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Evaluation the Functional Status of the Liver in Elite Jordanian Athletes Compared with Healthy Controls

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Abstract: Owing to considerable physical, endocrinological and metabolic adaptations, the analysis of biochemical data in elite and top-class athletes requires caution. With the aim to identify metabolic and biochemical adaptations to particular lifestyle conditions such as regular and strenuous physical exercise researchers measured the concentration of liver enzymes, bilirubin and serum albumin in Jordanian top athletes. A healthy liver is essential to optimum performance by athletes. Good liver function is required to burn fat, build muscle and provide energy. Sixty Jordanian first class athletes (34 males and 26 females, mean age 19.8±2 years with training experience of at least 5 years and with a minimal training load of 18 training hours per week participated in competitive different sports chosen in the study. Group of healthy male and female (control group), matched for age and gender was also included (n = 60). No subject revealed evidences of cardiovascular disease, diabetes (fasting glucose <7 mmol L^{-1}) or hypertension (blood pressure <130/80 mm Hg) when tested by specialized physicians. The levels of AST, ALT and ALP for evaluation the liver functions in athletes in different groups were measured 15-18 h rest and 12 h fasting using commercial analytical kits. The results showed a significant differences (p<0.5) were observed between experimental and control group for AST (34.18±13.23 and 26.19±7.42 U L^{-1}, respectively) for ALT (28.47±8.43 and 17.38±10.83 U L^{-1}, respectively) and for ALP (127.85±67.54 and 83.49±19.45 U L^{-1}, respectively). The concentration of serum albumin was decreased in athletes but the difference did not reach statistical significance (controls: 4.82± 0.37 g L^{-1}; athletes: 4.72±0.27 g L^{-1}). No effect of endurance exercise on serum bilirubin in healthy athletes. Researchers concluded that the most abnormalities observed on routine biochemical screening in elite Jordanian athletes are of no clinical significance.

Key words: ALP, AST, ALT, liver, athletes, glucose

INTRODUCTION

Strenuous physical exercise has a strong influence on human metabolism (Warburton *et al*., 2002). The high-intensity regular training-induced variations of plasma volume and metabolites; the interpretation of biochemical data in elite and top-class athletes requires caution. Several studies investigated the short-term influence of strenuous physical exercises on some biochemical analyses (Kratz *et al*., 2002; Neumayr *et al*., 2003). Physical exercise is a bodily activity that develops and maintains physical fitness and overall health. It is often practiced to strengthen muscles and the cardiovascular system and to hone athletic skills. Frequent and regular physical exercise boosts the immune system and helps prevent diseases of affluence such as heart disease, cardiovascular disease, type 2 diabetes and obesity. It also improves mental health and helps prevent depression (Hardman *et al*., 1998; Kunstlinger *et al*., 1987). Exercises are generally grouped into three types depending on the overall effect they have on the human body: flexibility exercises such as stretching which improve the range of motion of muscles and joints, aerobic exercises such as cycling, walking, running, hiking and playing tennis focus on increasing cardiovascular endurance and anaerobic exercises such as weight training, functional training or sprinting which increase short-term muscle strength (Bela *et al*., 1992; Hoppeler, 1986). Exercise is a stressor and the stresses of exercise have a catabolic effect on the body-contractile proteins within muscles are consumed for energy, carbohydrates and fats are similarly consumed and connective tissues are stressed and can form micro-tears. Liver is responsible for an incredibly wide range of

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functions in the body ranging from detoxification to protein synthesis, energy storage and digestive function. The liver plays a critical role in many bodily processes, including digestion and detoxification. Making healthful choices can promote the health and optimal functioning of this vital organ. Exercise in particular has been shown to prevent certain conditions associated with the liver. The liver is the main organ for conversion of one chemical species to another and this interconversion is the main route for preparing drugs for excretion from the body. Asymptomatic elevation liver transaminases during clinical trials could be drug related but other factors such as exercise (Apple and McGue, 1983) and diet (Manore *et al*., 1993) may also have had this effect. Several studies have described enzyme elevations in response to running (Vincent and Vincent, 1997; Kaplowitz, 2005). Whereas only a few have dealt with the effects of weightlifting (Smith *et al*., 2004). The effects of muscular exercise on clinical chemistry parameters may also vary depending on gender and on the fitness level of the individual (Veenstra *et al*., 1994). The study was designed to evaluate the functional status of the liver in elite Jordanian athletes compared with healthy controls. The sample included first class athletes (males and females) who participated in different national teams. To the best of the knowledge no similar studies were carried before among Jordanian athletes.

MATERIALS AND METHODS

Experimental subjects: Sixty Jordanian first class athletes 37 males and 23 females mean age 18.6±1 years with training experience of at least 5 years and with a minimal training load of 18 training hours per week participated in competitive different sports (aerobic, aerobic-anaerobic and anaerobic) were included in this study. A group of healthy male and female adolescents (control group), matched for age and gender was also included (n = 60). No subject revealed evidences of cardiovascular disease, diabetes (fasting glucose <7 mmol L^{-1}) or hypertension (blood pressure <130/80 mm Hg) when tested by specialized physicians. All subjects submitted their written consents to a single blood sampling. Athletes included in this study represented all types of sport metabolisms; aerobic (long distance swimming, long distance running), aerobic-anaerobic (football) and anaerobic (basketball, taekwondo, volleyball and short distance running).

Blood collection: Blood samples were drawn from antecubital vein early in the morning after 15-18 h rest and12 h of fasting. Samples were collected in plain tubes from the athletes and control group and were then allowed to clot and then serum was obtained by centrifuging at 4000 rpm (Cenformix).

Methods: Liver enzymes were examined after 15-18 h rest using commercial analytical kits from Sigma (St. Louis, Mo, USA).

Statistical analyses: Data were treated using SPSS. Means, standard deviations, t-test. A significance level of 0.05 was used throughout the whole study.

RESULTS AND DISCUSSION

The aim of this study was to evaluate the functional status of the liver among competitive Jordanian athletes. The sample included first class athletes who participated in different national teams. For evaluation the liver functions researchers measured the liver enzymes as AST, ALT and ALP. Anthropometrical characteristics as age, weight, height and BMI of athletes from different sport disciplines are shown in Table 1. Results of comparison for the study variables between the experimental group and control in Table 2 showed that significant differences ($p<0.05$) appeared between the experimental and control groups over all the levels of AST, ALT and ALP for evaluation the liver functions in athletes. The concentration of serum albumin was decreased in athletes but the difference did not reach statistical significance (controls: 4.82±0.37 g L^{-1}; athletes 4.72±0.27 g L^{-1}). No effect of endurance exercise on serum bilirubin in healthy athletes. Results of the present investigation demonstrate that values of laboratory testing lying outside conventional reference limits calculated on sedentary populations might express physiological adaptations to

Table 1: Means and standard deviations for age, weight, height and BMI for each group

Variables	Groups	N	Mean	SD
Age (year)	exp	60	18.43	2.320
	cont	60	18.63	1.750
Weight (kg)	exp	60	75.54	12.97
	cont	60	68.42	13.49
Height	exp	60	1.820	0.170
	cont	60	1.640	0.130
BMI	exp	60	24.53	2.750
	cont	60	24.16	3.620

Table 2: Results of comparison for the study variables between the two groups

Factors	Experimental groups	Control groups	p-value*
AST	33.17±15.63	23.27±5.640	0.000*
ALT	26.88±8.530	19.85±10.29	0.000*
ALP	119.85±67.78	82.78±22.74	0.000*
Albumin	4.82±0.370	4.72±0.270	0.197
Total bilirubin (mg dL^{-1})	0.8±0.2000	0.9±0.3000	0.243
Direct bilirubin	0.3±0.1000	0.4±0.1000	0.517

*p-value according to Mann Whitney test

regular and demanding physical aerobic activity. The clinical utility of biochemical screening using multiple parameters has often been assessed in the general non-athletic population. Athletes are usually thought to be physically.

The liver is the main organ for conversion of one chemical species to another and this interconversion is the main route for preparing drugs for excretion from the body. In recent years, there are many indications that liver enzymes levels in the blood and exercise have some kind of association. The act of exercising has an effect on the level of liver enzymes and when taking a blood test timed closely with the exercise, it could result with misleading outcome. It has long been known that physical exercise results in transient elevations of liver function tests (Dickerman *et al*., 1999; Pettersson *et al*., 2008). Asymptomatic elevations of liver function tests during strenuous exercise have resulted in increased serum transaminase levels (Oh and Hustead, 2011). As we had observed in the study that healthy subjects performing intensive physical activity exhibited altered liver function tests (elevations of AST and ALT).

However, other types of strenuous physical exercise such as marathon running are known to affect liver function tests (Clarkson *et al*., 2006). In the study, it has been shown that elite Jordanian athletes resulted in profound increases in the liver function parameters, AST and ALT. An increase in AST observed as a result of certain activities as walking on a treadmill for 5 min, a boxing competition, swimming, rowing and calisthenics. In military training, up to six fold increases in AST have been found (Lippi *et al*., 2004) and very large increases have been reported after ultra marathon running (Lippi *et al*., 2004). The results showed a significant increasing ($p<0.05$) in the level of ALP (Alkaline phosphates) in all groups compared to control groups. It was thought that the aerobic and anaerobic training exert different effects on bone metabolism. While aerobic training led to changes compatible with reduced bone resorption activity, anaerobic training seems to result in an overall accelerated bone turnover. Therefore, the impact of physical activity on bone turnover may depend on the kind of exercise performed. ALP activity is closely related with the bone metabolism and as the animal gets older this metabolism become slower (Risteli and Risteli, 1993). The liver makes more ALP than the other organs or the bones. Some conditions cause large amounts of ALP in the blood. These conditions include rapid bone growth (during puberty), bone disease or damaged liver cells. A combination of exercise types has the greatest effect on liver function. Palme (2004) recommends an exercise program that includes aerobic exercises such as walking outside or on a treadmill, bicycling and swimming as well as weight-bearing. Aerobic exercise focuses on the cardiovascular system and has an effect on blood oxygenation. Pettersson *et al*. (2008) found in their study that the liver function parameters, AST and ALT were significantly increased for at least 7 days after the exercise. In addition, LD and in particular, CK and myoglobin showed highly elevated levels. These findings highlight the importance of imposing restrictions on weightlifting prior to and during clinical studies. Intensive muscular exercise, e.g., weightlifting should also be considered as a cause of asymptomatic elevations of liver function tests in daily clinical practice. The concentration of serum albumin was decreased in athletes but the difference did not reach statistical significance. No effect of endurance exercise on serum bilirubin in healthy athletes. Researchers concluded that the most abnormalities observed on routine biochemical screening in elite Jordanian athletes are of no clinical significance.

CONCLUSION

Researchers concluded that the most abnormalities observed on routine biochemical screening in elite Jordanian athletes are of no clinical significance.

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REFERENCES

Apple, F.S. and M.K. McGue, 1983. Serum enzyme changes during marathon training. Am. J. Clin. Pathol., 79: 716-719.

Bela, E., M. Bonifazi, C. Martelli, G. Lupo and M. Paghi *et al*., 1992. Endocrine modification following endurance sea swimming. Proceedings of the 2nd Sports Medicine Congress of Northern Greece, May 28-31, 1992, Thessaloniki, Greece.

Clarkson, P.M., A.K. Kearns, P. Rouzier, R. Rubin and P.D. Thompson, 2006. Serum creatine kinase and renal function measures in exertional muscle damage. Med. Sci. Sports Exercise, 38: 623-627.

Dickerman, R.D., R.M. Petrusi, N.Y. Zachariah, D.R. Dufour and W.J. McConathy, 1999. Anabolic steroid-induced hepatotoxicity: Is it overstad? Clin. J. Sport Med., 9: 34-39.

Hardman, A.E., J.E. Lawrence and S.L. Herd, 1998. Postprandial lipemia in endurance-trained people during a short interruption to training. J. Applied Physiol., 84: 1895-1901.

Hoppeler, H., 1986. Exercise-induced ultrastructural changes in skeletal muscle. Int. J. Sports Med., 7: 187-204.

Kaplowitz, N., 2005. Idiosyncratic drug hepatotoxicity. Nat. Rev. Drug. Discovery, 4: 489-499.

Kratz, A., K.B. Lewandrowski, A.J. Siegel, K.Y. Chun, J.G. Flood, E.M. Van Cott and E. Lee-Lewandrowski, 2002. Effect of marathon running on hematologic and biochemical laboratory parameters, including cardiac markers. Am. J. Clin. Pathol., 118: 856-863.

Kunstlinger, U., H.G. Ludwig and J. Stegemann, 1987. Metabolic changes during volleyball matches. Int. J. Sports Med., 8: 315-322.

Lippi, G., G. Brocco, M. Franchini, F. Schena and G. Guidi, 2004. Comparison of serum creatinine, uric acid, albumin and glucose in male professional endurance athletes compared with healthy controls. Clin. Chem. Lab. Med., 42: 644-647.

Manore, M.M., J. Thompson and M. Russo, 1993. Diet and exercise strategies of a world-class bodybuilder. Int. J. Sport Nutr., 3: 76-86.

Neumayr, G., R. Pfister, H. Hoertnagl, G. Mitterbauer andW. Getzner *et al.*, 2003. The effect of marathon cycling on renal function. Int. J. Sports Med., 24: 131-137.

Oh, R.C. and T.R. Hustead, 2011. Causes and evaluation of mildly elevated liver transaminase levels. AAFP, Vol. 84.

Palme, M., 2004. Dr. Melissa Palmer's Guide of Hepatitis and Liver Disease. Penguin Putnam Inc., USA., ISBN: 9781583331880, Pages: 464.

Pettersson, J., U. Hindorf, P. Persson, T. Bengtsson, U. Malmqvist, V. Werkstrom and M. Ekelund, 2008. Muscular exercise can cause highly pathological liver function tests in healthy men. Br. J. Clin. Pharmacol., 65: 253-259.

Risteli, L. and J. Risteli, 1993. Biochemical markers of bone metabolism. Ann. Med., 25: 385-393.

Smith, J.E., G. Garbutt, P. Lopes and D. Tunstall Pedoe, 2004. Effects of prolonged strenuous exercise (marathon running) on biochemical and haematological markers used in the investigation of patients in the emergency department. Br. J. Sports Med., 38: 292-294.

Veenstra, J., V.M. Smit, R.T. Krediet and L. Arisz, 1994. Relationship between elevated creatine phosphokinase and the clinical spectrum of rhabdomyolysis. Nephrol. Dialysis Transplantation, 9: 637-641.

Vincent, H.K. and K.R. Vincent, 1997. The effect of training status on the serum creatine kinase response, soreness and muscle function following resistance exercise. Int. J. Sports Med., 18: 431-437.

Warburton, D., R. Welsh, M. Haykowsky, D. Taylor and D. Humen, 2002. Biochemical changes as a result of prolonged strenuous exercise. Br. J. Sports Med., 36: 301-303.