Effects of a 3–day survival training on selected coordination motor skills of special unit soldiers

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Abstract

Background & Study Aim: Survival training is gaining popularity in Polish Armed Forces since soldiers on military missions are likely to fight for survival. The aim of the study was the effects of a 72-h workout combined with sleep deprivation on selected motor coordination and psychomotor indices in soldiers from a special unit.

Material & Methods: Eight male soldiers from a special unit exercised for 72 h under restricted sleep conditions. They were examined 4 times (Day 1: before the training; Day 2: after 32 h of training; Day 3: after 44 h of training; Day 4: after 72 h of training) using the following tests: motor adjustment skill, computer-aided perception skills, body balance disturbation tolerance skills (BBDTS) and handgrip force differentiation.

Results: The results of the divided attention test remained practically unchanged throughout the training. Handgrip force differentiation (Error corr.) significantly (p<0.01) worsened on Day 4 compared with other days (86 ± 74 vs. 26 to 35). The number of mistakes in the Rotational Test significantly increased in subsequent measurements from 4.4±3.8 on Day 1 to 9.4±1.4 on Day 4. Also the velocities in all 4 running tests significantly (p<0.05) decreased on Day 4 compared with other days.

Conclusions: The three-day survival training combined with sleep deprivation negative affected on the coordination motor performance (handgrip differentiation, body balance disturbance tolerance skills and running velocities) but not the divided attention. This could have been due to an uneven adaptation to adrenergic stimulation associated with central and peripheral fatigue.

Key words: survival training • coordination motor abilities • special forces • sleep deprivation • psychomotor performance

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INTRODUCTION

The execution of military tasks by soldiers requires enhanced precision and divided attention. This is associated with the necessity of using arms, handling increasingly complex equipment and acting in an environment, in which they may encounter persons directly involved in the military conflict and those not connected with it at all. This is characteristic for terrorism and for anti-terrorist actions [1].

The lack of precision in such tasks may have tragic consequences, e.g. unintentional shooting of accidental persons or destroying wrong objects. During military missions it is also quite likely that the
soldiers would be forced to undertake a fight for survival. Consequently, survival training is becoming increasingly popular in the Polish Armed Forces. Theoretical and practical training engages increasing numbers of soldiers from various formations, especially those who are to participate in military missions. There are few studies concerning changes in psycho-physical fitness of soldiers subjected to such specialist military training but numerous reports exist on training on military field or on military training undertaken by civilians. Those reports pertain to physiological changes during 36-h survival training showed no change in maximum handgrip but an increased error was noted in the preset 50%max test [12]. However, no studies on psycho-physical fitness of soldiers subjected to survival training were reported.

The aim of this study was the effects of a 72-h workload-out combined with sleep deprivation on selected motor coordination and psychomotor indices in soldiers from a special unit.

**Material and methods**

**Subjects**

Eight male soldiers from a special unit volunteered to participate in the study consisting of three-day continuous survival training and approved by the local Committee of Ethics. The subjects aged 25 – 33 years, they were in service for 2 – 10 years, their body height ranged 170 – 188 cm, body mass 71 – 95 kg.

The training took place on military training grounds, in winter (night temperature ranging from –8 to –10°C). The tests were applied pre-training in the morning (8.00 – 9.30; Day 1), then after 32 h (Day 2), after 54 h (Day 3), and directly post-training (after 72 h; Day 4). During the first two nights the subjects could sleep for 3 h. On the third night they were fully deprived of sleep and performed an orienteering march (approx. 35 km), which included e.g. carrying an injured subject on a stretcher, carrying loads and construction of shelters. During the march the average heart rate was 102 bpm. Throughout the entire course the soldiers carried personal arms (machine guns) and a rucksack with basic equipment. The whole equipment weighed 15 kg. The main tasks of soldiers during the training course were creeping, setting campfire, preparation of meals and training in operational military tactics in forested areas.

**Methodology**

The following measurements were conducted:

1. Handgrip differentiation test using PZA/3359
dynamometer (Fabrication Enterprises Inc., USA). The device was held in the preferred hand in standing posture, arms along the trunk. The test was repeated 3 times and consisted of 3 tasks: maximum handgrip, executing the preset 50%max handgrip, and adjusting the force so as to attain the requested 50%max. Before the first session on Day 1 subjects were familiarized with the handgrip differentiation test procedure and performed the complete session as a warm-up. The results were presented as maximum force (in N) and as differences between the actual and preset 50%max results.

2. Motor adjustment skills ("speed adjustment index") were determined with the use of 4 running tests: 15-m sprint, shuttle run 3×5 m (standing start), 15-m slalom run (first pole at a 5-m distance from the start, the remaining 4 spaced by 1.2 m; standing start) and 15-m squat, crouching start. Running times were recorded electronically with 0.01 s accuracy; the results were presented as velocities (15/time) and as the speed adjustment index which was the sum of differences between running times of the tests and running time of the 15-m sprint [27].

3. Computer-aided, divided attention effect [28]. Two types of signals were displayed on the screen: figures (square, circle or cross) in the central part of the monitor. When displayed in the above sequence, the "+" key was to be pressed with the right thumb (or the "Q" key with the left thumb) each time when the asterisk appeared, all other sequences of figures being incorrect. The second type of signals consisted of small squares displayed in the corners of the monitor. When 4 squares were displayed in one of the corners, the "−" key was to be pressed with the right index finger (or the "I" key with the left index finger). The following results were presented: the number of perceived signals, the number of errors (omitted signals and incorrectly pressed keys) and the respective percent indices.

4. Body balance disturbance tolerance skills (BBDTS) – the ‘Rotational Test’ of Kalina et al. [15] was applied. The subject, standing on the line, was supposed to jump up with full rotation in the air, alternately clockwise and counter-clockwise, repeated 3 times, and land with both feet on the line in approx. 12 s in a constant rhythm. Several training jumps were allowed. The accuracy of landing and maintaining the balance was scored (0 – clean jump, 1 – one foot off line, 2 – both feet off line, 3 – lost balance with hand support) and totalled for all 6 jumps (score range from 0 – excellent to 18 – unsatisfactory). Criteria of an individual level assessment determined by the ‘Rotational Test’ are as follows: very high (0-1), high (2-3), average (4-9), low (10-12), very low (13-15), insufficient (16-18).

Data processing
The data were subjected to one-way ANOVA with the post-hoc Scheffe’s test using Statistica 6.0 software. The level of p<0.05 was considered significant.

RESULTS
The divided attention results were pretty uniform throughout the study (Tab.1). The same applied to maximum handgrip and to the 50%max results but the correction error proved significantly (p<0.01) highest on Day 4. Running velocities remained relatively stable on the first 3 occasions but on Day 4 significantly (p<0.05) decreased. The same was true for the speed adjustment index but the mean result on Day 4 was due to 3 subjects only. The ‘Rotational Test’ results showed a steady, significant (r = 0.563; p<0.01) deterioration with time.

DISCUSSION
The capacity to execute fast, precise movements and to modify them depending on changing combat conditions is considered superior to being physically fit and strong only. That capacity in military tasks requires an adequate psychomotor fitness. Divided attention, reaction time, perception, and sight and movement coordination depend on numerous factors like age, vigilance, mood, fatigue, etc. In this study, the degree of divided attention did not change during subsequent days of survival training. The soldiers performed the 90-s test on a similar level, irrespectively of mounting fatigue. The results obtained in earlier studies [4, 12] indicated that combined application of prolonged exercise and sleep deprivation did not affect psychomotor performance. Test duration was so short that subjects could remain focused long enough to overcome detrimental effects of sleep deprivation. It might be expected that application of longer-lasting, e.g. 5-min tests, adverse consequences of fatigue brought about by training and limited sleep deprivation could be noticed [29].

Among the desired skills during military actions is the capacity to differentiate the hand force output as this is a prerequisite for accuracy and economics in the execution of numerous tasks. It was shown in this study that special unit soldiers exhibited a decrease in that capacity only on Day 4 after a sleepless night and, thus, performed better than physical education students subjected to survival training. Namely, the
A high degree of motor adaptation capacity is of great assistance to soldiers performing diverse activities, e.g. running, sudden changing the running direction, crawling and stealthy approach, driving a vehicle or participation in direct combats. Only on the third day of activities combined with a sleepless night and an about 35-km orienteering march, the motor adaptation of soldiers significantly decreased. In contrast, physical education students participating in survival training achieved worse results of 15-m sprint already after only several hours, other components of the motor adaptation test being unaffected [12]. Moderate prolonged physical exertion combined with sleep deprivation affected adversely movement coordination as reflected in worsened body balance disturbance tolerance skills, a component of motor coordination, on Day 4. Similar results were reported also by Mikulski et al. [4] who applied 36-h moderate survival training combined with sleep deprivation in summer season with the use of posturography, and by Avni et al. [13] and Ma et al. [30] who applied sleep deprivation under sedentary conditions. Probably the long-lasting military training brings about more serious disorders to the dynamic body balance than to the static one. It seems that the future direction of research should concern the biochemical changes in the soldiers involved in survival training, similar like athletes and other people taking extreme challenges [31, 32].

<table>
<thead>
<tr>
<th>Table 1. Mean values (±SD) of handgrip strength, running velocity, divided attention and BBDTS indices in male soldiers (n = 8) participating in 72 hours survival training</th>
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</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Hand strength [N]</td>
</tr>
<tr>
<td>max</td>
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<tr>
<td>50% max</td>
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<tr>
<td>corrected 50% max</td>
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<td>Error 50%</td>
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<td>Error corr.</td>
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<td>Error 50% (absolute values)</td>
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<td>Error corr. (absolute values)</td>
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<tr>
<td>Running velocity [m/s]</td>
</tr>
<tr>
<td>15 m</td>
</tr>
<tr>
<td>3×5 m</td>
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<tr>
<td>15 m slalom</td>
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<tr>
<td>15 m squat</td>
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<tr>
<td>Speed adjustment index</td>
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<tr>
<td>Divided attention [%]</td>
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<tr>
<td>BBDTS [points]</td>
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</tbody>
</table>

* Significantly (p<0.05) different from the three others days; ** Significantly (p<0.01) different from Days 1 and 2; ^ Significantly (p<0.01) different from Day 1.
CONCLUSION

The three-day survival training combined with sleep deprivation negative affected on the coordination motor performance (handgrip differentiation, body balance disturbance (tolerance skills and running velocities) but not the divided attention. This could have been due to an uneven adaptation to adrenergic stimulation associated with central and peripheral fatigue.

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