舉重選手之訓練對其體組成、細胞損傷及體內抗氧化狀態之影響

The Effects of Exercise Training on Body Composition, Cell Injury and Antioxidative Status for Weightlifters

中文摘要

舉重運動為我國之高得獎率的運動項目之一，舉重選手為求成績進步，必須長期接受密集之高強度訓練計畫，除了容易造成肌肉損傷，並可能因此使得自由基的產生增加。本研究由國立體育學院運動技術學系選取舉重選手男女各 13、19 人，且其舉重經歷皆至少 3 年以上者為受試者，以探討台灣地區舉重選手經過兩週之運動訓練後，體內肌肉損傷狀況、抗氧化力及體組成之改變。並以同年齡之男女非舉重選手各 15、17 人為控制組，與舉重選手訓練前的狀態進行對照。此外並評估所有受試者之飲食攝取狀況。

利用與非運動員相較，藉以探討長期的運動訓練對舉重選手的各項生理值之影響。與控制組相比，舉重選手的瘦體組織（FFM）量、血漿中維生素 C 濃度及 glutathione peroxidase（GSH-Px）活性明顯低於控制組（$p<0.05$）；舉重選手血漿中 malondialdehyde＋4-hydroxy 2-（E）-nonenal（MDA＋4-HNE）及 Thiobarbituric acid-reactive substances（TBARS）之濃度及 creatine kinase（CK）活性（$p<0.05$）均明顯高於控制組。顯示舉重選手較非運動員有較高的氧化壓力及肌肉損傷狀況。飲食攝取部分，舉重選手的熱量及三大營養素之每日平均攝取量高於非運動員，但僅男性具有明顯差異；維生素 C、E 的攝取量則兩組間無明顯差異。

以兩週運動訓練前後的差異，藉以瞭解短期的運動訓練對於舉重選手各項生理值之影響。兩週訓練之後，FFM、體脂肪重及 FFM 和體脂肪百分比無明顯改變，且運動訓練對血漿中維生素 C、血脂質、鐵營養狀況及瘦體蛋白（Leptin）的濃度等皆沒有影響；而男性與女性選手血漿中瘦體蛋白的濃度與體脂肪百分比有明顯相關性（男性：$r=0.713$, $p<0.05$, 女性：$r=0.487$, $p<0.05$）。男性舉重選手於第一週訓練後，血漿中維生素 E 濃度及總抗氧化力（TAS）明顯降低，血漿中 glutathione（GSH）濃度明顯增加（$p<0.05$）；血漿中 MDA＋4-HNE 及 TBARS 濃度較訓練前高；CK 活性明顯增加（$p<0.05$）。經兩週訓練後，GSH-Px 活性降低，且 SOD 活性明顯降低（$p<0.05$）；CK 活性明顯增加（$p<0.05$）。女性舉重選手第一週訓練後血漿中維生素 E 的濃度明顯降低，CK 活性明顯增加（$p<0.05$）。經兩週訓練後，全血中的 GSH-Px、紅血球中的 SOD 活性及 TAS 值皆降低，血漿中 MDA＋4-HNE 及 TBARS 濃度增加，CK 活性明顯增加（$p<0.05$）。

根據以上結果推測，不論是長期或短期之運動訓練，皆會增加舉重選手體內的氧化壓力，並造成細胞損傷。然而肌肉損傷及氧化壓力所造成的傷害，可能可以藉由停止訓練而降低。故本研究之結果可供舉重教練為選手設計訓練計畫時參考之用，除了減少選手於訓練過程中所受到的傷害，並希望能以營養的角度給予選手幫助，將可能發生的傷害降到最低。

英文摘要

The weightlifters easily have cell injury due to the routine weight-training program; moreover, severe cell injury maybe brings some oxidative stress. This study is to examine the change of cell injury, antioxidant capacity, and body composition in weightlifters following two-week exercise training regimen. Thirteen male and nineteen female weightlifters gave their informed written consent to participate in this study. Besides, the data of 15 male and 17 female non-athletes was use as a control group. In order to study the effects of long-term exercise training in weightlifters, the data of weightlifters was compared with control group. In addition, dietary habit and pattern of subjects was evaluated.

Comparing with the control group, weightlifters had lower FFM amount. The glutathione peroxidase (GSH-Px) activity and the plasma Vitamin C concentration were significantly lower in weightlifters than control group. The malondialdehyde＋4-hydroxy 2-(E)-nonenal (MDA+4-HNE), thiobarbituric acid-reactive substances (TBARS) levels and creatine kinase acticity in weightlifters were significantly higher than control group. Daily energy and macronutrients intake in weightlifters were higher than control group. There was no significant difference in Vitamin C, E intake between weightlifters and control group.

After 2-week exercise training, the body composition, plasma Vitamin C, blood lipids and iron levels of the weightlifters had no significantly change. Plasma leptin level was strongly correlated with the percent of body fat in both male and female weightlifters. After 1-week exercise training, male weightlifters had significantly lower plasma Vitamin E and total antioxidant status (TAS) levels than before training. The MDA+4-HNE and TBARS levels, CK activity were significantly higher than before training. Two-week exercise training resulted in significant decrease in SOD activity and significant increase in CK activity of male weightlifters. For female weightlifters, the plasma Vitamin E decreased significantly and CK activities increased significantly after 1-week exercise training. The activities of GSH-Px and SOD, the level of TAS decreased significantly. Both MDA+4-HNE level and CK activity increased significantly after 2-week exercise training.

In conclusion, both long-term exercise training regimen and two-week exercise training resulted in the increase oxidative stress and cell injury in weightlifters.