Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **2532** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Cardiorespiratory Fitness Evaluation using Submaximal protocol with Muscle Oxygenation

Tuesday 4 June 2019 10:45 (15 minutes)

Low levels of cardiorespiratory fitness (CRF) are associated with high risk of cardiovascular disease (CVD) and all-cause mortality. Maximal oxygen consumption (VO2max) has been considered as a gold standard for determining CRF, which can be precisely measured by using the cardiopulmonary exercise testing (CPX) device with a maximal exercise protocol. However, this traditional methodology can be unavailable due to its high cost and risk. VO2max itself is not complete solution for CRF evaluation as it shows the level of CRF only. What limits the level of CRF and how to make improvement efficiently are not answered by VO2max. Recently, an alternative approach has been raised by researchers to evaluate VO2max by submaximal test based on the heart rate (HR). Compared with the maximal exercise based method, this submaximal test approach is more applicable and much safer, but at an expense of the VO2max estimation accuracy. Motivated by this, our group has proposed a novel method, which adds a new personalized performance related metric-muscle oxygen saturation (SmO2) that can be measured by a portage Near infrared spectroscopy (NIRS) device, to further improve the submaximal test accuracy and show the physical limitations that caused low levels of CRF. Furthermore, we also propose an adjustment algorithm to evaluate CRF with machine learning approach. Our test results show that the proposed adjustment algorithm improves the VO2max estimation in submaximal test and indicates the physical limitation for each subject at their own level of CRF, which thus demonstrates the feasibility of using SmO2 for CRF evaluation. To our best knowledge, our group is the first to propose this idea, which will be of great significance to clinical applications.

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Session Classification: T2-11 General Instrumentation (DAPI) | Instrumentation générale (DPAI)

Track Classification: Applied Physics and Instrumentation / Physique appliquée et de l'instrumentation (DAPI / DPAI)