Brief communication

Acute effects of whole-body cryotherapy on sit-and-reach amplitude in women and men

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1. Introduction

Flexibility is an intrinsic property of body tissues, which among other factors determines the range of motion (ROM). A decrease in neural activation of the muscle has been linked with greater ROM. Cryotherapy is an effective technique to reduce neural activation. Hence, the aim of the present study was to evaluate if a single session of whole-body cryotherapy (WBC) affects ROM. 60 women and 60 men were divided into two groups (control and experimental). After the initial sit-and-reach test, experimental group performed a 150 s session of WBC, whereas the control group stayed in thermo-neutral environment. Immediately after, both groups performed another sit-and-reach test. A 3-way analysis of variance revealed statistically significant time x group and time x gender interaction. Experimental groups improved sit-and-reach amplitude to a greater extend than the control group. Our results support the hypothesis that ROM is increased immediately after a single session of WBC.

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knowledge, no studies have examined the acute effects of WBC on ROM. Therefore, the aim of the present study was to test the hypothesis that a single WBC session will increase ROM as measured by the sit-and-reach test.

2. Materials and methods

During the initial physical examination by the qualified physician all participants with increased blood pressure, chronic low back pain and contradictions to WBC were excluded from the study. In total, 60 male and 60 female participants agreed to take part in this study and signed the informed consent approved by the University’s medical ethics committee. Participants were then pseudo-randomly divided into a WBC and a control group (30 males and 30 females in each group). Socio-demographic information for each group is presented in Table 1.

Participants were instructed not to perform any physical activity for at least 24 h prior to the experiment. Upon arrival, they were sat down for 30 min wearing only swimwear, woolen socks and wooden clogs to acclimate to the room temperature (22.0 ± 0.5 °C). Following acclimation, each participant performed the sit-and-reach test using a Flex-Tester box (Cranlea, Birmingham, UK). Participants were barefoot with legs fully extended and instructed to lean forward as far as possible with the end position held for at least 2 s. The task was repeated two times.

Following the baseline measurement, the WBC group completed the cryo-session (150 s) in a cryo-cabin (Space Cabin, Criomed Ltd, Kherson, Ukraine). A 150 s duration and set temperature range of the cryo-session (150 s) in a cryo-cabin (Space Cabin, Criomed Ltd, Kherson, Ukraine). A 150 s duration and set temperature range of -130 and -140 °C was used as recently recommended [4]. The control group was instructed to perform similar movement (standing rotations) for the same duration in a thermo neutral environment (22.0 ± 0.5 °C). Immediately after the cryo-exposure or control task, the sit-and-reach test was repeated.

The better of the two trials from each time point was taken for further statistical analysis and means ± standard deviations were calculated. The Shapiro–Wilk test was used to test for the normality of the distribution. A 3-way mixed analysis of variance (ANOVA) was used to test the flexibility values for significant differences between the WBC and control group and between the genders. Gender (2) and group (2) were the inter-subject factors, while the time(2) was the intra-subject factor. Before each ANOVA, Mauchly’s test of sphericity was performed and appropriate corrections were calculated. The level of significance for all tests was set at p < 0.05. All statistical analyses were performed using the IBM SPSS statistics 22.0 software for Mac (Armonk, NY, USA).

3. Results

The differences between the two time points for each gender and group are illustrated in Fig. 1. A 3-way analysis of variance revealed statistically significant time × group and time(2) × gender(2) interaction (F(1,108) = 49.4; p = 0.000; η² = 0.314 and F(1,108) = 6.6; p = 0.012; η² = 0.057, respectively). There was a statistically significant main effect for the between-gender difference where females reached further than males (F(1,116) = 21.05; p = 0.000; η² = 0.154).

Post hoc comparisons for males revealed that the WBC group statistically significantly increased the forward reach amplitude (p = 0.000), whereas the control group did not significantly differ in forward reach amplitude (p = 0.348). For females, both WBC and control group statistically significantly increased the forward reach amplitude (p = 0.000 and p = 0.004, respectively).

4. Discussion

The aim of the present study was to examine the effects of WBC on ROM through a sit-and-reach test. Based on the results we can accept the hypothesis that a single session of WBC increases ROM in men in women.

Our hypothesis was set based on the observations that cryostimulation decreases neural activity and allows more elongation of the muscle at a given load. We have observed an increased ROM in the two groups who performed WBC. The main factor associated with these changes is most likely reduced skin temperature and consequential reduction in neural activity. Skin temperature of the lower extremity immediately after 150 s of WBC in a cryo-sauna was reported to fall for more than 10 °C [4,10]. These results are supported with previous findings [8], reporting an increase in active ROM of the hip after applying ice to the hamstrings. This was similarly observed in a study by Newton [15] using a cooling spray. Both of these studies [8,9] concluded that cryo-stimulation reduces pain sensation related muscle spasm allowing longer elongation of the targeted muscle. Cryo-stimulation is linked with a short-term reduced proprioception acuity [3], which further suggests that the somatosensory system is affected when cold is applied to the muscle.

Previous research has suggested that local cryo-stimulation inhibits spinal excitability [1] and reduces the nerve conduction velocity. In theory, inhibited activity of muscle spindles and afferent fibres would inhibit muscle activation during its lengthening allowing more stretch at a given load. It is known that body temperature after WBC remains reduced for up to 30 min after the exposure. Reduced neural activity due to cryo-stimulation supports the findings from the present study that ROM is increased immediately after WBC.

An interesting observation from the present study is a slight, but

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Table 1: Socio-demographic information of the participants (mean ± SD).

<table>
<thead>
<tr>
<th></th>
<th>Age (years)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>WBC</td>
<td>36.4 ± 9.7</td>
<td>181.4 ± 7.8</td>
<td>83.4 ± 12.4</td>
<td>25.5 ± 3.4</td>
</tr>
<tr>
<td>Control</td>
<td>31.0 ± 10.1</td>
<td>176.5 ± 6.3</td>
<td>73.5 ± 9.6</td>
<td>23.8 ± 3.5</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC</td>
<td>33.8 ± 10.7</td>
<td>167.5 ± 6.8</td>
<td>64.3 ± 9.6</td>
<td>22.9 ± 3.0</td>
</tr>
<tr>
<td>Control</td>
<td>31.8 ± 10.0</td>
<td>166.5 ± 6.6</td>
<td>60.0 ± 8.4</td>
<td>23.0 ± 4.3</td>
</tr>
</tbody>
</table>

WBC, whole-body cryotherapy.
statistically significant increase in ROM for women in the control group. Women are known for being more prone to acute effects of stretching on ROM than men [6]. There is a possibility that the effect of the baseline sit-and-reach test would interfere with the results during the post measurements. However, when taking into account the relative difference from baseline and comparison to the WBC group, we see that the change in the control group is a lot smaller than the change in the WBC group.

In summary, our results support the hypothesis that ROM is increased immediately after a single session of WBC. This is of practical value for practitioners working with symptomatic and non-symptomatic clientele aiming to increase ROM. Further research to understand the underlying mechanisms of this phenomenon is warranted.

References