Automatic Classification of Skating Cross-Country Skiing Sub- Techniques based on a Single Wearable Sensor and Biomechanical Models

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mands of the intensity of resistance training, a category-ratio scale (CR10) was used by the subjects after each training session. The participants of both groups trained twice a week for 9 weeks. The HAT and WUP programs used the same exercises, the same total training volume and the same total intensity in these six weeks. The difference between the two programs was in the distribution within each training phase. The HAT and WUP groups trained using a periodized strength programs with all programs variables controlled (e. g., volume and intensity). The HAT group used a linear not varying intensity, whereas the WUP group had a varied intensity. The results show that both the HAT and WUP groups made significant ($p \leq 0.05$) increases in strength and power. Thus, HAT and WUP are similarly effective over a nine-week training period, and the decision to use HAT or WUP depends on the preferences of the individual athlete.

[YIA] Periodization of plyometrics: is there an optimal overload principle?

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This study investigated the acute and chronic effects of three plyometric training (PT) programs with equal training loads (intensity × volume × frequency) on speed, agility and jumping performance. Forty-four male recreational team sport athletes were either assigned to a program that (1) increased training volume with exercises of mixed intensity (Mix), (2) kept training volume equal and increased exercise intensity (LowHi), (3) increased training volume and kept exercise intensity low (Low) or to a (4) control group (Control). Subjects trained twice a week for 8 weeks and were tested for 5 m (5 m) and 10 m sprint (10 m), 5 × 10 m shuttle run (5 × 10 m), squat jump (SJ), countermovement jump without (CMJ) and with arm swing (CMJa) and standing broad jump (SBJ). The change in 5 m, 10 m, 5 × 10 m and SJ performance did not significantly ($p > 0.05$) differ between groups. Sprinting and agility did not change after 8 weeks of PT ($p > 0.05$). The CMJ, CMJa and SBJ increased in the PT groups compared to the control group ($p < 0.05$). There was no difference ($p > 0.05$) between PT groups. Additionally, it was shown that a training session of high intensity was more likely to diminish performance the following days. To conclude, PT programs following a different overload pattern, i. e. different combination of volume and intensity, but equal training load showed similar performance effects in recreationally trained men. However, prior to competition, a PT of low intensity is preferred over a PT of high intensity in order to avoid a decline in performance.

Monitoring with Wearable Technology

The use of higher dimensional analyses to visualize the training process

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Quantifying the training load imposed onto team sports athletes is complex given the concurrent multi-modal training programs that these athletes undertake. Consequently, in the age of technology, a wealth of data representing different aspects of the training process are collected. To prevent data overload, optimizing how this data travels from collection to presentation to coaches is crucial to embed data into decision making. Using training and competition load data collected over three seasons, this presentation will provide an overview of how we have embedded higher dimensional analyses in professional rugby league practice to visualize and communicate the relationship between multiple variables relating to the training process and its outcomes (e. g. injury, performance). In particular, the use of principal component analysis to visualize the differences in external and internal training intensities of technical-tactical training drills. Also, the use of partial least squares correlation analysis to visualize the relationship between contextualized player motion (e. g. speed when defending within own half) and technical-tactical performances during competition.

Heart rate variability guided endurance training in recreational runners

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The aim was to investigate whether heart rate variability (HRV) guided exercise prescription yields comparable results on 5000 m running performance and key components of endurance performance in recreational runners.
Thirty-one recreational runners were systematically parallelized to one of two groups performing a 4-wk mesocycle with similar training intensity distribution (100%TRIMP) followed by a 3-wk mesocycle with 50% increased TRIMP compared to the first 4-wk mesocycle, and one-wk tapering. Both groups used similar individualized training plans with the HRV group having their training adjusted based on a 6-minute HRV test by Polar Electro Oy each morning during the second mesocycle. VO2peak and running economy were assessed at baseline (T0), after four (T1), seven (T2), and eight weeks (T3).
HRV trained less sessions and with a lower mean intensity as CONTROL. The 5000 m time decreased in CONTROL from T0 to T2 and T3, and from T0 to T3 and T1 to T3 in HRV. VO2peak increased from T1 to T2 ($p = 0.02$) with HRV and from T0 to T3 ($p = 0.006$) with control. Running economy improved only from T0 to T3 and from T2 to T3 ($p < 0.01$) with HRV. An individual mean response analysis indicated a high number of responders ($n = 8$ of 16) in CON and in HRV ($n = 9/13$).
Despite less training time HRV guided training showed comparable improvements in 5000 m running performance. HRV guided training may be a potential method to adjust exercise intensity and improve performance in recreational runners.

Automatic Classification of Skating Cross-Country Skiing Sub-Techniques based on a Single Wearable Sensor and Biomechanical Models

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The aim of this study was to design and validate a sub-technique classification algorithm for everyday cross-country trainings, based on a single sensor worn on the upper back and biomechanical models. The sensor (FieldWiz, Advanced Sport Instruments, Switzerland) recorded GNSS data, acceleration, and angular velocity. Using a customized fusion algorithm and a trunk model [1], the athlete's center of mass kinematics were obtained. Cycles were detected based on maxima in trunk inclination and a Gaussian mixture model was used to assign each cycle to its corresponding sub-technique (Gear 2, 3, 4) based on cycle distance, amount of lateral excursion and trunk inclination periodicity. Gaussian mixture parameters were determined from a separate dataset of short roller skiing trials. The algorithm was validated against video recordings with 5 junior level athletes skating on a 2.4 km lap with roller skis at medium intensity. Turns were removed and uphill and flat sections were selected. 925 sec of data remained, and each second was attributed one sub-technique. Gears 2, 3, 4 were skied during 81, 600, 244 s, respectively. 98.4% of all seconds were correctly classified and misclassifications mainly happened during transitions. This approach of model-based sub-technique classification proved extremely efficient, is fully automatic, and can be used during daily trainings. On-snow validity should be assessed in the future and other sub-techniques (e. g. double poling) could be added.

References

1. Fasel, et al. (2016). Remote Sensing. , 8(671) https://doi.org/10.3390/rs8080671.