erythrocythemia. Both subjects and personnel involved in the measurements were kept unaware of treatment used. All subjects were residents of Albuquerque 3 years prior to the beginning of the study and were acclimatized to the altitude of the city (1500 to 1800 m). Their previous 1,500 meter times prior to the study are shown in Table 1. These times and resting heart rates show them to be relatively well trained for amateur runners. The subjects were instructed to maintain their normal daily activities and training schedule throughout the course of the study. Relative anthropometric and other data are shown in Table 1 as means ± 1 SD. Informed consent was obtained from all subjects after approval by the University of New Mexico Human Research Review Committee.

A double-blind, crossover, experimental design was utilized. The subjects were prevented from observing experimental treatments by wearing blacked-out goggles and having loud music played through headphones during all infusion processes. Those recording study results were blinded as to treatment order.

The subjects underwent two phlebotomies (450 ml each) spaced eight weeks apart. Red blood cells were separated from whole blood and stored, using the high-glycerol freezing technique [8]. The subjects continued training (112-140 km / week) for approximately 12 weeks after the second phlebotomy before receiving the infusions.

Five days before the first infusion, collection of baseline data was initiated. Treadmill studies were done five days before infusion, blood specimens were collected four days before, and the 1,500 m race two days before. Two days after the first infusion, treadmill studies were repeated; at three days, blood specimen collection; and at five days the second race. Two days after the second race, the second infusion was given, and the procedures were repeated at the same intervals. Infusion treatments consisted of an autologous infusion of 400 ml of previously frozen deglycerolyzed RBCs or a placebo infusion of 100 ml of normal saline (the approximate amount of saline used to resuspend the RBCs). The subjects were randomly divided into two groups (1 and 2) and were randomly assigned treatments, with the order of receipt of the infusion treatments reversed using a crossover double-blind design.

The subjects ran a series of three 1,500 m open-competition track races at 7-day intervals on a 400 m rubberized asphalt outdoor track located at altitude (1803 m). The first race was used as a baseline control measure, while the second and third races were run five days after the first and second infusions respectively.

Three maximal treadmill tests were taken three days prior to each race to determine maximal oxygen uptake (VO_2 max) and pre and post blood lactates were measured. Each subject's maximal aerobic power was measured by a progressive intensity continuous effort treadmill test. The warm-up consisted of 6 minutes of running at 14 km/h at a 0% treadmill grade. The subjects then ran continuously for three minutes at 15 km/h at 0% treadmill grade. Then the treadmill speed was held constant and the grade increased 2% per minute until the subject could no longer maintain the pace.

Established procedures were followed to determine maximal 0_2 uptake [9]. These tests were conducted in a moderate ($22^{O}C$ ambient temperature, 28% relative humidity) thermal environment.

Blood samples were taken 5 minutes after termination of each treadmill test to determine peak levels of lactate. Lactates (La) were analyzed using the Sigma Kit #826-UV as described by Henry [10].

Blood samples (10 ml) were collected in heparinized syringes from the ante-cubital vein two days prior to each race. Samples were analyzed for hemoglobin (Hb), hematocrit (Hct), 2,3-diphosphoglycerate (2,3-DPG), and partial pressure of oxygen at 50% saturation (P_{50}). The Hb was measured employing the method of Van Kampen & Ziljska [11] and the Hct was measured on a micro-hematocrit centrifuge (coefficient of variation 1.2%). The 2,3-DPG was measured enzymatically using a method that has a coefficient of variation of 2.0%. A device that generates an oxyhemoglobin dissociation curve by measuring arterial oxygen pressure through a membrane and saturation spectrophometrically on deoxygenated blood, which is reoxygenated in stages, was used to determine P_{50} values (reproducible to 1 mm Hg). Two subjects received the saline solution first and were designated as group 1. The other two subjects received the RBC infusion initially and were designated as group 2.

Analysis of the data was performed using an adjusted F-test.

TABLE 1

Description of Subjects

Subject	*Age*	*Height cm*	*Weight kg*	*RHR bpm*	*Pre Phlebotomy Hct %*	*Max VO_2 ml/kg/min*	*km per week*	*Years Running*	*1,500 m time at altitude before study*	
									Min	*Sec*
Group 1 (placebo first)										
1	40	181	77.8	44	45	59	136	12	4	29
2	39	175	62.8	41	43	64	140	9	4	22
Group 2 (blood infusion first)										
3	28	172	61.1	43	44.5	67	112	13	4	12
4	39	171	59.8	42	39.5	61	115	6	4	31
Mean	36.5	174.7	65.3	42.5	44.1	62.5	125.7	10	4	23
SD	5.6	4.2	8.3	1.2	0.8	3.1	14.2	3.1		08

TABLE 2

Individual Performance Tests Results: Race Time in Increments of 400 meters (Minutes and Seconds)

Subject	*Race*	*400 m*	*800 m*	*1200 m*	*1500 m*
	1	68	2.18	3.31	4.22
1	2	67	2.18	3.31	4.23
	3 *	68	2.17	3.28	4.17
	1	69	2.18	3.30	4.21
2	2	66	2.17	3.29	4.22
	3*	68	2.17	3.26	4.16
	1	64	2.11	3.22	4.11
3	2 *	65	2.11	3.18	4.08
	3	65	2.12	3.18	4.09
	1	70	2.20	3.32	4.24
4	2 *	71	2.19	3.28	4.19
	3	69	2.19	3.27	4.19

* Red blood cell infusion. Race 1 is baseline. The other race was after placebo saline infusion (2 or 3 without an asterisk).

TABLE 3

Allocation of Familywise Alpha among Individual Contrasts Comparison among Infusion Conditions

Dependent Variable	*BL, Sal vs. OB*	*Sal vs. OB*	*BL vs. Sal; BL vs. OB; BL vs. Sal, OB; or BL, OB vs. Sal*	
RT	.014 (69.932)	.014	.003 (331.83)	.04
Hct	.014	.014	.003	.04
Hb	.0014 (712.79)	.0014	.0003 (3331.83)	.004
La	"	"	"	.004
DPG	"	"	"	.004
P_{50}	"	"	"	.004
$V0_2$	"	"	"	.004
	.035	.035	.0075 x 4	.100

Note : Numbers in parentheses are the critical values for F (1,2) at the specified individual alphas, obtained via O'Grady's[13] PROB program.