ISSN 2822-2032 (Print) 2822-2040 (Online)

Medical Journal of Eastern Nepal

Volume 01, Number 01, Issue 01, June 2022, 27-31

Original Article

DISCOVER THE ASSOCIATION BETWEEN MUSIC AND PAIN.

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Submitted: 19-Apr-2022, Revised: 30-Apr-2022, Accept: 15-May-2022

DOI: https://doi.org/10.3126/mjen.v1i1.45860

ABSTRACT

Background:
Pain is one of the most common reasons individuals see their doctors, and pain medicines are among the most regularly given prescriptions. Music is a nonpharmacological technique that can be used to help control postoperative pain. Unrelieved pain can be a cause of anxiety and stress, despite the greater understanding of pain treatment.

Methods:
The study was done on 30 undergraduate students of both sexes from Kathmandu University. First and foremost, when the patient entered the experiment room, he or she was put in a comfortable chair and given ten minutes to rest. One of the subjects' hands was utilised to hold pulse rate and GSR transducers. The respiratory belt was wrapped around the chest. The hand attached to the transducers was placed on their laps, and the other hand was dipped into the chilled water without moving the body.

Results:
There was significant decrease in pulse rate (threshold p=0.000), (tolerance p=0.000), respiratory rate (threshold p=0.001), (tolerance p=0.003), galvanic skin response (threshold p=0.029), (tolerance p=0.005) and pain intensity (p=0.000) with music in comparison to without music under cold pressor pain. Threshold time and tolerance time were significantly increased while listening to music ($p<0.05$).

Conclusion:
The influence of music on pain perception was explored in this study, in which the experimental pain was caused by a cold pressor. The overall result suggests that listening to music reduces enhanced sympathetic activity caused by cold pressor discomfort.

Keywords: Pain, Adjunct, Respiratory rate, Pain

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Citation
Khadka P, Bhattarai A, Nepal O, Discover the association between music and pain, MJEN. 2022 June; 1(1):27-31.

INTRODUCTION

According to a study conducted in the United States of America in its population, pain is one of the most common reasons individuals see their doctors, and pain medicines are among the most regularly given prescriptions [1]. Pain has increasingly been seen as having emotional and cognitive components in addition to sensory physiological ones, according to the "gate control" paradigm[2]. Both acute and chronic pains are reduced by music. Music-induced bliss has been discovered to be equivalent to a tangible reward involving the striatal dopaminergic system[3]. Fast-paced music stimulates the brain, whereas soft music relaxes it. It also softens the breath rate, lowers the pulse rate, and relaxes the entire body. Anxiety is substantially decreased, inner processes are synchronised, and immunity is improved when the body and mind are at peace, proving that music may be an effective therapeutic[4]. Since ancient Greece, music has been used to cure pain. It is affordable and readily available. Our level of musical engagement is influenced by a complex interplay of personal, societal, and cultural factors[5]. Music is useful in lowering postoperative pain following a variety of procedures, including intestinal surgery, open heart surgeries, and more [6-9]. Many studies indicate that listening to music during or after surgery reduces the amount of morphine required [7,10]. Skin conductance, heart rate, and respiratory rate can be measured combined with subjective pain reports, which might be utilised as a one-of-a-kind technique for examining individual variations in nociception modulation, according to the literature [11]. The influence of music on experimentally produced pain perception, as measured by pulse rate, respiratory rate and skin conductance will be investigated in this study.

METHODS

The study was done on 30 undergraduate students of both sexes after it was approved by IRC, Kathmandu University (Female 20, Male 10). The experiment took place on the grounds of Kathmandu University's School of Medical Science-Basic Science. The experiment began after receiving formal consent from the pupils. First and foremost, when the patient entered the experiment room, he or she was put in a comfortable chair and given ten minutes to rest. One of the subjects' hands was utilised to hold pulse rate and skin conductance transducers. The respiratory belt was wrapped around the chest. The hand attached to the transducers was placed on his or her lap, and the other hand was allowed to dip into the chilled water without moving the body. The study was performed after the approval of the ethical review committee of the institute.

The testing room was quiet. Doors and windows were kept shut at all times. For each session, just the experimenter and the subject were permitted in the room. To reduce noise, the room's internet connection was disconnected, and mobile phones were turned off. The cold pressor equipment consisted of a tank large enough to hold the subject's hand up to the wrist, fingers apart, in cold water with crushed ice. The temperature was kept at a constant of 1-2 degrees. The subject first felt cold, then crushing agony, which is the tolerance point, at which time the subject was instructed to remove his hand. Temperatures of 1-5 degrees might be maintained without causing any problems. The cold pressor test is noninvasive and safe, having been used as an experimental stimulus since 1937[12].

It was used as an experimental pain stimulus in this investigation since cold stress has been proven to be unpleasant. In this study, pulse rate, galvanic skin response, and respiratory rate are employed as a measure of sympathetic function. This test is mainly used to determine how autonomic function is responding. Because one of the subject's hands was used to connect pulse rate and galvanic skin response transducers, blood pressure could not be obtained as a parameter in this study.

Before the cold pressor test, a baseline for pulse rate, respiratory rate, and Galvanic skin response was acquired once the AD apparatus was set up. The subject was instructed to place his or her hand in cold water that was kept at a temperature of 1-2 degrees Celsius. The time when the individual first felt pain was recorded as the pain threshold. When the subject's hand could no longer bear the discomfort, he or she removed it from the cold pressor bath. Pain tolerance was measured at this point.

On the display of the PC connected to the AD device, the recordings were marked. Throughout the operation, the subject's pulse rate, respiratory rate, and gsr were measured, and at the conclusion, he or she rated the pain level on a Visual Analogue Scale.

After that, the individual was told to relax for 5 minutes. While the individual was listening to music, the identical procedure was repeated. Files were saved on the computer and transferred to an excel sheet when the experiment was completed. SPSS software was used to conduct the analysis.

Analogue Visual Scale - Participants were asked to mark between "no pain" and "worst possible pain" on a scale of 0-100mm.

0mm indicates no discomfort, 0 to 20mm indicates mild pain, 20 to 50mm indicates moderate pain, and 50 to 80mm indicates severe pain. The worst pain is between 80 and 100mm.

Headphones provided the music. The music had a beat

rate of 60-80 beats per minute or less to reduce the likelihood of entrainment boosting the heart rate. There were no words in the music, and it had a consistent melodic quality with no powerful beats or percussion.
Indian classical music was chosen because it is culturally related to the Nepalese people and is soothing in several studies. According to the genre of music, the music profile and autonomic functions are synced. Classical music calms and decreases autonomic responses, but rock music tends to exacerbate them.[13]

RESULTS

SPSS 23 was used to analyse the data. Because normality plots revealed that the data for pulse rate and respiratory rate was normally distributed, a Paired t-test was used.
For the galvanic skin response, threshold time, and tolerance time, normality plots revealed non-normal data. For these parameters, the Wilcoxon signed-rank test was used. P-value <0.05 was considered significant and p<0.01 was considered highly significant.
The mean pulse rate at pain tolerance without music (to1) was 89.00± 1.69 beats per min and with music(to2) reduced to 83.40± 1.36 beats per min, which was statistically significant. (p=0.000)
The mean respiratory rate at pain tolerance was 20.12±.45 per minute without music (to1) and 18.44±.47 per minute with music (to2), which was statistically significant (p=0.001).
GSR AMaxSlope at pain tolerance was 3.43±1.431µS without music (to1) and -.03±.357µS with music (to2), which was statistically significant (p=0.007).
The mean VAS was 62.17±2.04 without music (VAS1) and 47.33±2.59 with music (VAS2), which was statistically significant (p=0.000).

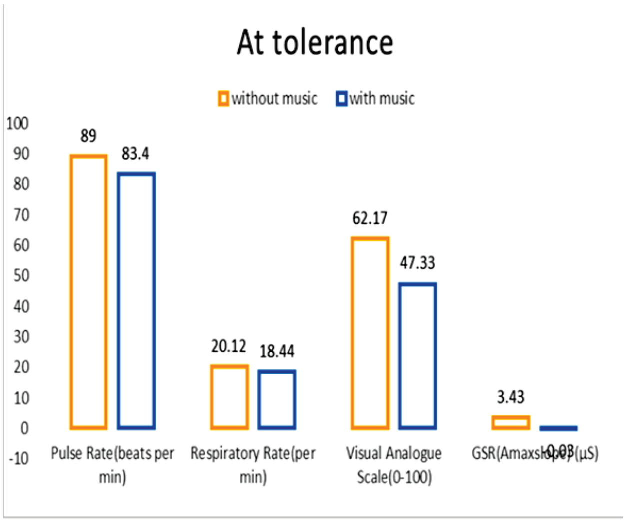

Figure: Bar graph showing the changes in variables with and without music.

DISCUSSION

The notion that there is a link between pain and music and its effects may be seen in physiological markers was investigated in this study. Much research has shown that audio-analgesia reduces chronic and acute pain. Because pain is so subjective, its impact varies from person to person. When pain is endured over an extended period, it might have negative consequences. Both acute and chronic pain can lead to anxiety, despair, and drug addiction. The usage of analgesics may not always be desirable because of its side effects.
Melzack created the "gate control theory" in 1965, which is now generally acknowledged across the world. It claims that the gating mechanism can control the transmission of impulses from the fibers to the spinal cord and brain. Synapses that transmit impulses from the spinal cord to the brain act as gates that can close or open in response to inputs. When the gates are open, the pain signal can reach the brain. Any other signal, like touch or proprioception, will compete with pain sensation to close the gate[14]. Music and pain perception follows a descending pattern and when a person listens to music, the music signals compete with pain sensations and close some gates, reducing discomfort[15].
Scientists have just begun to investigate the parts of the brain that are engaged while listening to music. The impact of music is observed at all three levels using the fMRI technology, which collects data from the spinal cord, brain stem, and cortex. There are studies that researched the impact of music on the central nervous system. Music stimuli elicited activity in the limbic, frontal, and auditory regions of the brain, as well as parts of the descending pain analgesic system, according to the findings. When compared to the group that was not listening to music, the brainstem and spinal cord exhibited more activity while listening to music [16,17]. Music listening is pleasurable and has been linked to emotional brain activity. Dopamine is released in response to intensely enjoyable music and the prospect of a reward, which explains the importance of music to humans [4,18]. The influence of music on pain perception has been studied in various ways by various research. Some of them connected music with emotions[13]. Some have taken into account music's ability to distract, while others deal with chronic pain and acute postoperative discomfort [19].
Subjective reactions were employed to evaluate pain in several previous research. Some modern research looks at both subjective and objective characteristics to assess pain and the impact of various pain-relieving interventions[7]. All of these researches are based on the concept that music may be used in conjunction with analgesics to help to reduce tension, anxiety, and pain[20,21]. There are no negative consequences of

listening to music. It does not necessitate a stay in the hospital. It can help with drug usage, anxiety, and depression associated with chronic pain. As a result, it is effective as a supplement to analgesics.
Objective measures included pulse rate, respiratory rate, and galvanic skin response, while subjective measures included VAS (Visual Analogue Scale), threshold time, and tolerance time.

Pulse Rate- When music was used in this investigation, the pulse rate at threshold and tolerance were both considerably lower than when no music was used. Similarly, in prior investigations, people who listened to music had lower pulse rates than those who did not listen to music [22,23]. Some studies found no significant differences; however, the music group had a lower heart rate [12,21]. Only a few of them indicated a marginal difference between the music and non-music groups [7,8,10]. The conflicting results are due to inter-individual diversity in reaction to stimuli and music [24.]

Respiratory Rate- When music was used in this study, the respiratory rate at threshold and tolerance were both considerably lower than when no music was used. Previous research has shown similar results [20,21]. Cardiovascular reactions are linked to musical profiles, according to Luciano Bernardi et al. music was used to cause changes in respiratory rate as well as other cardiovascular alterations in their study [25.] Some research found no significant difference between the music group and the control group. Patients undergoing heart surgery were the subjects of one of these investigations. It describes how cardiac medicines including beta-blockers, hypertension meds, and digitalis might be contributing to the inconsequential outcome[8.]

Galvanic Skin Response- The GSR is an excellent predictor of physiological stimulation. In reaction to cold pressor pain, sympathetic activation increases skin conductance. It was predicted that music may calm people, thereby lowering its value as a pain and stress indicator. The data from GSR recordings were used to examine Apeak, Height, AMaxSlope, and AMinSlope, although the focus of this article was on AMaxSlope. When compared to the 'no music' condition, all GSR metrics except Height were considerably lowered while listening to music. Similar findings have been seen in other research [11,19]. In our investigation, the graph's apeak and slopes show no variance.

Visual Analogue Scale- The Visual Analogue Scale (VAS) is a valid tool for determining subjective pain response. It's been around for a long time and has been utilized in pain studies. In this study, subjects reported a lower scale while listening to music than when they were not listening to music. Many studies have discovered comparable responses to music on the VAS scale [5,12]. They utilized the VAS scale to assess pain, just like we did. Other research has employed subjective pain measuring scales such as the MC Gill questionnaire, numeric rating scale, anxiety scale, depression scale, and so on.
While listening to music, both the threshold and tolerance times increased dramatically. In comparison to the non-music group, those who listened to music reported a lower 'initial sense of pain' (threshold) and were able to withstand cold pressor discomfort for longer. Similar findings have been observed in previous research [3,5,12.]
Many pain studies employed both subjective and objective criteria to assess pain. They discovered that while listening to music there was considerable reductions in pain, anxiety, and even sadness [20]. The assertion is supported by research that revealed significant subjective results and conflicting physiological measure data [8]. Other stress indicators, such as cortisol, blood glucose, salivary alpha-amylase, IgA, and oxygen saturation level, have been employed in prior research in conjunction with one or more [7,10,19]. While listening to music, these stress indicators revealed a decrease in pain and tension.
In this study, gender differences in non-music and music conditions were shown to be inconsequential whereas Mahmoudi et al. discovered that women are more sensitive to music for pain alleviation in 2013 research [4]. Non pharmacological interventions included treadmill exercise, cognitive intervention, and pleasant fragrance in certain trials. In terms of gender comparisons, they obtained varied results . Roger B.Fillingim et al. (2009) published a review article in which they cited studies in which males were responsive to treadmill exercise as a pain-relieving measure, as well as other articles in which females were more responsive, concluding that there is no conclusive evidence of gender differences in response to non-pharmacological pain relief interventions [26.]
In the absence of music, males and females were shown to be more sensitive to cold pressor pain. Even though only GSR was significant, other metrics in this study showed an elevated mean value for females who did not listen to music. There is evidence that women are more sensitive to pain than men due to biological, social, and cultural factors. It might be because women are more prone to clinical pain syndromes and are therefore more aware of unpleasant feelings.

CONCLUSION

The influence of music on pain perception was explored in this study, in which the experimental pain was caused by a cold pressor. To compare pain without and with music, PR, RR, and GSR were objective pain measurements, whilst VAS, threshold time, and tolerance time were subjective techniques. The total result suggests that listening to music reduces enhanced sympathetic activity caused by cold pressor discomfort. In our study, there was no significant gender difference in pain alleviation by music. The values of all the criteria are dramatically lowered after listening to music, implying that music decreases stress and pain perception.

Funding: None
Conflict of interest: None
Ethical approval: Yes

REFERENCES

[1] Carol A McPhillips-Tangum, Daniel C Cherkin, Lorna A Rhodes, Christine Markham et al. Reasons for Repeated Medical Visits Among Patients with Chronic Back Pain. J Gen Intern Med. 1998. 13(5):289-29
[2] Turk, D.C., Melzack, R. (2001) The measurement of pain and the assessment of people experiencing pain. In: Handbook of pain assessment, 2nd edition. The Guilford Press, New York. pp. 3-11.
[3] SalimpoorVA, BenovoyM, Larcher K, Dagher A, Zatorre RJ. Anatomically distinct dopamine release during anticipation and experience of peak emotion to music. Nat.Neurosci.2011;14(2),257-262.doi: 10.1038/nn.2726. Epub 2011 Jan 9.
[4] Ghaffaripour Sina,Hida Mohmoudi, Mohammad Ali, Abbas Alipour and Abdolhamid Chodedri . Music can effectively reduce pain perception in women rather than men. Pak J Med Sci. 2013; 29(1):128-131.
[5] MacDonald RA, Mitchell A et al. An Experimental investigation of the effects of preferred and relaxing music listening on pain perception. Journal of music therapy.2006; XLIII(4):295-316.
[6] Stanton-HicksM, Good M, Grass JA, Cranston Anderson G, Choi C, Schoolmeesters LJ, Salman A. Relief of postoperative pain with jaw relaxation, music, and their combination. Pain.1999;81(1-2): 163–172
[7] Amin Ebneshaidi, Mohseni M. The Effect of Patient-Selected Music on Early Postoperative Pain, Anxiety, and Hemodynamic Profile in Cesarean Section Surgery. The Journal of alternative and complementary medicine. 2008; 14(7) : 827–831
[8] Nadiye Ozer, Karaman Ojlu Z, Arslan S, Gunes N. Effect of Music on Postoperative Pain and Physiologic Parameters of Patients after Open Heart Surgery. American society for pain management nursing.march2013; (14)1:20-28
[9] Ahn S, Marion Good. Korean and American Music Reduces Pain in Korean Women After Gynecologic Surgery. Pain Management Nursing.2008;9(3): 96-103
[10] Nilsson U, Unooson 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
[11] J.L.Rudhy, Klanci M, McCabe, Ame E Williams. Affective modulation of autonomic reaction to noxious stimulations. International journal of Psychophysiology.2007;63(1):105-109
[12] Brodie EE, Mitchell LA, Mac Donald RA. A comparison of the effects of preferred music, arithmetic, and humor on cold pressor pain. European journal of pain:2006;10(4): 343-351.
[13] Harpreet Kaur, Rashshree Ravishankar, SS. Goudar. An experimental study to evaluate the effect of instrumental Indian classical and western music therapy on learning and memory in stress-induced young rats. Journal of Pharmacy.2012; 2 (4) :29-32
[14] Melzack R, Wall PD. Pain mechanisms: a new theory. Science. 1965 Nov 19;150(3699):971–979.
[15] DG Thomas Parambi, Vikash Pravakar, Reshmi Krishna A., Shreeja C Nair et al. The rhythm of life: Music therapy for body, mind, and soul.2011:2 (2):237-246.
[16] Menon V, Levitin DJ. The rewards of music listening; Response and physiological connectivity of the mesolimbic system. Neuroimage.2005; 28(1):175-184.
[17] Christine E . Dobek et al . Music Modulation of pain perception and pain-related activity in the brain, brain stem, and spinal cord. The journal of pain.2014:15(10):1057-1068.
[18] Anne J Blood, Robert J.Zatorre.Intensely pleasurable responses to music correlate with activity in the brain region implicated in reward and emotion. PANS .2001 Sept; (98)20:11818-11823.
[19] Roy M , Lebius A, Huguieville L, Peretz I, Rainville P. Spinal modulation of nociception by music .European Journal of pain. 2012; 16(6) : 870-877.
[20] Ersa ekin korhan, Khorshid L, Uyar M. The effect of music therapy on physiological signs of anxiety in patients receiving mechanical ventilatory support. Journal of clinical nursing.2011;20(7-8):1026–1034 doi: 10.1111/j.1365-2702.2010.03434.x.
[21] Cynthia Allison Devis. The Effects of Music and Basic Relaxation Instruction on Pain and Anxiety of Women Undergoing In-Office Gynecological Procedures. Journal of music therapy. XXIX(4)1992: 202-216
[22] Tse MMY, Chan MF, Benzie IFF. The effect of music therapy on postoperative pain, heart rate, systolic blood pressure and analgesic use following nasal surgery. J Pain Palliat Care Pharmacother. 2005;19(3):21-9 DOI: 10.1080/ J354v19n03_05
[23] Makoto Iwanaga, Maki Ikeda, Tatsuya Iwaki. The Effects of Repetitive Exposure to Music on Subjective and Physiological Responses. Journal of music therapy. 1996; 33(3): 219-230
[24] L.Mourot, Bouhaddi M, Regnard J. Effects of CPT on cardiac autonomic control in normal subjects. Physiol.Res.2009; 58:83-91.
[25] Luciano Bernardi, Porta C, Casucci G, Balsamo R, Bernardi N, Fogari R . Dynamic Interactions Between Musical, Cardiovascular, and Cerebral Rhythms in Humans.Circulation. 2009; 119(25): 3171-80
[26] Roger B. Fillingim,Christopher D.King, Margaret C,Ribeiro-Dasilva,Bridgett Rahim Williams and Joseph L Riley. Sex ,Gender and Pain.A review of recent clinical and experimental findings.J Pain.2009 may;10(5):445-485.