DATA SET 1
EXPLORE 1C LESSON 18

Study 1

Selective glycogen depletion pattern in human muscle fibers after exercise of varying intensity and at varying pedaling rates

Publish Date: August 24, 1974
Journal: Journal of Physiology
Authors: Gollnick PD, Piehl K, Saltin B
Link: https://doi.org/10.1113/jphysiol.1974.sp010639

Overview of the Study:
Scientists wanted to study the changes to the amounts of glycogen in human skeletal muscle fibers after bicycle exercise of varying intensity performed at different pedaling rates. Muscle glycogen is a form of stored glucose, an energy source for the cells of the body. To study glycogen level changes in muscles, thirteen male students ranging from 20-30 years of age were studied. The subjects were assigned to groups which exercised at loads requiring an energy expenditure representing approximately 30, 60, or 90% of their maximum effort. These workloads were referred to as low-, medium-, and high-intensity, respectively. Muscle biopsy samples were taken at rest and at 0, 40, 120, and 180 minutes for the low-intensity group; 0, 20, 60, and 120 minutes for the medium-intensity group; and 0, 15, 30, and 75 minutes for the high-intensity group.

Samples were obtained from the quadriceps femoris (vastus lateralis) muscle using the needle biopsy technique. Resting samples were taken with subjects in a supine position and exercise samples were taken with subjects seated on the bicycle ergometer, exercise being interrupted only long enough to take the biopsy (5-10 sec). In this procedure, a dedicated needle is inserted mainly in the vastus lateralis, and approximately 20–100 mg of muscle sample is obtained. A portion of the sample was immediately frozen in liquid nitrogen and stored at - 80 °C. The muscle glycogen level in the sample was then determined via biochemical analysis.

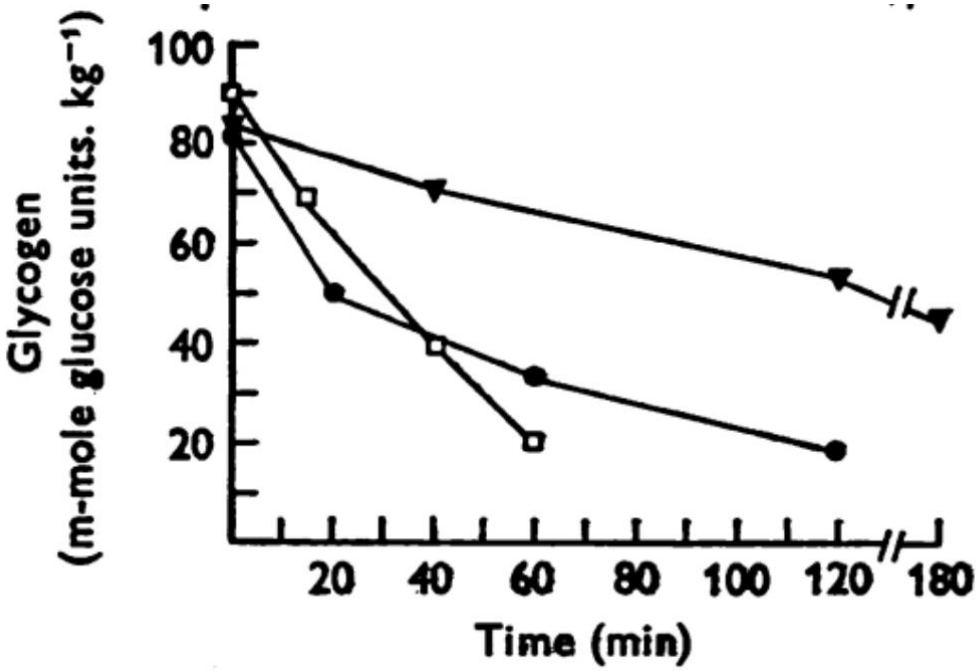

Figure 2: Changes in the mean value for muscle glycogen at low (triangle), medium (circle), and high (square) exercise intensities performed at 60 rev/min.

Study 2

Human skeletal muscle glycogen utilization in exhaustive exercise: role of subcellular localization and fiber type

Publish Date: June 1, 2011
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Authors: Joachim Nielsen, Hans-Christer Holmberg, Henrik D Schrøder, Bengt Saltin, and Niels Ørtenblad
Link: https://doi.org/10.1113/jphysiol.2013.251629

Overview of the Study

The aim of this study was to quantitatively estimate the changes in muscle glycogen levels in response to exercise. To study this, ten elite cross-country skiers in their early twenties completed approximately a 20 km skiing time trial, which is exhaustive to both arms and legs. The average finish time was 57 minutes. Muscle biopsies were taken from the arm and leg before (Pre) and immediately after (Post) the race. The biopsies were taken from two different muscle fiber types: Type 1 fibers (slow-twitch fibers, which are typically involved in long-duration, low-intensity exercise) and Type 2 fibers (fast-twitch fibers, which are typically involved in short-duration, high-intensity exercise). The muscle glycogen level in each sample was then determined via biochemical analysis.

Muscle glycogen is a form of stored glucose, an energy source for cells of the body. Scientists studied the levels of glycogen in both type I and II fibers of both arm and leg skeletal muscle before, immediately after, and during recovery from 1 hour of the skiing time trial. In both the arm and the leg muscles, they measured three subcellular locations of glycogen within muscle fibers. These locations were: Intra - glycogen located within the myofibrils, IMF - glycogen located between myofibers, and SS - glycogen located outside of the myofibers.

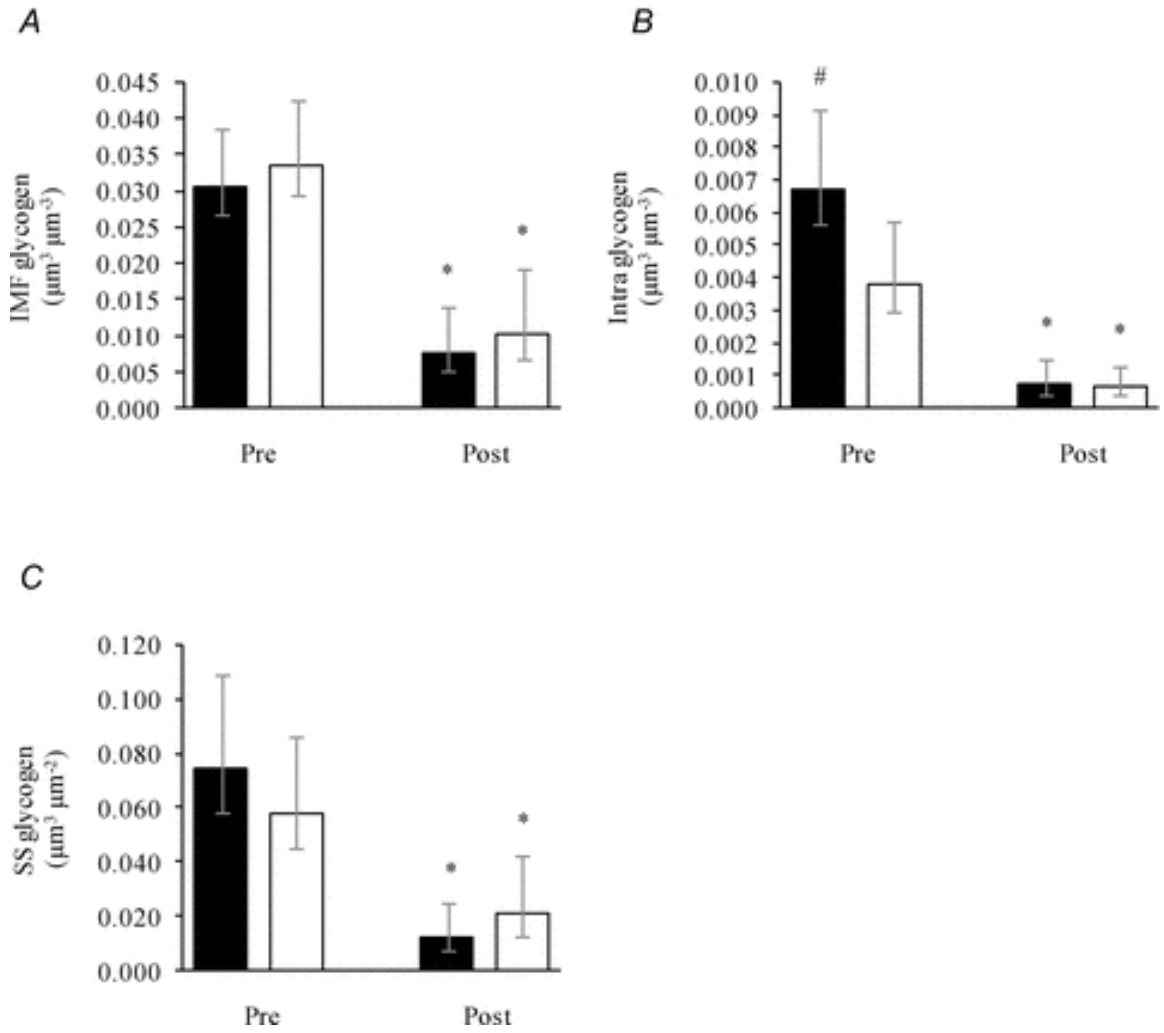

Figure 2: Glycogen content in three subcellular localizations of arm skeletal muscle (m. triceps brachii) before (Pre) and after (Post) approximately 1 hour of exhaustive exercise

Three subfractions of glycogen, IMF (A), Intra (B), and SS (C), were estimated in type I (filled bars, Pre: n = 29, Post: n = 28) and II fibers (open bars, Pre: n = 30, Post: n = 26) pre- and post-exercise. Bars and vertical lines represent geometric means ± 95% CI, respectively. *, $P < 0.0001$ vs. Pre. #, $P < 0.05$ vs. type II fibers.

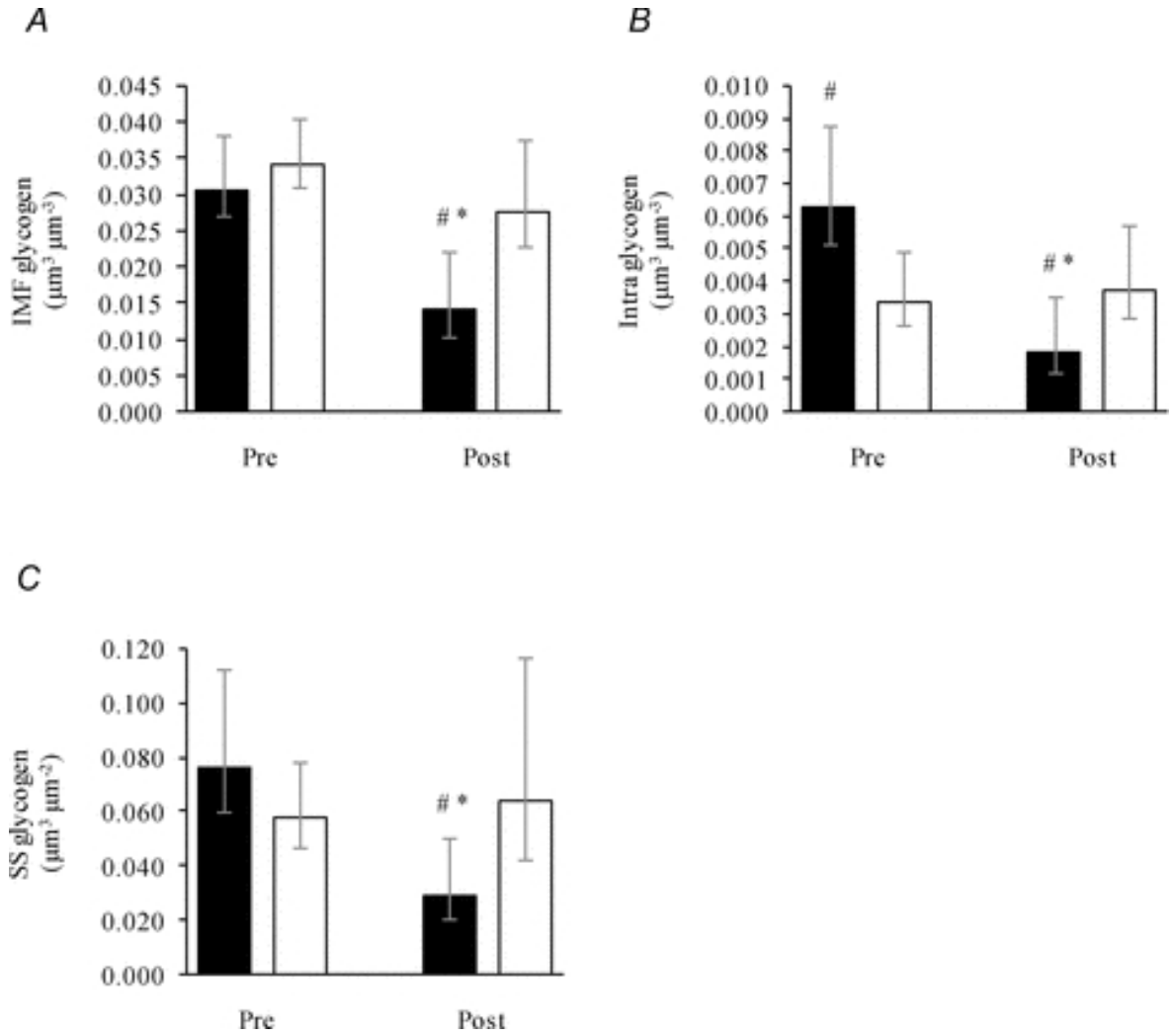

Figure 3: Glycogen content in three subcellular localizations of leg skeletal muscle (m. vastus lateralis) before (Pre) and after (Post) approximately 1 hour of exhaustive exercise. Three subfractions of glycogen, IMF (A), Intra (B), and SS (C), were estimated in type I (filled bars, Pre: n = 30, Post: n = 24) and II fibers (open bars, Pre: n = 29, Post: n = 26) pre- and post-exercise. Bars and vertical lines represent geometric means ± 95% CI, respectively. *, $P < 0.0001$ vs. Pre. #, $P < 0.05$ vs. type II fibers.