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Evaluation of blood microcirculation efficiency and physiological profile in active people

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Abstract
Objective: The study aimed to assess the functional profile and establish the microcirculatory status by evaluation of the baseline biomarkers and changes in skin temperature during the local heating test, parameters measured in healthy subjects and students after physical exercise. **Materials and methods:** We examined blood pressure and applied the local heating tests to investigate the health of the microvascular system and the body's ability to adapt to environmental stressors. **Results:** The results indicate that while most individuals exhibit optimal microcirculatory parameters, lifestyle factors such as body mass index (BMI) and hydration status also play a significant role. Participants with higher BMI values showed slight increases in blood pressure. **Discussion:** Endothelial function is more stable in women, suggesting a potential protective role of hormonal or behavioral influences. **Conclusion:** The data indicate a need for proactive monitoring and health promotion, even in a young population. By identifying early deviations from the physiological norm, this study supports the prevention of long-term cardiovascular risk.

Keywords: Functional indicators, skin temperature fluctuations, wellness lifestyle, youth, higher education.

1. Introduction

This study provides explanation of how changes in the functional profile relate to skin temperature responses during local heating, emphasizing the role of microcirculation in oxygen, nutrient delivery, thermoregulation and waste products removal. Local heating tests are widely used to assess the reactivity and efficiency of the microcirculation—the network of small blood vessels responsible for delivering oxygen, nutrients, and removing metabolic by-products [1, 2]. Changes in the functional profile (emotional, mental, physical status, and self-reported well-being) often correlate with alterations in microvascular responses [3, 4]. These essential functions are mediated by a vast network of arterioles, capillaries, and venules that ensure adequate tissue perfusion and cellular homeostasis [5, 6]. Any impairment in this finely tuned system may lead to early vascular dysfunction, which often precedes overt clinical symptoms [2-4]. Hemorheology, the study of the deformation and flow properties of blood and its forming elements, is crucial for understanding microcirculatory efficiency [7-8]. Blood rheology and vascular function interact continuously to provide adequate oxygen and nutrient delivery to tissues: they should be considered in parallel [9]. Parameters such as blood and plasma viscosity, red blood cell (RBC) deformability, and aggregation are directly linked to vascular resistance, perfusion quality in impaired blood fluidity in peripheral arterial occlusive disease [10]. The results of our study revealed a parallel impairment of blood rheological parameters and skin microcirculation in patients with type 2 diabetes [11]. While changes in the functional profile and skin temperature during the local heating test were measured to identify possible signals of abnormalities. The disruption of sustainable and balanced health is often associated with daily stress, age, overweight, motivation and internal power for motor activity and sports, especially among students [12-15]. Recent studies have shown that health changes can occur very early due to improper daily nutrition, lack of motor activity and physical recovery [16-20]. Early adulthood (18–29 years) is usually

considered a physiological peak, characterised by maximum cardiovascular, respiratory and metabolic efficiency [21]. However, this age group is increasingly exposed to sedentary lifestyles, suboptimal diets, energy drinks, alcohol, vaping and irregular sleep patterns, and an increasing proportion of people with special needs [22-24]. These factors can initiate subtle but progressive alterations in blood flow properties and endothelial function, thereby increasing the long-term risks of cardiovascular disease. From a social and public health perspective, the study of functional profiles (including for the social group of people with disabilities) is of strategic importance [25-27]. But objective assessment of possible abnormalities can reveal only microcirculatory health with details. Therefore, in young people, microcirculatory and functional profiles serve as biomarkers of strategic importance for health and performance assessment. University students often represent a transitional population undergoing significant behavioral and physiological changes. Understanding their vascular profile not only provides information on early biomarkers of disease but also informs health education campaigns targeting modifiable risk factors. Promoting awareness of microvascular health may lead to more conscious lifestyle choices and thus a reduction in health burden later in life.

This study aims to assess the functional profile and establish the microcirculatory status through baseline biomarkers and skin temperature changes during the local heating test, measured parameters in healthy subjects and students. By identifying early deviations from normative values, the study aims to highlight the importance of proactive monitoring of cardiovascular health and to support the implementation of preventive strategies tailored to active populations.

2. Methods

2.1. Participants: Sample Size

Twenty-seven students (six men, 21 women) with an average age of 30.7 years, all Bulgarians, students at the National Sports Academy "V. Levski", in the academic year 2024/2025, participated in the study. They were divided into an experimental and a control group (with gender equality). Inclusion criteria: Non-smokers, without chronic diseases, BMI 18.5–24.9 kg/m². Exclusion criteria: Use of medications, history of cardiovascular/metabolic diseases.

2.2. Statistics

Correlation analysis was conducted to reveal the interdependencies between these variables. The study aimed to analyze the physiological responses associated with different basic exercises (upper and down parts of the body), to determine how intense movements affect oxygenation levels and overall cardiovascular and respiratory function. Wellness Lifestyle Index (WLI) - a composite score obtained from questionnaires assessing nutrition, sleep, physical activity and mental well-being, self-assessment diaries of the participants (via a visual scale).

2.3. Study limits

As this study is within the objectives of the Heritage BG Scientific Center of Excellence, all experts were recruited through a public announcement. Participants gave informed consent for the publication of their data. The study was conducted: from September 2023 to April 2025. Reflecting the basic principles of a Wellness lifestyle, we present the following interpretation of the “Wellness types” structure (see Fig. 1):



Fig. 1. The "Wellness types" structure

2.4. Measurements

2.4.1. Measurement of the biological and emotional markers

To assess and analyse mental and spiritual wellness we selected the emotional states which reflect to the life satisfaction. In this context the process refers to a judgmental evaluation of one's life based on their own standards. The scale is subjective, but personalised tool to register the emotional aspects of life satisfaction and does not focus on specific domains such as career or relationships. This instrument captures a broad, reflective judgement that allows one to weigh different aspects of life according to their own unique, personal criteria of what makes a good life. (see Fig. 2).

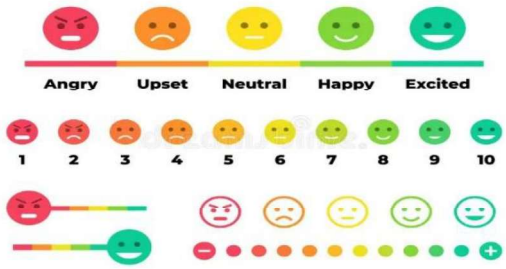


Fig. 2. The satisfaction personalised scale (1 to 10)

The following methods for recording biomarkers were used in our study: The Santa medical fingertip pulse oximeter is a clinically validated device designed for the non-invasive measurement of arterial blood oxygen saturation (SpO_2), pulse rate, and pulse intensity. Data are presented via a high-contrast digital LED display, allowing for rapid visualisation. The A&D Medical oscillometer was used for non-invasive blood pressure monitoring to obtain precise measurements of systolic and diastolic blood pressure. This apparatus demonstrated the highest measurement fidelity, with deviations limited to ±1 mmHg from reference standards.

2.4.2. Measurements, utilising local heating test

The changes in the skin temperature during the local heating test were measured with the Microtest LTH-100WF device (FM diagnostics, Perm, Russia). The skin temperature was measured on the palm surface of the distal phalanx of the second (index) finger with a temperature sensor [8,9]. The investigation of skin temperature has generally been conducted at ambient environmental temperature of 22 °C ± 1 °C. The subjects were lightly clothed and in a supine position. Depending on the applied functional test, the

experiment lasted a different time.

The Microtest LTH-100WF device consisted of a built-in miniature resistance heater mounted outside the temperature sensor in the same plastic housing. Once the heating element was turned on and reached a steady state, the thermal equilibrium between the heater, the sensor and the top layer of the skin was established. Skin temperature measurements were carried out continuously for 25 min. Approximately 10 -15 minutes during the local heating test, while heater reached the temperature of about 40 ± 0.7 °C and then 10 min after the local heating. The MT Handler program was used to process the signals of the skin temperature by applying the WAST method.

The study included an NSA group of 14 students (n=14; 10 women and 4 men, mean age 30,69±13,19 years and mean weight 70,46±12,07 kg. Their experimental data were compared with a control group of totals of 15 healthy subjects (12 women and 3 men, mean age 54.9±7.96 years).

Comparisons between groups examined were performed by the t-test for group means, followed by the non-paired Mann-Whitney U-test. Differences were considered significant when $p < 0.05$.

All the participants gave and signed informed consent prior to participation in the study.

3. Results

3.1. Functional and emotional Wellness Monitoring

Beyond sex-related differences, a notable pattern emerged in the variation coefficients: active individuals whose blood pressure approached the upper limit of the normal range tended to exhibit higher microcirculatory efficiency, reflected in their baseline functional biomarkers and in the skin-temperature responses during the local heating test. The interpretation and relevance of these indicators in healthy, physically active individuals suggest that blood flow and microcirculation operate at near-optimal performance levels. The interpretation and relevance of these indicators for healthy active individuals reflect blood flow and microcirculation, which are usually at peak performance (see Table 1).

Table 1
Full Variation coefficients represent the relationships between the recorded indicators.

Indicators	Mean	SD	Variance	CV (%)	Skewness	Kurtosis
Oxygen (%)	94.5	1.299	1.667	1.363	0	-1.36
Temp1 (C°)	36.1	0.182	0.033	0.554	8.1E-14	-1.64
Temp2 (C°)	36.4	0.184	0.034	0.501	-8.1E-14	-1.64
Room Temp (C°)	23.65	1.286	1.656	5.442	-0.519	-0.942
Diastolic BP	118.75	10.345	106.917	8.707	0.095	-1.826
Systolic BP	82.75	4.5	20.25	5.438	0.728	-1.069
Pulse (bpm)	105.25	43.645	1904.917	41.468	0.131	-1.791
Emotion (points)	4.25	0.957427	0.916667	22.5277	-0.49338	-1.3719
Physical (points)	4.125	1.030776	1.0625	24.98852	-0.11532	-1.84775

Below is an analysis of the variation statistics we provided in Table 1. It interprets mean levels, dispersion, coefficient of variation, and the shape of distributions (skewness, kurtosis) for each indicator:
Most stable indicators: Oxygen saturation and skin temperatures (Temp1 and Temp2) showed exceptionally low variability, demonstrating strong physiological homeostasis, but it changed after the Wellness exercises. Baseline skin temperature was extremely stable, reflecting well-regulated thermoregulatory function. The low standard deviation (SD = 1.299) showed minimal fluctuation. For body temperature, the standard deviation (SD) had very small spread (0.182). Skewness and Kurtosis: Near zero skewness (symmetric); negative kurtosis suggests a flatter distribution (see Fig. 3).

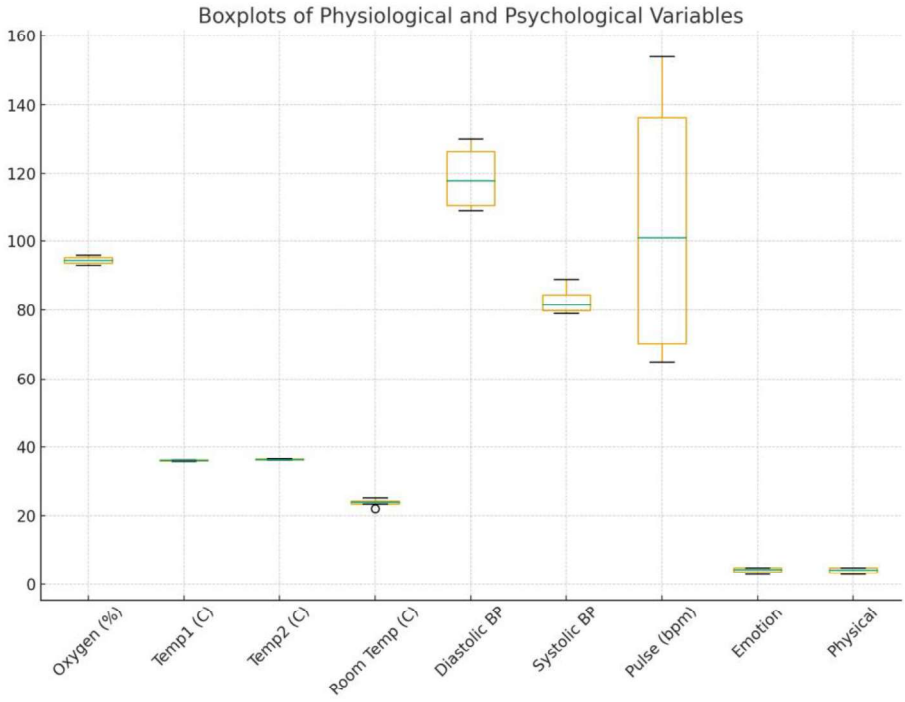


Fig. 3. Visualisation of biomarker data using boxplots based on variation statistics

The Diastolic Blood Pressure (DBP mean: 118.75 mmHg; SD: 10.345; CV = 8.7%) marks slight positive Skewness values and strongly negative kurtosis (flat distribution). Diastolic BP varies moderately. Some values approach the upper normal limit, consistent with increased cardiovascular activation during exercise. The Systolic Blood Pressure (SBP mean: 82.75 mmHg; SD: 4.5; CV = 5.44%; Skewness: 0.728 (right-skewed)—higher values appear more frequently; Kurtosis: −1.069 (flat distribution). The interpretation of data guide to moderate variability with a tendency towards higher systolic pressures, reflecting normal cardiovascular response to physical exertion. The data for the heart frequencies: Pulse (bpm) mean: 105.25 bpm; SD: 43.645 had very high variation. The skewness/kurtosis values were near-symmetric but highly platykurtic. The data interpretation indicates that the pulse rate is the most variable indicator, influenced by rest vs. post-exercise conditions—expected in a protocol including exertion tests. Moderately variable indicators: Blood pressure values vary within expected physiological ranges. Most variable parameter: Pulse rate (CV > 40%) clearly reflected rest vs. post-exercise differences. Psychophysiological indicators: Emotion and Physical status showed moderate variability, consistent with subjective responses to physical load.

3.2. Analysis of Significant Relationships

Low blood viscosity and high RBC flexibility allow for efficient oxygen and nutrients delivery. Endothelial function is usually intact, promoting proper vessel dilation and immune regulation. The potential risk factors in this age group are smoking, sedentary behavior and poor diet, which can impair hemorheological properties early. Obesity and early metabolic syndrome may increase blood viscosity and reduce microcirculatory efficiency. Chronic stress can disrupt endothelial function, increasing cardiovascular risk. (see Table 2; Fig. 4)

Oxygen (O_2): Strong negative correlation with room temperature (-0.762) and pulse rate (-0.746). Higher oxygen saturation is associated with lower room temperature and lower pulse rate, indicating better physiological adaptation. Positive correlation with physical condition (0.629), suggesting that higher oxygen levels are a marker of improved physical well-being.

Table 2
Correlation coefficients represent the relationships between the recorded indicators.

Index	Oxygen (%)	Temp.1 (C°)	Temp.2 (C°)	Room Temp (C°)	Diastolic BP	Systolic BP	Pulse (bpm)	Emotion	Physical
Oxygen (%)	1								
Temp1 (C°)	0,464	1							
Temp2 (C°)	0,435	0,216	1						
Room Temp (C°)	-0,762	-0,4681	-0,025	1					
Diastolic BP	-0,082	0,575	-0,468	-0,392	1				
Systolic BP	-0,346	0,242	-0,617	-0,124	0,707	1			
Pulse (bpm)	-0,746	-0,533	-0,495	0,436	0,261	0,365	1		
Emotion (points)	0, 277	0, 395	0, 452	0, 077	0, 092	0, 123	0, 028	1	
Physical (points)	0,629	0,607	0,403	-0,602	0,094	-0,069	-0,827	0, 078	1

Blood Pressure: Diastolic (DBP) and systolic (SBP) blood pressure show a strong positive correlation (0.707). DBP is positively related to body temperature (0.575), suggesting a physiological thermoregulatory response.
Pulse Rate: Strong negative correlation with physical condition (-0.827). A lower pulse is indicative of better physical fitness and well-being. It also shows a negative relationship with oxygen saturation (-0.746).
Emotional State: Positive correlation with body temperature (t°2: 0.452), indicating a possible link between psycho-emotional status and physiological responses.
Physical Selfness: Strongly correlated with oxygen (0.629) and body temperature t°1 (0.607). Strong negative correlation with pulse rate (-0.827). The data indicate that better physical and emotional condition is associated with higher oxygen saturation, lower pulse rate, moderate body temperature, and lower ambient temperature. These results support the view that Wellness & Spa practices that regulate temperature, breathing, and physiological balance may have a positive impact on overall health and well-being.

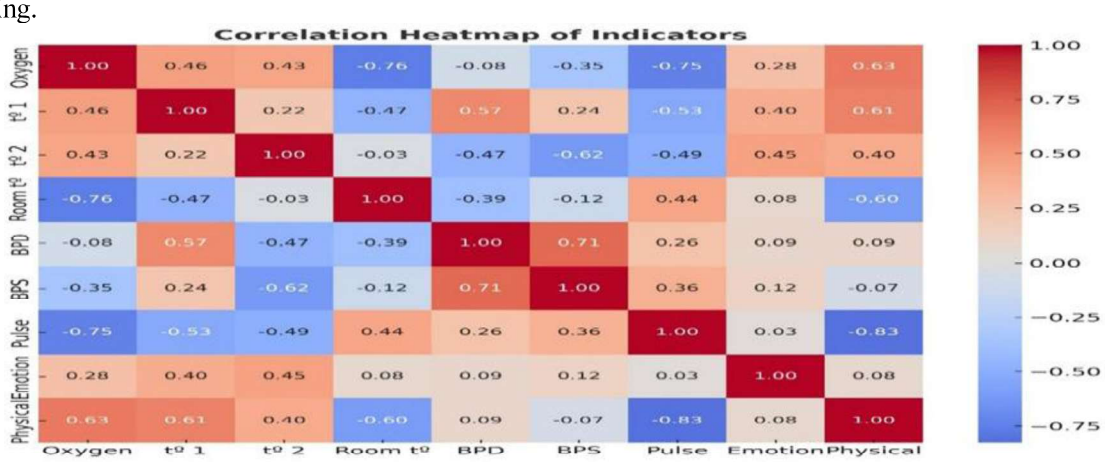


Fig. 4. Heatmap of Correlations between Indicators (from -0.75 to 1.00)

Health Significance: Maintaining optimal microcirculation is essential for brain function and cognitive abilities, muscle performance and recovery, immune response efficiency and long-term cardiovascular health.

3.3. Results of the assessment of microvascular tone regulation in the two studied groups.

The data obtained from the Microtest LTH-100WF device ("FM-Diagnostics", Perm, Russia) are presented in Table 5. Two groups were studied, and the measurement was carried out under different conditions. The measurements in the NSA group of students were made after light physical exertion (exercises for arms,

legs, and push-ups) in a supine position. The examined subjects in the control group do not perform any physical exercises before the investigation. The data in the two control groups were compared. In the range of skin blood flow oscillations, three subranges were analyzed, reflecting different factors for regulating vascular tone: myogenic oscillations (0.05–0.14 Hz), neurogenic activity (0.02-0.05 Hz) and endothelial mechanisms (0.0095-0.02 Hz). Using a functional test for local heating, the regulation of microvascular tone in both studied groups was evaluated. Statistical data processing was performed using Sigma Plot 11.0. The Mann-Whitney U nonparametric statistical test was used to compare the results of two groups. All values were compared and analyzed at $p < 0.05$, which allowed us to conclude that there was a statistically significant difference between the groups. The results are presented as mean values and standard deviation (± SD) (see Table 3).

Table 3

Average values and standard deviations of the root mean square values of the amplitude of oscillations of the skin temperature in endothelial (RMSe), neurogenic (RMSn) and myogenic (RMSm) frequency bands during (1) and after (2) local heating in both studied groups (NSA and controls).

Oscillation range	Group	During local heating (mean ± SD)	After local heating (mean ± SD)
Endothelial (*10^{-3}) RMSe	NSA	21,3±9,62 (n=12)	7,93±5,56(n=11)
	Controls	27,6 ±9,15(n=12)	5,42 ± 1,79 (n=14)
Neurogenic (*10^{-3}) RMSn	NSA	12,6 ±1,38 (n=11)	5,09±3,28** (n=12)
	Controls	15,2±4,03 (n=10)	2,76 ± 1,3 (n=16)
Myogenic (* 10^{-3}) RMSm	NSA	6,64±2,68 ***(n=13)	2,49±0,99 *(n=10)
	Controls	2.88 ± 1,74 (n=16)	0,51± 0.16 (n=10)

The statistical significance for the individual frequency ranges between the two groups (NSA and Controls): *p=0,001, ** p=0,003, ***p=0,028.

The results from Table 3 are presented through box-plot diagrams (Fig. 5). The diagrams present the root mean square values of the amplitude of skin temperature fluctuations during local heating and after its completion in three frequences ranges of microvascular tonus regulation.

The results from Table 3 and Fig.5 show that no significant differences in the amplitudes of oscillations were observed in the endothelial frequency range (a) during the local heating test and after the cessation of the heat stimulus, although the mean values in group 1 after the cessation of the heat stimulus were higher than those in group 2. A significant difference between group 1 and group 2 (p=0.003) was found in the neurogenic frequency range (b) after the cessation of the heat stimulus. In the myogenic frequency range, significant differences were observed between the two studied groups both during the application of the heat stimulus (p=0.028) and after its cessation (p=0.001).

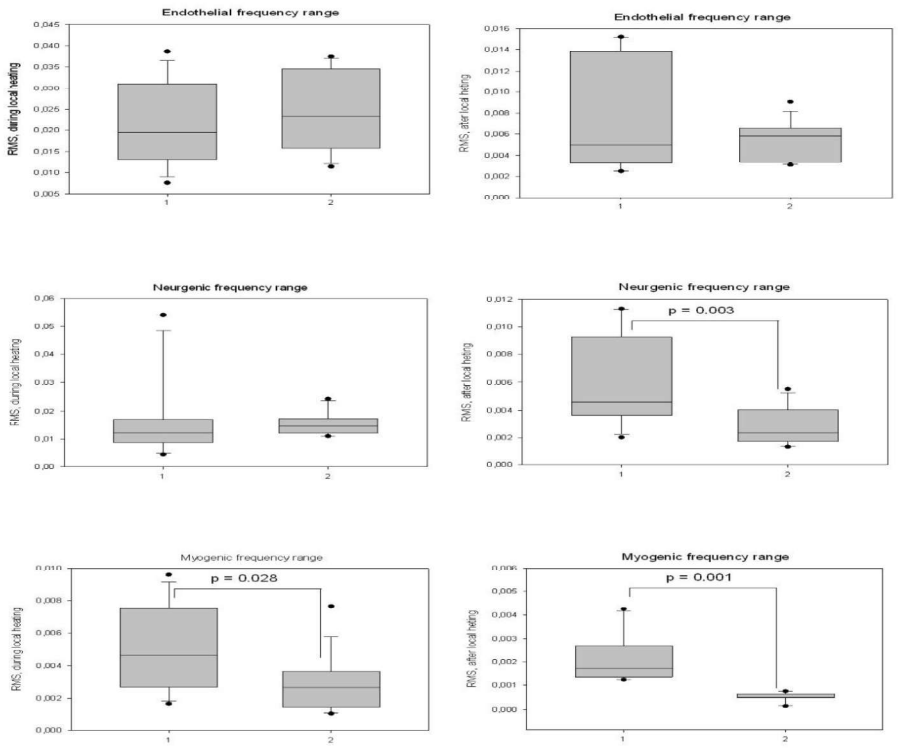


Fig. 5. Box-plot diagrams of the comparison of the root mean square values of the amplitude of skin temperature fluctuations in: (a) endothelial (1- NSA, 2- Controls), (b) neurogenic (1- NSA, 2- Controls) and (c) myogenic (1- NSA, 2- Controls) frequency range during local heating and after local heating for the two studied control groups (1- NSA, 2- Controls).

4. Discussion

Sustainable health of body and mind is equivalent to a balanced functional profile, and it is directly proportional to lifestyle: nutrition, stress, physical activity, adaptation to different social categories. Another dimension of interpretation involves the broader role of psychological stress and its downstream effects on microvascular health. Students experiencing chronic academic or personal stress have been shown in other studies to have reduced nitric oxide bioavailability and impaired vasodilation [1-5].

This could help explain outliers with reduced root mean square values of the skin oscillations amplitude for the temperature fluctuations in neurogenic (RMSn) frequency bands despite otherwise normal physiological markers. Incorporating stress management techniques may be a valuable addition to preventive interventions. Additionally, hydration status was an uncontrolled but acknowledged variable that could affect skin oscillations amplitude positively. Mild dehydration, which is common among students, especially those who consume caffeine and alcohol regularly, can lead to transient increases in blood pressure. Future studies could control hydration to more accurately isolate lifestyle and metabolic influences. Finally, the application of these findings should extend beyond health prevention for Wellness lifestyle. Recreation wellness programs and institutional wellness initiatives could leverage micro-circulatory screening as a motivational tool for active adults. Personalized feedback based on regular Wellness activities and good hydration might encourage adherence to healthier routines. In summary, the present findings build a compelling case for incorporating microvascular assessments into preventive health strategies for active adults. The subtle early changes observed reinforce the concept that the microcirculatory status and the changes in skin temperature during a local heating test can begin well before clinical symptoms emerge. The healthy aging process includes emphasizing the need for early prevention

by detecting changes related to skin temperature responses (during local heating,) emphasizing the role of microcirculation in oxygen, nutrient delivery, thermoregulation, and toxic removal.

5. Conclusions

The study highlights the utility of integrating microcirculatory assessments into routine health checkups for students and active adults. With early identification of microcirculatory and functional profiles, individuals can adopt individually tailored lifestyle modifications that may significantly reduce long-term risks for cardiovascular and metabolic diseases. The findings reinforce that proactive care during early adulthood offers a critical window for long-term health preservation, making microcirculatory health a promising focus for future screening, public health and wellness programs. Preventive strategies targeting nutrition, exercise, stress management, and hydration should be emphasised during this stage of life.

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References

[1] Roberts, K.A., van Gent T, Hopkins N.D., Jones H., Dawson E.A., Draijer, R., Carter, H.H., Atkinson C.L., Green D.J., Thijssen, D.H.J., Low, D.A., 2017. Reproducibility of four frequently used local heating protocols to assess cutaneous microvascular function. Microvasc Res.,112:65-71. doi: 10.1016/j.mvr.2017.03.005.

[2] Paskova, V., Antonova, N., Velcheva, I., Chaushev, N., Chalakov, H., 2020. Skin blood flow regulation mechanisms in patients with Diabetes mellitus type 2, Series on Biomechanics, 34, 3, 37- 42

[3] Parshakov, A., Zubareva, N., Podtaev, S., Frick, P., 2017. Local Heating Test for Detection of Microcirculation Abnormalities in Patients with Diabetes-Related Foot Complications. Advances in Skin & Wound Care 30, 4, 158-166, DOI: 10.1097/01.ASW.0000508635.06240.c9

[4] Smirnova, E., Shulkina , S., Loran , E., Podtaev, S., Antonova, N., 2018. Relationship between skin blood flow regulation mechanisms and vascular endothelial growth factor in patients with metabolic syndrome. Clinical Hemorheology and Microcirculation 70, 2018, 129–142, DOI 10.3233/CH-170247

[5] Singh Sara, J. D., Toya, T., Ahmad, A., Clark, M. M., Gilliam, W. P., Lerman, L. O., Lerman, A., 2022. Mental Stress and Its Effects on Vascular Health. *Mayo* Clinic Proceedings, 97, 5, 951. https://doi.org/10.1016/j.mayocp.2022.02.004

[6] Celermajer, D. S., Sorensen, K. E., Gooch, V. M., Spiegelhalter, D. J., Miller, O. I., Sullivan, I. D., Lloyd, J. K., Deanfield, J. E., 1992. Non-invasive detection of endothelial dysfunction in children and adults. The Lancet, 340, 8828, 1111–1115.

[7] Dintenfass, L., 1985. Rheology of blood in diagnostic and preventive medicine. Butterworth-Heinemann, 29-40.

[8] Baskurt, O. K., Meiselman, H. J. 2003. Blood rheology and hemodynamics. Seminars in Thrombosis and Hemostasis, 29, 5, 435–450.

[9] Antonova, N., Ivanov, I., 2023. Methods for assessing microcirculatory, hemorheological changes and oxygen transport in athletes of various sports disciplines. In Proceedings of the XXIV Scientific Conference „FIS Communications 2023 in physical education, sport and recreation, 197-204, University of Niš, Faculty of Sport and Physical Education, Niš, Serbia.

[10] Volkova, E., Zamyshlyaev, A., Tikhomirova, I., Kolobanov, A., Gerasenkov, V., Muravyov, A., Antonova, N., Velcheva, I., 2024. The contribution of red blood cell microrheological characteristics to impaired blood fluidity in peripheral arterial occlusive disease (PAOD) and their correction with gasotransmitters. Series on Biomechanics,38, 2,3-10, DOI: 10.7546/SB.01.02.2024

[11] Antonova, N, I. Velcheva, Paskova, V., 2022. Hemorheological and microvascular disturbances in patients with

type 2 diabetes mellitus. Clinical Hemorheology and Microcirculation, 81, 4, DOI:10.3233/CH-221393, 325-341.
[12] Angelcheva, M., S. Petkova, 2019. Effects of combination between relax massage and Dr Bach flower remedies on everyday stress. In Proceedings of the International Scientific Congress Applied Sports Sciences, Balkan Scientific Congress Physical Education, Sports, Health, 348-352, National Sport Academy Press, Sofia.
[13] Nesheva I., O. Bozhkova, 2025. Implementing a Wellness program to overweight students and working people through training in the methodology. Strategies for Policy in Science and Education, Spets. izd. Year XXXIII, 33, 2, 99-108.
[14] Dimitrova N., 2017. The factor motivation for judo training with children. International Journal of Kinesiology and Other Related Sciences. Researching in Kinesiology. 45, 2, 161 - 163;
[15] Dimitrova, N., 2019. Resistance while managing its own inertial power field. Trakia Journal of Sciences, 17, 1, 631 – 634.
[16] Polimenov, M., 2025. Referentsii kŭm sistemata na profesionalno obrazovanie i obuchenie v sektor turizŭm. [In Bulgarian]. Strategii na obrazovatelnata i nauchnata politika. 33, 2, 187-195.
[17] Polimenov, M., 2025. Transfer of innovation in service technology for increasing the restaurant quality product. International Scientific journal Smart Innovations in Recreational, Wellness Industry and Niche Tourism. 1, 2, 29 – 35.
[18] Tomova, T. 2024. Modeling rituals through combined Wellness Influences International Scientific journal Smart Innovations in Recreational, Wellness Industry and Niche Tourism, 6, 2, 15-24.
[19] Tomova, T., 2025. The impact of manual Wellness therapies and body massage - a stress relief effect. German International Journal of Modern Science, 105, 23-27.
[20] Popova-Dobreva, D., 2022. Uelnes inovatsii i dobri aromaterapevtichni praktiki v Bŭlgariya. [In Bulgarian]. Sdruzhenie Tsentŭr za vŭrkhovi postizheniya Nasledstvo BG. Nauchni Izvestiya, II, 3, 2, 98-104.
[21] Nesheva, I., 2023. A wellness tool to perform healthy lifestyle practices In the Bulgarian school system. Journal, Strategies for policy in science and education 31, 5, 560-572.
[22] Angelcheva, M., 2017. Extracurricular sport activities and institutionalized children. socialisation effects. In Proceedings of the International. Scientific Congress Applied Sports Sciences. National Sport Academy Press, Sofia 333-336.
[23] Aleksandrova, V., 2000. The effect of swimming on health and physical activity in children with visual disabilities - Journal of Environmental Protection and Ecology, 2, 22, 847-857.
[24] Dimitrova, N., 2019. Reactions of the motor system in local and global activities. Trakia Journal of Sciences, 17, 1, 635 – 637.
[25] Aleksandrova, V., 2021. Adapted swimming for children with disabilities (Adaptirano pluvane za detsa s uvrezhdaniya) Monography, 56-73, ISBN 978-954-718-659-0 1-188. [In Bulgarian]. Scientific Publishing House NSA Press, Sofia.
[26] Dimitrova, N., 2025. Specificity of balance in disposal (weightlifting). German International Journal of Modern Science,102, 63-66.
[27] Dimitrova, N., 2020. Control of the spatial structure in preschool children. Trakia Journal of Sciences, 18, 1, 854 – 856.

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