Extracting and Assessing Data from Wearables to Inform and Improve Outcomes for Sports Medicine

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Introduction: Wearable bioelectronics include devices which measure physiological signals and biomarkers in an unobtrusive, continuous, and real-time manner. Despite the ability for these devices to detect and measure markers in a non-invasive manner, there remains an unmet medical need for these devices to translate the acquired data into actionable insight to create value for the user and medical personnel. Large data sets are needed to develop and train models to ultimately create clinical value. This forms the premise for the presented work. Based off of previous work involving the use of wearable sensors to quantify player load on soft tissue injury in elite-level athletes, we hypothesized that there remains a need to measure physiological parameters in addition to position and motion to be able to monitor and predict the overall health of an athlete in a continuous manner to improve performance. This study sought to determine the relationship between stress levels, training load, workout intensity, and recovery as it affects athletic performance in student-athletes on the Case Western Reserve University (CWRU) club rowing team using wearable technology. The following questions motivated the study: 1) is there a correlation between stress levels (physiological and/or emotional) and performance in student-athletes, 2) can the acute to chronic workload ratio (ACWR) be used to predict and prevent the incidence of soft-tissue injuries, and 3) can the measurement of physiological parameters and biosignals provide coaches a robust platform to tailor and modify training regimens to maximize athlete performance?

Materials and Methods: The presented work evaluated the utility of a commercial wearable patch in conjunction with developed-analytics to assess and predict mental cognition, performance, and health of student-athletes in a controlled training environment over a one-month period. Utilizing a recently approved IRB protocol, twenty student athletes were recruited having matched the necessary inclusion criteria of demonstrating the “fastest 2K time” for the top ten men and top ten women on the team. A commercial wearable patch was assigned to each subject and used for the duration of the study. The following parameters were measured utilizing the sensor: heart rate (beats per minute, BPM), stress levels (%), recovery (%), calories burned, activity levels, and respiration rate (breaths per minute). Average energy expenditure (AEEE) and VO2 max levels were calculated from the sensor data. Additionally, sweat rate, blood lactate levels, ACWR, and sleep were collected and/or calculated independently of sensor data to provide a holistic understanding of the student-athlete.

Results and Discussion: At the time of abstract submission, the clinical study had not yet been performed but is scheduled for January 14-February 14 2019. A preliminary study was performed to assess the efficacy of the wearable patch during a real-time high intensity training period. The patch was placed on a student athlete for forty minutes to measure heart rate, respiration rate, activity levels, and calories burned. Instantaneous energy expenditure was derived from calories burned (Figure 1). The acute workload, sweat rate, and VO2 max level over the duration of the training session were calculated to be 1200 (arbitrary unit, A.U.), 0.15 mL/hour, and 36.4 (ml/kg/min) respectively.

Translational Impact: The application of analytics to extract physiological data from wearable sensors heightens its translational utility for sports medicine. Initial results suggest that measurement and extraction of such data can pave the way for the development of robust data sets to positively inform and improve performance in athletes.

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