

**UNIVERSITI TEKNOLOGI MARA**

**EFFECTS OF MUSIC ON  
CARDIORESPIRATORY FUNCTION,  
PERCEIVED EXERTION AND  
ACUTE MOUNTAIN SICKNESS  
SYMPTOMS IN SIMULATED HIGH  
ALTITUDE ENVIRONMENT**

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**PhD**

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## AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

Music had been used for exercise as well as sports performance enhancement, and has the potential to reduce the risk of altitude illness. This study investigated the effects of music listening on cardiorespiratory function, perceived exertion and acute mountain sickness (AMS) at high altitude. In a cross-over study design, eleven (n=11) male participants (age:  $27.73 \pm 3.29$  years; weight:  $66.14 \pm 8.13$  kg; height:  $167.91 \pm 3.65$  cm) underwent three types of interventions: no music (NM), relaxing music (RM) and arousal music (AM). Each group was exposed to simulated hypoxic condition (5000 m) in a hypobaric chamber with one week washout period in between intervention. The cardiac function was assessed using blood pressure (BP), heart rate (HR) and echocardiogram. The respiratory function was evaluated using respiratory rate (RR), pulse oximeter (SpO<sub>2</sub>), spirometer and lung ultrasound (B-lines for fluids leakage). The rate of perceived exertion (RPE) was measured using Category-Ratio (CR10) Borg scale whereas the Acute Mountain Sickness(AMS) symptoms were assessed using Lake Louise Score (LLS). These measurements were recorded at the sea level (SL), 3000m and 5000m. Significant effects of music ( $p < 0.05$ ) were seen on HR, EF, SpO<sub>2</sub>, B-lines appearance on lung ultrasound, RPE and LLS. For the HR, the mean was  $80.45 \pm 16.54$ ,  $75.82 \pm 10.39$  and  $80.00 \pm 14.18$  bpm at SL, 3000 and 5000m respectively in NM group. Significant difference was seen in AM group when compared to NM with decreased HR by 16.16%, 3.24% and 7.83% at SL, 3000 and 5000m respectively ( $p = 0.021$ ). For the EF, the mean was  $65.50 \pm 6.03\%$ ,  $57.29 \pm 7.21\%$  and  $58.06 \pm 8.99\%$  at SL, 3000 and 5000m respectively in NM group. Significant difference of EF were seen in AM group when compared to NM with reduction by 18.29%, 0.31% and 4.50% at SL, 3000 and 5000m respectively ( $p = 0.013$ ). For SpO<sub>2</sub>, at SL, the mean was  $97.36 \pm 1.12\%$  with NM and this decreased by 0.45% with RM; but higher by 1.19% with AM. At 3000m, the SpO<sub>2</sub> was  $87.45 \pm 4.08\%$  with NM, but higher by 5.00% and 4.46% with RM and AM respectively. At 5000m, it was  $75.82 \pm 11.40\%$  with NM but higher by 2.27% and 5.27% in the RM and AM groups respectively. Significant difference was seen in AM ( $p = 0.020$ ) and RM ( $p = 0.032$ ) groups when compared to NM. For B-lines, with NM, the mean number of lines were 0,  $1.55 \pm 0.93$  and  $3.36 \pm 1.50$  at SL, 3000 and 5000m respectively. There were reductions by 88.38% and 94.64% of lines with RM compared to NM, at 3000 and 5000m respectively ( $p < 0.001$ ). With AM, there were reductions by 41.29% and 72.91% at similar respective altitudes ( $p = 0.001$ ). The mean RPE scores were  $6.00 \pm 1.73$ ,  $3.27 \pm 0.79$  and  $3.55 \pm 1.04$  in NM, AM and RM groups respectively with significant difference seen in AM ( $p = 0.004$ ) and RM ( $p = 0.002$ ) groups when compared to NM. The mean LLS were  $4.55 \pm 2.25$ ,  $1.55 \pm 1.64$  and  $1.55 \pm 1.63$  in NM, AM and RM group respectively with significant difference seen in AM ( $p = 0.002$ ) and RM ( $p = 0.037$ ) groups. In conclusion, this study showed that in a simulated high altitude environment, exposure to AM showed significant reduction of mean HR and EF. Both AM and RM exposure resulted in significantly higher SpO<sub>2</sub>, less number of 'B-lines' on lung ultrasound, less AMS symptoms and less RPE scores. Music exposure could potentially benefit high altitude climbers in terms of less AMS symptoms, less RPE, better SpO<sub>2</sub> and less fluids leakage into lung tissues. Music exposure provided favourable physiological changes in high altitude environment, which may have implications to reduce the risk of AMS.

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