Research Article
DOI: http://dx.doi.org/10.47746/FMCR.2021.2505


# Thermalism as A Determinant of Quality of Life and Sleep: A Novel Approach to The Sector Using SF-36v2 and Pittsburgh Index

**Sandra Pereira[1†] | Jani Silva[1,2†] | Catarina Marques[1] | Ana Galvão[3] | Maria José Alves[1,3,4*]**

***Correspondence:** Maria José Alves

**Address:** [1]AquaValor – Centro de Valorização e Transferência de Tecnologia da Água – Associação, Rua Dr. Júlio Martins n.º 1, 5400-342 Chaves, Portugal; [2]Molecular Oncology and Viral Pathology Group, IPO-Porto Research Center (CI-IPOP), Portuguese Oncology Institute of Porto (IPO-Porto), Rua António Bernardino de Almeida, 4200-072 Porto, Portugal; [3]Escola Superior de Saúde de Bragança (ESSa), Instituto Politécnico de Bragança, Bragança, Avenida D. Afonso V, 5300-121, Bragança, Portugal; [4]Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

† These authors contributed equally to this work

**e-mail** ✉: maria.alves@ipb.pt

**Received:** 17 August 2021; **Accepted:** 26 August 2021



## ABSTRACT

**Aim:** Thermalism has been used to improve health status, with emphasis on well-being, including relaxation, stress relief, depression, and even recovery and energy reserve. This study aimed to evaluate the perception of quality of life (QOL) by SF-36v2, and the quality of sleep, using the Pittsburgh Index, in individuals who attended the therapeutic thermalism at Chaves thermal Spa, in different treatment time points, pre-and post-treatment for 14 days. **Methodology:** Thermal Spa patients attending therapeutic thermalism at Chaves thermal Spa (N=90) completed a questionnaire with information on sociodemographic data, on health-related quality of life (SF-36v2), and on quality of sleep (Pittsburgh Sleep Quality Index (PSQI)). **Results:** In the thermal pre-treatment evaluation, participants revealed a good quality of life in the physical and social functioning, vitality, emotional role functioning, and mental health domains. In the post-treatment assessment, there all QOL indexes were improved, physical functioning, physical role functioning, bodily pain, and emotional role functioning. The participants revealed a good sleep quality in the following dimensions: sleep duration and efficiency, use of sleeping medications, and daytime dysfunction. In the second evaluation time-point, there was an improvement of all sleep quality indices, except for the sleep duration component. Regarding the quality of life and sleep by sociodemographic variables, data revealed that men had a better quality of life and sleep than women. **Conclusion:** Thermal treatments provided significant benefits for the quality of life and sleep. These results may contribute to improve the knowledge on the potentialities of thermal treatments and, ultimately to attract tourists seeking the benefits of thermal waters on its holistic vision.

***Keywords:*** *Spa Therapy, Thermalism, Quality of Life, SF-36v2, Quality of Sleep, Pittsburgh Index*

## Introduction

Spa therapy or thermalism has been used for health promotion and in the treatment of inflammatory and chronic processes, being this effect entirely related to the properties and composition of thermal mineral water (Araújo *et al*., 2019). Since health is synonymous with well-being, happiness,

and a long life without illness, water metaphorically symbolizes life in all its exuberance (Cantista, 2008). The thermalism concept has changed over time, no longer being exclusively associated with the therapeutic component. In fact, thermalism has acquired a more preventive approach, with the recovery directed to the prevention of disease and health promotion, with the terminology of wellness thermalism (Cantista, 2008; Leandro and Leandro, 2015).

Natural mineral waters have been described as deep circulating water with bacteriological and physicochemical unique characteristics, which, in turn, are related to several therapeutic properties or health beneficial effects (Cantista, 2008; Oliveira *et al*., 2020). Despite the fact that initial medicinal use of natural mineral waters was empirical; today, its scientific recognition is increasingly acknowledged (Pittler *et al*., 2006; Falagas *et al*., 2009). The therapeutic effects associated with thermal waters cover several areas of medical intervention, ranging from respiratory, digestive, and dermatological to musculoskeletal disorders (Pittler *et al*., 2006; Cantarini *et al*., 2007; Ferreira *et al*., 2010; Hanzel *et al*., 2018; Oliveira *et al*., 2020).

The water of Chaves thermal Spa has a unique composition in the Iberian Peninsula, being characterized as sodium bicarbonated, mesomineralized, and carbonic water. Naturally hot (described as 77°C), it is, therefore, hyperthermal water, rich in minerals, especially sodium, silica, fluoride, and hydrogen carbonate (DGEG, 2021). It is important for stimulating the metabolic and organic functions, with anti-inflammatory, pain relief, and relaxation effects. Moreover, hyperthermal waters may enhance the blood flow, allowing to dissipate the algogenic chemicals and facilitating muscle relaxation. The hydrostatic effect may relieve pain by reducing peripheral oedema and by dampening sympathetic nervous system activity (Gabrielsen *et al*., 2000). On the other hand, tourism associated with thermal waters has a positive impact on the growth and development of low-density territories, contributes to mitigate regional imbalances and asymmetries, attracting people, generate employment and provide other forms of tourism (Antunes, 2005).

There is a growing need to transform Spas into places of rest and well-being, equipped with qualified human resources and facilities with excellent conditions, making them appealing to young and old users (Cantarini *et al*., 2007). Although the evolution of the thermal concept is evident, the mechanism of action is not completely elucidated, and it is difficult to distinguish the efficacy of the thermal method from the benefits that could be derived from a stay in the thermal Spa environment (Cantarini *et al*., 2007). Spa treatments are still being discussed regarding the therapeutic effects and their role in modern medicine (Verhagen *et al*., 2000; Cantarini *et al*., 2007). As an example, few randomized, controlled trials clinical studies, reviews, and meta-analyses have been performed to study the efficacy of these treatments regarding musculoskeletal, respiratory, dermatological disorders and (Pittler *et al*., 2006;

**DOI: http://dx.doi.org/10.47746/FMCR.2021.2505**

Cantarini *et al*., 2007; Horváth *et al*., 2012; Hanzel *et al*., 2018).

Since the introduction of the quality of life (QOL) concept in the medical literature and databases in the 1960s, this concept has become increasingly acknowledged in the latest decades (Post, 2014). The World Health Organization (WHO) firstly approached the QOL as a condition of complete physical, mental, and social well-being and not merely the absence of disease (WHO, 1947). The achievement of a better quality of life has become an imperative requirement and, therefore, the definition and understanding of this concept is crucial within the most diverse areas: psychology, sociology, philosophy, economics, health, among others (Costanza *et al*., 2007). Notwithstanding several studies discuss the topic focusing on the definition of quality of life, there is not a unanimous definition recognized (Rejeski and Mihalko, 2001; Bowling, 2005; Karimi and Brazier, 2016). The WHO subsequently defined QOL as a broad ranging concept including physical and psychological health status, level of independence and social relationships, and ultimately in features of evolving environment "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (WHOQOL Group, 1993). As so, it has been recognized that QOL is more than health status, clinical symptoms, or functional capability, health is only one dimension of quality of life (Karimi and Brazier, 2016). Furthermore, according to some authors (Camfield and Skevington, 2008; Diener *et al*., 2009), the concept of quality of life is synonymous with well-being. Nevertheless, other authors refer to the concept of well-being as an integral part of the QOL concept.

The quality of sleep is one of the indicators that allows the assessment of QOL and health. Sleep, like nutrition and physical activity, is a critical indicator of health and well-being (Buysse, 2014), and according to the National Sleep Foundation (2016), is an accurate barometer of the subject's mental state. As so, sleep disorders are a global epidemic that interferes with the health and quality of life of about 45% of the world's population, being an unmet public health problem that should be studied in different dimensions. Sleep is coordinated by the direct relationship between circadian rhythm and homeostatic regulation, assuming a central modulating role in hormone release, glucose regulation, cardiovascular activity, thermoregulation, and pain tolerance. Sleep quality assumes a leading role in the regulation and restoration of the biological functions of individuals, having a significant impact on their QOL and morbidity (Rijo-Ferreira and Takahashi, 2019; Zhang and Sehgal, 2019). From a cognitive and neurological perspective, sleep quality interferes with our ability to process our emotions, both on a personal and social level, which can lead to mood and behavioral changes (Emert *et al*., 2017). Sleep disturbances reflect a significant loss in quality of life, decreased work performance, increased incidence of mental disorders, and decreased alertness with impaired personal safety (Rijo-Ferreira and Takahashi,

2019; Zhang and Sehgal, 2019).

To the best of our knowledge, this is the first research work in Portugal aiming at evaluating the perception of QOL by SF-36v2, and the quality of sleep, using the Pittsburgh Index, in individuals who attended the therapeutic thermalism (Chaves thermal Spa), in different treatment time points, pre-and post-treatment for 14 days.

## Methodology

### *Study Population and Data Collection*

As described in Table 1 the sample for this research was composed of 90 participants (mean age 68.33 ± 14.67 years), who attended therapeutic thermalism at Chaves thermal Spa, between June and October 2020. All the participants voluntarily participated in this study, gave their written informed consent, and were asked to complete a questionnaire at the beginning and at the end of 14-day thermal treatments. This study was conducted under the Green Health project (Norte-01-0145-FEDER-000042), with the objective of establishing digital strategies based on biological assets to improve well-being and promote the green health.

Study participants completed a questionnaire with information on (1) sociodemographic data (age, gender, marital status, educational level, professional and economic status, and place of residence), (2) on health-related quality of life (SF-36v2) (Ferreira 2000a, Ferreira 2000b) and (3) on quality of sleep (Pittsburgh Sleep Quality Index (PSQI)) (Buysse, Reynolds III *et al*., 1989). Participants who did not complete the SF-36v2 and PSQI were excluded from the study.

The SF-36v2 is a 36-point item questionnaire measuring the quality of life/ health and well-being that includes composite or summary scales reflecting perceived physical and psychosocial health and functioning. It comprises eight domains: physical functioning, physical role functioning, bodily pain, general health, vitality, social functioning, emotional role functioning, and mental health. Additionally, SF-36v2 comprises two summary components, each derived from four domain scores: the physical component and the mental component. Domains and summary components are expressed from 0 to 100 scale, with higher scores indicating a better health-related quality of life. The Portuguese version of SF-36v2 was validated by Ferreira (Ferreira, 2000a; Ferreira, 2000b).

The PSQI is a 19-item self-rated questionnaire designed to measure sleep quality and disturbance over the past month (Buysse *et al*., 1989). The 19 items are grouped into 7 components, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of

sleeping medication, and daytime dysfunction. Each of these components yields a score ranging from 0 to 3, with 3 indicating the greatest dysfunction. The component scores vary from 0 to 21, with high total scores indicating poor sleep quality. The global PSQI score distinguishes the good sleepers and poor ones; scores > 5 suggest clinically significant sleep complaints (Buysse *et al*., 1989; Bertolazi *et al*., 2011; Beaudreau *et al*., 2012). The Portuguese version was adapted by Ramalho (2008).

The internal consistency of the scales used in this study was evaluated using data collected at the time of admission to the Chaves thermal Spa. The PSQI has acceptable internal consistency (Cronbach α = .76 for the global score). The SF-36v2 internal consistency ranges from .79 to .95, which translates into acceptable to very good in GH and PF components, respectively.

## Statistical Analysis

The present study used an exploratory, quantitative, descriptive, inferential, and longitudinal design. IBM SPSS statistics version 26.0 was used for all statistical analysis and the significance was set at 5%. Descriptive statistics were used to describe sociodemographic variables and global/components/ domains of SF-36v2 or PSQI and were calculated as mean and standard deviation. Univariate normality of the data distribution was analyzed for the various age groups, educational level, professional and economic status, was assessed using the Shapiro–Wilk or Kolgomorov–Smirnov test. The homogeneity of variances was tested using Levene's test, to define which tests to use, parametric or non-parametric tests. As non-normally distributed data were observed, non-parametric tests were applied in comparisons by age group, level of education, professional and economic status. The Student's t-test was applied as a parametric test in the analysis of independent and paired samples. Non-parametric tests, Mann–Whitney and Kruskal-Wallis tests were used for comparing independent data samples and more than two data samples, respectively.

## Results and Discussion

To the best of our knowledge, this is the first work in Portugal aiming at evaluating the perception of QOL by SF-36v2, and the quality of sleep, using the Pittsburgh Index, in individuals who have undergone thermal treatments, namely therapeutic thermalism, for 14 days.

As described in Table 1 the sample for this research was composed out of 90 participants, being 58 women (64.4%) and 32 men (35.6%). Most respondents are over 66 years old (67.8%), married (58.9%), and have primary school education (48.9%). As also can be seen from Table 1, the majority of participants is retired (71.1%) and has middle economic status (76.7%). A recent study conducted at Curia thermal Spa corroborated these results by showing that 62% of participants are women, and 42.7% are aged

between 61 and 80 years, and 62% are women (Lopes, 2018). Although the health and wellness tourism sector, including thermal therapy, is visibly evolving, and growing, there is still an alternative perception that thermal activities related to health and disease prevention and treatment are mainly associated with elderly individuals. According to Lourenço, 2012 (Lourenço *et al*., 2013), most of the thermal Spa users are over 60 years old, that once a year, seek alternative medical treatments or Spa services for about two to three weeks. Regarding the educational level, the participants are characterized by having mostly primary education (48.9%), which is in line with the results obtained by Lopes, 2018 (Lopes, 2018). Concerning the professional status, 71.1% of the participants are retired, also in compliance with Lopes, 2018 (Lopes, 2018), who found that 75.3% of the users of the Curia thermal Spa were retired.

**Table 1:** Sociodemographic data of study participants

| Variables | | n | % |
|---|---|---|---|
| Gender | Men | 32 | 35.6 |
| | Women | 58 | 64.4 |
| | Total | 90 | 100.0 |
| Age | < 45 years | 8 | 8.9 |
| | 45-65 years | 21 | 23.3 |
| | 66-74 years | 25 | 27.8 |
| | > 74 years | 36 | 40.0 |
| | Total | 90 | 100.0 |
| Marital status | Single | 13 | 14.4 |
| | Married | 53 | 58.9 |
| | Divorced | 5 | 5.6 |
| | Widower | 19 | 21.1 |
| | Total | 90 | 100.0 |
| Educational level | Uneducated | 2 | 2.2 |
| | Primary | 44 | 48.9 |
| | Secondary | 25 | 27.8 |
| | University | 19 | 21.1 |
| | Total | 90 | 100.0 |
| Professional status | Retired | 64 | 71.1 |
| | Active | 26 | 28.9 |
| | Total | 90 | 100.0 |
| Economic status | Lower | 2 | 2.2 |
| | Middle | 69 | 76.7 |
| | High | 19 | 21.1 |
| | Total | 90 | 100.0 |

The results of the participants' geographical distribution indicate the districts of Porto (28.9%), Lisbon (17.8%), and Vila Real (15.6%) as the most frequently reported (Fig. 1). Overall, 64.5% of study participants came from districts located in the northern region of Portugal, being this result probably associated with geographical proximity. Lopes (2018) also showed that attendance to the thermal Spa is influenced by the proximity to the place of origin. It was also found that 7.8% of the thermalists came from countries as Spain, Switzerland, and Luxembourg, suggesting a national preferential demand, which is also correlated to the results obtained by Lopes, 2018 (Lopes, 2018).

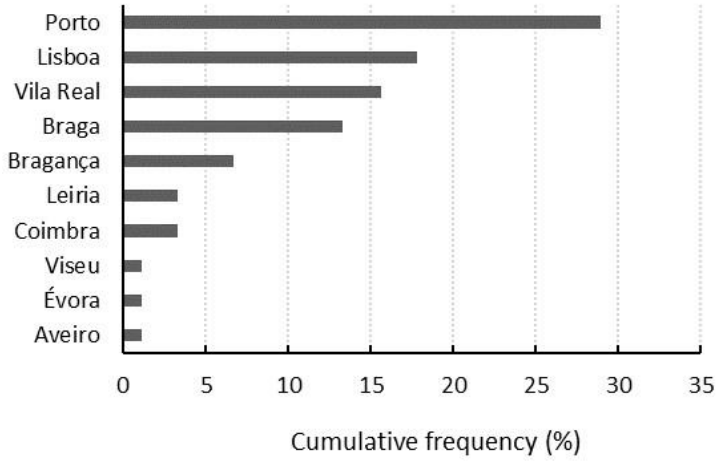


**Figure 1:** Geographical distribution of study participants by district.

## Quality of Life: SF-36v2

As can be observed in Table 2, in the thermal pre-treatment assessment, participants revealed a better quality of life in the following domains: physical functioning, vitality, social functioning, emotional role functioning, and mental health. In the post-treatment evaluation, it was observed that all QOL indexes were improved, especially in domains of physical functioning, physical role functioning, bodily pain, and emotional role functioning (Table 2). In line with the data obtained in this study, Hanzel *et al*. (Hanzel *et al*., 2018) found that patients suffering from rheumatic diseases treated with thermal water presented a significant improvement in the performance of activities that involve greater physical effort. They also found that an improvement in the ability to perform daily tasks occurred in parallel. In addition, other authors (Pittler *et al*., 2006; Franke *et al*., 2007; Kulisch *et al*., 2009, Horváth *et al*., 2012), obtained similar results, even though in different thermal Spas, with natural mineral water presenting different microbiological and chemical characteristics (Oliveira *et al*., 2020)

**Table 2:** Quality of life assessed by the SF-36v2 scale in the pre- and post- thermal treatment periods.

| Domains | Pre-treatment | | Post- treatment | |
|---|---|---|---|---|
| | Median | Mean ± SD | Median | Mean ± SD |
| Physical functioning | 75.00 | 70.72 ± 24.06 | 80.00 | 73.67 ± 22.45 |
| Physical role functioning | 65.63 | 63.82 ± 29.89 | 68.75 | 67.08 ± 26.55 |
| Bodily pain | 62.24 | 58.25 ± 27.56 | 77.55 | 70.09 ± 24.53 |
| General health | 60.00 | 57.44 ± 19.13 | 60.00 | 60.42 ± 20.69 |
| Vitality | 75.00 | 68.82 ± 22.30 | 75.00 | 71.53 ± 19.39 |
| Social functioning | 93.75 | 81.53 ± 24.49 | 100.00 | 84.17 ± 21.92 |
| Emotional role functioning | 91.67 | 78.43 ± 24.82 | 95.83 | 80.09 ± 23.36 |
| Mental health | 80.00 | 73.44 ± 18.22 | 80.00 | 75.22 ± 18.51 |
| **Components** | | | | |
| Physical component | 66.79 | 62.20 ± 21.34 | 69.96 | 67.81 ± 18.31 |
| Mental component | 80.63 | 75.55 ± 19.16 | 84.84 | 77.75 ± 17.87 |

SD, Standard deviation

The results presented in Table 3, introduced the comparisons made using the SF-36v2 parametric (gender - t-Student) and non-parametric tests (age group and educational level- Kruskal-Wallis; professional and economic status - Mann-Whitney). The significance level values obtained are presented in Table 3. From the comparisons made by gender, statistically significant differences were found regarding all dimensions except for emotional role functioning and mental health. The average values of SF-36v2 domains were higher in men than women, meaning that the former presented a better QOL (Table 4). From the comparisons made per age group, there are statistically significant differences in the following dimensions: vitality, social functioning domains, and mental health component. Table 5 shows the mean values ± standard deviation (SD) by age group in these three variables. The comparisons made between the four age groups allowed to conclude that the participants aged under 45 years present a statistically lower quality of life than the participants older than 74 years.

**Table 3:** Comparisons between the domains of SF-36v2 and sociodemographic variables.

| Domains | Gender | Age | Educational level[1] | Professional status | Economic status[2] |
|---|---|---|---|---|---|
| | *P* value | | | | |
| Physical functioning | **.008*** | .479 | **.031*** | .437 | .803 |
| Physical role functioning | **.018*** | .934 | .789 | .683 | .927 |
| Bodily pain | **.001*** | .178 | .522 | .078 | .875 |
| General health | **.027*** | .984 | .697 | .922 | .791 |
| Vitality | **.002*** | **.020*** | .288 | **<.001*** | .264 |
| Social functioning | **.002*** | **.043*** | .143 | **.003*** | .070 |
| Emotional role functioning | .244 | .221 | .130 | **.006*** | .777 |
| Mental health | .128 | .075 | .183 | **.008*** | .196 |
| **Components** | | | | | |
| Physical component | **.001*** | .753 | .526 | .457 | .943 |
| Mental component | **.009*** | **.033*** | .232 | **<.001*** | .417 |

[1] Two less qualified participants were excluded.

[2] Two participants with poor economic status were excluded.

* - significance level, $P \leq 0.05$.

**Table 4:** Quality of life comparisons by gender.

| Domains | Men | Women | *t*-test | |
|---|---|---|---|---|
| | Mean ± SD | | *t* | *P* |
| Physical functioning | 79.06 ± 18.81 | 66.12 ± 25.51 | 2.742 | **.008*** |
| Physical role functioning | 72.85 ± 22.60 | 58.84 ± 32.34 | 2.404 | **.018*** |
| Bodily pain | 70.73 ± 26.26 | 51.37 ± 25.99 | 3.370 | **.001*** |
| General health | 62.66 ± 12,70 | 54,57 ± 21,45 | 2.246 | **.027*** |
| Vitality | 77.73 ± 16.18 | 63.90 ± 23.76 | 3.268 | **.002*** |
| Social functioning | 90.63 ± 15.55 | 76.51 ± 27.01 | 3.146 | **.002*** |
| **Components** | | | | |
| Physical component | 71.32 ± 16.22 | 57.72 ± 22.39 | 3.312 | **.001*** |
| Mental component | 81.99 ± 14.54 | 72.00 ± 20.55 | 2.678 | **.009*** |

* - significance level, $P \leq 0.05$.

Concerning the educational level, statistically significant differences were only obtained in the domain of physical functioning (P=0.031, data not shown). These results indicated that participants with the primary educational level have a statistically significantly lower QOL than higher-level ones.

Statistically significant differences were also found regarding the professional status in all dimensions associated with the mental health domain, and consequently, significant differences were also found in this component. Table 6 shows that retired participants presented the greatest QOL in terms of vitality, social functioning, emotional role functioning, mental health domains, therefore, in the mental health component.

**Table 5:** Association of quality of life with age groups.

| Domains | <45 years | 45 - 65 years | 66 - 74 years | >74 years | K-W test[1] | |
|---|---|---|---|---|---|---|
| | | | | | K-W | *P* |
| | Mean ± SD | | | | | |
| Vitality | 48.44 ± 22.84 | 66.67 ± 17.93 | 68.50 ± 24.10 | 74.83 ± 21.05 | 9.829 | **.020*** |
| Social functioning | 59.38 ± 27.35 | 82.14 ± 20.38 | 81.50 ± 26.05 | 86.11 ± 23.10 | 8.173 | **.043*** |
| **Components** | | | | | | |
| Mental health | 57.50 ± 18.71 | 74.05 ± 17.00 | 72.40 ± 19.64 | 77.36 ± 16.41 | 8.720 | **.033*** |

[1] K-W, Kruskal-Wallis test.

**Table 6:** Association of quality of life with professional situation.

| Domains | Active | Retired | M-W test[1] | |
|---|---|---|---|---|
| | Mean ± SD | | Z | *P* |
| Vitality | 56.25 ± 18.96 | 73.93 ± 21.64 | -3.839 | **<.001*** |
| Social functioning | 71.63 ± 23.60 | 85.55 ± 23.80 | -3.014 | **.003*** |
| Emotional role functioning | 68.27 ± 23.81 | 82.55 ± 24.20 | -2.758 | **.006*** |
| Mental health | 65.96 ± 18.55 | 76.48 ± 17.31 | -2.639 | **.008*** |
| **Components** | | | | |
| Mental health | 65,53 ± 18.31 | 79.63 ± 18.09 | -3.553 | **<.001*** |

SD, Standard deviation. [1] K-W, Mann–Whitney test. * - significance level, $P \leq 0.05$.

The results presented in Table 7 give the components and the final PSQI score, taking into consideration the two time-points, pre-and post-thermal treatments. Considering the nature of this index, lower scores in each dimension translate into better sleep quality. As so, it was observed that in pre-treatment, the participants revealed a better sleep quality in the following dimensions: sleep duration and efficiency, use of sleeping medications, and daytime dysfunction, with mean values varying between 0.73 and 0.86. On the other hand, in the second evaluation time-point, there was an improvement of all sleep quality indices, except for the sleep duration component. The median value of the two evaluations remained unchanged in all dimensions (data not shown). Overall, the mean PSQI score decreased from 6.73 to 6.14 in the pre-and post-treatment, respectively.

**Table 7:** Quality of life assessed by the PSQI scale in the pre-treatment and post-treatment periods.

| Components | Pre-treatment | Post- treatment |
|---|---|---|
| | Mean ± SD | |
| Subjective sleep quality | 1.12 ± 0.61 | 1.02 ± .45 |
| Sleep latency | 1.10 ± 1.03 | .86 ± .98 |
| Sleep duration | .79 ± .68 | .81 ± .65 |
| Habitual sleep efficiency | .73 ± .95 | .70 ± .93 |
| Sleep disturbances | 1.37 ± .55 | 1.19 ± .47 |
| Use of sleeping medications | .77 ± 1,32 | .77 ± 1,32 |
| Daytime dysfunction | .86 ± .65 | .80 ± .56 |
| **PSQI** | **6.73 ± 3.56** | **6.14 ± 3.19** |

SD, Standard deviation.

The results presented in Table 8 resulted from the comparisons between PSQI and parametric (gender - t-Student), non-parametric tests (age group and educational level- Kruskal-Wallis; professional and economic status - Mann-Whitney). The significance level values obtained are also presented in Table 8. As can be observed in Table 9, there are statistically significant differences between men and women in sleep latency, use of sleeping medication, and global sleep quality index (P≤0.001). It was also found that men presented better sleep quality than women in the different components and globally.

**Table 8:** Comparisons between the components of PSQI and sociodemographic variables.

| Domains | Gender | Age | Educational level[1] | Professional status | Economic status[2] |
|---|---|---|---|---|---|
| | *P* value | | | | |
| Subjective sleep quality | .252 | .125 | .229 | .1335 | .267 |
| Sleep latency | **<.001*** | .803 | .359 | .566 | .356 |
| Sleep duration | .937 | .052 | .829 | .156 | .594 |
| Habitual sleep efficiency | .914 | **.027*** | .390 | **.002*** | .447 |
| Sleep disturbances | .276 | **.026*** | .115 | .962 | .947 |
| Use of sleeping medications | **<.001*** | .337 | .203 | .383 | .544 |
| Daytime dysfunction | .421 | .388 | .993 | .734 | .496 |
| PSQI | **.001*** | .348 | .797 | .331 | .665 |

* - significance level, *P*≤0.05.

**Table 9:** Association of sleep quality with gender.

| Components | Men | Women | *t*-test | |
|---|---|---|---|---|
| | Mean ± SD | | *t* | *P* |
| Sleep latency | .63 ± .83 | 1,17 ± .68 | -3,674 | **.001*** |
| Use of sleeping medications | .09 ± .53 | 1,14 ± 1,47 | -4,870 | **<.001*** |
| **PSQI** | 5.31 ± 2.40 | 7.52 ± 3.85 | -3.338 | **.001*** |

SD, Standard deviation. * - significance level, *P*≤0.05.

From the comparisons made by age group, it can be concluded that there are statistically significant differences in the dimensions, sleep efficiency and sleep disturbances, in the age groups <45 years and 66-74 years. The comparisons made between the four age groups allowed to conclude that participants <45 years have a statistically better sleep efficiency than participants >74 years (P=0.027). Likewise, participants aged between 66 and 74 years have significantly fewer sleep disorders than the thermal bathers older than 74 years old (P=0.026). In the comparisons made by professional status, according to the Mann-Whitney test, statistically significant differences were only obtained in the dimension of sleep efficiency. Active participants presented a significantly better sleep efficiency than retired ones (P=0.002). Regarding the educational level and economic status, there are no statistically significant differences in any of the dimensions or global index.

The study has some limitations. First, the sample size due to the current circumstances caused by Covid-19, which translated into difficulty in applying the questionnaires in different periods and the almost non-existence of international thermalists. Second, the study participants were volunteers which may be a source of bias and may not be a representative thermal population. Last, the results obtained from the self-administered questionnaires, supported by the subjective evaluation of the participants, is a

known limitation of this methodology.

The effects of thermalism as having a therapeutic or wellness intent are ascribed to the atmosphere of the thermal mineral water. Thus, WHO has been encouraging the use of complementary medicine in health systems, in an integrative perspective with classical medicine (Cantista, 2008). Thermal Spas are part of a specific context of "health places" with an environment favoring therapeutic effects, and according to WHO recognizing the important role of the so-called "Health Resort Medicine". As so, Loureiro and Almeida, 2013 (Loureiro *et al*., 2013) refer that wellness services, such as thermal Spas, are promoters of a healthy mind and body by allowing the prevention of diseases, the reduction and/or elimination of stress, the improvement of mental and psychological health, that is, the improvement of QOL on its holistic vision. Latorre- Román *et al*., observed a significant improvement in pain perception, emotional state, sleep, and depression in elderly people who underwent thermal treatments after 12 days of treatment. Likewise, Hanzel, *et al*. (Hanzel *et al*., 2018), found a significant improvement in the performance of activities involving greater physical effort in patients with osteoarthritis after thermal treatments. Recently, Koçak, *et al*. (Koçak *et al*., 2020), observed an improvement in sleep quality in women with morbid obesity after 15-days of thermal treatments.

## Conclusions

This work provides for the first time the beneficial effect of thermal treatments on the improvement of health and well-being, namely quality of life and sleep, in individuals who attended therapeutic thermalism at Chaves thermal Spa between June and October 2020.

At beginning of the treatment, study participants self-reported a satisfactory quality of life, especially on social functioning and emotional role performance. After 14-days thermal treatments, there were five domains of the SF-36v2 scale that were improved, namely physical functioning, physical role functioning, bodily pain, social functioning, and emotional role functioning. As so, the treatments provided a statistically significant benefit in terms of physical functioning, physical role functioning, bodily pain, vitality, and social functioning. Regarding the perception of quality of life, data revealed that men had a better quality of life than women, with special relevance in the physical component. Participants younger than 45 years old presented a statistically lower quality of life than those older than 74 years old regarding vitality and social functioning. Those with primary level education have a statistically significant lower quality of life in terms of physical function than those with higher educational level. Finally, retirees presented the greatest quality of life in all components associated with mental health.

Additionally, after 14-days thermal treatments, the mean PSQI values were lower, indicating an improvement in quality of sleep. Regarding the quality of sleep by sociodemographic variables, we found that men presented better quality of sleep in the different components and, globally; the sleep efficiency was higher in younger age groups and sleep disturbances increased with age; retired participants had a significantly worse sleep efficiency than professionally active participants.

Our recommendation, based on existing studies as well as on the results of the current one carried out by our research team, is to contribute to an increase in demand for thermal therapy or wellness, as well as understand and further explore the effect of treatments on improving quality of life and sleep.

## Financial Support

The authors wish to acknowledge financial support from the project "AquaValor – Centro de Valorização e Transferência de Tecnologia da Água" (NORTE-01-0246-FEDER-000053), supported by Norte Portugal Regional Operational Programme (NORTE 2020) and from the project "GreenHealth - Digital strategies based on biological assets to improve well-being and promote green health" (Norte-01-0145-FEDER-000042), supported by Norte Portugal Regional Operational Programme (NORTE 2020).

## Author Contributions

S.S. and J.S., study conceptualization and methodology; S.S., J.S. C.G., data collection; S.S. and J.S., Writing - original draft preparation; S.S., J.S., C.G., A.G. and M.J.A., Writing - review and editing; A.G. and M.J.A., design and supervision.

## Declaration of Competing Interest

The authors declare that they have no conflict of interest to report.

## References

Antunes J. Turismo de saúde: o caso do termalismo em Portugal. InAtas Do 11. o Congresso APDR 2005; pp. 1-25.

Araujo AR, Paiva T, Ribeiro MP, Coutinho P. Innovation in Thermalism: An Example in Beira Interior Region of Portugal. InHealth and Wellness Tourism. *Springer, Cham* 2015; pp. 165-180.

Beaudreau SA, Spira AP, Stewart A, Kezirian EJ, Lui LY, Ensrud K, Redline S, Ancoli-Israel S, Stone KL, Study of Osteoporotic Fractures. Validation of the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale in older black and white women. *Sleep Med* 2012; 13: 36-42.

Bertolazi AN, Fagondes SC, Hoff LS, Dartora EG, da Silva Miozzo IC, de Barba ME, Barreto SS. Validation of the Brazilian Portuguese version of the Pittsburgh sleep quality index. *Sleep Med* 2011; 12: 70-75.

Bowling A. "Measuring health outcomes from the patient's perspective." *Handbook of Health Research Methods* 2005; pp.

428-444.

Buysse DJ. Sleep health: can we define it? Does it matter? *Sleep* 2014; 37: 9-17.

Buysse DJ, Reynolds III CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989; 28: 193-213.

Camfield L and Skevington SM. On subjective well-being and quality of life. *J Health Psychol* 2008; 13: 764-775.

Cantarini L, Leo G, Giannitti C, Cevenini G, Barberini P, Fioravanti A. Therapeutic effect of spa therapy and short wave therapy in knee osteoarthritis: a randomized, single blind, controlled trial. *Rheumatol Int* 2007; 27: 523-529.

Cantista P. O termalismo em Portugal. *Anales de hidrologia médica* 2008; 2010: 1.

World Health Organization. Constitution of the world health organization 1947; 1: 29-43.

Costanza R, Fisher B, Ali S, Beer C, Bond L, Boumans R, Danigelis NL, Dickinson J, Elliott C, Farley J, Gayer DE. Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecological Economics* 2007; 61: 267-276.

DGEG. "Termalismo e Geotermia." Retrieved 25.05.2021.

Diener E, Lucas RE, Scollon CN. Beyond the hedonic treadmill: Revising the adaptation theory of well-being. InThe science of well-being. *Springer, Dordrecht* 2009; pp. 103-118.

Emert SE, Tutek J, Lichstein KL. Associations between sleep disturbances, personality, and trait emotional intelligence. *Pers Individ Dif* 2017; 107: 195-200.

Falagas ME, Zarkadoulia E, Rafailidis PI. The therapeutic effect of balneotherapy: evaluation of the evidence from randomised controlled trials. *Int J Clin Pract Suppl* 2009; 63: 1068-1084.

Ferreira MO, Costa PC, Bahia MF. Effect of São Pedro do Sul thermal water on skin irritation. *Int J Cosmet Sci* 2010; 32: 205-210.

Ferreira PL. "Development of the Portuguese version of MOS SF-36. Part I. Cultural and linguistic adaptation." *Acta medica portuguesa* 2000a; 13: 55-66.

Ferreira PL. "Development of the Portuguese version of MOS SF-36. Part II --Validation tests." *Acta Med Port* 2000b; 13: 119-127.

Franke A, Reiner L, Resch KL. Long-term benefit of radon spa therapy in the rehabilitation of rheumatoid arthritis: a randomised, double-blinded trial. *Rheumatol Int* 2007; 27: 703-713.

Gabrielsen A, Videbaek R, Johansen LB, Warberg J, Christensen NJ, Pump B, Norsk P. Forearm vascular and neuroendocrine responses to graded water immersion in humans. *Acta Physiologica Scandinavica* 2000; 169: 87-94.

Hanzel A, Horvát K, Molics B, Berényi K, Németh B, Szendi K, Varga C. Clinical improvement of patients with osteoarthritis using thermal mineral water at Szigetvár Spa—results of a randomised double-blind controlled study. *Int J Biometeorol* 2018; 62: 253-259.

Horváth K, Kulisch Á, Németh A, Bender T. Evaluation of the effect of balneotherapy in patients with osteoarthritis of the hands: a randomized controlled single-blind follow-up study. *Clin Rehabil* 2012; 26: 431-441.

Karimi M and Brazier J. Health, health-related quality of life, and quality of life: what is the difference? *Pharmacoeconomics* 2016; 34: 645-649.

Koçak FA, Kurt EE, Sezgin FM, Şaş S, Tuncay F, Erdem HR. The effect of balneotherapy on body mass index, adipokine levels, sleep disturbances, and quality of life of women with morbid obesity. *Int J Biometeorol* 2020; 64: 1463-1472.

Kulisch Á, Bender T, Németh A, Szekeres L. Effect of thermal water and adjunctive electrotherapy on chronic low back pain: a double-blind, randomized, follow-up study. *J Rehabil Med* 2009; 41: 73-79.

Leandro ME and da Silva Leandro AS. Da saúde e bem-estar/mal-estar ao termalismo. Sociologia: Revista da Faculdade de Letras da Universidade do Porto. 2015; 30: 75-96.

Lopes S.R.F.d.S. Satisfação dos visitantes relativamente às estâncias termais e território envolvente: caso de estudo da Curia, Universidade de Aveiro, 2018.

Loureiro SM, Almeida M, Rita P. The effect of atmospheric cues and involvement on pleasure and relaxation: The spa hotel context. *Int J Hosp Manag* 2013; 35: 35-43.

Lourenço FM. *O posicionamento* do turismo de saúde e bem-estar. O caso das Termas de São Pedro do Sul (Doctoral dissertation, Instituto Politécnico de Viseu. Escola Superior de Tecnologia e Gestão de Viseu) 2012.

Oliveira AS, Vaz CV, Silva A, Ferreira SS, Correia S, Ferreira R, Breitenfeld L, Martinez-de-Oliveira J, Palmeira-de-Oliveira R, Pereira C, Cruz MT. Chemical signature and antimicrobial activity of Central Portuguese Natural Mineral Waters against selected skin pathogens. *Environ Geochem Health* 2020; 42: 2039-2057.

Pittler MH, Karagulle MZ, Karagulle M, Ernst E. Spa therapy and balneotherapy for treating low back pain: meta-analysis of randomized trials. *Rheumatol* 2006; 45: 880-884.

Post M. Definitions of quality of life: what has happened and how to move on. *Top Spinal Cord Inj Rehabil* 2014; 20: 167-180.

Rejeski WJ and Mihalko SL. "Physical activity and quality of life in older adults." *J Gerontol A Biol Sci Med Sci* 2001; 56: 23-35.

Rijo-Ferreira F and Takahashi JS. Genomics of circadian rhythms in health and disease. *Genome Med* 2019; 11: 1-6.

Verhagen AP, De Vet HC, De Bie RA, Kessels AG, Boers M, Knipschild PG. Balneotherapy for rheumatoid arthritis and osteoarthritis. *Cochrane Database Syst Rev* 2000; 1: CD000518.

WHOQOL Group. Study protocol for the World Health Organization project to develop a Quality of Life assessment instrument (WHOQOL). *Qual Life Res* 1993; 2: 153-159.

Zhang SL and Sehgal A. Circadian Rhythms and Disease. Emery and Rimoin's Principles and Practice of Medical Genetics and Genomics (Seventh Edition). R. E. Pyeritz, B. R. Korf and W. W. Grody, *Academic Press*: 2019; 299-314.