
MEDICAL RESORT TREATMENT IN POST COVID-19 PATIENTS WITH PERSISTENT MUSCULOSKELETAL SYMPTOMS

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Abstract: Medical Climatotherapy in sanatorium conditions is a traditional method applied by Physical and Rehabilitation Medicine in the convalescent period, after infectious and non-infectious diseases. Rehabilitation is an essential part of long-term medical care after COVID-19 and is a very important element in the recovery process. A large number of patients in the recovery phase after SARS-CoV-2 infection have prolonged clinical symptoms that can persist for weeks and months after the acute phase of illness. In conjunction with the increasing number of patients who have survived coronavirus infection, the need for post-coronavirus care to recover and overcome residual clinical symptoms is also increasing. The long-lasting effects of COVID-19 can be manifested by respiratory system impairments, but also any other system in the body, including musculoskeletal symptoms, decreased physical capacity, reduced quality of life and psycho-emotional symptoms. In resort settings, natural physical factors are combined with preformed physical factors together with appropriate physical activity, nutritional and dietary regime. The main resort factors are: climate, mineral waters and healing mud. There is a growing need to develop an effective strategy and management of post-acute rehabilitation measures for post-COVID-19 patients to address a large contingent of those in need with a focus on older people with co-morbidities. Medical rehabilitation provides opportunities for a continuum of care that can be successfully delivered in a resort setting in the absence of contraindications. Aim: to investigate the potential benefits of the application of climato-resort treatment in patients in period of recovery with symptoms of Long COVID- 19 or post COVID-19 syndrome (PCS). Materials and Methods: a review of the available scientific literature was conducted, covering global databases (Pubmed, Google Scholar, Science Direct) using keywords that included the terms: post COVID-19 condition, SPA/Resort treatment, mountain climatotherapy, thalassotherapy, rehabilitation, functional recovery. Results: A review of the specialist literature found evidence for the therapeutic benefits of conducting rehabilitation in a resort setting. The application of natural and preformed physical factors resulted in overcoming residual symptoms on the broncho-pulmonary system, improving the functional capacity of the respiratory system and skeletal musculature, increasing the tolerance to exercises and physical activity, and influencing the psycho-emotional consequences of COVID-19. Conclusions: Resort and climatotherapy can be an important factor in the recovery process after COVID-19, for prevention and improvement of the body's resistance to the adverse effects of environmental factors, infectious agents, and the negative effects of modern lifestyle.

Keywords: Health Resort therapy, Long COVID- 19, post COVID-19 syndrome, Musculoskeletal symptoms rehabilitation, mountain climatotherapy, thalassotherapy, functional recovery

1. INTRODUCTION

A large number of patients in the recovery phase after SARS-CoV-2 infection have prolonged clinical symptoms that can persist for weeks and months after the acute phase of the disease, and sometimes even longer (Chopra et al. (2021); Goertz et al. (2021); Mandal et al. (2021)). For these patients, recovery to the baseline state of health is a slow process and is accompanied by reduced functional activity.

COVID-19 is now known to affect many organs and systems. The disease is multisystematic with a variety of clinical manifestations, and symptoms outside the respiratory system can occur during the acute phase as well as at later stages and in the recovery phase. Symptoms other than the those of the respiratory system may be associated with cardiovascular, neurological, hepatic, renal, dermatological, rheumatic, musculoskeletal, psychosocial and/or cognitive derangements of varying severity (Nalbandian et al. (2021) Vladimirova- Kitova L. (2021); Kostov K. (2021)). Today, long-term morbidity and prolonged symptoms are particularly topical in medical practice and are engaging the attention of both medical professionals and acute phase survivors who continue to have persistent health problems (Lauwers et al. (2022)). According to a number of authors, approximately 20% of patients experiencing acute COVID-19 may develop persistent clinical manifestations lasting more than a month after the acute infection. The elderly and patients with chronic polymorbidities are identified as most affected (Mackenzie JS, Smith DW. (2020); Niknam, Z. et al. (2022)). Researchers of this problem often report persistent patient complaints which may include a combination of different symptoms such as: fatigue, weakness and low exercise tolerance, muscle pain, arthralgias in weight bearing and peripheral joints (Alnamlah & Almarwani (2023). Lauwers et al. (2022)), dyspnoea (Kostov K. (2021)), headaches, neurocognitive complaints (Baig (2020); limited daily activity,

reduced quality of life, etc. (Augustin et al. (2021)) (Greenhalgh et al. (2020) Jimeno-Almazán et al. (2021)) Castro JP et al. (2022)) (Pfefferbaum & North (2020); Fujita et al. (2021); Hou et al. (2020))

Due to these reasons, it has recently become more and more relevant to apply the factors of Physical and Rehabilitation Medicine during the recovery phase after acute COVID-19 (Sakai T. et al. (2023)).

Climatotherapy in sanatorium settings is a traditional method that Physical and Rehabilitation Medicine applies in the convalescent period, after infectious and non-infectious diseases have been spent. Rehabilitation is an essential part of long-term medical care after COVID-19 and is a very important element in the recovery process (Petrova M. et al. (2023)). In order to achieve optimal recovery, rehabilitation activities are individually prescribed and tailored according to the severity and extent of the body's damage, comorbidities and individual tolerance (Mollova K. et al. (2022) Grishchikina et al. (2023)). The determination of the rehabilitation potential is performed by a multidisciplinary team of specialists (Takeva I. et al. (2021)) coordinated by a specialist physician (PRM). A thorough examination of the patients allows to conduct rehabilitation that will lead to an improvement in functional status and minimize the adverse health and economic consequences of the disease, both for the individual patient and for society, as a whole (Kashilska Y. & Petkov A. (2021)).

In a resort setting, natural physical factors (Matsumoto S. (2018)), are combined with preformed physical factors together with appropriate exercise, diet and nutrition. The main resort factors are: climate, mineral waters and healing mud (Koleva, Yoshinov (2022)). In climatotherapy, the meteorological factors and the climate of the given area are used for curative and prophylactic purposes. The main climatic complexes applied are: thermal complex (temperature, humidity, wind, thermal (infrared) part of solar radiation); aero-electric complex (air ionization); actinic complex (ultraviolet radiation from the sun); aero-chemical complex (air aerosol).

The aim of this study was to investigate the potential benefits of the application of climatic curative treatment in patients in the period of recovering with symptoms of Long COVID- 19 or post COVID-19 syndrome.

2. MATERIALS AND METHODS

A review of the available scientific literature was conducted, covering global databases (Pubmed, Google Scholar, Science Direct and Cyrillic publications) using keywords that included the terms: post COVID-19 condition, Long COVID- 19 resort treatment, mountain climatotherapy, thalassotherapy, rehabilitation, functional recovery.

3. RESULTS

A review of the specialized literature found evidence for the therapeutic benefits of conducting rehabilitation in a resort setting. The application of natural and preformulated physical factors resulted in overcoming residual symptoms of the broncho-pulmonary system, improving the functional capacity of the respiratory system and the skeletal musculature, increasing the tolerance to physical load and activity, and influencing the psycho-emotional consequences of COVID-19.

4. DISCUSSION

In relation to the increasing number of patients who have experienced coronavirus infection, the need for post-coronavirus care to recover and overcome residual clinical symptoms is increasing. The long-lasting effects of COVID-19 can be manifested by respiratory system impairment, but also any other system in the body, including musculoskeletal symptoms, decreased physical capacity, reduced quality of life, and psycho-emotional disturbances. (Barker-Davies et al. (2020)) After recovery from acute COVID-19, residual symptoms may be observed as a consequence of organ failure that has occurred during the acute phase, or new symptoms that are provoked and appear after the primary infection has been resolved. Very often, these symptoms are not dependent on the severity and the course (asymptomatic, manifest-severe or mild) of the disease (Jimeno-Almazán et al. (2021); Yong SJ. (2021)).

A growing need has been observed for the development of an effective strategy (Szromek AR. (2021)) and management of post-acute rehabilitation measures for patients after COVID-19, which should cover a large population in need with a focus on older people with comorbidities. Medical rehabilitation provides opportunities for a continuum of care (Cevei M. et al. (2022) Grabowski DC & Joynt Maddox KE (2020)), which can also be successfully implemented in resort settings in the absence of contraindications.

Patients referred for climato-balneotherapy should not be contagious. They should be free of residual signs of acute infection and after two consecutive negative tests (RT-PCR) for coronavirus infection (Antonelli, Donelli (2020); Masiero et al. (2020)).

Medical resort therapy is a branch of Physical and Rehabilitation Medicine that allows the application of natural factors in the form of sea therapy or mountain climatotherapy combined with the application of physical modalities and therapeutic exercises. The Bulgarian climatic resorts additionally offer the possibility of hydro-, balneo- and

mud-therapy due to the availability of natural resources that provide this therapy through the availability of natural thermal mineral springs and therapeutic mud(Angelova T. (2022)) Resort treatment is mainly carried out by sea therapy (thalassotherapy) or mountain-climatic therapy.

Sea treatment (Thalassotherapy) in the Black Sea climate zone

The application of marine climatic factors has a number of advantages that make sea-treatment a suitable therapy for patients in the convalescent period. Typical for this climatic zone - breeze circulation provides sub-comfort and comfort in terms of thermo-energetic conditions. Industrial pollution is absent; the air is rich in salts and light negative aero ions; diffuse UV radiation predominates. Thermo-energetic conditions at seaside in breezy weather, alone or in combination with moderate outdoor physical activity, have a beneficial effect on glucose uptake, stimulate lipolysis and regulate fat metabolism, reduce resistance to endogenous insulin. Thalassotherapeutic factors are applied through Heliotherapy (sun baths); Air baths; Sea bathing; Psammotherapy (sand bathing); Warm Sea baths and peloid therapy. It is recommended to start sea bathing after 3-5 days of adaptation of the patient to the sea climate. The cold load is part of the heat loss that cannot be compensated by the body's heat production during sea bathing. The cold load regime is selected according to the phase of the disease, general condition, age, constitution, hardiness, etc. (Dimitrov S. (2022)).

Characteristics of mountain climatotherapy.

Absence of air pollution, a small number of cloudy days, comfortable and subcomfortable thermoenergetic conditions, predominance of direct UV radiation, reduced partial pressure of oxygen, increased level of negative aeroions is characteristic for the mountain climatotherapy. Mountain climatotherapy increases physical and mental performance, stimulates the physiological state of the adrenal glands (increased synthesis of corticosteroids and catecholamines), reduces resistance to endogenous insulin, stimulates lipolysis and hematopoiesis. It improves the function of the respiratory system. The lungs work more economically. Climato-prophylaxis in mountain conditions has hardening effect (Chasovnikarova (2002)). Mountain climatotherapy is carried out in resorts that are located at different altitudes and with specific climatic features. High-mountain (above 2000m: Saragjol, Vihren hut, Belmeken, etc.) areas are not suitable for conducting recreation for patients in the convalescent phase. They are suitable for healthy individuals and have a training effect. Among the more famous Bulgarian mid-mountain resorts (1200 - 2000m) are Pamporovo (1650m), Vitosha (1500m), Borovets (1350m) and others. Low mountain resorts are located in the transition zone (800 and 1200m) (Panagyurishte (1050m), Batak (1035m), Chepelare (1115m), Velingrad (800m), Kostenets (800m), etc.) and Plain zone below 800m. In this zone are located a number of spa resorts: Momin Prohod, Sapareva Banya, Narechen, Bankya, Pavel Banya, Hisar, Sandanski, etc.

The therapeutic application of climatic factors is subdivided into several main types. According to the intensity of the irritation, climatic treatments can range from gentle to severe irritation. Depending on the intensity of irritation, treatments are subdivided into: those requiring precise dosing and those not requiring precise dosing. The most frequently applied conditioning procedures (therapies) include: aeration; air bath; heliotherapy; dosed walking on terrain paths; treatment with reshaped physical factors (electrotherapy, ultrasound, electromagnetic fields, light therapy, etc.); kinesitherapy, diet and nutritional regime, etc. (Ryazkova (2002)).

Climatic therapy in patients after COVID-19

Climato-therapy is also recommended for patients recovering from COVID-19. (Bakalova (2022); Petrova et al. (2022)) In the early recovery period, it is indicated that climatotherapy should be conducted in a climatic zone that is located in the same climatic area corresponding to the patient's place of residence. Especially in patients with severe COVID-19 or in childhood, moving to a new climatic zone could lead to impaired adaptation or exacerbation of comorbid chronic diseases. (Petrova, Khan (2021))

The goals of sanatorium treatment in patients who have experienced COVID-19 include: activation of defense and adaptive mechanisms, prevention of complications, faster recovery after the infection, prevention of complications from hypokinesia and drug-induced dysbacteriosis (Verbovoj et al. (2021)), prevention of complications of other organs and systems beyond the respiratory system.

Patients with mildly progressed COVID-19 may be referred 1-2 weeks after the end of the acute period for sanatorium treatment in the same climatic zone. After the second week, those who have been ill may be referred for climatotherapy in the Black Sea climatic zone or for mountain climatotherapy in a low or mid-high mountain climatic zone. In moderate course of the disease, patients are referred for climatotherapy in the same climatic zone 1-2 weeks after the end of the acute period, and after 3-4 weeks, they can conduct sanatorium treatment in a sea or mountain climatic zone. For patients with severely advanced COVID-19, climatotherapy is indicated at the earliest 2-3 weeks after illness, and after the fourth week, patients are indicated for thalassotherapy or mountain climate treatment. (Petrova et al. (2021))

Therapy in resort conditions is administered after determining the rehabilitation potential of the patient. It includes an assessment of the general condition of the patient, laboratory indicators (general blood count, biochemistry, blood

coagulation status), the results of instrumental studies: an ECG, a spirometry, an imaging study of the lungs. The basic principles of rehabilitation, such as individual approach, gradualness of load, systematicity, distraction is observed. An individual rehabilitation programme is developed for each patient, taking into account the clinical condition, the comorbidities present and the psycho-emotional state. A gentle training program with individual dosage of physical activity intensity is applied.

The walks start from the first days of the sanatorium treatment, gradually increasing their duration. It is recommended to conduct a dosed walking on terrain health paths (terrain cure route) (Kokhan et al., 2022). Landscape therapy is also a recreational method aimed at improving health through the impact of the beauty of nature, landscapes and medical walks. Air baths, including metered exposure of the body fully or partially undressed to fresh air, are an active method of aerotherapy and are prescribed after the adaptation period is over. They can be conducted alone or as a preparation for water treatments with a regime of low and medium cold load.

Rehabilitation in resort settings of patients after COVID-19 complicated by pneumonia focuses on restoring normal lung function. Respiratory exercises, large muscle group exercises are applied to improve circulation and increase exercise tolerance after the viral infection experienced (Bailly M. et al. (2022)).

Conducting rehabilitation in a resort setting is recommended by European Spas Association (ESPA). A number of European countries (Slovakia, Czech Republic, Slovenia, Luxembourg, France) include in their health strategies targeted budgets through which health insured citizens benefit from specialised rehabilitation programmes after coronavirus infection (Katsarova S. (2022)).

SARS-CoV-2 viral infection has been found to be more common in patients with comorbidities such as type 2 diabetes mellitus, obesity, cardiovascular disease, chronic lung disease, and cancer (Huang et al. (2020); Zhang and (Liu 2020)) In the elderly, immune system dysfunction and mitochondrial activity are key factors in the development of COVID-19 disease. (Ganji& Reddy (2021)) SARS-CoV-2 infection causes oxidative stress, mitochondrial dysfunction, platelet dysfunction and coagulation, (Archer et al. (2020)) including high morbidity and mortality. Regeneration of mitochondria damaged by SARS-CoV-2 virus can be achieved by a variety of means, including respiratory exercise, increased physical activity, reduction in daily caloric intake, increased daily intake of food with antioxidant properties (Ganji and Reddy (2021)), balneo-rehabilitation (Maccarone, Mesiero (2021)), and targeted supplementation with coenzyme Q 10. (Gvozdjáčová et al. (2019)). Gvozdjáčová et al. (2022)) conducted a study in sanatorium conditions at an altitude of 1005m ((Tatranská Polianka High Tatras in Slovakia) on healthy volunteers and PCS patients whose symptoms included: breathing difficulties, shortness of breath, chills, heart palpitations, general fatigue, muscle and joint pain, chest pain, headaches, hearing impairment and visual disturbances (Gvozdjáčová et al. (2023)). As a result of the study, Gvozdjáčová et al. (2022) found that mountain climatotherapy reduced: the extent of physical, cognitive and mental impairment; general fatigue, muscle, joint and chest pain, headaches, memory impairment and depression; increased red blood cell (RBC) count, MCV and HgB, MCHC was reduced compared to baseline; as well as the blood glucose level. The authors found no changes in SpO₂ levels and lipid profile (CHOL, HDL-CH, LDL-CH, TAG), persistent dyslipoproteinemia in the observed patients; CRP was higher in patients after COVID-19 compared to placebo controls and did not improve after climatotherapy. Although the course of rehabilitation is relatively short (16-18 days), mountain climatotherapy and targeted balneo-rehabilitation in PCS may contribute to the improvement of mitochondrial bioenergetics of thrombocytes and to the recovery of the general condition of patients (Gvozdjáčová et al. (2022)). In another study, Kokhan, S. et al. reported that a three-week stay in favorable climatic sanatorium conditions (Trans-Baikal Territory (Russia)) combined with physical rehabilitation resulted in improved resting respiratory rate and oxygen saturation (SpO₂). In addition, exercise tolerance as measured by the six-minute test (6 MWD) increased, as did individual scores reported on the Borg Scale, shortness of breath and chest pain, and muscle pain. The authors found a significant improvement in quality of life as measured by the EQ-5D-3L questionnaire in both women and men (Kokhan, 2018).

Climate - thalassotherapy in St. Constantine and Helena. The healing treatments by the coast begin with walks and inhalation of iodine vapours and negatively charged anions. They act on the mucous membrane of the nasopharynx, bronchial tree and the entire respiratory system. By a neuro-reflex pathway, the body is stimulated to produce more endogenous corticosteroids. Iodine vapors and anions have a secretory effect, improve expectoration and enhance local immunity of the mucosa of the upper and lower respiratory tract. Sea treatment in the St. Constantine and Helena is carried out by sea baths, thalassotherapy, sea aerotherapy, inhalations with sea water and peloid therapy (mud therapy according to the Egyptian method). Seawater refers to waters with a complex mineral composition. The salt composition and trace elements as well as dissolved gases nitrogen, oxygen, iodine, bromine and sulphur contribute to the increase of metabolism in the whole organism (Dimitrov S. (2022)).

Climatic-resort treatment in Sandanski. Sandanski is a suitable resort for climate treatment after COVID-19 (ESPA (2023)). Sandanski (234m.) has a transitional-continental climate with Mediterranean influence. The air is

clean, poor in allergens, rich in oxygen and negative ions air. The average annual temperature is +14°C, the average annual relative humidity is 66% and the annual sunshine duration is 2436 hours. The mineral waters are hyperthermal (42-81 °C). Their chemical composition is: weakly mineralised, hydrocarbonate-sulphate-sodium, silicic (75-135mg/l metasilicic acid) and fluoric (6.5mg/l). Climatotherapy in Sandanski can be carried out 1-2 weeks after COVID-19 treatment, according to individual rehabilitation programs, which include: balneotherapy (mineral shower, mineral baths); physiotherapeutic procedures; aerosol therapy; medication-inhalation treatment; hydrotherapy and hydro-kinesitherapy; diet therapy (Bakalova, 2022)).

5. CONCLUSION

Resort and climatotherapy can be an important factor in the recovery process after COVID-19, for prevention and improvement of the body's resistance to the adverse effects of environmental factors, infectious agents and the negative effects of modern lifestyle.

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