HUMAN COLD EXPOSURE, ADAPTATION AND PERFORMANCE IN A NORTHERN CLIMATE


Tiina Mäkinen

Objectives. The purpose of the study was to examine the amount of cold exposure and factors affecting it at the population level in Finland, to determine what type of cold acclimatisation, if any, develops in urban residents in winter, and to find out whether cold acclimatisation or acclimation has a functional significance on psychological or physical performance. Tasks of low physical activity requiring attention and concentration (cognition, postural control) were assessed in cold.

Study design. Cross-sectional population survey and controlled laboratory trials.

Methods. In the population study Finns aged from 25 to 74 years (n=6,951) were queried of their wintertime outdoor exposure duration and factors affecting it. In experimental studies seasonal cold acclimatisation (thermal responses) and its effect on cognition were assessed in the laboratory, where 15 young urban subjects were exposed to cold in winter and summer in bright or dim light. A controlled cold acclimation trial (n=10) was performed to study the effects of repeated exposures to cold on cognitive performance and postural control in young urban subjects.

Results. In the Finnish population the average amount of cold exposure in winter represents 4% of the total time. Most of the cold exposure occurs during leisure time and in outdoor occupations (agriculture, forestry, mining, industry, construction). Factors explaining increased occupational cold exposure were: occupation, age and a lesser amount of education. Factors associated with more leisure-time cold exposure were: being employed in outdoor occupations, being a pensioner, housewife, unemployed, practising physical exercise, and reporting at least average health. The experimental studies showed seasonal differences and aggravated thermal responses in urban residents in winter, but did not detect habituation responses typical of cold acclimatisation. In both seasons, acute moderate cold

exposure resulted in positive, negative or mixed effects on cognition, reflected as changes in response times and accuracy. Simple cognitive tasks were impaired in cold, and in complex tasks both negative, positive and mixed effects were observed. It is suggested that cold exposure affects cognition through different mechanisms related to either distraction or arousal. Cold exposure increased postural sway by 70-90%, suggesting impaired postural control.

Conclusions. Population cold exposure is on average short in winter, and possibly insufficient to cause cold habituation among urban residents. A moderate cold exposure affects cognition both negatively and positively, which effects are task-specific and dependent on the degree of cooling. Whole body postural control is considerably impaired in cold. This finding is important in population groups at higher risk of falling (e.g. elderly, or persons with impaired balance due to neurologic or musculosceletal disorder). Repeated exposures to moderate cold, reducing stress and discomfort and dampening physiological responses, did not markedly affect cognitive performance or postural control.

Keywords: cold climate, cold exposure, population, acclimatisation, acclimation, body temperature regulation, cognition, postural control

Tiina M Mäkinen, Ph.D.
Centre for Arctic Medicine, Thule Institute
University of Oulu
Email: tiina.makinen@oulu.fi

Permission to publish this abstract was obtained from Acta Universitatis Ouluensis series Medica D876 (Mäkinen, Tiina M (2006) Human cold exposure, adaptation and performance in a northern climate.ISBN 951-42-8088-I (Paperback), ISBN 951-42-8089-X (pdf) for electronic version (http://herkules.oulu.fi/isbn951428089X/), ISSN 1796-223.