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Exercise physiology

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Abstract
The way in which our body responds to physical exercise can be explained through 'Exercise Physiology', a branch of biological sciences. The dietary carbohydrates in the digestive track will get broken down into glucose and converted to ATP (Adenosine Triphosphate) in the cells, which is the energy currency to our body. Whatever glucose the cells don't need immediately for energy, store in the liver and muscles as glycogen. Likewise, excess proteins and fats through our food store as triglycerides, until our body needs a backup energy source, necessary for physical exercise. The aim of the present review is to look over the reduction process of stored fat during exercise. The two main sources of energy for muscular exercise are carbohydrates (glycogen and glucose) and fats (triglycerides). Approximately 100 k. cal. of energy are expended per mile of walking. Continuous physical exercise for about 20 minutes, first mobilizes the stored glycogen from liver in a cyclic manner by oxidizing it in the cells to get ATP needed for muscular contractions. As exercise progresses from low to moderate intensity, our body will switch on to oxidize fat from stored triglycerides. Frequently exercised muscle tissue is in a constant state of remodeling, leading to increase in endurance, strength, flexibility and power.

Keywords: Exercise, Glycogen, Triglycerides, Mobilization, Oxidize

1. Introduction
We obtain energy from the food we consume, using that energy to maintain body temperature and perform other life functions. Carbohydrates, proteins and fats in our food are the building blocks; whereas vitamins and minerals are like nuts and bolts to our body engine. Every extra gram of carbohydrate gets stored along with 3 grams of water. According to Iowa State University; USA, a healthy adult body can store about 500 grams of carbohydrate. Skeletal muscles store about 400 grams of glycogen, the liver stores 90 to 110 grams of glycogen and our blood circulates roughly 25 grams as glucose. As carbohydrates contain 4 calories per gram, our body is capable of storing about 2,000 calories of carbohydrates.
Proteins are chains made up of amino acids that contribute to muscle growth, circulatory health, tissue repair, enzyme and hormone synthesis and the development of a robust immune system. Fat doesn't directly make us "fat" – excess calories make us "fat". The body needs fat to absorb and move vitamins A, D, E and K through the bloodstream. Moreover, fat is a concentrated source of energy as one gram of fat contains 9 calories, much more than a gram of protein or carbohydrate.
The branch of biological sciences that is concerned with the way in which the body responds to exercise is Exercise physiology. It provides scientific support at various levels to athletes and teams within a single sport or several sports. Exercise physiologists typically work with people to improve fitness. The aim of the present review is to look over the reduction process of stored fat during exercise.

1.1 Literature review
High intake of carbohydrate rich foods in general can promote fatty liver, as the liver convert's excess carbohydrate into fat [1] obesity on the other hand increases the risk of diabetes [2] and if a person has diabetes, it increases their risk of developing fatty liver disease. Fat in the liver cause's fatty liver disease and it may be alcoholic or nonalcoholic [3, 4]. During exercise, skeletal muscle glycogen breaks down for regulation of insulin sensitivity [5]. By giving a series of glucagon injections to rats, a low initial liver glycogen content resulted in a higher plasma free fatty acid concentrations during a subsequent period of exercise [6].

People store large amounts of body fat in the form of triglycerides within fat (adipose) tissue as well as within the muscle fibers (intramuscular triglycerides), until our body needs a backup energy source [7]. But, the breakdown of muscle glycogen is under the control of muscular contractions during physical exercise [8].

1.2 Fate of dietary carbohydrates in the body

The carbohydrates in our food get broken down into glucose, get absorbed into the blood through the small intestine. Then, insulin in the blood signals the cells to take up glucose. In the cells, glucose will be oxidized to ATP (Adenosine Triphosphate), which is the energy currency to our body. Whatever glucose the cells don't need immediately for energy is stored in the liver and skeletal muscles (the major movers of the body) as glycogen. When the storage capacity for glycogen is reached, the excess calories can be transported to the fat cells and store as triglycerides within fat (adipose) tissue as well as within the muscle cells as intramuscular triglycerides [7] until our body needs a backup energy source.

1.3 Fate of dietary proteins and fats in the body

Protein in the food is digested to amino acids, which enter the bloodstream and used for building muscle tissue and repairing damaged tissues [9]. Excess amino acids are converted to ammonia, which further alter by the liver to urea. Excretion of urea is performed by kidneys, which becomes an extra workload leading to kidney disease. Many researchers have also found that excessive intake of protein increases calcium excretion in urine [10].

Dietary fats in the digestive track are converted to fatty acids and glycerol which are either burnt as fuel or stored in the body adipose tissue between the skin and muscles as body fat and will cause weight gain. Unused calories will also be stored in the blood plasma and other cells as triglycerides.

2. Mobilization of stored fat during physical exercise

During physical exercise, stored glycogen starts breaking down into glucose [8, 11] to provide ATP to the muscle cells [12] as an energy source for contraction (Fig.1).

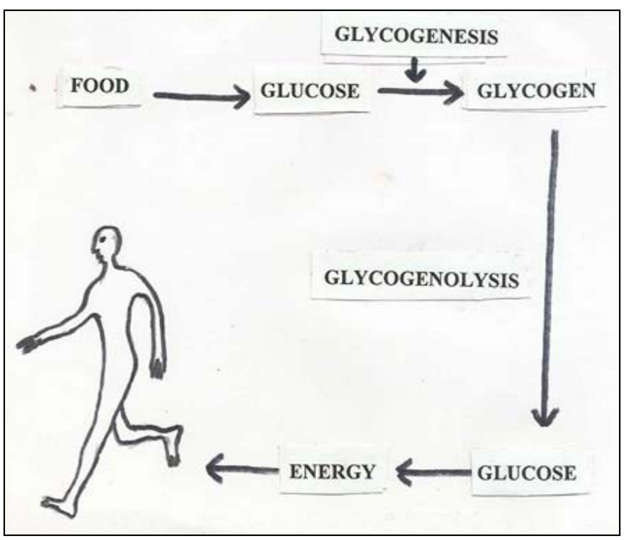

Fig 1: Energy obtaining process

Lactate accumulating inside the muscle cells at the time of continuing the process is taken up by the liver through the bloodstream and converted back to glucose as showed in Cori cycle (Fig.2).

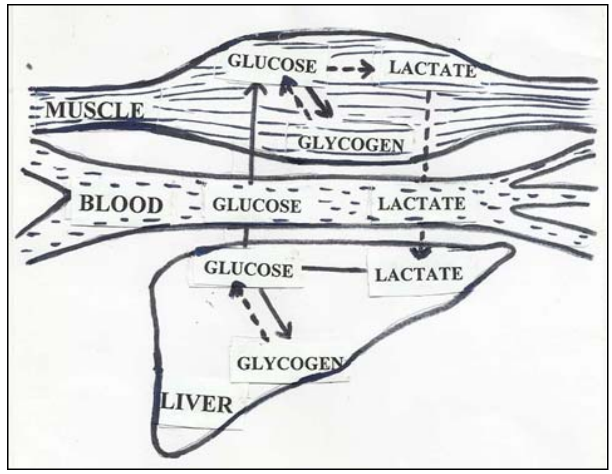

Fig 2: Cori cycle

The glucose is then supplied to the muscles [5] through the bloodstream, ready to be used for further movements. If muscular activity has been stopped, the glucose is used to replenish the supplies of glycogen in the liver as well as in the muscle [13].

The duration of exercise is positively correlated with fat use [14]. During prolonged exercise of greater than 20 minutes, the use of carbohydrate to fuel the activity gradually shifts towards fat as the fuel. If fat is going to be used to fuel activity, the triglyceride molecule needs to be broken down into a free glycerol and three free fatty acid molecules. As the duration of exercise still increases, more triglyceride molecules will break down and the resulting free fatty acid molecules are being used to get energy. When compared to carbohydrate stored as muscle glycogen, these fat stores are mobilized and oxidized at relatively slow rates during exercise. As exercise progresses from low to moderate intensity, 25-65% of total fat oxidation increases due to a relatively large use of intramuscular triglycerides [7].

3. Discussion

Regarding dietary carbohydrates, they can be mobilized and oxidized rapidly enough to meet the energy requirements for intense muscular contractions [7]. This comment is in hold with the present observation as every extra gram of carbohydrate gets stored which is used as backup energy source during physical exercise. With respect to dietary fat as fuel during exercise, two major phenomena viz. "metabolic crossover effect" and the "duration effect," are involved [14]. The former be crossover from fat oxidation at lower intensities toward carbohydrate usage at high intensities. The later be during prolonged, low-intensity exercise, the use of carbohydrate to fuel the activity gradually shifts toward an increasing reliance on fat as the fuel. These facts support the present review, as the duration of exercise increases, more triglyceride molecules will break down and the resulting free fatty acid molecules are being used to get energy.

Further, in connection with the diet to athletes, they need nutrition according to different situations [15]. This view more or less coincides with the present overview as athletes have to continuously load and reload muscle glycogen, as it would be the primary fuel in physical activity and in case of strength-training athlete's protein intake will also be well in excess. So, importance of diet plays a crucial role of sporting performance. The present analysis is also aided by the previous evidence that muscle contractions principally stimulate glycogenolysis [8]. As the muscle has to contract continuously while performing exercise, more glycogen will break down to supply the required energy (Fig. 1).

Progressive decrease in muscle glycogen concentration is partially compensated by plasma glucose utilization with the intensity of exercise [12]. In course of correction, lactate accumulated in the muscle at the time of continuous physical exercise will be taken up by the liver and converted back to glucose and the glucose is then supplied to the muscle to be used for further movements or to replenish stored glycogen (Fig.2). When the glycogen concentrations are very high, the rate of plasma glucose utilization will be decreased.

Moreover, the opinions in the present review were also recommended by the reports that dynamic glycogen metabolism is also important for healthy regulation of blood glucose and prevention of insulin resistance[5] and various types of physical activity are inversely associated with the prevalence of nonalcoholic fatty liver disease (NAFLD) [3].

4. Conclusion

Carbohydrates are the fuel that make body's engine run; athletes need plenty of carbohydrates before, during and after exercise. In order to maximize and optimize performance and recovery, athletes have to continuously load and reload muscle glycogen stores as muscle glycogen is the primary fuel used by the body during exercise followed by fat as fuel. The dietary patterns reported by various groups of athletes provide protein intake also well in excess of 2 g/kg body mass per day, especially in the case of strength-training athletes. Muscle is the largest type of tissue in our body and is extremely malleable because it responds to the type, duration and intensity of exercise that will be performed. Frequently exercised muscle tissue is in a constant state of remodeling, leading to increase in endurance, strength, flexibility and power. Instead, a healthy exercise routine leads to achieve gradual weight loss.

The present analysis is preliminary and more research is needed to fully elucidate the influence of exercise intensity, diet and training status on intramuscular triglyceride oxidation.

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