stress markers, and telomere length had a positive correlation between all these.[19] A study showed that music therapy improved endothelial function in coronary artery disease patients by increasing sodium levels and decreasing reactive oxygen species.[27]

Effect of music on glucose.

In stress or fight and flight response, the body needs rapid availability of energy which is provided by gluconeogenesis.[28] A study by Mothahedian et al showed that classical music can be used to lower the increased stress hormone level (cortisol) and also lowered glucose levels.[29] Western classical music has been used to treat hyperglycemia in diabetic patients and better-controlled levels of HbA_{1c}.[30-32]

Saleem and Saleem reported that listening to relaxing music and Quranic verses reduced the level of cortisol.[33] Studies in India have revealed that listening to Indian music reduced stress hormones during a surgical procedure.[34,35] Music therapy reduces cortisol and stress biomarkers in children undergoing minor surgical procedures.[36,37]

Effect of music on body weight

Exposure to music changes appetite to change weight.[38] In hunger, ghrelin is secreted by the stomach. It acts on the hunger center in the hypothalamus to increase hunger. Increase in ghrelin, appetite, and weight was more with rock as compared to classical music.[35]

Effect of music on lipids

Madhuri et al showed that exposure to relaxing music resulted in decreased levels of lipids in the body.[39] The music lowers lipid levels by increasing metabolic rate.[40]

As music affects cortisol levels which then alters blood lipid levels.[41] Increased cortisol secretion results in increased lipid levels including raised triglycerides and total cholesterol levels whereas HDL levels are changed variably.[42] Cortisol raises lipoprotein lipase resulting in increased free fatty acid levels.[43] In another study, a positive correlation between cortisol, glucose, and lipid profile was reported.[44] Music therapy had a beneficial effect on psychological constructs and atherogenic lipoprotein in patients with severe hypercholesteremia.[45]

AUTHOR'S CONTRIBUTION

MJJS: Literature survey and script writing
MSA: Edit and proofreading

REFERENCES

1. Nilsson U, Unosson M, Rawal N. Stress reduction and analgesia in patients exposed to calming music postoperatively: a randomized controlled trial Eur J Anaesthesiol. 2005 Feb;22(2):96-102. https://doi.org/10.1017/S0265021505000189

2. Yamamoto M, Naga S, Shimizu J. Positive musical effects on two types of negative stressful conditions. Psychol. Music. 2007 Apr;35(2):249-75. https://doi.org/10.1177/0305735607070
3. Alagha J, Ipradjian A. The effects of different types of music on stress levels. Global Journal of Human-Social Science: A Arts & Humanities—Psychology. 2017;17(5):1-5.
4. Johnson AJ, Elkins GR. Effects of music and relaxation suggestions on experimental pain. IRISH. 2020 Apr 2;68(2):225-45. https://doi.org/10.1080/00207144.2020.1719842.
5. Sanivarapu SL. India's rich musical heritage has a lot to offer to modern psychiatry. Indian J Psychiatry. 2015 Apr;57(2):210. doi: 10.4103/0019-5545.158201.
6. Papazova JZ. REVIEW| On The History of Rock Music. IASPM Journal. 2016 Nov 8;6(1):161-3.
7. Montagu J. How music and instruments began: A brief overview of the origin and entire development of music, from its earliest stages. Frontiers in Sociology. 2017 Jun 20;2:8.
8. Davies S. Rock versus classical music. J. Aesthet. Art Crit.. 1999 Apr 1;57(2):193-204. https://doi.org/10.2307/432312.
9. Bowling DL, Purves D. A biological rationale for musical consonance. Proc. Natl. Acad. Sci. 2015 Sep 8;112(36):11155-60. https://doi.org/10.1073/pnas.150576811.
10. Trimble M, Hesdorffer D. Music and the brain: the neuroscience of music and musical appreciation. BJPsych international. 2017 May;14(2):28-31. doi: https://doi.org/10.1192/S2056474000001720.
11. Chikahisa S, Sei H, Morishima M, Sano A, Kitaoka K, Nakaya Y, Morita Y. Exposure to music in the perinatal period enhances learning performance and alters BDNF/TrkB signaling in mice as adults. Behavioural brain research. 2006 May 15;169(2):312-9. https://doi.org/10.1016/j.bbr.2006.01.021.
12. Yaribeygi H, Panahi Y, Sahraei H, Johnston TP, Sahebkar A. The impact of stress on body function: A review. EXCLI journal. 2017;16:1057. doi: 10.17179/excli2017-480.
13. McEwen BS. Central effects of stress hormones in health and disease: Understanding the protective and damaging effects of stress and stress mediators. Eur. J. Pharmacol. 2008 Apr 7;583(2-3):174-85. https://doi.org/10.1016/j.ejphar.2007.11.071.
14. Nater UM, Gaab J, Rief W, Ehlert U. Recent trends in behavioral medicine. Curr Opin Psychiatry. 2006 Mar 1;19(2):180-3. doi: 10.1097/01.yco.0000214345.37002.77.
15. Khalfa S, BELLA SD, Roy M, Peretz I, Lupien SJ. Effects of relaxing music on salivary cortisol level after psychological stress Ann. N. Y. Acad. Sci. 2003 Nov;999(1):374-6. https://doi.org/10.1196/annals.1284.045.
16. Gong S, Miao YL, Jiao GZ, Sun MJ, Li H, Lin J, Luo MJ, Tan JH. Dynamics and correlation of serum cortisol and corticosterone under different physiological or stressful conditions in mice. PloS one. 2015 Feb 20;10(2):e0117503. https://doi.org/10.1371/journal.pone.0117503
17. Hellhammer DH, Wüst S, Kudielka BM. Salivary cortisol as a biomarker in stress research. Psychoneuroendocrinology. 2009 Feb 1;34(2):163-71.. https://doi.org/10.1016/j.psyneuen.2008.10.026
18. Bringman H, Giesecke K, Thörne A, Bringman S. Relaxing music as pre-medication before surgery: a randomised controlled trial. Acta Anaesthesiologica Scandinavica. 2009 Jul;53(6):759-64. https://doi.org/10.1111/j.1399-6576.2009.01969.x.
19. Uedo N, Ishikawa H, Morimoto K, Ishihara R, Narahara H, Akedo I, Ioka T, Kaji I, Fukuda S. Reduction in salivary cortisol level by music therapy during colonoscopic examination. Hepato-gastroenterology. 2004 Mar 1;51(56):451-3..
20. van der Wal-Huisman H, Dons KS, Smilde R, Heineman E, van Leeuwen BL. The effect of music on postoperative recovery in older patients: A systematic review. J. Geriatr. Oncol. 2018 Nov 1;9(6):550-9. https://doi.org/10.1016/j.jgo.2018.03.010
21. Nilsson U. The anxiety-and pain-reducing effects of music interventions: a systematic review. AORN journal. 2008 Apr 1;87(4):780-807. https://doi.org/10.1016/j.aorn.2007.09.013.

22. Blood AJ, Zatorre RJ. Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. Proc Natl Acad Sci. 2001 Sep25;98(20):11818-23. https://doi.org/10.1073/pnas.1913558.
23. Koelsch S. Towards a neural basis of music-evoked emotions. Trends Cogn Sci. 2010 Mar 1;14(3):131-7. https://doi.org/10.1016/j.tics.2010.01.002
24. Voss JA, Good M, Yates B, Baun MM, Thompson A, Hertzog M. Sedative music reduces anxiety and pain during chair rest after open-heart surgery. Pain. 2004 Nov 1;112(1-2):197-203. https://doi.org/10.1016/j.pain.2004.08.020.
25. Knight WE, Rickard NS. Relaxing music prevents stress-induced increases in subjective anxiety, systolic blood pressure, and heart rate in healthy males and females J. Music Ther. 2001 Dec 1;38(4):254-72. https://doi.org/10.1093/jmt/38.4.254..
26. Forlenza MJ, Miller GE. Increased serum levels of 8-hydroxy-2′-deoxyguanosine in clinical depression. Psychosom Med. 2006 Jan 1;68(1):1-7. doi: 10.1097/01.psy.0000195780.37277.2a.
27. Ilic MD, Gordana Kocic MD, Dejan Simonovic MD, Gordana Lazarevic MD. Effects of music therapy on endothelial function in patients with coronary artery disease participating in aerobic exercise therapy. Altern Ther Health Med. 2017 May 1;23(3):30.
28. Radahmadi M, Shadan F, Karimian SM, Nasimi A. Effects of stress on exacerbation of diabetes mellitus, serum glucose and cortisol levels and body weight in rats. Pathophysiology. 2006 Feb 21;13(1):51-5. https://doi.org/10.1016/j.pathophys.2005.07.001.
29. Tabrizi EM, Sahraei H, Rad SM, Hajizadeh E, Lak M. The effect of music on the level of cortisol, blood glucose and physiological variables in patients undergoing spinal anesthesia. EXCLI J. 2012;11:556..
30. Pillai AM, Dave DJ. Evaluation of the effect of Indian classical music on the blood sugar level of Type-2 Diabetes Mellitus patients. Music and Medicine. 2018 Oct 28;10(4):175-9.
31. Mandel SE, Davis BA, Secic M. Effects of music therapy and music-assisted relaxation and imagery on health-related outcomes in diabetes education: a feasibility study. Diabetes Educ. 2013 Jul;39(4):568-81.
32. Faulkner M, Murphy M, Davison G, Rowe D, Hewitt A, Nevill A, Duly E, Trinick T, McNeilly AM. The physiological effects of a walking to music intervention in adults with intermediate hyperglycemia. doi: 10.4236/ojemd.2021.111004 https://www.scirp.org/journal/paperinformation.aspx?paperid=106787
33. Saleem S, Saleem T. Efficacy of music and quranic verses in reducing cortisol level: A stress biomarker in medical undergraduates. Current Psychology. 2021 Jun 10:1-6. https://doi.org/10.1007/s12144-021-01971-6.
34. Wang MC, Zhang LY, Zhang YL, Zhang YW, Xu XD, Zhang YC. Effect of music in endoscopy procedures: systematic review and meta-analysis of randomized controlled trials. Pain medicine. 2014 Oct 1;15(10):1786-94.
35. Hasanah I, Mulatsih S, Haryanti F, Haikal Z. Effect of music therapy on cortisol as a stress biomarker in children undergoing IV-line insertion. JTUMED 2020 Jun 1;15(3):238-43. https://doi.org/10.1016/j.jtumed.2020.03.007 link: https://www.sciencedirect.com/science/article/pii/S1658361220300421
36. Hasanah I, Haikal Z. The Effects of Music Therapy on Cortisol Levels as a Biomarker of Stress in Children. InMusic in Health and Diseases 2021 Aug 23. Intech Open.DOI: 10.5772/intechopen.99734 https://www.intechopen.com/chapters/78219
37. Hegde S. Music therapy for mental disorder and mental health: the untapped potential of Indian classical music. BJPsych international. 2017 May;14(2):31-3. https://doi.org/10.1192/S2056474000001732.
38. Russo C, Russo A, Gulino R, Pellitteri R, Stanzani S. Effects of different musical frequencies on NPY and Ghrelin secretion in the rat hypothalamus Brain Res. Bull. 2017 Jun 1;132:204-12.
39. Sharma M, Mathur KC. Effects of music therapy on clinical and biochemical parameters of metabolic syndrome. J. Bangladesh Soc. Physiol. 2011;6(2):108-15.

40. Yamasaki A, Booker A, Kapur V, Tilt A, Niess H, Lillemoe KD, Warshaw AL, Conrad C. The impact of music on metabolism. Nutrition. 2012 Nov 1;28(11-12):1075-80. https://doi.org/10.1016/j.nut.2012.01.020.
41. Qureshi GM, Seehar GM, Zardari MK, Pirzado ZA, Abbasi SA. Study of blood lipids, cortisol and haemodynamic variations under stress in male adults. J Ayub Med Coll Abbottabad. 2009 Mar 1;21(1):158-61.
42. Titov VN, Pitsin DG, Fedorova MP. Effects of cortisol on lipid and lipoprotein synthesis in rat hepatocytes. Biokhimiia (Moscow, Russia). 1978 Nov 1;43(11):2002-10.
43. Vincent AM, Hayes JM, McLean LL, Vivekanandan-Giri A, Pennathur S, Feldman EL. Dyslipidemia-induced neuropathy in mice: the role of oxLDL/LOX-1. Diabetes. 2009 Oct 1;58(10):2376-85.
44. Maduka IC, Neboh EE, Ufelle SA. The relationship between serum cortisol, adrenaline, blood glucose and lipid profile of undergraduate students under examination stress. Afr. Health Sci. 2015 Mar 11;15(1):131-6. doi: 10.4314/ahs.v15i1.18.
45. Nathan J, McIntosh S, Niemiec C, Williams G, Coykendall C, Lin Y, Holub A, Thevenet-Morrison K, Block R. Effects of Music Therapy on Psychological Constructs and Atherogenic Lipoproteins in Patients with Severe Hypercholesterolemia. J. Clin. Lipidol. 2021 Sep 1;15(5):e19-20. doi:https://doi.org/10.1016/j.jacl.2021.08.041