ABSTRACT

The study aimed at assessing the whole-body vibration (WBV) exposure among large blast - hole drill operators with regard to the ISO recommended threshold values and its association with personal, machine and rock related factors. This study included 39 drill operators who were working in six iron ore surface mines of eastern India. In this study, WBV were measured in terms of following methods: frequency-weighted RMS acceleration (m s^{-2}) and vibration dose value, VDV (m $s^{-1.75}$). The health risks of operators were assessed based on daily frequency-weighted RMS acceleration and VDV. Related data on personal, machine and rock related factors were collected from workers' face-to-face interviews, mine management office and laboratory investigation. The daily exposure level of frequency-weighted RMS acceleration, A(8), showed that 71.8% of the operators exceeded the ISO upper limit; whereas, in terms of VDV, 69.3% of the operators exceeded the ISO upper limit. In this study, relationship of various risk factors was assessed with parameters of WBV through statistical analyses. Bivariate correlation revealed that potential predictors of WBV were model type and age of drill machine, thickness of seat pad, seat rest height, hardness, uniaxial compressive strength (UCS) and density of rock for both frequency-weighted RMS acceleration as well as VDV. The stepwise multiple regression model revealed that potential predictors of frequency-weighted RMS acceleration for dominant (z - axis) axis were age of operator ($\beta = 0.011$, SE = 0.006), body mass index ($\beta = -0.04$, SE = 0.01), dummy variable 2 (Model ROC L6 compared to IDM 30E; $\beta = -0.691$, SE = 0.10), height of seat rest ($\beta = -0.04$, SE = 0.02), UCS ($\beta = 0.02$, SE = 0.007) and density of rock ($\beta = 0.47$, SE = 0.22). The regression model performed for VDV showed that potential predictors for dominant axis were age of operator ($\beta = 0.25$, SE = 0.10), body mass index of operator ($\beta = -0.59$, SE = 0.34), dummy variable 2 ($\beta = -6.42$, SE =1.69) and density of rock ($\beta =14.77$, SE = 3.5). The result of logistic regression analysis revealed that based on adjusted odds ratios, age of operator and UCS of rock were significant risk factors for frequency-weighted RMS acceleration. Adjusted odds ratios of VDV also showed that age of operator and UCS of rock were significant risk factors. The present study demonstrates that drill operators in iron ore mines of eastern India were exposed to a very high level of WBV mostly due to the exposure in z - axis. As a result, they are highly vulnerable to health risks from WBV. As the nature of the rock cannot be changed, WBV prevention should be explored by the following ways: using the most suitable and recent machines with proper design in mines which can handle rock hardness, compressive strength and density; improvement of the seat including an appropriate suspension system; development of ergonomic and participative approaches to improve cab design and limit prolonged sitting posture. However, these possible interventions should be monitored and evaluated.

Keywords: Drill operators, iron ore mine, multivariate analysis, whole-body vibration.