Muscle damage, hydration and energy supplementation during recreational alpine skiing

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Introduction

Maximal and supramaximal forces are produced, from skeletal muscle contractions, during an alpine ski turn (Hintermeister, Zeglinksi). While performing hundreds of turns in a few hours of skiing, there is an increased risk of inducing muscle damage. Due to the ever-changing contraction requirements during a turn, muscle glycogen becomes an important substrate for muscle contraction. Tesch (1995) reported that muscle glycogen stores could be depleted by more than 50%, with some fibers containing little to no glycogen, during skiing. Additionally, significant levels of ischemia and hypoxia occur during training in alpine ski racers (Szmedra). It is well known that the glycogenolytic rate increases during ischemia. Thus, there is a high metabolic demand placed on muscle during skiing. Furthermore, metabolic stress can be exacerbated since skiers will often ski from 2 to 3 hours before ingesting fluids and food. Thus, the purpose of this study was to examine the effects of energy and fluid supplementation on markers of muscle damage during 3 hrs of recreational alpine skiing.

Methods

Thirty-one intermediate to expert level skiers were ability-matched and randomly assigned to one of three groups. The carbohydrate + protein (CP; Accelerade®, 6g CHO + 1.5g protein/100 mL) and water placebo (PL) groups ingested 1.62 L during and after skiing. The third group did not consume any fluids (NF). All skiers skied for 3 hrs (average 6405 vertical meters) at self-selected velocities. All skiing was conducted from 900 hr to 1200 hr. Venous blood samples were collected the evening before and 2 hr after skiing.

Results

Data are mean ± SEM. Myoglobin (Mb) concentration did not change for CP (24.8 ±1.4 to 25.6 ±1.6 ng/mL). However, Mb rose ($p < .05$) from 26.4 ±1.3 to 40.0 ±2.8 ng/mL for PL and from 29.0 ±1.3 to 82.9 ±3.6 ng/mL for NF. Likewise, creatine kinase (CK) concentration was maintained for CP (113.5 ±24.7 to 120.0 ±20.6 U/L), but increased significantly from 117 ±27.2 to 174 ± 43.4 U/L for PL and from 126 ±23.2 to 243 ±34.3 U/L for the NF. The change in cortisol was less for CP than NF (40.1 ±22.8 vs. 88.4 ±29.7 ng/mL), but not PL (63.2 ±13.4 ng/mL).

Conclusions

While ingesting CP during skiing, Mb and CK concentrations did not significantly change from baseline, indicating minimal, if any, muscle damage. However, Mb increased by 54% and 186% for the PL and NF groups, while CK rose by 49% and 93% for PL and NF. Supplying an energy source to the active muscle during skiing is crucial in minimizing metabolically induced muscle damage since muscle glycogen is utilized at high rates during skiing. Although eccentric muscle contractions predominate during alpine skiing, it is unlikely that mechanical forces generated by these contractions led to changes in muscle damage since skiers averaged more runs with the CP (3.8) than the NF (2.9) during the final hour. This study also demonstrates that skiers need to ingest fluid at regular intervals during alpine skiing, but that the ingestion of a CP beverage added a significant benefit, above that of a PL, in minimizing muscle damage.

References

Hintermeister R et al. (1997). Med Sci Sports Exerc 29:548-553.
Tesch PA (1995). Med Sci Sports Exerc 27:310-314.
Zeglinksi et al. (1998). Int J Sports Med 19:447-454