



**The recovery of soldiers and top military athletes  
after a physical exercise**

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My work as the head of coaching in our Sports School of Defence Forces contains mainly planning and coordination with different sport branches and with military service and sport training. Our military service system for top athlete is that the recruits serve 11 months. During their service they may practise sports about half of the time - the rest is used for practising military skills. That is why it is very important to know the facts about recovery systems. Unfortunately we have not enough personnel for physical research but what we have is close cooperation with the civilian research institutes such as the University of Jyväskylä and all the Sports Institutes.

First of all I will show you a familiar curve about normal effect of one exercise to performance (App 1). The recovery process in soldiers and military athletes from fatigue caused by physical stress follows general principles. The recovery time is dependent of the extent of exertion and factors relating to the physical condition in athletes - it is the training background, nutrition and, to a large extent, also the post-exertion activities, such as cooling-down, stretching, fluid intake, going to sauna and massage. In military athletes, recovery can be taken into account through training intervals which can also benefit the programming of military service.

The recovery time varies individually, but these activities after training should always bear in mind. You should teach your coaches and athletes, that the exercise does not end when they leave the training place. You can do a lot to slow down the recovery (curve b) and also to make it faster (curve a). Easiest way of fastening is dope what - luckily - is forbidden in sports.

The importance of recovery must be underlined as overexertion clearly weakens performance (App 2). This is caused by the catabolism of hormones, the decline in the coordination and economy of the nervous system, the fall of pain threshold, insomnia, anorexia and the weakening of immunological system.

Those recovery times you can see are only theoretical and I emphasize individual.

Those are:	glycogen	24 - 36 hours
	micro muscle damage	1 - 7 days
	myofibrillar protein	1 - 2 days
	micro tendon damage	2 - 4 days.

Here you can see an example (App 3) how testosterone and corticosteroid contents behave during a long manoeuvre combined with only 1 - 2 hours sleep per day. You can see the testosterone level comes under 5 nanomoles on the third day but will be back to normal on the 8th day (the 3rd day of recovery) and near 30 nanomoles on the 12th day.



Corticosteroid will reach it's maximum on 4th day (over 550 nmol), but will be back to normal on the 8th day. The study was done to normal Finish conscripts.

These results (App 4) are from 93 by Väänänen and others from the Nijmegen march in Holland which may be familiar to some of you - very enormous and fine happening where both soldiers and civilians march together.

The objective of this research was to find out about the system's general strainbuilding and the maintenance and recovery of muscle capacity over a period of four days. Eight Finnish soldiers from 26 to 48 years of age participated in the research where it was shown that men in good condition can march a total of 185 km in four successive days without significant detrimental physiological effects. From the slide you can see the effect on serum creatine kinase activity and muscle soreness scores (i.e. DOMS delayed onset muscle soreness). The creatine kinase was normal after one week and no muscle soreness was found.

And here is the same in numbers (App 5) - also testosterone and cortisol.

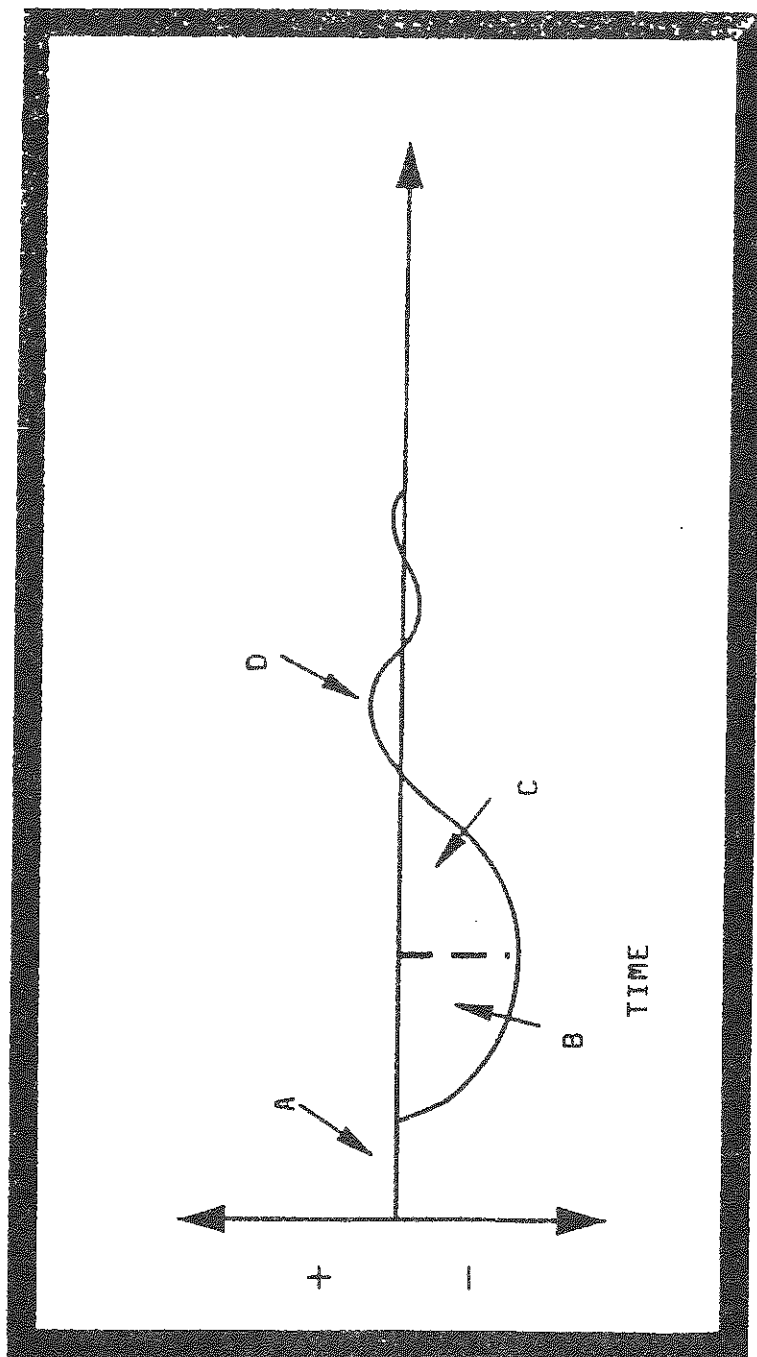
A march research (App 6) in 1994 that was conducted at the Sports School on short-term effects of exertion yielded similar results. Eight athletes from 19 to 20 years of age, all in top condition, marched on a treadmill. They marched wearing three different types of gear, ten kilometres per gear in about three hours.

The first march was completed in sports gear without additional load. The second with light combat equipment (additional load 29 Kg), and the third with full combat equipment (40 kg). The pulse rise was at it's maximum 23 beats/min, the level of lactate acid all the time under 2 mmol/l and the rise in respiration rate at it's maximum 25 times/min. The strain on the test group was light aerobic with fast recovery. It has to be remembered, however, that the march took place in facilitated circumstances. For example we did not stimulate enough the real marchand did too slight changes to the treadmill ankle.

As a conclusion we should bear in mind that only recovered muscle can develop (App 7) and respond to training impulses. According to our national Olympic Committee recovery from temporary fatigue happens individually but within few hours. The ATP and KP contents, the lactate acid content in muscles and blood, and the content of stress hormones recover quickly.

The time of recovery in overstraining or accumulating fatigue is considerably longer: the glycogen content in muscles is from 1 to 2 days, level of cortisol and testosterone is from 2 to 3 days and recovery from muscle damage caused by creatine kinase takes from 1 to 2 weeks. In more serious cases where the autonomic control of the system has been disrupted recovery may take from 1 to 4 weeks.

The fall in the recovery process should be compensated by clearly decreasing the strain, doing other athletic exercises, doing light strength training, ensuring a satisfactory energy intake by sleep and by minimising all stress factors, for example, change of environment.



The EFFECT OF ONE EXERCISE TO PERFORMANCE

A before exercise

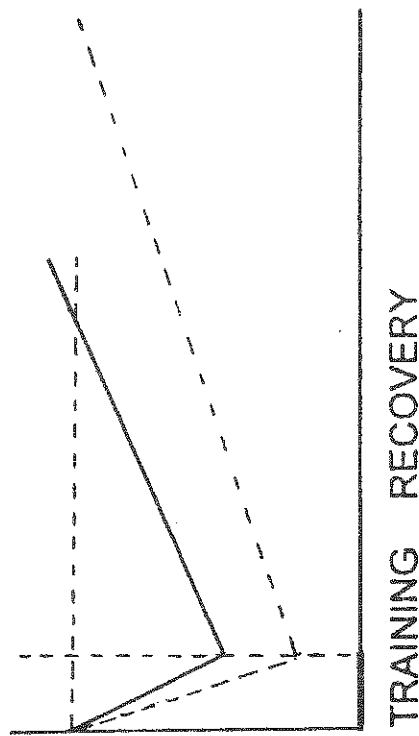
B during exercise

C recovery

D supercompensation



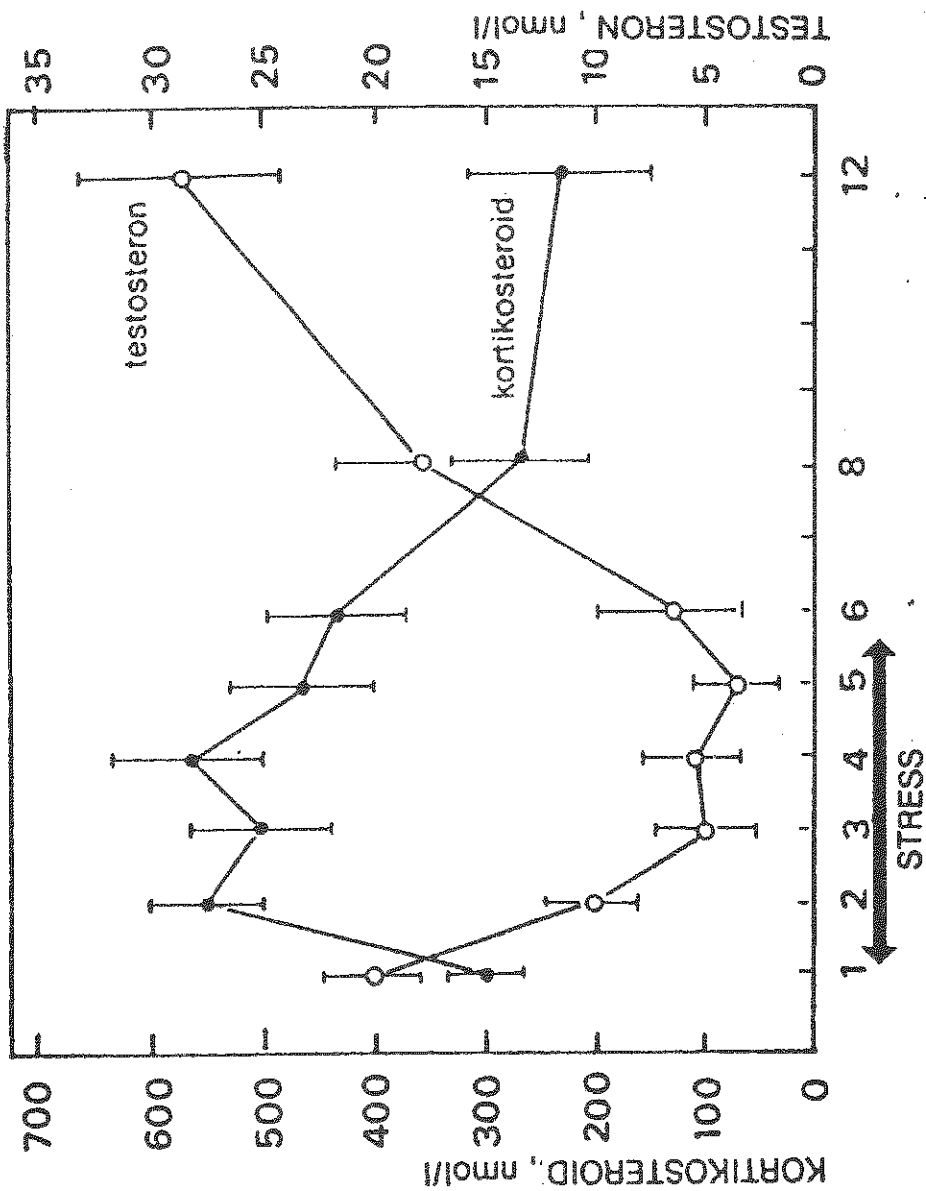
## THE EFFECT OF TRAINING VOLUME AND RECOVERY



Effect of training volume on the recovery time

Recovery times of the various systems:

- |                         |           |
|-------------------------|-----------|
| 1. Glycogen             | 24-36 hrs |
| 2. Micro muscle damage  | 1-7 days  |
| 3. Myofibrillar protein | 1-2 days  |
| 4. Micro tendon damage  | 2-4- days |



Testosteron and glukokortikoid contents in blood during and after a 5 day manoeuvre. Energy consumption was about 40 000 kJ (10 000 kcal) per day and sleeping time 1 to 2 hrs per day.



## Four Day March - totalling 185km (Nijmegen)

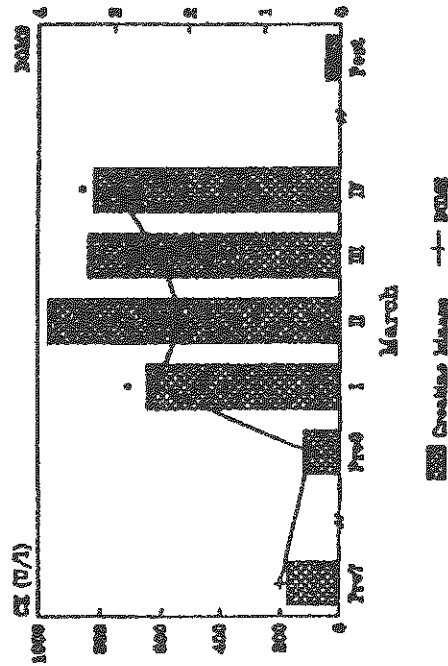
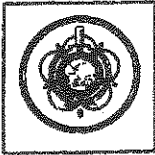


Figure 1. The effect of a four day march on serum creatine kinase activity and muscle soreness scores ( $n=6$ , mean  $\pm$  SD). The blood samples were taken one week before the first marching day (Pre7), one week after the last march (Post) and within half an hour after each walking session (March I, II, III and IV), on the first marching day blood (Pre0) was drawn in the morning, too. Analyses of the Wilcoxon matched-pairs signed-ranks test compared with DOMS Pre0, \*  $p<0.05$ .



## Four Day March - totalling 185km (Nijmegen)

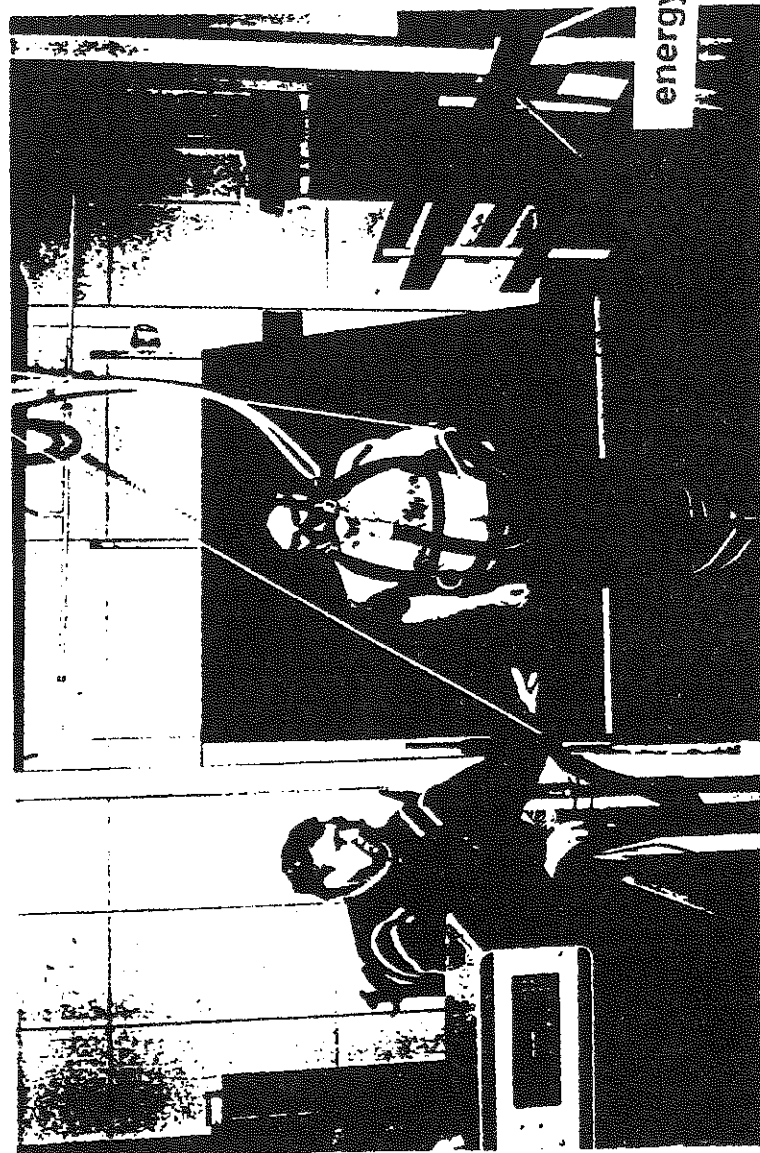
Measuring times	Pre7	Pre0	Marches				Post	
			I	II	III	IV		
CK (U x l <sup>-1</sup> )	x	174	124	641	964	833	819	49
	sd	142	67	440	737	625	409	28
T (U x l <sup>-1</sup> )	x	13	16	11	12	12	12	13
	sd	5,6	4,3	3,7	5,6	5,1	4,0	6,5
C (U x l <sup>-1</sup> )	x	279	465	390	243	353	285	275
	sd	50	95	138	78	174	110	69

Table 1. The effect of a four day march on serum creatine kinase (CK), testosterone (T) and cortisol (C) (n=6, mean  $\pm$  SD). The blood samples were taken one week before the first marching day (Pre7), one week after the last march (Post) and within half an hour after each walking session (March I, II, III and IV), on the first marching day blood (Pre0) was drawn in the morning, too.



# MARCH ON A TREADMILL (Sports School of Finnish Defense Forces)

WHAT ARE THE PHYSICAL CHANGES DURING MARCHES WITH 3  
DIFFERENT LOADS



10 km

HR 4 - 23 beats / min

Lactate under 2 mmol

energy 50 % fat / 50 % carbohydrate

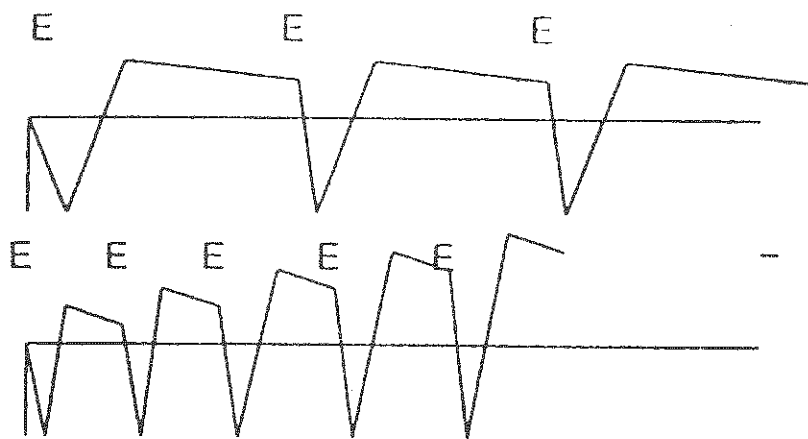
respiratory frequency 2 - 15 times / min





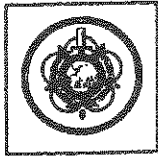
## TRAINING INTERVALS AND SUPERCOMPENSATION

Exercise intervals too far apart



Exercise intervals at an optimum

Effect of training intervals on super compensation



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