

Publication date: 01.03.2024  
DOI: 10.24412/2782-6570-2024\_03\_01\_5  
UDC 712; 551.58; 796.5

## DEVELOPMENT AND SCIENTIFIC SUBSTANTIATION OF THE ORION NO. 1 TERRAIN CURE ROUTE OF THE ORION ATHLETE REHABILITATION AND RECOVERY CENTER IN KISLOVODSK

L.N. Odrova, G.N. Ter-Akopov, A.P. Tychinina, S.V. Nopin

FSBI "North-Caucasian Federal Research and Clinical Center of the Federal Medical and Biological Agency", Essentuki, Russia

**Abstract.** Aim of the study – the development and scientific substantiation of the Orion No. 1 terrain cure route of the Orion athlete rehabilitation and recovery center in Kislovodsk. The research materials included the results of bioclimatic route monitoring on the Orion No 1 route, as well as reference materials of meteorological observations at the meteorological site in the Kislovodsky National Park for 2023, guiding documents, and scientific articles. The conducted research demonstrated that the integral index of bioclimatic potential (K(BKP)) on the Orion No. 1 route amounted to 2.23 points out of 3.0 possible. Consequently, the developed Orion No. 1 terrain cure route corresponds to a high functional suitability for the arrangement of climate treatment of athletes, favorable conditions for their recreation and recovery.

**Keywords:** terrain cure path, bioclimatic potential, athletes, rehabilitation, recovery.

**Introduction.** Modern recreational medicine is characterized by a variety of therapeutic physical culture methods, one of which is terrain cure. Terrain cure is a comprehensive concept based on scientific substantiation of the therapeutic walking method, effect of which may be enhanced by additional effects of the territory, such as climate [1]. Walking is a simple, accessible and familiar movement. This fact makes it possible to widely use terrain cure from the first days of rehabilitation and recovery of athletes, without spending a lot of time on learning the correct technique of walking through therapeutic routes and immediately receiving a positive effect [2]. Controlled walking increases endurance, function of the cardiovascular system, respiratory organs, improves work of the musculoskeletal system, recovers tone of vessels and muscles, improves mental state, metabolism, hardens a body, is considered as the prevention of various diseases [3].

For athletes going through rehabilitation in the Orion center, presence of terrain cures that start from the center itself is an effective, safe and pleasant way to recover and improve health.

Aim of the study: the development and scientific substantiation of the Orion No. 1 terrain cure route of the Orion athlete rehabilitation and recovery center in Kislovodsk.

**Methods and organization.** Materials of the study included bioclimatic route monitoring on the Orion No. 1 route, as well as reference materials of meteorological observations at the meteorological site in the Kislovodsky National Park for 2023, guiding documents, and scientific articles.

The study included bioclimatic monitoring of the Orion No. 1 route, comprehensive analysis method and model of climate evaluation for athlete rehabilitation and recovery.

The terrain cure bioclimatic monitoring was carried out from February 20 to February 22, 2024. The research program included measurements of the concentration of positive and negative light air ions (with mobility  $K > 0.5 \text{ cm}^2/\text{V}\cdot\text{s}$ ), the number of aerosol particles of different size gradations (8 gradations in the range from 0.2 to 10  $\mu\text{m}$ ) in the surface atmosphere (at the breathing level of 1.5 m), registration of air temperature, humidity and pressure, oxygen and carbon dioxide content in

the air, illumination level in the open place and under the tree crown, ambient dose equivalent power (ADEP) of gamma radiation.

The assessment of bioclimatic potential was done with the bioclimatic component comprehensive analysis (weather element modules, solar radiation mode, circulation mode, humidity mode, natural air ionization mode) of the given territory according to the method [4-5] with the allocation of categories of their suitability for climate therapy for athletes according to the gradations accepted in balneology on the basis of the impact of bioclimatic components on the adaptation systems of a body:

- irritating (unfavorable) – 0 points;
- training (relatively favorable) – 1 point;
- sparingly training (favorable) – 2 points;
- sparing (especially favorable) – 3 points.

Following devices were used in the study: MAC-01 light-sized air ion counter (State Register of measuring instruments No 20429-11), RadiaSkan-801 radiation dosimeter (State Register of measuring instruments No 69478-17), SACHM 4801-01 aerosol analyzer, a mobile version (State Register of measuring instruments No 676936-19-19), DT-1309 light meter,

IKV-8 air quality monitor (State Register of measuring instruments No 71394-18), and Polar V800 heart rate monitor.

**Results and discussion.** The Orion No. 1 terrain cure route is an easy and short route alongside the bank of the Olkhovka River. Its length is 1300 m, height difference is from 0 to 14 m, and the angle of ascent does not exceed 4°. In some places the path is flat, in other places it goes down. The approximate time of the route is 20-30 minutes. The terrain cure route starts and ends at the entrance to the Orion athlete rehabilitation and recovery center in the lower part of the Kislovodsky National Park. The route follows the bank of the Olkhovka River past the Mirror Pond, Crystal Spring, not reaching the Colonnade, turns in the opposite direction on the bridge. The route continues along the bank of the Olkhovka River, past the Flower Calendar, crosses the river through the bridge next to the Glass Jet and returns to the starting point. The route description is presented in a form of coordinates of terrain cure stations (TS) in table 1 and graphically in figure 1.

Table 1

Orion No. 1 terrain cure station (TS) scheme

| № TS          | Location description    | N. latitude/<br>E. longitude, | Altitude<br>ASL, m | Mean HR,<br>beats/min | Average<br>speed,<br>km/h | Max HR,<br>beats/<br>min |
|---------------|-------------------------|-------------------------------|--------------------|-----------------------|---------------------------|--------------------------|
| TS-1          | Clinic exit,<br>descent | 43.89308/<br>42.71997         | 858                | 83                    | -                         | -                        |
| TS-2          | Bridge, flat area       | 43.89763/<br>42.71748         | 844                | 89                    | 5.3                       | 102                      |
| TS-3          | Bridge, ascent          | 42.89444/<br>42.72032         | 849                | 95                    | 4.3                       | 103                      |
| TS-4/<br>TS-1 | Clinic entrance         | 43.89308/<br>42.71997         | 858                | 100                   | 4,6                       | 112                      |

Note: ASL – above sea level; HR – heart rate. The calculation was carried out for a woman, age – 31 years; body length – 165 cm; body mass – 56 kg. The average and maximum values were registered in the period between terrain cure stations. TS-4 and TS-1 coincide, as the route is circular.

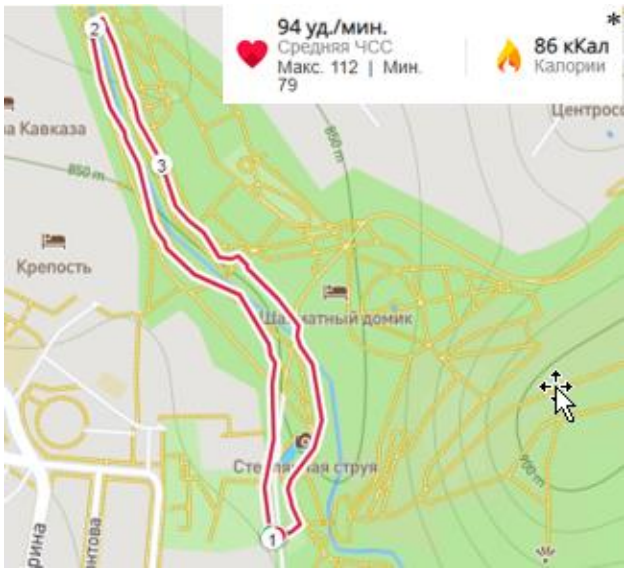


Fig. 1. Scheme of the Orion No. 1 terrain cure route

Energy expenditure during walking on the route amounted to 86 kcal. The calculation was performed for a 31-year-old woman, height – 165 cm, weight – 56 kg, walking at an average speed of 4.86 km/hour. Walking was performed in heart rate zone № 1 (light activity zone) and heart rate zone № 2 (aerobic I, lipid).

According to the data of reconnaissance surveys on the Orion No. 1 route, 3 sample areas (SA) for microbiological studies were registered, their location is shown in table 2. Bioclimatic features of the Orion No. 1 route are shown in table 3. The obtained data indicate their uniformity over the entire route.

Table 2

Reconnaissance scheme of the Orion No. 1 terrain cure route

| №SA  | Location description  | North latitude, degrees | East longitude, degrees | Altitude above sea level, m |
|------|-----------------------|-------------------------|-------------------------|-----------------------------|
| SA-1 | Glass Jet             | 43.89344                | 42.72052                | 845                         |
| SA-2 | Olkhovka River Valley | 43.89790                | 42.71761                | 827                         |
| SA-3 | Flower Calendar       | 43.89687                | 42.71853                | 837                         |

Note: SA – sample area

Table 3

Bioclimatic features of the Orion No. 1 terrain cure route

| №SA  | Bioclimate indices |       |         |                    |                       |                                    |           |                  |
|------|--------------------|-------|---------|--------------------|-----------------------|------------------------------------|-----------|------------------|
|      | T, °C              | RH, % | AP, hPa | O <sub>2</sub> , % | CO <sub>2</sub> , ppm | $\sum[(N-)+(N+)]$ /IUC, background | K/O, klx  | ADEP, $\mu$ Sv/h |
| SA-1 | 1.2                | 80    | 693     | 21.53              | 477.5                 | 680/0.28                           | 1,56/5.42 | 0.09             |
| SA-2 | 1.2                | 82.5  | 694     | 21.79              | 477                   | 560/0.6                            | ns/4.49   | 0,08             |
| SA-3 | 1.75               | 82.5  | 694     | 21.77              | 470.5                 | 520/0.49                           | ns/5.08   | 0.09             |

Note: SA – sample area; T, °C – air temperature; RH, % – relative humidity; O<sub>2</sub>, % – relative oxygen content in the air; CO<sub>2</sub>, ppm – relative carbon dioxide content in the air, number of units/million; AP, hPa – air pressure;  $\sum[(-)+(+)]$ /IUC (ion unipolarity coefficient) – air ionization background on the SA, ion/cm<sup>3</sup>; O/T – illuminance (klx), in the open (O), and under the tree crown (T), ns – no shadow; ADEP,  $\mu$ Sv/h – ambient dose equivalent power

The air of the Orion No. 1 route is saturated with oxygen. Its content amounted to 21.53-21.77% with the norm of 21%. The content of carbon dioxide slightly exceeded the generally accepted standard: 470.5-477.5 ppm (number of units/million) with the norm for the open area of 450 ppm, which may be due to the proximity of the route to urban infrastructure.

Air ion levels on the route is characterized by its high quality. The sum of negative and positive ions amounted to 520-680 ion/cm<sup>3</sup> with low ion unipolarity coefficient (IUC): 0.28-0.49.

Radiation levels on the route is safe, the obtained values of 0.08-0.09 µSv/h are significantly lower than the standard of 0.5 µSv/h.

Another important parameter of air purity is the level of aerosol particles of the surface

layer of the atmosphere in the size range from 0.2 to 10 µm. On the route this index ranges from 49769 (paving stone section) to 55616 (unpaved section) particles/l (table 4).

The level of biologically significant aerosol concentration in the particle size range from 0.5 to 1 µm was slightly exceeded at the 2 sites of high tourist interest (3169 and 3175 particles/l). At the less active site, concentration of this type of aerosol was below 3000 particles/l (2846 particles/l) (table 4).

The bioclimatic potential of the Orion No. 1 terrain cure route was studied according to the following climate-forming factors: modules of weather element, solar radiation mode, circulation mode, humidity mode, natural air ionization mode [6-8]. The obtained results are presented in table 5.

Table 4

Surface atmosphere aerosol pollution on the Orion No. 1 terrain cure route

| № SA | SA name               | Aerosol concentration 0.2-10 µm, particles/l | Aerosol concentration 0.5-1 µm, particles/l |
|------|-----------------------|----------------------------------------------|---------------------------------------------|
| SA-1 | Glass Jet             | 49769                                        | 3175                                        |
| SA-2 | Olkhovka River Valley | 55616                                        | 2846                                        |
| SA-3 | Flower Calendar       | 51415                                        | 3169                                        |

Table 5

Bioclimatic potential of the Orion No. 1 route

| Microbioclimatic modules                                                                   | Value | Category of medical and climatic conditions | Rate, points |
|--------------------------------------------------------------------------------------------|-------|---------------------------------------------|--------------|
| 1. Weather element modules ( $k_1/n = 31/13 = 2.38$ )                                      |       |                                             |              |
| Number of days per year with comfortable conditions at noon, EET 12-24 c.d.                | 153   | especially favorable                        | 3            |
| Duration of summer period (EET>15 c.d.), days                                              | 95    | favorable                                   | 2            |
| Duration of winter period (EET below -0 c.d.)                                              | 102   | relatively favorable                        | 1            |
| Duration of frost-free period, days                                                        | 258   | especially favorable                        | 3            |
| Number of days per year with severe weather (EET below -10 c.d.)                           | 18    | especially favorable                        | 3            |
| Number of days per year with recreationally favorable weather (EET between 0 and +24 c.d.) | 264   | especially favorable                        | 3            |
| Number of days per year with hot weather (EET>24 c.d.)                                     | 0     | especially favorable                        | 3            |
| Average monthly air temperature in July, °C                                                | 19.1  | especially favorable                        | 3            |

Table 5 (continued)

|                                                                                                                                                                                        |          |                      |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------|---|
| Average monthly air temperature in January, °C                                                                                                                                         | -2.9     | especially favorable | 3 |
| Average annual air temperature, °C                                                                                                                                                     | 9.4      | favorable            | 2 |
| Number of days per year with $\geq 1$ mm precipitation                                                                                                                                 | 130      | unfavorable          | 0 |
| Absolute maximum air temperature, °C                                                                                                                                                   | 32.7     | favorable            | 2 |
| Absolute minimum air temperature, °C                                                                                                                                                   | -15.5    | especially favorable | 3 |
| 2. Solar radiation mode modules (SRM) ( $k_2/n = 4/2 = 2$ )                                                                                                                            |          |                      |   |
| Gradation of solar radiation's biological effect by UVI value and degree of potential danger of damaging effect of UV solar radiation in winter at noon, c.u.                          | 0-2      | especially favorable | 3 |
| UVI limits from May to August before noon from 06 to 10 hours and after noon from 16 to 19 hours                                                                                       | 0-5.2    | relatively favorable | 1 |
| 3. Circulation mode modules (CM) ( $k_3/n = 8/3 = 2.67$ )                                                                                                                              |          |                      |   |
| Number of days with strong wind ( $>15$ m/s) per year                                                                                                                                  | 8        | favorable            | 2 |
| Average monthly wind speed in summer, m/s                                                                                                                                              | 1.31     | especially favorable | 3 |
| Average monthly wind speed in winter, m/s                                                                                                                                              | 1.93     | especially favorable | 3 |
| 4. Air humidity mode modules (AHM) ( $k_4/n = 11/4 = 2.75$ )                                                                                                                           |          |                      |   |
| Number of days with relative humidity values below 30% per year                                                                                                                        | 0        | especially favorable | 3 |
| Average annual relative humidity, %                                                                                                                                                    | 75.5     | favorable            | 2 |
| Average monthly relative humidity at 1 p.m. in July, %                                                                                                                                 | 57       | especially favorable | 3 |
| Average monthly relative humidity at 1 p.m. in January, %                                                                                                                              | 55.5     | especially favorable | 3 |
| 5. Natural air ionization modules ( $K_5/n = 4/3 = 1.3$ )                                                                                                                              |          |                      |   |
| Number of positive light air ions (with mobility $>0.5/\text{cm}^2/\text{V}\cdot\text{s}$ ) in the surface atmosphere, $\text{ion}/\text{cm}^3$ (according to the winter episode data) | 150-210  | unfavorable          | 0 |
| Number of negative light air ions (with mobility $>0.5/\text{cm}^2/\text{V}\cdot\text{s}$ ) in the surface atmosphere, $\text{ion}/\text{cm}^3$ (according to the winter episode data) | 350-530  | relatively favorable | 1 |
| Ion unipolarity coefficient ( $\text{IUC}=\text{N}+/\text{N}-$ ) (according to the winter episode data)                                                                                | 0.28-0.6 | favorable            | 3 |
| Total: $K(\text{BKP})=\sum K_1+.....+K_{26} = 58/26 = 2.23$ points                                                                                                                     |          |                      |   |

Note: EET – equivalent-effective temperature; UVI – ultraviolet index

Integral index of bioclimatic potential ( $K(\text{BKP})$ ) on the Orion No. 1 route amounted to 2.23 points out of 3.0 possible, which conditionally corresponds to a high functional suitability for the arrangement of climate

treatment of athletes, favorable conditions for their recreation and recovery.

**Conclusion.** Thus, we developed the Orion No. 1 terrain cure route, length – 1300 m, height difference – from 0 to 14 meters, angle of ascent

– no more than 4°. The terrain cure route runs along the bank of the Olkhovka River, begins and ends at the entrance to the Orion athlete rehabilitation and recovery center. The therapeutic effect of the route in terms of bioclimatic potential is high due to the uniqueness of humidity and circulation mode, the number of days with a favorable stay in the fresh air (264 days), positive impact of solar radiation, as well as the standard value of the ion unipolarity coefficient.

The developed terrain cure route assumes the possibility of gradual increase in physical activity by daily 2-3 times its repetition at different speed until the required therapeutic effect

is achieved. It is recommended to exercise not earlier than 1.5-2 hours after eating, therapeutic procedures and finish no later than 1 hour before their start. During the terrain cure route completion, the “work-up” and “finishing the activity” stages occur. Their duration depends on the duration of the time in total, the average is 5-10 minutes. Breathing should be even, through the nose. It should be combined with the rhythm and pace of walking. Clothing and shoes should be comfortable, not constricting movements. A sign of good training is calm and even breathing, as well as slight pleasant feeling of fatigue [9, 10].

**Conflict of interest.** The authors declare no conflict of interest.

## REFERENCES

1. Barashkov G.N., Sergeev V.N., Karamnova N.S. Terrencures and physical training by walking: rehabilitation-preventive aspects. *Profilakticheskaya Meditsina*, 2021, no. 24 (5), pp. 87-93. DOI: 10.17116/profmed20212405187. (in Russ.)
2. Temkin I.B., Olkhova E.I. Terrain cure in resort treatment of patients with cardiovascular diseases in Kislovodsk: methodological guidelines. Pyatigorsk, 1968. 25 p. (in Russ.)
3. Man'shina N.V. Resort treatment for everyone. Health at the resort. Moscow: Veche, 2007. 592 p. (in Russ.)
4. Povolotskaya N.P., Slepykh V.V., Zherlitsina L.I. et al. Method for assessing landscape and climatic potential of resorts and health locations: methodological guidelines of the FMBA of Russia No. 13. Pyatigorsk: FMBA of Russia: FSBI “North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency”, 2021. 39 p. (in Russ.)
5. Povolotskaya N.P., Kortunova Z.V. Bioclimatic passport of Kislovodsk clinic – branch of the Pyatigorsk clinic (initiative research project). Pyatigorsk, 2017. 31 p. (in Russ.)
6. Granberg I.G., Povolotskaya N.P., Golitsyn G.S. et al. Medical weather forecasting system at the federal resorts of Caucasian Mineral Waters: Methodological guidelines. Pyatigorsk: Pyatigorsk clinic: A.M. Obukhov Institute of Atmospheric Physics of the Russian Academy of Sciences: Hydrometeorological Center of Russia, 2009. 23 p. (in Russ.)
7. Povolotskaya N.P. Weather classification and assessment of human thermal state when applying climate therapy and recreation in Caucasian Mineral Waters. Issues of medical climatology and climate therapy of patients at resorts. Pyatigorsk: Pyatigorsk Research Institute of Balneology and Physiotherapy, 1975. pp. 16-23. (in Russ.)
8. Povolotskaya N.P. Modern principles and methods of estimating climate for resort medicine. Collection of materials of the Scientific and Practical Conference with International Participation “Relevant issues of resort science: past, present and future”, dedicated to the 150<sup>th</sup> anniversary of the the founding of the Russian Balneological Society in Pyatigorsk, October 17-18, 2013. Pyatigorsk: Ministry of Health of the Russian Federation: FMBA of Russia: Pyatigorsk Clinic, 2013. pp. 278-280. (in Russ.)
9. Barashkov G.N., Sergeev V.N. Physical training of walking and terrencures – modern approaches and opportunities in the resort. *Herald of physiotherapy and health resort therapy*, 2020, no. 1, pp. 47-54. (in Russ.)
10. Badalov N.G., Barashkov G.N., Persyanova-Dubrova A.L. Terrenkurs and physical training by walking. *Russian Journal of Physiotherapy, Balneology and Rehabilitation*, 2016, no. 15 (6), pp. 317-322. DOI: 10.18821/1681-3456-2016-15-6-317-322. (in Russ.)

**INFORMATION ABOUT THE AUTHORS:**

**Lyubov N. Odrova** – Junior Researcher of the Center of Biomedical Technologies, FSBI “North-Caucasian Federal Research and Clinical Center of Federal Medical and Biological Agency”, Essentuki.

**Gukas N. Ter-Akopov** – Candidate of Economic Sciences, General Director of the FSBI “North-Caucasian Federal Research and Clinical Center of Federal Medical and Biological Agency”, Essentuki, e-mail: sk@fmbamail.ru.

**Aleksandra P. Tychinina** – Researcher of the Center of Biomedical Technologies, FSBI “North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency”, Essentuki, e-mail: a.cozinowa@yandex.ru.

**Sergej V. Nopin** – Candidate of Technical Sciences, Leading Researcher of the Center of Biomedical Technologies, FSBI “North-Caucasian Federal Research and Clinical Center of Federal Medical and Biological Agency”, Essentuki, e-mail: work800@yandex.ru.

**For citation:** Odrova L.N., Ter-Akopov G.N., Tychinina A.P., Nopin S.V. Development and scientific substantiation of the Orion No. 1 terrain cure route of the Orion athlete rehabilitation and recovery center in Kislovodsk. *Russian Journal of Sports Science: Medicine, Physiology, Training*, 2024, vol. 3, no. 1. DOI: 10.24412/2782-6570-2024\_03\_01\_5