CFD Simulations of Respiratory Airflow in Human Upper Airways Response to Walking and Running

Endalew Getnet Tsega[1]

[1]Bahir Dar University

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Abstract

Walking and running are common types of physical activities people do in day to day living, to improve health and physical fitness or for recreation. During a physical activity, rate and depth of breathing increase because working muscles need extra oxygen in order to produce energy. In this study, computational fluid dynamics (CFD) simulations were used to investigate respiratory airflow flow dynamics in human upper airways response to walking and running. The numerical simulations were done in a realistic CT-scan airway model using ANSYS Fluent 19.0 software. Flow fields were characterized numerical and flow patterns were investigated in the airway model during inspiration and expiration in response to walking and running. The axial velocity distribution and secondary flow patterns were analyzed response to the two physical activities at different cross-sections of the airway model. The maximum velocity, wall pressure, and wall shear stress values for running were respectively 3.2, 9.4 and 5.9 times higher than that of walking during inspiration. More mixing of streamlines was observed during running than walking because of the occurrence of greater turbulence. More skewed flows at airway curvatures were observed at the inspiration than expiration. The result of this study supported the fact that running is a more intensive activity than walking from respiratory dynamics point of view.

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