



## AGE DEPENDENCE OF THERMAL IMAGING ANALYSIS OF BODY SURFACE TEMPERATURE IN WOMEN AFTER CRYOSTIMULATION

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AGNIESZKA DĘBIEC-BAK, KATARZYNA GRUSZKA,  
KRZYSZTOF A. SOBIECH, ANNA SKRZEK \*

University School of Physical Education, Wrocław, Poland

### ABSTRACT

**Purpose.** The aim of the study was to analyse changes in body surface temperature after a cryostimulation session in women of two different age groups. **Methods.** The study included 21 female university students aged  $21 \pm 1.8$  years and 15 middle-aged women aged  $57.8 \pm 3.6$  years. All participants were subjected to the effects of extreme low temperature in a cryogenic chamber at  $-120^{\circ}\text{C}$  for 3 min. Body surface temperature measures were taken before and immediately after treatment by a thermal imaging camera. Qualitative and quantitative analysis of the captured thermographic images was performed for 12 anterior and posterior body areas in the standing position. **Results.** Differences in body surface temperature were found between both age groups prior to the cryostimulation treatment. Temperatures ranged from  $29.55^{\circ}\text{C}$  to  $33.49^{\circ}\text{C}$  in the younger group and  $30.45^{\circ}\text{C}$  and  $32.70^{\circ}\text{C}$  in the older group for the same body areas. Lower temperatures were observed in the older subject group for all analysed areas. After cryostimulation, greater body cooling was observed in the younger group particularly in the lower limbs. The greatest temperature reduction in both groups was observed in the lower limbs, dropping a maximum of  $6.31^{\circ}\text{C}$ , whereas the lowest variation in temperature was observed in the shoulder area by approximately  $2^{\circ}\text{C}$ . **Conclusions.** The results of the study showed varied distribution of body surface temperature in both age groups. Lower temperatures of the trunk and shoulders were observed in older women compared with the younger women. Greater body cooling following cryostimulation was observed in the group of younger women particularly in the area of the lower limbs.

**Key words:** thermal imaging, age, women, whole body cryotherapy

### Introduction

Homeostasis is a complex mechanism that involves numerous interrelated biological processes and allows the body to survive in a continually changing external environment. Thermoregulation, or the ability to maintain a constant body temperature within a normal range, depends on the maintenance of heat balance by factoring in the amount of thermal energy generated in the body through metabolic processes and the heat lost to the external environment. From a medical point of view, the most important thermoregulatory processes include heat transport via blood flow through tissue and organs such as the skin; physical phenomena including thermal convection, radiation and conductivity; and the removal of heat by evaporation (primarily in the form of perspiration). The effectiveness of these processes depends, among others, on the temperature gradient between the body's surface and the objects it is in contact with as well as the humidity and movement of surrounding air mass. The various changes that can occur in an environment may interfere with the body's ability to maintain thermal balance, especially in the elderly and children and in patients with systemic disease such as advanced heart disease or impaired sweating function [1–5].

The occurrence of hypothermia is a frequent risk in the older population as the adaptive mechanisms and physical and chemical processes determining thermoregulation are often impaired in advanced age. The vasoconstrictor response to cold is reduced in many aged individuals, leaving them more susceptible to heat loss than younger subjects when in low temperature rooms. Furthermore, when in cool rooms, aged individuals have been shown to feature reduced sensitivity to cold, noting a difference only when skin temperature decreased by  $2\text{--}3^{\circ}\text{C}$  (in young individuals by  $1^{\circ}\text{C}$ ) [6, 7].

However, recent years have seen increasing interest in the effects of extremely low temperatures on the human body and, in particular, their beneficial application. This has been reflected in the broad application of low temperature methods (termed cryotherapy) in physiotherapeutic and many other fields of medicine as an effective tool in combating the various negative symptoms of illness [8–10]. However, the application of cryotherapy in older patients is often recognized as an absolute or relative contraindication. This is explained by the fundamental role thermoregulatory mechanisms play in the body after being submitted to cryogenic stimulation. The effects of cooling the body evoke the body's defence mechanism and, as such, depend on the correct functioning of these mechanisms, which may not be the case in an older population [10, 11].

However, information on the maintenance of body surface temperature in various age groups is still lacking,

\* Corresponding author.

albeit this being a very important issue in the safe use of cryostimulation and cryotherapy methods. Therefore, the aim of this study was to analyse changes in body surface temperature as a result of a whole body cryostimulation session of women in two different age groups by thermographic examination, where thermal imaging has been cited as an objective, repeatable and non-invasive method in the observation and analysis of the changes caused by procedures using extremely low temperatures [1, 2, 12].

### Material and methods

The study involved 36 healthy individuals, 21 were female students from the University of Physical Education in Wrocław, Poland aged  $21 \pm 1.8$  years and 15 middle-aged women aged  $57.8 \text{ years} \pm 3.6$  years. The research project was approved by the University's Senate Committee for Scientific Research Ethics and participants provided their written informed consent prior to enrolment in the study. A priori analysis of the two age groups' somatic characteristics found statistically significant differences in body mass index (BMI). According to criteria proposed by the World Health Organisation (WHO), individuals with BMI between 18.5 and 24.9 have healthy body mass. A value between 25.0 and 29.9 is classified as overweight, while a value of 30 and above indicates obesity [13]. In the younger group, all participants were within healthy weight limits with a mean BMI of  $21.3 \pm 1.9$ . However, nine subjects in the older group (60% of the sample) were classified as overweight, with a mean BMI of  $24.2 \pm 3$  for this group.

All participants were subjected to the effects of extreme low temperature in a CR-2002/05 Cryogenic Chamber (Creator, Poland) at a temperature of  $-120^\circ \text{C}$  for 3 min. Testing was performed at the Cryotherapy

Laboratory of the Creator Private Centre for Preventive Treatment and Rehabilitation located in Wrocław, Poland.

Body surface temperature was taken before and immediately after cryostimulation treatment. Body temperature was registered with a ThermoVision A20M camera (moviMED, USA) connected to a PC equipped with ThermoCAM Researcher ver. 2.8 software (FLIR Systems, USA). Thermographic imaging was performed at a distance of 2 m from the subject and included registration of minimum, maximum and mean temperature values for 12 body areas: anterior shoulder (A1), anterior trunk (A2), anterior right upper limb (A3), anterior left upper limb (A4), anterior right lower limb (A5), anterior left lower limb (A6), posterior shoulder (A7), posterior trunk (A8), posterior left upper limb (A9), posterior right upper limb (A10), posterior left lower limb (A11), posterior right lower limb (A12) (Fig. 1). Prior to the initial thermographic examination the subjects were without outer clothing (only underwear) for approximately 10 min in order to balance body temperature.

The Shapiro-Wilk test was first used to assess the normality of the data and showed no evidence to reject the null hypothesis of normal distribution. Statistical characteristics of the studied parameters are presented using arithmetic mean ( $\bar{x}$ ) and standard deviation ( $SD$ ). Comparison of the mean values recorded for the two age groups was performed using Student's *t* test for independent samples. Differences between the analysed parameters were calculated by analysis of variance (ANOVA) with repeated measures, and post-hoc comparisons were made with Fisher's Least Significant Difference test (LSD). Spearman's rank correlation coefficient was calculated in order to examine the strength of associations between the variables. For all applied statistical tests, a level of  $p < 0.05$  was considered statistically significant. Statistica ver. 9.0 (Statsoft, USA) software was used for all statistical analysis.

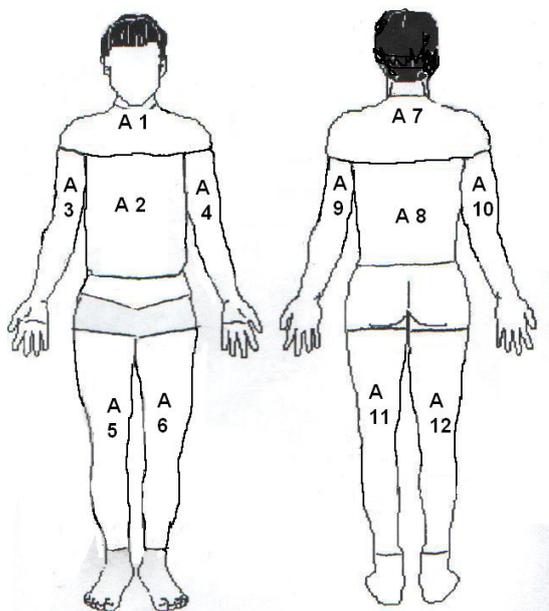


Figure 1. Measurement fields of the 12 examined body areas

Body area	Description of area
A1	Anterior shoulder
A2	Anterior trunk
A3	Anterior right upper limb
A4	Anterior left upper limb
A5	Anterior right lower limb
A6	Anterior left lower limb
A7	Posterior shoulder
A8	Posterior trunk
A9	Posterior left upper limb
A10	Posterior right upper limb
A11	Posterior left lower limb
A12	Posterior right lower limb

**Results**

Analysis of differences in the temperature distribution of the examined body areas found that temperatures were the highest around the trunk, lower in the upper limbs and the lowest in the lower limbs. The mean temperature values are presented in Table 1. Mean minimum and maximum temperatures prior to cryostimulation ranged from 29.55° C for the anterior lower left limb (A6) to 33.49° C for the anterior shoulder (A1) in the younger group and 30.45° C to 32.70° C in the older group for the same body areas, respectively.

After treatment in the cryogenic chamber, mean temperature values for all body areas significantly decreased. Immediately after the procedure, temperatures in the younger group ranged from 23.79° C for the anterior lower left limb (A6) to 31.69° C for the anterior shoulder (A1), while the older group presented minimum and maximum values from 25.96° C for the posterior lower right limb (A12) to 30.67° C for the anterior shoulder (A1).

When comparing temperature values between the younger and older group prior to cryostimulation, statistically significant differences were found in four areas: A5, A6, A7 and A8. After cryostimulation, significant differences were also noted in areas A5, A6 and A7 but also areas A1, A1 and A12 (Tab. 2, Fig. 2).

Decreases in mean body temperature between the younger and older group after cryostimulation were different depending on body area (Tab. 3). The greatest temperature reduction in both groups was observed in the region of the lower limbs, reaching 6.31° C for the posterior left lower limb (A11). The smallest recorded temperature change after cryostimulation was at the posterior shoulder (A1) with a decrease of approximately 2° C. Comparisons of the younger and older groups indicated significant differences in temperature changes before and after cryostimulation in the areas of the

Table 2. Mean temperature differences between the younger and older group

Test area	Before cryostimulation <i>p</i> value	After cryostimulation <i>p</i> value
A1	0.0638	<b>0.0164</b>
A2	0.7352	0.1350
A3	0.8791	0.4520
A4	0.8217	0.3955
A5	0.0384	0.0000
A6	0.0336	0.0000
A7	0.0229	0.0006
A8	<b>0.0384</b>	0.0817
A9	0.6921	0.9263
A10	0.7514	0.8776
A11	0.1683	<b>0.0000</b>
A12	0.4294	<b>0.0000</b>

Bold font denotes statistical significance at *p* < 0.05

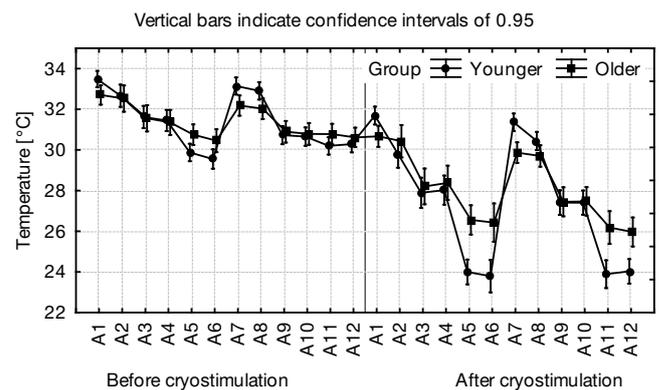


Figure 2. Graphical distribution of mean temperatures in analysed body areas

Table 1. Distribution of mean temperatures of the analysed body areas

Test area	Temperature before cryostimulation				Temperature after cryostimulation			
	Younger <i>n</i> = 21		Older <i>n</i> = 15		Younger <i>n</i> = 21		Older <i>n</i> = 15	
	$\bar{x}$	<i>SD</i>	$\bar{x}$	<i>SD</i>	$\bar{x}$	<i>SD</i>	$\bar{x}$	<i>SD</i>
A1	33.49	0.99	32.70	0.77	31.69	1.13	30.67	0.73
A2	32.67	1.45	32.53	0.83	29.80	1.84	30.43	0.89
A3	31.62	1.30	31.56	1.12	27.89	1.89	28.21	1.30
A4	31.45	1.32	31.35	0.92	28.02	1.77	28.38	1.35
A5	29.88	1.13	30.75	0.66	24.00	1.53	26.56	1.11
A6	29.55	1.33	30.45	0.53	23.79	1.96	26.43	1.53
A7	33.15	1.04	32.18	0.80	31.36	1.07	29.87	0.80
A8	32.90	1.06	32.03	0.82	30.44	1.16	29.70	0.74
A9	30.73	1.14	30.89	0.78	27.41	1.39	27.45	1.32
A10	30.66	1.09	30.79	0.92	27.40	1.39	27.47	1.27
A11	30.20	1.15	30.78	0.60	23.89	1.54	26.18	1.54
A12	30.29	1.10	30.62	0.54	24.03	1.33	25.96	1.41

Table 3. Differences in mean temperature changes between the younger and older group

Test area	Temperature change following cryostimulation [° C]				Difference between groups <i>p</i> value
	Younger <i>n</i> = 21		Older <i>n</i> = 15		
	$\bar{x}$	SD	$\bar{x}$	SD	
A1	1.80	0.47	2.03	0.75	<b>0.4785</b>
A2	2.87	0.83	2.10	0.68	<b>0.0226</b>
A3	3.68	0.84	3.35	1.02	0.3235
A4	3.42	0.87	2.97	1.11	0.1799
A5	5.88	1.07	4.19	1.09	<b>0.0000</b>
A6	5.76	1.36	4.03	1.28	<b>0.0000</b>
A7	1.79	0.64	2.31	0.79	0.1164
A8	2.47	0.67	2.32	0.73	0.6715
A9	3.32	0.86	3.45	1.25	0.7044
A10	3.25	0.84	3.32	1.12	0.8388
A11	6.31	1.18	4.60	1.43	<b>0.0000</b>
A12	6.26	1.08	4.65	1.35	<b>0.0000</b>

Bold font denotes statistical significance at *p* < 0.05

lower limbs and shoulders, with the younger group of women showing greater loses in body temperature.

ANOVA of mean temperature differences depending on body area indicated statistically significant differences. Post-hoc comparisons with the LSD test also indicated statistically significant differences albeit with more significant differences in the younger group (Tab. 4 and 5). Differences that were not statistically significant occurred primarily in symmetrical areas of the body, at analogous regions of the posterior and anterior and left and rights of the body.

**Discussion**

The benefits of cold temperatures in providing analgesic, anti-inflammatory and anti-edema effects have been utilized in many fields of medicine as well as in wellness and physiotherapy applications [1]. Full body exposure to the effects of extremely low temperatures is known to cause a thermal stress response [6]. This ini-

Table 4. Mean temperature differences between the examined body areas in the younger group

Test area	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
	Before cryostimulation											
A1		<b>0.0008</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.1654	<b>0.0173</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>
A2	0.0000		<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0486</b>	0.3285	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>
A3	0.0000	0.0000		0.4816	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.0000	0.0003	0.0001	0.0000	0.0000
A4	<b>0.0000</b>	<b>0.0000</b>	0.5841		0.0000	0.0000	0.0000	0.0000	0.0032	0.0012	0.0000	0.0000
A5	0.0000	0.0000	0.0000	0.0000		0.1840	<b>0.0000</b>	<b>0.0000</b>	<b>0.0005</b>	<b>0.0014</b>	0.1840	0.0930
A6	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.3898		0.0000	0.0000	0.0000	0.0000	0.0080	0.0027
A7	0.1776	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>		0.3189	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>
A8	0.0000	0.0090	0.0000	0.0000	0.0000	0.0000	0.0002		0.0000	0.0000	0.0000	0.0000
A9	0.0000	0.0000	0.0486	0.0118	0.0000	0.0000	0.0000	0.0000		0.7693	<b>0.0303</b>	0.0693
A10	<b>0.0000</b>	<b>0.0000</b>	<b>0.0464</b>	<b>0.0112</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.9844		0.0608	0.1276
A11	0.0000	0.0000	0.0000	<b>0.0000</b>	0.6530	0.6814	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>		0.7249
A12	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.9066	0.3285	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.5708	
After cryostimulation												

Bold font denotes statistical significance at *p* < 0.05

Table 5. Mean temperature differences between the examined body areas in the older group

Test area	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
	Before cryostimulation											
A1		0.5382	<b>0.0001</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.0709	<b>0.0195</b>	<b>0.0000</b>	<b>0.0000</b>	0.0000	0.0000
A2	0.4041		<b>0.0008</b>	<b>0.0001</b>	<b>0.0000</b>	<b>0.0000</b>	0.2334	0.0850	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>
A3	0.0000	0.0000		0.4833	<b>0.0055</b>	<b>0.0001</b>	<b>0.0301</b>	0.1012	<b>0.0220</b>	<b>0.0080</b>	<b>0.0072</b>	<b>0.0012</b>
A4	<b>0.0000</b>	<b>0.0000</b>	0.5452		<b>0.0375</b>	<b>0.0018</b>	<b>0.0042</b>	<b>0.0194</b>	0.1116	0.0508	<b>0.0467</b>	0.0108
A5	0.0000	0.0000	0.0000	0.0000		0.2981	<b>0.0000</b>	<b>0.0000</b>	0.6234	0.8981	0.9263	0.6373
A6	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.6462		<b>0.0000</b>	<b>0.0000</b>	0.1258	0.2426	0.2572	0.5691
A7	<b>0.0055</b>	0.0517	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>		0.5947	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>
A8	<b>0.0008</b>	<b>0.0120</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.5691		0.0001	0.0000	0.0000	0.0000
A9	0.0000	0.0000	0.0087	0.0013	0.0021	0.0004	0.0000	0.0000		0.7166	0.6902	0.3359
A10	<b>0.0000</b>	<b>0.0000</b>	<b>0.0108</b>	<b>0.0016</b>	<b>0.0016</b>	<b>0.0003</b>	<b>0.0000</b>	<b>0.0000</b>	0.9418		0.9716	0.5488
A11	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.1912	0.3961	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>		0.5728
A12	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0396</b>	0.1096	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	0.4517	
After cryostimulation												

Bold font denotes statistical significance at *p* < 0.05

tiates many processes intended to balance energy losses as various bodily functions are dependent on maintaining a constant body temperature. These thermoregulatory mechanisms are what control heat regulation within the body. The character of body surface temperature change depends on numerous factors including the ability of skin and fatty tissue to act as an isolating layer thereby influencing heat transfer, the difference between body surface temperature and the temperature of a stimulus (e.g. ambient air temperature), its duration, and also the body's individual thermoregulatory properties [11, 14].

The thermal imaging results of the study found that temperature distribution in the examined body areas prior to cryostimulation presented the highest values around the trunk area and the lowest in the lower and upper limbs. These differences were statistically significant in both age groups. The observed differences are most likely due to the anatomical features of the analysed body areas [1, 2, 15]. Skin covering areas of the body with high vascular concentration shows greater warmth than skin lying directly on bone where there is a lack of richly vascularised tissue. Additionally, the reason for such a surface temperature gradient may be also due to the body parts' thermal inertia. The limbs have a large surface area in relation to their volume, hence the greater ability to lose heat. Meanwhile, the internal organs in the trunk and abdominal cavity, which maintain core body temperature, cause these regions of the body to register higher body surface temperatures [3, 6].

The obtained results confirm the findings of other studies [2, 5, 14] and are similar to those reported by Skrzek et al. [6] on the distribution of body surface temperature in a group of healthy, middle-aged subjects, which found that the highest temperature values were observed around the shoulder area while the lowest temperatures were around the knee joints. Sobiech et al. [11] analysed the characteristics of body temperature in women aged approximately 55 years after whole body cryotherapy and found similar temperature differences in the same areas of the body. Chudecka et al. [3] and Zalewski et al. [12] also observed that the highest temperatures were in the trunk area and the lowest around the knee joints.

Comparative analysis between the two age groups found that the temperatures recorded in the areas of the shoulder and trunk were lower in all analyses in the older women (with the differences statistically significant for the posterior sections). This may be the result of the physical mechanism of normothermia, which changes with age although the scope of change varies from individual to individual. Another possible explanation is that the lower temperatures in the shoulder and trunk areas in older women are associated with the fatty tissue content most probably located in these areas of the body. This can be inferred by the statistically significantly higher values of BMI in the group of

older women, which qualified the majority of the sample as overweight. Similar findings were reported in other studies, indicating a link between body temperature in various areas of the body and BMI value and skinfold thickness [3, 6, 14]. This suggests that temperature distribution on the surface of the skin is dependent on body composition including lean and fat tissue content. Fatty tissue is a poorer conductor of heat than muscle and skin and causes body areas rich in fatty tissue to present lower temperatures [6, 12]. This was confirmed by Sobiech et al. [11], who found that body areas with greater fat content and thicker skinfold thicknesses presented lower temperature values. Similar observations in temperature changes in relation to different areas of the body were provided by Chudecka et al. [3]. Here, when comparing the distribution of body surface temperature in groups of men and women while taking into consideration body fat distribution, the authors showed that low temperature values were correlated to body areas of high fatty tissue content.

Thermographic analysis in the present study found decreases in body surface temperature in all examined areas following cryostimulation. However, heat loss was not uniform across the body. Statistical analysis indicated statistically significant temperature differences between the younger and older age groups in the areas of the lower limbs before and after cryostimulation, the shoulder (A1, A7) before and after cryostimulation, and the posterior trunk areas (A2, A8).

The study found that the younger group showed greater temperature decreases than the older group. Based on the findings of other researchers, it may be assumed that such differences between age groups may result from anatomical considerations. Additionally, this variation in body cooling may also be due to an uneven distribution of thermoreceptors on the surface of the skin. The reaction to a cold stimulus may be weakened by an uneven distribution and reduced number of receptors and also the efficiency of thermoregulatory effector mechanisms [6, 12]. In reference to other authors, it may be assumed that a stronger reaction in the area of the lower limbs and a lower temperature decrease around the trunk area in the younger age group may be the result of the increased efficiency of the circulatory system, the speed of blood flow and the thermal inertia of the mentioned areas, all of which allowed the body to react more efficiently to the extreme temperature [3, 6]. Furthermore, our findings did not confirm the notion of decreased thermoregulatory function to changes in external temperature in aged individuals. The results did not confirm concerns that advanced age is a contraindication to applying cryotherapeutic treatment.

In individuals of more advanced age, there may also be an impaired vasoconstriction response to reduced temperature. This results in higher skin heat conductivity than in younger subjects, leading to greater heat loss. This may be also associated in part with the reduced

efficiency of the circulatory system, which is controlled by the sympathetic nervous system and therefore be responsible for an incorrect information flow to regulatory centres [11, 14]. However, in our study no such adverse reactions were observed in the group of older women. It is possible that this group has not yet been experienced the full effects of the aging process or that the levels of obesity found among this group caused less intense cooling in the examined body areas.

Our study showed symmetrical temperature distribution in analogous body areas in both age groups, which also suggests the lack of disease. Other studies have also confirmed varied albeit symmetrical temperature distribution in different areas of the body [8].

This study confirmed the safe application of temperatures of  $-120^{\circ}\text{C}$  for a period of 3 minutes to aged individuals. Comparisons of the two age groups found that the younger group of women experienced greater losses in body heat. This was especially apparent in the lower limbs, with the older women featuring a significantly lower reduction in temperature, and also signifying that they are not at risk of experiencing frostbite.

Analysis of the differences in body surface temperatures among the selected body areas found that the number of disparities between both age groups was reduced following the cryostimulation treatment. Statistical analysis showed that within the 66 relationships for the 12 examined body areas, 53 relationships were significantly different in the younger group prior to cryostimulation and then 57 relationships following cryostimulation. Whereas in the older group 42 relationships were significantly different prior to cryostimulation, with 56 then observed following cryostimulation. This observation indicates the differences between the groups prior to cryostimulation and its effects on narrowing this gap between different groups.

### Conclusions

1. The results of the study show varied distribution of body surface temperature, depending on the studied area, both in young and older women.

2. Lower temperatures of the trunk and shoulders (A1, A2, A7, A8) were observed in the group of older women in comparison with the younger group.

3. Greater body cooling following cryostimulation was observed in the group of younger women particularly in the area of the lower limbs.

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### Correspondence address

Anna Skrzek  
Wydział Fizjoterapii  
Akademia Wychowania Fizycznego  
al. I.J. Paderewskiego 35  
51-612 Wrocław, Poland  
e-mail: anna.skrzek@awf.wroc.pl