Effect of Training on the serum creatine Kinase (CK) levels of Athletes

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ABSTRACT: The effect of training on the serum creatine kinase levels of athletes was evaluated clinically. Study was conducted in 46 highly-trained athletes. The collective results indicate that training has effect on the serum creatine kinase. The study showed that there was significant difference (P=0.002) between the serum creatine kinase (CK) values of pre-training and post-training values for the study groups and their controls. The study showed that serum CK is a marker for skeletal and myocardial muscle damage. Muscle damage reduces performance in endurance activities.

Thus, knowing and identifying factors such as energy requirements, mechanical efficiency and oxygen intake, is essential to performance (Bircher et al., 2006; Nezhad and Farhadi, 2012).

In this paper, we report the effect of training on the serum creatine kinase levels of University of Port Harcourt athletes.

2. Materials and Methods

2.1. Population and sample

Forty-six volunteers (22 males and 24 females), who were training for the Nigerian Universities Games (NUGA) were enrolled in the study with the 14 control group (7 males and 7 females). The volunteers and the controls were divided into 2 groups of 30 males and 30 females, ages 18 – 28 years. The endurance of all participants was measured by a treadmill run with...
increasing workload (stepwise every min), until muscle fatigue (time-to-fatigue). The time-to-fatigue was measured pre-study and at day 30. Serum creatine kinase measurements were also made at the same intervals using lactate analyzer.

2.3. Data Analysis

The data generated were analyzed by multivariate statistical methods. For statistical analysis SPSS software (version 20.0, Chicago, USA) was used, the paired t test and independent samples-test were used to compare values of the experimental treatment and control group. A comparison was considered statistically significant if the P value was < 0.05.

3. RESULTS ANALYSIS

Table 1 shows the serum creatine kinase (IU/L) levels of participants before training (pre-training) and after training (post-training). The study showed that there was a significant difference (P=0.001) between the serum creatine kinase (CK) values for pre-training and post-training among the study group. The study also showed a significant difference (P=0.001) between the serum CK values for pre-training and post-training among the controls (Table 1).

The study showed a significant difference (P=0.001, P=0.002 and P=0.05) between the serum CK values of females before and after training among the study groups and controls. It also showed a significant difference (P=0.001, P=0.006 and P=0.05) between the serum CK values of male subjects before and after training among the study groups and their controls. Other details are shown in Table 1.

Table 1: Serum Creatine kinase (IU/L) levels of participants before training and after training

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Key: _ = Haemolysis

Table 2 shows the serum creatine kinase (IU/L) values of participants group before training and after training in relation to their demographic characteristics. The study showed that there was no significant difference (P=0.265) between the serum creatine kinase (CK) values of pre-training values for Group I and Group II study groups. There was a significant difference (P=0.023) between the serum CK values of male subjects before and after training among the study groups and their controls. Other details are shown in Table 2.

Table 2: Comparative analysis of serum creatine kinase (IU/L) values of participants before training and after training in relation to their demographic characteristics.
DISCUSSION

The purpose of the present study was to evaluate the effect of training and 30-day endurance training on the performance of university athletes. The serum levels of skeletal muscle enzymes is a marker of the functional status of muscle tissue and varies widely in both pathological and physiological conditions (Brancaccio et al., 2007). An increase in these enzymes may represent an index of cellular necrosis and tissue damage following acute and chronic muscle injuries (Mokuno et al., 1987; Szumilak et al., 1998; Brancaccio et al., 2007). Changes in serum levels of muscular enzymes and isoenzymes are also found in normal subjects and in athletes after strenuous exercise (Priest et al., 1982; Munjal et al., 1983; Wolf et al., 1987; Ide et al., 1999; Brancaccio et al., 2007): the amount of enzyme from muscle tissue to blood can be influenced by physical exercise (Boros-Hatfaludy et al., 1986; Brancaccio et al., 2007). Muscle creatine kinase (CK) activity measured from needle muscle biopsies shows different behaviour before and after training (Linossier et al., 1997; MacDougall et al., 1998), and the serum level of CK changes according to different protocols and to the intensity and level of training (Ohkuwa et al., 1984; Klapcinska et al., 2001; Szabo et al., 2003; Brancaccio et al., 2007).

The study of serum CK in sports medicine allows to obtain information on the state of the muscle (Brancaccio et al., 2007). High levels of serum CK in apparently healthy subjects may be correlated with physical training status. However, if these levels persist at rest, it may be a sign of subclinical muscle disease, which training loads may evidence through the onset of symptoms such as profound fatigue (Angelini, 2004; Brancaccio et al., 2007).

In normal serum, total CK is provided mainly by the skeletal muscle and is almost only of the MM fraction. Total CK levels depend on age, gender, race, muscle mass, physical activity and climatic condition. The 2.5 and 97.5 percentile reference limits have recently been revisited (Stomme et al., 2004; Brancaccio et al., 2007).

Young adult males have high serum levels of CK (Borges and Essen-Gustavsson, 1989), which decline slightly with age during the geriatric period (Tietz et al., 1992). There are marked sex differences in CK serum levels at rest (Fu et al., 2002), with lower values in females than in males. After muscular exercise, sex-linked differences are still present (Amelink et al., 1988), and oestrogen may be an important factor in maintaining post-exercise membrane stability, thus limiting CK leakage from the damaged muscle (Amelink et al., 1990; Tiidus, 2000; Brancaccio et al., 2007).

Many factors determine the degree to which serum enzyme activities increase during and after exercise (Brancaccio et al., 2007). The highest post-exercise serum enzyme activities are found after very prolonged competitive exercise such as ultramarathon running (Nuviala et al., 1992) or triathlon events (Denvir et al., 1999). Weight-bearing exercises, which include eccentric muscular contractions such as downhill running, induce the greatest increases in serum enzyme activities (Malm et al., 2004). There is a breakpoint at 300–500 IU/l of CK serum release after exercise, and the levels of enzyme are associated with distinctive individual muscular properties (Brancaccio et al., 2007). Subjects can be classified into high and low responders. In high responders, the cross-sectional area and volume of the quadriceps femoris muscle were significantly lower than those in low responders (Totsuka et al., 2002; Brancaccio et al., 2007).

Daily training may result in persistent serum elevation of CK (Kratz et al., 2002), and resting CK levels are higher in athletes (Hortobagyi and Denhan, 1989; Fallon et al., 1999), but the significant increases of CK occurred after exercise are usually lower in trained subjects when compared with untrained subjects (Vincent and Vincent, 1997; Fehrenbach et al., 2000; Garry and McShane, 2000). In fact, if athletes and sedentary subjects undertake the same physical exercise test, the CK levels of athletes are lower than those recorded in matched healthy control subjects (Karamizrak et al., 1994; Garry and McShane, 2000).

Total creatine kinase (CK) levels depend on age, gender, race, muscle mass, physical activity and climatic condition (Brancaccio et al., 2007). High levels of serum CK in apparently healthy subjects may be correlated with physical training status, as they depend on sarcomeric damage: strenuous exercise that damages skeletal muscle cells results in increased total serum CK (Brancaccio et al., 2007). The highest post-exercise serum enzyme activities are found after prolonged...
exercise such as ultradistance marathon running or weight-bearing exercises and downhill running, which include eccentric muscular contractions (Brancaccio et al., 2007). Total serum CK activity is markedly elevated for 24 h after the exercise bout and, when patients rest, it gradually returns to basal levels. Persistently increased serum CK levels are occasionally encountered in healthy individuals and are also markedly increased in the pre-clinical stages of muscle diseases (Brancaccio et al., 2007).

Some authors, studying subjects with high levels of CK at rest, observed that, years later, subjects developed muscle weakness and suggested that early myopathy may be asymptomatic. Others demonstrated that, in most of these patients, hyperCKemia probably does not imply disease (Brancaccio et al., 2007).

In many instances, the diagnosis is not formulated following routine examination with the patients at rest, as symptoms become manifest only after exercise (Brancaccio et al., 2007). Some authors think that strength training seems to be safe for patients with myopathy, even though the evidence for routine exercise prescription is still insufficient. Others believe that, in these conditions, intense prolonged exercise may produce negative effects, as it does not induce the physiological muscle adaptations to physical training given the continuous loss of muscle proteins (Brancaccio et al., 2007).

High CK serum levels in athletes following absolute rest and without any further predisposing factors should prompt a full diagnostic workup with special regards to signs of muscle weakness or other simple signs that, in both athletes and sedentary subjects, are not always promptly evident (Brancaccio et al., 2007).

These signs may indicate subclinical muscle disease, which training loads may evidence through the onset of profound fatigue. It is probably safe to counsel athletes with suspected myopathy to continue to undertake physical activity at a lower intensity, so as to prevent muscle damage from high intensity exercise and allow ample recovery to favour adequate recovery (Brancaccio et al., 2007).

In this study, results showed expected increases in the serum creatine kinase levels of participants following training, signifying exercise-generated muscle damage (Brancaccio et al., 2007).

CONCLUSION
The finding of this study has further confirmed the effect of training on athletes. Habitual activity seems to be the most important factor in the differences observed among athletes (Paton and Hopkins, 2005; Nezhad and Farhadi, 2012). Physical activity is supported by both aerobic and anaerobic systems of energy production. Each system contributes to the total energy and the percentage of total energy contributed by each system depends on the type (karate, cycling, running, jumping and dancing), and the duration of the sport (wrestling a few minutes, football-90 mins). The sources of fuel for the production of the energy are the glycogen stores in the liver and muscles and the fat stores in the muscles and adipose tissues.

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