EFFECT OF EXERCISE ON BLOOD OXYGEN AFFINITY
AND ERYTHROCYTE 2,3-DIPHOSPHOGLYCERATE
IN ANEMIC ATHLETES

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The purpose of this study is to compare endurance athletes with anemia and those without anemia for any changes in blood O_2 affinity and erythrocyte 2,3-diphosphoglycerate (2,3-DPG) during heavy exercise under normoxia and hypoxia conditions.

Twelve healthy males, aged 19-33 yrs., volunteered as subjects. Most of the subjects were long-distance runners and all had regularly exercised for at least 3 yr prior to the experiment. Initially, they were equally divided into two groups, based on their hemoglobin concentration (Hb), as anemia (Hb<14 g.dl^{-1}) and control (Hb>14 g.dl^{-1}). Most of the subjects participated only in one single group. One of the subjects participated in both groups due to alteration in his blood Hb level as affected by changing in training volume. Therefore, the number of subjects (n) in the anemia and the control groups were 6 and 7, respectively. Both subject groups had similar average age, body weight, height and predetermined maximal aerobic power. Individual subject in each group performed two incremental-load exercise tests until exhaustion on a cycle ergometer for open-circuit measurement of maximal O_2 uptake (VO_2max), one in normoxia (breathing room air) and the other in hypoxia (F_{O_2} = 14%), in randomized order. During each exercise test, continuous non-invasive determination of ventilatory and various gas exchange parameters including arterial O_2 saturation (SaO_2) were done. A week later, the subject performed another two exercise bouts at constant relative load of 85% VO_2max, one in normoxia and one in hypoxia, in randomized fashion. Prior to each exercise bout, a venous blood sample was taken after 20 min of rest in normoxia or hypoxia. At the last (3^{rd}) min of exercise at 85% VO_2max, another venous blood sample was drawn. The blood samples were analyzed for blood gases and 2,3-diphosphoglycerate (2,3-DPG). Calculation of P_{50} in vivo and at standard condition was performed.

It was found that hypoxia caused, in both subject groups, significant decreases in maximal work load (p<0.01), VO_2max (p<0.01), and oxygen pulse (p<0.01) and arterial oxygen saturation (SaO_2) (p<0.001) at VO_2max. The changes were comparable between the two subject groups. For exercise at 85% VO_2max in normoxia, standard P_{50} and SaO_2 levels were decreased (p<0.01) whereas in vivo P_{50} was not affected by exercise in both subject groups. The change in exercise SaO_2 was less in the anemia compared with the control (p<0.05). For exercise in hypoxia, the in vivo P_{50} was increased above resting level (p<0.01) in both groups but not significantly different from normoxic exercise value. The standard P_{50} similar to that of the resting level but greater than the normoxic level (p<0.01). However, there were no significant differences in these P_{50} values between anemia and control athletes in all cases, although 2,3-DPG was always greater in anemia than control (p<0.001).

The results of this study suggest that athletic anemia has adverse effects on desaturation of arterial blood during constant heavy exercise in hypoxia but it had no effect on blood O_2 affinity during exercise in either normoxia or hypoxia.
งานวิจัยนี้มีจุดประสงค์เพื่ศึกษาการเปลี่ยนแปลงระดับความสามารถในการปล่อยออกซิเจนจากเม็ดเลือดแดงสุ่มเม็ดอ่อน (Pₖₒ) และ 2,3-ดิฟิฟิซิฟิโรไซต์ในเม็ดเลือดแดงของนักกีฬาที่มีภาวะโรคหัวใจ (EFFECT OF EXERCISE ON BLOOD OXYGEN AFFINITY AND ERYTHROCYTE 2,3-DIPHOSPHOGLYCERATE IN ANEMIC ATHLETES) คณะ zar 工 รูปรัตถกรรมวิทยาเทคนิค: พิพิธภัณฑ์ จิดิตรมณี, ว.ม. ซุมพัด ผลประยุกต์, Ph.D., จุฬาลงกรณ์, น.บ., 109 หน้า ISBN: 974-04-1389-7