



## **The influence of Monfortinho thermal waters on human health**

### **A influencia das águas termais de Monfortinho na saúde humana**

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#### **ABSTRACT**

The thermal waters have numerous medicinal advantages, highlighting their anti-inflammatory and immuno-modulatory properties, useful in the treatment of various pathologies of the respiratory, gastrointestinal, musculoskeletal, skin, among others (Prandelli et al, 2013; Zajac, 2021; Franz et al, 2021). Several studies demonstrate the importance that this type of water presents in cardiovascular pathologies, namely in its use as protectors of the most important risk factors for the triggering of these pathologies (Laukkanen et al, 2015; Laukkanen et al, 2018). Some authors report that balneotherapy is associated with normalization of lipid profile parameters (Heinonen & Laukkanen, 2018; Esperland et al, 2022) as well as reducing susceptibility to viral infections (Kunutsor et al., 2017; Kunutsor et al., 2021). There is also the component associated with skin and the delay of aging, as demonstrated in studies in the area (Vaz et al, 2022). Of course, there are studies that demonstrate the possibility of the existence of some interurrences, with special incidence in the cardiac area and in the psychiatric area - note, however, that the studies referred to point to the pre-existence of pathology (Zaccardi et al, 2017; Laukkanen et al 2018).

**Keywords:** Monfortinho, Thermal Waters, Health.

#### **RESUMO**

As águas termais possuem inúmeras vantagens medicinais, destacando-se as suas propriedades anti-inflamatórias e imuno-modulatórias, úteis no tratamento de diversas patologias do foro respiratório, gastrointestinal, musculoesquelético, da pele, entre outros (Prandelli et al, 2013; Zajac, 2021; Franz et al, 2021). Vários estudos demonstram a importância que este tipo de águas apresenta nas patologias cardiovasculares, nomeadamente na sua utilização como protetores dos fatores de risco mais importantes para o desencadear destas patologias (Laukkanen et al, 2015; Laukkanen et al, 2018). Alguns autores referem que a balneoterapia se encontra associada à normalização dos parâmetros do perfil lipídico (Heinonen & Laukkanen, 2018; Esperland et al, 2022) bem como, à redução da suscetibilidade a infeções virais (Kunutsor et al., 2017; Kunutsor et al., 2021). Há ainda a componente associada à pele e ao retardamento do envelhecimento, como demonstrado em trabalhos da área (Vaz et al, 2022). Naturalmente que há estudos que demonstram a possibilidade de existência de algumas intercorrências, com especial incidência na área cardíaca e na área psiquiátrica - ressaltar, contudo que os estudos referidos apontam para a pré existência de patologia (Zaccardi et al, 2017; Laukkanen et al 2018).

**Palavras-chave:** Monfortinho, Águas Termais, Saúde.



## 1 INTRODUCTION

The thermal waters have numerous medicinal advantages, highlighting their anti-inflammatory and immuno-modulatory properties, useful in the treatment of various pathologies of the respiratory, gastrointestinal, musculoskeletal, skin, among others (Prandelli et al, 2013; Zajac, 2021; Franz et al, 2021). Several studies demonstrate the importance that this type of water presents in cardiovascular pathologies, namely in its use as protectors of the most important risk factors for the triggering of these pathologies (Laukkanen et al, 2015; Laukkanen et al, 2018). Some authors report that balneotherapy is associated with normalization of lipid profile parameters (Heinonen & Laukkanen, 2018; Esperland et al, 2022) as well as reducing susceptibility to viral infections (Kunutsor et al., 2017; Kunutsor et al., 2021). There is also the component associated with skin and the delay of aging, as demonstrated in studies in the area (Vaz et al, 2022). Of course, there are studies that demonstrate the possibility of the existence of some interurrences, with special incidence in the cardiac area and in the psychiatric area - note, however, that the studies referred to point to the pre-existence of pathology (Zaccardi et al, 2017; Laukkanen et al 2018).

The thermal waters, heated in the interior of the Earth through their internal heat, when they surface will originate the springs or hot springs and are mostly made up of minerals, which determine their chemical characteristics and consequently their therapeutic effects and their applicability in terms of treatments of the Human Being. The most abundant chemical compounds in these waters are sulfates, bicarbonates, silicates, as well as calcium, magnesium and sodium ions (Vaz et al, 2022; Silva et al., 2020).

In Portugal, thermal treatments have been in increasing demand in recent decades, with the Termas de Monfortinho being one of the main reference points at national level and in which the present study was developed (Oliveira et al, 2020; Araujo et al, 2017). These spas, located in Beira Baixa, next to the Serra de Penha Garcia trace their history back to the early eighteenth century, with the well-known doctor Ribeiro Sanches describing the therapeutic qualities of the waters. The evolution was emerging naturally and the populations were using these waters for treatments, and In 1989 are recognized by order of the General Directorate of Health the therapeutic properties of the thermal waters and in 2008 (on March 19) were added to the joint order of the General Directorate of Health new functions and therapies for the waters of the spas: metabolic-endocrine, rheumatic and musculoskeletal diseases, circulatory system, nephrouinary system and respiratory system (Termas de Monfortinho, 2023).

In the Termas de Monfortinho, the waters used for thermal treatments are bicarbonated, sodium, calcium, magnetic and silicate, with a pH of 5.45 (Monfortinho, 2021). In this way, this thermal spa is directed to the treatment of chronic skin diseases, hepato-vesicular diseases, gastrointestinal diseases, rheumatic diseases, respiratory diseases and even renal lithiasis (Oliveira et al, 2020; Silva et al., 2020).



## 2 GOAL

The main objective of this study was to verify the influence of balneotherapy on cardiorespiratory function and on the biochemical parameters of lipids and glucose.

## 3 METHODOLOGY

### 3.1 SAMPLE DESCRIPTION:

The present study is of the observational and cross-sectional analytical type. The sample collection was carried out during the month of September 2021, at the Termas de Monfortinho.

The sample consisted of eight individuals, five females and three males.

### 3.2 STUDY PROTOCOL:

After informing the users of the Termas de Monfortinho of the possibility of participating in the study, an informed, free and informed consent was applied, as well as a questionnaire followed by the evaluation of the defined cardiovascular and biochemical parameters.

The data were coded in order to obtain an ID that did not refer to any data that could identify the participant, ensuring confidentiality and anonymity.

### 3.3 COLLECTED VARIABLES:

In order to evaluate the health status of the participants in the pre and post thermal treatment, the following nominal qualitative variables were collected through a questionnaire: gender, reason for the treatment, associated risk factors and existence of cardiac pathology.

As for the quantitative variables, age, SBP (systolic blood pressure) and DBP (diastolic blood pressure), SaO<sub>2</sub> (oxygen saturation), and biochemical parameters (glucose, total cholesterol, triglycerides, low-density lipoproteins (LDL) and high-density lipoproteins (HDL) and respiratory parameters (FVC (forced vital capacity), FEV<sub>1</sub> (maximum expiratory volume in the 1st second) were collected. IT (Tiffeneau Index), FEF 25/75 (expiratory debts)).

### 3.4 STATISTICAL ANALYSIS:

After the completion of the data collection, the variables (obtained through the survey) were coded, to be analyzed in the statistical analysis program SPSS® and thus create a database.

Through the execution of normality tests, it was verified by the *Shapiro-Wilk* test that the sample was abnormally distributed, with a confidence interval of 95% for a value of  $p < 0.05$ , and the *nonparametric Mann Whitney test* was used.



### 3.5 ETHICAL ISSUES

The investigation team respected and complied with the principles mentioned in the Helsinki declaration, ensuring that there were no conflicts of interest.

The individuals who showed interest in participating in the study were duly clarified in relation to doubts they might present, accessed the informed consent that was also duly clarified and explained. After signing it, each individual was always informed of their rights and was free to abandon the study at any time if they so wished. All confidentiality of the data collected was guaranteed by the use of an "ID", thus preserving the identification of the participants. The data provided by the participants are exclusively accessible to the research team and were eliminated following the best computer practices at the end of the study.

The data collected were used for statistics and this work is only of academic interest, and there is no economic interest.

### 4 FINDINGS

A mean age of  $67.38 \pm 9.07$  years was obtained, with the minimum age found being 51 years and the maximum 80 years.

Most individuals resorted to balneotherapy for reasons of disease, being the most frequent respiratory (2), skin (3) and osteoarticular (3). Still, two individuals reported that they were undergoing treatments for leisure.

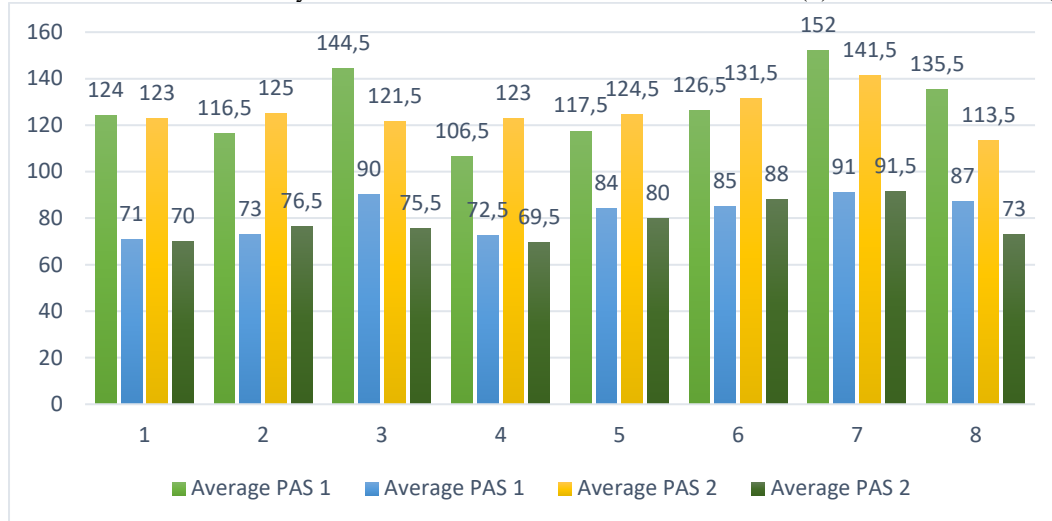
The most recurrent risk factor was sedentary lifestyle followed by high cholesterol, which was reported by 5 and 3 individuals, respectively.

With regard to heart disease, only one of the participants reported being aware of the existence of a heart problem, already diagnosed and followed up previously.

Regarding the assessment of blood pressure and oxygen saturation, it was found that there were no significant changes after the treatment period (Figure 1). At the time of blood pressure assessment, most individuals were normotensive.



Figure 1 - Table of the variation of Systolic and Diastolic Blood Pressure in the Pre (1) and Post-treatment (2) thermal.



Regarding the lipid profile, there was a decrease in total cholesterol in most individuals (75%) after balneotherapy (Figure 2). Regarding glycemia and, contrary to what would be expected, it increased in the post-treatment (62.5%) (Figure 3).

Figure 2 – Table of the variation of Total Cholesterol in the Pre (1) and Post-treatment (2) thermal.

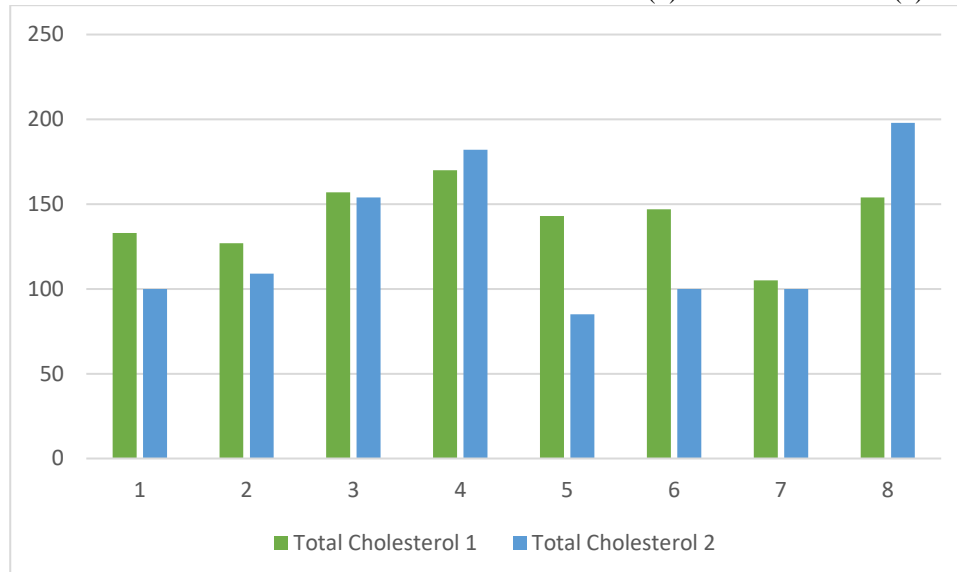
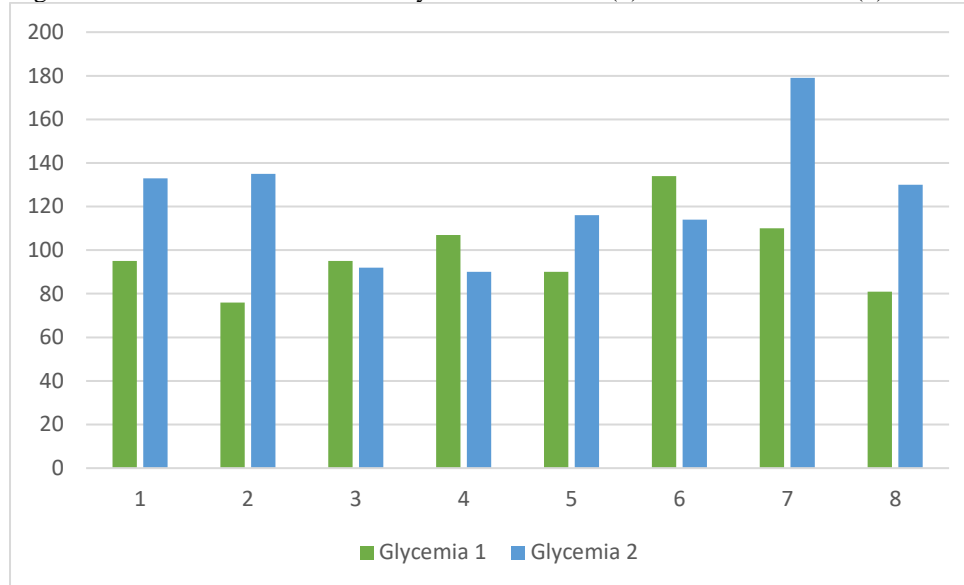




Figure 3 - Table of the variation of Glycemia in the Pre (1) and Post-treatment (2) thermal.



Regarding the electrocardiographic evaluation, all individuals presented sinus rhythm and heart rates within the normal range, both in the pre-treatment and in the post-treatment. Regarding the evaluation of respiratory parameters through spirometry, no significant changes were found in the two periods analyzed.

The type and duration of treatments were not similar for all individuals, with a minimum duration of 4 days and a maximum of 14 days, with an average duration of treatments of 8.75 days.

To complement the study, subjects were also asked if they had contracted SARS-CoV-2 infection. Only two of them said they had ever been diagnosed with COVID-19 (through PCR testing), and it was not the determining factor for the thermal treatments. In addition, there were no respiratory changes in these individuals.

## 5 DISCUSSION

Thermal treatments have been used for many years to improve certain health conditions, both from the point of view of intervention and from the point of view of prevention. Several clinicians suggest the use of these therapies as a complement to the traditional use of pharmacology, or even as a single therapy (Olsson, 2018). There are even studies that demonstrate an inverse relationship between the use of these therapies and neurodegenerative diseases (Laukkanen et al, 2017).

The report of improvements at various levels is quite extensive (Roine et al, 1992), however there are also studies that demonstrate some complications when using these therapies, namely at the cardiac level (Zaccardi et al, 2017).

Several studies have revealed improvements in lipid profile after thermal treatments (Olsson, 2018; Heinonen & Laukkanen, 2018), corroborating what was found in the present study. In fact, in the work



before us, the observation that 75% of individuals have lowered total cholesterol levels is very positive. The evaluation of glucose did not reveal positive results after balneotherapy, however it was not performed in fasting, so this error factor may have negatively influenced the achievement of correct results. Glucose assay should be performed fasting for a more credible evaluation, it was not possible to guarantee this condition in the present study due to issues that could not be controlled by the research team, namely the treatment schedules (Sanders & Deadman, 1985).

As mentioned earlier, one of the main reasons that led the participants to resort to thermal treatments were respiratory, skin and osteoarticular pathologies, as well as for leisure purposes. Some studies show improvements at the osteoarticular level after thermal treatments, namely in joint movements, as well as in the reduction of pain associated with these pathologies (Bálint et al., 2007; Hanzel et al, 2018). Although specific parameters for these cases were not evaluated, some clients reported that they presented improvements after a few sessions of balneotherapy. Thus, to understand the beneficial effects of treatments on these individuals, a more specific assessment should have been made for these cases, using, for example, the Questionnaire for Osteoarthritis *Western Ontário and McMaster Universities* (WOMAC) and the World Health Organization Quality of Life Questionnaire.

As it is mentioned in the scientific community, for a correct evaluation of the effectiveness of thermal treatments several factors must be considered: characteristics of the study group (number of clients, age, sex, associated pathologies, diet and complementary therapies), amount of thermal water ingested, duration of treatment, among others (Petraccia et al., 2006). The beneficial effects of the thermal treatments were verified, although some difficult to demonstrate from the statistical point of view, however some factors (type of treatment and its variable duration, reason for having resorted to the Termas de Monfortinho) may have conditioned the achievement of such remarkable results, as observed in other studies analyzed here. Highlight the lack of any reference by the participants of negative intercurrent in the course of their passage through the Termas de Monfortinho, contrary to what was reported in some studies consulted (Zaccardi et al, 2017; Laukkanen et al 2018).

The fact that it is a therapy directed to each individual and pathology, made it complex to carry out a comparative analysis between different cases. Thus, the application of a qualitative study should be considered soon.

## **6 FINAL CONSIDERATIONS**

The high potential of the treatments and the therapeutic properties of the thermal waters of the Termas de Monfortinho is indeed remarkable. However, with the present study it was noticed that no significant improvements were registered in the parameters evaluated, except for Total Cholesterol.



The main limitation of the present study was related to the fact that the sample had a small number of individuals and, consequently, could not be representative, and it was not entirely feasible to extrapolate results. In addition, the heterogeneity of treatments performed in the spas, as well as their duration, compromised the comparison of results.

Prospects should be subject to a more complete, adapted, continuous evaluation over a longer period, using, as mentioned above, a qualitative study.





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