

Changes of body composition, physical fitness, and blood variables according to the short-term weight reduction in college ssireum athletes

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The purpose of the study was to investigate the influence of short-term weight loss on body shape, physical fitness, and blood variables in college ssireum (one of the Korean traditional martial art) athletes. Six college ssireum athletes participated as subjects. The weight loss program includes 50% of limited diet, 5.5 hr of physical and skill training. Body composition such as weight, body fat, muscle mass, and body mass index (BMI) was determined. Fitness test such as shuttle run, sit-up, trunk extension test, grip test, sitting reach test, and side step test was measured. Blood variables such as total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein, glucose, reactive oxygen species (ROS), malondialdehyde (MDA), and superoxide dismutase (SOD) were checked before and after the short-term weight reduction. The results revealed significant decrease in body composition such as weight,

body fat, muscle mass, and BMI. Fitness test also showed significant decrease in sit-up, trunk extension test, and grip test. The results demonstrated positive significant change in side step test, shuttle run, and sitting reach test. The results of blood variables showed significant decrease in total cholesterol, LDL, glucose and SOD. In contrast, MDA revealed significant increase and no significant change was found in ROS. Finally, it is assumed that a proposal of weight loss without decrease of muscle mass, muscle force, and muscle endurance is necessary because of the negative effects on muscle force and muscle endurance which should be used during actual games.

Keywords: Body composition, Physical fitness, Blood variables, Weight reduction

INTRODUCTION

Ssireum, one of the Korean traditional martial art, is known as a game which needs weight control as well as physical fitness and techniques. Athletes participating weight limit games attempt to achieve the lowest possible weight to gain an advantage over opponent who have inferiority in strength and body size (Artioli et al., 2010a). However, Franchini et al. (2012) reported that weight loss prior to competition might be a bad effect on the physical fitness components, especially when more than 5% of weight reduction in short-term less than 7 days due to decrement of performance and physiological capacity, and bad effects on psychological components.

On the contrary, Utter et al. (2002) reported that weight loss does not produce harmful effects on performance and Sundgot-Borgen and Garthe (2011) emphasized different limits and circumstances of weight reduction produce different results individually. Athletes in weight limit competition reduce their weight by use of different methods of weight reduction such as exercise, sweat suit, sauna, fluid deprivation, and food restriction (Oppliger et al., 2003). In extreme cases, they use diet pill, diuretic, self-inducing vomiting, and laxative abuse.

Therefore, this study was performed (a) to identify the changes from short-term and midterm weight reduction on body composition, physical fitness, and blood variables in college ssireum athletes, (b) to investigate the problems which might occur during

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Table 1. Physical characteristics of the subjects (n=6)

Characteristic	Mean ± SD
Age (yr)	21.33 ± 10.3
Height (cm)	175.98 ± 5.40
Weight	97.08 ± 18.77
Body mass index (kg/m ²)	31.20 ± 4.75

SD, standard deviation.

those weight reduction periods, and (c) to propose the most effective and nondetrimental weight reduction system.

MATERIALS AND METHODS

Participants

The subjects of this study were 6 college male ssireum athletes. Physical characteristics of the subjects are listed in Table 1.

Experimental procedures

Measurement of body composition, physical fitness, and blood variables

Evaluation of body composition was performed 30 min prior to body evaluation. Weight, % body fat, muscle mass, and body mass index (BMI) were measured by the use of Inbody 720 (Biospace, Co., Seoul, Korea). To identify the difference of performance-related physical fitness based on weight reduction cardio-pulmonary endurance (shuttle run), muscle endurance (sit-up), muscle force for trunk extension (Model 5402, Takei, Niigata, Japan) and grip test (Model 5401, Takei), agility (side step), and flexibility (sitting reach test) were measured.

Blood collecting was performed from antecubital vein at the time of pre and post weight reduction. Blood variables including total cholesterol, low-density lipoprotein (LDL), reactive oxygen species (ROS), malondialdehyde (MDA), and superoxide dismutase (SOD) were analyzed.

Diet and exercise program

For 3 days short-term weight reduction, a diet program was run with the assistance of a nutrition specialist. Each subject consumed 50% of daily caloric consumption and each diet contained 55% of carbohydrate, 35% of fat, and 10% of protein. Exercise program was maintained 3 times a day of which consisted both physical fitness training and technical training.

Statistical analysis

To identify the differences of body composition, fitness test, and

Table 2. Change in body composition

Variable	Pre	post	t	P-value
Weight (kg)	97.08 ± 18.77	91.86 ± 17.72	11.795	0.000***
Body fat (%)	21.45 ± 6.01	20.55 ± 5.56	3.998	0.010*
Muscle mass (kg)	70.16 ± 9.66	66.92 ± 9.25	7.795	0.001**
Body mass index (kg/m ²)	31.20 ± 4.75	29.58 ± 4.42	11.171	0.000***

Values are presented as mean ± standard deviation.

* $P < 0.05$. ** $P < 0.01$. *** $P < 0.001$.

Table 3. Changes in performance related physical fitness variables

Variable	Pre	Post	t	P-value
Grip (kg)	52.96 ± 4.12	46.65 ± 5.14	8.345	0.000***
Back strength (kg)	176.81 ± 8.67	150.41 ± 11.92	7.787	0.001**
Sit & reach (cm)	11.33 ± 6.36	15.08 ± 5.55	-5.724	0.002**
Side step (rep/30 sec)	36.83 ± 6.43	41.00 ± 5.93	-5.000	0.004**
Sit-up (rep/60 sec)	45.16 ± 7.54	39.50 ± 5.31	4.610	0.006**
Shuttle run (repetition)	64.33 ± 16.80	72.33 ± 15.83	-0.725	0.005**

Values are presented as mean ± standard deviation.

** $P < 0.01$. *** $P < 0.001$.

blood variables before and after the short-term weight reduction, data were analyzed with IBM SPSS Statistics ver. 21.0 (IBM Co., Armonk, NY, USA) and statistical significance was set at $P < 0.05$ for all tests.

RESULTS

Table 2 shows the changes of body composition based on 3 days of short-term weight reduction. The results show that there were significant differences between pre and post weight ($t = 11.795$, $P = 0.000$), % body fat ($t = 3.998$, $P = 0.010$), muscle mass ($t = 7.795$, $P = 0.001$), and BMI ($t = 11.171$, $P = 0.000$).

The changes of physical fitness factors based on the weight reduction are presented in Table 3. According to Table 3, the grip strength ($t = 8.345$, $P = 0.000$), trunk extension strength ($t = 7.787$, $P = 0.001$), and sit-up ($t = 4.610$, $P = 0.006$) showed significant decrease, respectively. Side step ($t = -5.000$, $P = 0.004$) for agility, shuttle run ($t = -0.725$, $P = 0.005$) for cardiopulmonary function, and sitting reach ($t = 5.724$, $P = 0.002$) for flexibility showed significant increase, respectively.

The changes of blood variables based on 3 days short term weight reduction are presented in Table 4. Significantly decreased levels of total cholesterol ($t = 3.338$, $P = 0.021$), glucose ($t = 3.905$, $P = 0.011$), LDL ($t = 3.923$, $P = 0.011$), and SOD ($t = 3.652$, $P = 0.015$) were found. On the contrary, there was significant increase in the level of MDA ($t = -7.4$, $P = 0.001$). No significant difference

Table 4. Changes in blood variables

Variable	Pre	Post	t	P-value
TC (mg/dL)	177.83 ± 19.07	162.00 ± 11.31	3.338	0.021*
Glucose (mg/dL)	92.66 ± 4.80	77.83 ± 8.99	3.905	0.011*
LDL-c (mg/dL)	102.50 ± 19.19	91.66 ± 13.53	3.923	0.011*
SOD (pg/mL)	54.36 ± 4.83	48.61 ± 3.59	3.652	0.015*
MDA (pmol/mL)	0.14 ± 0.01	0.15 ± 0.01	-7.400	0.001**
ROS (pg/mL)	87.91 ± 4.30	92.41 ± 6.80	-2.318	0.068

Values are presented as mean ± standard deviation.

TC, total cholesterol; LDL-c, low-density lipoprotein cholesterol; SOD, superoxide dismutase; MDA, malondialdehyde; ROS, reactive oxygen species.

* $P < 0.05$. ** $P < 0.01$.

was found in ROS level.

DISCUSSION

The results of this study revealed that the change in body composition from short-term weight reduction did not affect the body fat level rather than significant decrease of body fluid, lean body mass, and body weight as other studies reported (Artioli et al., 2010b; Brito et al., 2012; Hall and Lane, 2001; Mendes et al., 2013). This result is also coincided with the report which asserted that short term weight loss brings decrease of dehydration as well as decrease of accumulation of ATP-PC and glycogen in the muscle tissue (Rhyu et al., 2014).

In this study, decreases of physical fitness, muscle endurance and increases of flexibility, agility, and cardiopulmonary functions were found. However, it is contrary to the results of reports which demonstrated that all components of the physical fitness including cardiopulmonary function and anaerobic power as well as muscle strength and endurance decreased (Kazemi et al., 2005; Khodae et al., 2015; Reljic et al., 2013). Some authors reported increase or no change of agility, flexibility, and fatigue after weight reduction (Papadopoulou et al., 2017; Steen et al., 1988).

In blood variables, there were decreases of total cholesterol, glucose, LDL, and SOD, while increases of MDA and ROS are reported. According to some researchers (Papadopoulou et al., 2017; Pettersson and Berg, 2014; Slater et al., 2005; Steen et al., 1988), they reported that functions of blood lipid and antioxidants are changed due to short-term weight reduction.

From the results above, it was identified that malnutrition from weight reduction and loss of lean body mass from excessive loads of exercise bring decrease of muscle strength and muscle endurance. However, it is thought that increases of flexibility, agility, and cardiopulmonary function are due to the contribution of de-

creased subcutaneous fat and improvement of endurance performance from weight reduction.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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