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Is there an Optimal HIIT Protocol for Muscular Development of Adolescent Athletes?

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Muscular development via high-intensity interval training (HIIT) can be varied by training protocols such as different work-to-rest ratios. **PURPOSE:** This study examined the effects of different HIIT protocols on muscle function and fatigue resistance in adolescent Taekwondo athletes. **METHODS:** Forty-seven adolescent Taekwondo athletes (age: 16.7 ± 0.8 [SD] years, height: 175.2 ± 6.0 cm, weight: 66.2 ± 10.5 kg, body mass index: 21.5 ± 2.5 kg/m², training experience: 53.4 ± 10.6 months) were randomly assigned to the control group (n=12) vs. 3 HIIT groups by work-to-rest ratios: 1) 1:2 [30s:60s] (n=12), 2) 1:4 [30s:120s] (n=12), and 3) 1:8 [30s:240s] (n=12). The intensity of HIIT was achieved at 90-100% of participants' maximal heart rate. All HIIT groups completed 10 sessions over 4 weeks while the control group maintained their regular Taekwondo training. The muscular function was assessed by isokinetic muscle strength (60°s^{-1}) and endurance (180°s^{-1}) of the knee extensor and flexor. Fatigue resistance was measured with an isokinetic dynamometer. The participants performed 3 sets of 20 maximal extensions and flexion contraction at 120°s^{-1} with 1 min interval between each set. The data were normalized with each participant's body weight and calculated as total work done for extensor ([Nm]/[kg]). Total work done was calculated as the sum of work done during each set. Repeated measures ANOVA (4 groups \times 2 measurement time-points) was used to assess changes in muscle function and fatigue resistance, with significance set at $p < 0.05$. **RESULTS:** No significant interaction effects were observed for the group by time on isokinetic muscle strength/endurance. However, a positive effect on improving muscle fatigue resistance was observed at the first set of assessment in the HIIT with 1:4 (Pre: 4719.2 ± 577.3 vs. Post: 5166.0 ± 534.7 Nm/kg, $\Delta 10.2\%$, $p < 0.05$) and 1:8 groups (4845.6 ± 384.1 vs. 5271.0 ± 725.2 Nm/kg, $\Delta 8.6\%$, $p < 0.05$). In addition, 1:4 group exhibited fatigue improvement in the second set (4259.1 ± 390.2 vs. 4574.8 ± 385.5 Nm/kg, $\Delta 7.7\%$, $p < 0.01$), while other groups did not show any improvement. **Conclusion:** The HIIT 1:4 group (30s all-out with 120s rest) lasting over a brief 4-week period showed improvement in fatigue resistance. Our data may provide practical guidelines for muscle development by HIIT in adolescent athletes.

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