

Sports biomechanics



**ASSIGN
BUSTER**

Athletes throughout the world are always seeking to build muscle, enhance energy, improve physical performance and have an overall edge on fellow athletes (Wolinsky, I et al, 2004, Slater, G et al, 2000). Ergogenic aids can include nutritional aids. It also include pharamcological aids, physiological aids and psychological aids (Ferrando et al, 1993). Ergogenic aids can be split into synthetic and natural aids. Synthetic is where the aid cannot be produced via the body, such as anabolic steroids, where as natural can be created in the body, such as creatine and blood.

The three ergogenic aids being discussed are blood doping, anabolic steroids and creatine supplementation. Creatine was discovered in 1835 with the first creatine supplementation study coming in the 1900's on animals and humans (Mendel 1911, Jose, et al. 2002). There is a wide range of atheletes that use creatine as a supplement (Jose, et al. 2002). Jose, et al. 2002 suggests that creatine is the substrate of Creating Kinase to form Phosphocreatine (PCr) which is a high-energy compound and an important energy store for Adenosine Triphosphate (ATP) resynthesis in muscle. his was also reiterated by Wyss, M et al 2000.

During bouts of high-intensity exercise, muscle cells utilize their stores of (PCr) to maintain the intracellular ATP concentrations required for the maintenance of muscular effort (Bemben and Lamont 2005 & Sculnthorpe, et al. 2010). Intramuscular stores of PCr are limited, but supplementation of a normal diet with powdered creatine can increase total intramuscular creatine concentrations by approximately 15% to 20% (Mesa et al. 2002 & Sculnthorpe, et al. 2010). There have been a number of studies that show if creatine supplementation has an effect.

Four studies were done and were field based. And of the four, all four failed to show an ergogenic improvement (Goldberg et al. 1997, Burke et al. 1996, Mujika et al. 1996 & Redondo et al. 1996) but all of which were pre 2000. All four studies were done using short exercise bouts of 30 seconds and all failed to show an improvement in performance. More research shows that another five field studies, involving activities, which were swimming and running, only a single study showed improvement.

The activities lasted between 30-150 seconds (Burke et al. 1996, Mujika et al. 1996, Thompson et al. 1996 & Grindstaff et al. 1997). Terrillion et al 1997 was the only study to show an improvement. According to Williams et al, 1998 it is likely that creatine supplementation is less effective in elite or highly trained athletes. It was indicated that elite and highly trained athletes performing single competition-like exercise tasks did not benefit from creatine supplements. If creatine is used there are proposed side effects which affect human health and performance. Francaux et al, 2006 suggests one side effect includes an increase in total body mass, particularly muscle mass.

Francaux then went on to suggest that the average increase in body mass amounts to 1 to 2 kg, or 1% to 2.3% of total body mass. A further side effect is muscle cramps. There has been a number of studies to show if this was true in athletes. A study was done on sedentary females who supplemented creatine. Vandenberghe et al, 1997 found that none of the subjects suffered from cramps as a result of creatine supplementation. In another study, Greenwood et al, 2003, embarked on a study involving 96 young healthy

subjects who trained over 3 years, reported no cramping associated with creatine supplementation.

It is published, in sports newspapers and periodicals, that creatine supplementation leads to liver dysfunction but there is little scientific information on liver-metabolism changes induced by oral creatine supplementation (Francaux et al, 2006). Blood doping is the next ergogenic aid which is going to be discussed. Blood doping can provide an aerobic advantage due to the increase of oxygen-carrying capacity in blood (John et al, 2004 & Smith et al 1992). It gives a significant advantage to endurance athletes and influences aerobic performance.

Blood doping is defined by the World Anti-Doping Agency as the misuse of techniques and/or substances to increase one's red blood cell count. By increasing the amount of red blood cells there is an increase in oxygen being delivered to the muscles. During high intensity exercise, the body cannot get enough oxygen to the muscles in order for them to perform to their potential. The lack of ability to get oxygen to the muscles is called oxygen debt which results in lactic acid being formed which is a waste product of anaerobic cellular respiration within the muscle tissue.

This can cause muscle soreness that is usually felt after a hard or long workout. Oxygen is carried to the muscles by two different delivery systems. Three percent of oxygen is carried in plasma and 97 percent is bound to haemoglobin. Therefore if haemoglobin amounts are increased, this will lead to increased oxygen levels that can be transported to the muscles. This will allow the muscles to become more fatigue resistant (Jones et al 1988 &

Gledhill 1982). There are two different techniques of blood doping, Homologous and Autologous (John 2004 & Wilmore 2008).

Homologous transfusions is the use of a matched donors blood. Athletes do not have to suffer detraining effects as the blood can be used immediately (Wilmore et al 2008 & Jones et al 1988). Autologous blood doping involves removing two units of the athlete's blood, storing the blood and then reinfuse seven days before performance (Jones et al 1988 ; wilmore et al 2008). The withdrawal of the blood needs to be performed at least three weeks before reinfusion to allow haemoglobin to recover to normal levels.

An interval of eight to twelve weeks is needed in order to allow the athlete not only to regain his haemoglobin, but to get back to his previous level of fitness and overcome the detraining effect of blood donation (Eichner 1997 ; Jones et al 1988). These transfusions artificially increase the hematocrit mass and thus the oxygen-carrying capacity of blood (John et al 2004). Bloody doping was first researched in 1974. Eichner 1987 suggested that boosting the haematocrit to 55% by homologous transfusion made exercise at altitude easier.

In a further study, Elblom et al 1972, used three men of which had 800mL of their own blood reinfused. 4 weeks after it had been drawn it had a 13% increase in haemoglobin level and a 9% increase in maximal oxygen uptake (V_{O2max}). On a brief, all-out treadmill run, their run time to exhaustion increased 23%. (Eichner 2007) Three studies in the 1980s used freeze-preserved autologous red cells. In one, doping increased V_{O2max} by 5% and

brief, all-out run time to exhaustion by 35%. In the second, doping cut mean 5-mile run time by 45 seconds.

In the third, doping cut mean 10km race time by 69 seconds. Blood doping was used throughout the Olympic Games by a number of athletes in 1972. In the 1984 Olympics, seven US cyclists doped with blood from relatives or friends (Eichner 2007). As time went on and more research was done there were just more findings showing that blood doping can manipulate and influence overall performance and which is why this is a recognized banned act. Although blood doping has been proved to work, it has its side effects. When infusing blood there is a potential transfer of infection.

The infections could include hepatitis and also aids (Wilmore et al 2008 ; Jones et al 1988). When homologous transfusion is used, any intravenous infusion carries risks. This could be venous thrombosis, phlebitis and also septicaemia. This can be more high risk if the transfusion is done in a less sterile environment. The raised haematocrit and increased blood viscosity following transfusion may well be compounded by an athlete spending many hours inactive. This could include travelling to events. This is running a high risk of venous thrombosis and also pulmonary problems, such as heart attacks.

For autologous blood doping, venesection of 500 ml of blood on one or more occasions has a marked detraining effect, and will limit the amount and quality of the training in the run up to competition (Jones et al 1988).

Anabolic steroids is a synthetic ergogenic aid, which means it can be manufactured. Anabolic steroids remain a widely abused drug. An estimated

1 to 3 million athletes in the United States alone have used anabolic steroids (Silver 2001 ; John M 2004). Anabolic-androgenic steroids (AAS) are chemically modified analogs of testosterone.

Male sexual characteristics and muscle anabolism is responsible by the endogenous hormone (John 2004). Steroids are a group of hormones which are produced by two sets of glands, the adrenal glands and the sex glands. Silver 2001 and John 2004 suggest that the physiologic action of anabolic steroids is thought to be similar to native testosterone. The molecule diffuses across the cell membrane after binding to a receptor. This complex then binds to the nucleus of a cell, stimulating messenger RNA synthesis, which leads to an increase in structural and contractile protein.

Anabolic steroid use has been mainly associated with weightlifting (Bahrke et al 1990) and bodybuilding (Kanayam et al 2001), while it has also made its way into professional club sports (i. e. football). Highly competitive sporting environments seem to show the use of steroids and also used in young adults, high schools and local sports clubs (Copeland et al 2000 ; Nilsson et al 2001). Recent studies have shown whether the use of steroids works or doesn't work. Crist et al 1983 suggests that there have shown minimal effects on body composition and strength.

In studies using higher dosing over longer periods, the effects seem to be more pronounced. In a prospective, placebo-controlled study of testosterone enanthate (TE) with and without exercise over a 10-week period, Bhasin et al 1996 showed that supraphysiologic weekly doses of TE increased triceps (505mm² difference) and leg area (738 mm² difference) as well as strength

in the bench press (10 kg difference) and squat (17 kg difference) in subjects not engaged in strength training.

In addition, those subjects assigned to TE administration and exercise had greater increases in fat-free mass (6 kg) and muscle size as well as strength (22 kg increase in bench press, 38 kg increase in squat) than did those assigned to either no-exercise group(Bhasin et al 1996 ; (John et al 2004)

There has been a collection of evidence that the misuse of Steroids poses various threats to physical and mental health (Kashkin et al 1989 ; Landry et al 1990).

Mood disorders and adverse psychological reactions such as anger, aggressiveness, violence, drug abuse, and dependence, have all been associated with steroid use (Johnson, 1990 ; Copeland et al 2000). This is common especially among female users (Gruber and Pope, 2000). Kuipers et al 1991 found that anabolic steroids induced a 25% to 27% decrease in HDL cholesterol and an increase in diastolic blood pressure after 8 weeks of use.

Overall in this study 3 different types of ergogenic aids have been explained and evidence to show if they work, safe and allowed in sport. Blood doping is a wide area and more research can be done in this subject to determine side effects more aswell as anabolic steroids. It is well published that stress and anxiety are side effects but not backed up enough. Ergogenic aids have such an array of substances in the field and the three discussed above give a balance of banned and non banned substances and shows the severity and the implications each one brings.