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## STATE OF THE ART IN TURKISH RESEARCH IN MEDICAL BALNEOLOGY AND HYDROCLIMATOLOGY

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### **Introduction**

Turkey has a lot of thermal and mineral springs and their use for health purposes is a long lasting tradition and is connected with the cultures of ancient civilizations and later Romans and Ottomans [1]. Health resort medicine or spa medicine has a great tradition in Turkey. This tradition is still vivid and mostly accompanied by empiricism and intuitiveness. Even today, traditional methods are predominantly used in most spas and health resorts in Turkey [2]. However, it has assumed some important aspects of modern balneotherapeutic methods as well in last decades [2,3]. We have collected data on the characteristics of traditional and modern balneological and spa therapy forms in Turkey that are widely used in the treatment of rheumatic diseases [1,2]. Spa and balneotherapy forms differed according to the spa centre ; they might be either stationary or ambulatory ; and mono (single) or complex modalities [2]. Unlike other European countries [3], nearly 90 % Turkish patients who underwent balneotherapy or spa therapy courses were suffering of rheumatic disorders, primarily of degenerative joint diseases, followed by soft tissue and inflammatory rheumatic diseases [1,2]. So, the main indication for spa therapy and balneotherapy in Turkey was and is rheumatic diseases.

### **The state of the art Balneology in Turkey in late 90ties**

We published a systematic review in 2004 in which the studies that have been completed between 1990 and 2000 in different spas in Turkey on the efficacy and effectiveness of spa therapy and balneotherapy for rheumatic diseases have been searched and analyzed independent of their study design [4]. A descriptive evaluation of the studies was carried out. A total of 15 published studies have been found and analyzed. The analyzed studies were conducted with varying designs as follows :

- uncontrolled retrospective studies,
- uncontrolled prospective studies,
- non-randomized controlled trials,
- randomized controlled trials.

Five studies were controlled randomized studies ; five were controlled, but non-randomized

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studies. Furthermore, the two of them were uncontrolled prospective pilot studies and two were uncontrolled retrospective studies with nearly 4000 patients included. In these studies, therapeutic effect of balneotherapy was investigated in the following diseases :

- osteoarthritis,
- rheumatoid arthritis,
- ankylosing spondylitis,
- psoriatic arthritis,
- low back pain,
- fibromyalgia.

We have concluded that nearly all forms of spa therapy and balneotherapy evaluated for the treatment of rheumatic diseases in Turkey were effective. A definitive conclusion, however, was not possible because of the heterogeneity of the study designs, methodological flaws and the publication bias. It was clear that in future good quality randomized controlled trials were needed. Although balneological therapies especially are used on skeletal system disorders [5], there was weak scientific evidence concerning their efficacy and effectiveness yet in beginning of new millennium, not only in Turkey [6], but in many other countries [7,8].

The properties and designs of these previous studies that were included in our review are summarized table 1.

**Table 1 : Studies in balneology in late nineties in Turkey, investigated rheumatic diseases, design of the studies and the total number of patients [adapted 4]**

Disease	Study design			
	Uncontrolled		Controlled	
	Retrospective	Prospective	Non randomized	Randomized
Fibromyalgia				2 Studies n : 60
Knee Osteoarthritis		1 Study n : 60	4 Studies n : 164	
Osteoarthritis		1 Study n : 36		
Low back pain			2 Studies n : 52	1 Study n : 50
Rheumatoid arthritis	2 Studies n : 1703			1 Study n : 57
Ankylosing spondylitis	2 Studies n : 1712			1 Study n : 45
Psoriatic arthritis	1 Study n : 542			
Total	5 Studies n : 3957	2 Studies n : 96	6 Studies n : 216	5 Studies n : 212

## The state of the art Balneology in Turkey 2000

In Turkey, during the first decade of new millennium, balneological studies have been intensified and strengthened mainly at the balneological departments and research centers at universities and scientific research has been promoted in many spas and has been sponsored by some spa establishments. In Turkish universities there are three Departments of Medical Ecology and Hydroclimatology which are the main (principal) academic institutions dealing with research in Medical Hydrology, Climatology and Balneology as well as undergraduate and post graduate (specialization) education and training. These departments are located at Istanbul Medical Faculty of Istanbul University, Istanbul, Gülhane Military Medical Academy, Ankara and Medical Faculty of Gaziosmanpaşa University, Tokat. Besides these departments there exist two University Research Centers in Balneology and Climatology ; Atatürk Balneotherapy and Rehabilitation Center, Uludag University, Bursa and Health Resort Medicine and Thalassotherapy Education, Research and Application Center of Akdeniz University, Antalya. On the other hand some Departments of Physical Medicine and Rehabilitation of various medical faculties of Turkey where spa facilities are found, are also involved balneological research last decade. Amongst them the most prominent is Department of Physical Medicine and Rehabilitation of Medical Faculty of Kocatepe University, Afyon. All these university institutions are summarized in table 2.

**Table 2 : Scientific Balneological Departments and Research Institutions and Departments with Balneological Interest of Universities in Turkey**

### **Departments of Medical Ecology and Hydroclimatology in Medical Faculties of Universities**

- Istanbul Medical Faculty of Istanbul University, Istanbul
- Gülhane Military Medical Academy, Ankara
- Medical Faculty of Gaziosmanpaşa University, Tokat

### **Balneological Research Centers in Universities**

- Atatürk Balneotherapy and Rehabilitation Center, Uludag University, Bursa
- Health Resort Medicine and Thalassotherapy Education, Research and Application Center of Akdeniz University, Antalya

### **Departments with Balneological Interest of Medical Faculties of Universities**

- Department of Physical Medicine and Rehabilitation of Medical Faculty of Kocatepe University, Afyon
- Department of Physical Medicine and Rehabilitation of Medical Faculty of Pamukkale University, Denizli
- Department of Physical Medicine and Rehabilitation, Turkish Armed Forces Rehabilitation Center, Gulhane Military Medical Academy, Ankara
- Department of Physical Therapy and Rehabilitation, Health Institution of Higher Education, Dumlupinar University, Kütahya
- Department of Dermatology of Medical Faculty of Cumhuriyet University, Sivas

### **Department of Medical Ecology and Hydroclimatology of Istanbul Medical Faculty of Istanbul University**

The Department of Medical Ecology and Hydroclimatology of Istanbul Medical Faculty of Istanbul University is the biggest and the oldest institution of its kind. Since its foundation in 1938, it has been active as a research and education center and acted as a specialization school in Medical Hydroclimatology as well. Most of the scientific research and the studies that have been conducted in this department focused on effectiveness and efficacy of spa and balneotherapy. A vast variety of studies such as clinical pragmatic trials, experimental studies, mechanisms of effect studies (spa packages, bathing, drinking, Sulfur, Brine, CO<sub>2</sub> waters effects) and reviews have been published in peer-reviewed international journals mainly in English and then in German, but none in French by the researchers of this department. The list of publications in English and German reported by authors from the Department of Medical Ecology and Hydroclimatology of Istanbul Medical Faculty of Istanbul University is given in table 3.

**Table 3 : Studies published in English and German by the authors from Department of Medical Ecology and Hydroclimatology of Istanbul Medical Faculty of Istanbul University**

#### **Mechanisms of Effects of Studies**

- **Die Wirkung der Balneotherapie auf die spirometrischen Befunde bei Patienten mit Osteoarthritis**  
Karagülle MZ, Tütüncü ZN, Yüzbaşıoğlu N, Aslan O, Aydın S, Mutlu A.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 02, 1994
- **Effects of thermal sulphur bath cure on adjuvant arthritic rats**  
Karagülle MZ, Tütüncü ZN, Aslan O, Başak E, Mutlu A.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 02, 1996
- **Changes in TNF $\alpha$  plasma levels in osteoarthritic patients under balneotherapy with acratothermal water**  
Tütüncü ZN, Turan M, Barut A, Yüzbaşıoğlu N, Karagülle MZ.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 03, 1996
- **Wirkung des CO<sub>2</sub>-Bades auf Blutdruck und Thermoregulation**  
Sisli-Karadeniz H, Karagülle MZ, Akdur H, Yüzbaşıoğlu N.  
*Naturamed* 7, 1995
- **Evaluation of the Effects of H<sub>2</sub>S and CO<sub>2</sub>-Water Baths on Peripheral Circulation Disorders**  
Dönmez A, Tütüncü ZN, Öztürk K, Odabaşı E, Aktaş Ş.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 06, 2000
- **Akut wirkungen kalter CO<sub>2</sub>-Teilbäder auf Mikrozirkulation und Schmerzempfindlichkeit**  
Karagülle O, Candir F, Kalinin J, Gehrke A, Karagülle MZ, Gutenbrunner C.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 01, 2004

### Clinical Trials

- **Balneologie mit Akratotherme bei Gonarthrose**  
Dönmez A, Karagülle MZ, Turan M.  
*Naturamed* 7, 1995
- **Comparison of two Traditional Spa Therapy Regimens in Patients with Knee Osteoarthritis An Exploratory Study**  
Odabaşı E, Karagülle MZ, Karagülle M, Turan M, Karagülle O.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 06, 2002
- **SPA therapy in fibromyalgia : a randomised controlled clinic study**  
Dönmez A, Karagülle MZ, Tercan N, Dinler M, Işsever H, Karagülle M, Turan M.  
*Rheumatol Int* 2005 Dec;26(2):168-72.
- **10-day course of SPA therapy is beneficial for people with severe knee osteoarthritis. A 24-week randomised, controlled pilot study**  
Karagülle M, Karagülle MZ, Karagülle O, Dönmez A, Turan MA.  
*Clin Rheumatol* 2007 Dec;26(12):2063-71

### Reviews

- **Hydrotherapy, balneotherapy and spa treatment in pain management**  
Bender T, Karagülle Z, Bálint GP, Gutenbrunner C, Bálint PV, Sukenik S.  
*Rheumatol Int* 2005 Apr;25(3):220-4.
- **Die traditionellen und empirischen Kurortbehandlungsverfahren in der Türkei**  
Karagülle MZ, Tütüncü ZN, Özer N.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 03, 1995
- **Balneotherapie und Kurorttherapie rheumatischer Erkrankungen in der Türkei : Ein systematischer Review**  
Karagülle MZ, Karagülle M.  
*Forsch Komplementärmed Klass Naturheilkd* 11, 2004
- **Spa therapy and balneotherapy for treating low back pain : meta-analysis of randomized trials**  
Pittler MH, Karagülle MZ, Karagülle M, Ernst E.  
*Rheumatology* (Oxford). 2006 Jul;45(7):880-4.

### Letter to the Editor

- **Balneotherapy for fibromyalgia at the Dead Sea**  
Karagülle Z, Dönmez A.  
*Rheumatol Int* 2002 Mar;21(5):210-1.

### Other Departments of Medical Ecology and Hydroclimatology

Medical Ecology and Hydroclimatology Department at Gülhane Military Medical Academy in Ankara has been established in 1983. Here only undergraduate education is being given since then, but no post-graduate or specialization training is provided. They mostly published in Turkish, and very recently two articles in English on the effects of mud therapy and its mechanisms of chemical effects and an earlier controlled trial on mud therapy for knee osteoarthritis together with the Istanbul Department (Table 4).

**Table 4 : Studies published in English by the authors from Department of Medical Ecology and Hydroclimatology at Gülhane Military Medical Academy in Ankara at Gülhane Military Medical Academy in Ankara**

- **Comparison of two Traditional Spa Therapy Regimens in Patients with Knee Osteoarthritis An Exploratory Study**  
Odabaşı E, Karagülle MZ, Karagülle M, Turan M, Karagülle O.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 06, 2002
- **Lipophilic components of different therapeutic mud species**  
Odabaşı E, Gul H, Macit E, Turan M, Yildiz O.  
*J Altern Complement Med* 2007 Dec;13(10):1115-8.
- **Does mud pack treatment have any chemical effect ? A randomized controlled clinical study**  
Odabaşı E, Turan M, Erdem H, Tekbas F.  
*J Altern Complement Med* 2008 Jun;14(5):559-65.

The third and “youngest” existing Balneological academic department has been established very newly in 2004 at Gaziosmanpasa University Medical Faculty in Tokat, a province located in central Anatolia and famous with spa towns and hamams. An assistant professor with a restricted assisting personal help but with a strong collaboration with Istanbul Department and other departments in the Medical Faculty has managed to conduct some clinical trials and publish them in Turkish peer-reviewed journals since the foundation of the department [9-11].

**Atatürk Balneotherapy and Rehabilitation Center of Uludag University in Bursa**

One of the two university balneological research centers in Turkey ; Atatürk Balneotherapy and Rehabilitation Center, at Uludag University, in so called “water city” Bursa is an unique place having the advantage of being the only hospital spa center belonging to a university. The historical spa clinic where Atatürk Balneotherapy and Rehabilitation Center (ABRC) was established has been built during the late period of Ottoman Empire, on the slope of an inactive volcano called Uludağ. Today it functions with its physical therapy, rehabilitation and balneotherapy units where orthopedic, neurological and mainly rheumatic diseases are treated and rehabilitated in outpatient and inpatient settings. The authors of this center have published mostly randomized controlled clinical trials aiming to asses the efficacy of balneotherapy in rheumatoid arthritis, ankylosing spondylitis, knee osteoarthritis, fibromyalgia and osteoporosis and to shed light on the mechanisms of effects of balneotherapy in osteoarthritis. These reports are summarized in the table 5.

**Table 5 : Studies published in English by the authors from Atatürk Balneotherapy and Rehabilitation Center at Uludag University, Bursa**

**Mechanisms of Effects of Studies**

- **The effect of balneotherapy on the plasma-β-endorphine (BE) level in patients with osteoarthritis**  
Yurtkuran M, Ulus IH, Irdesel FJ.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 05, 1993

- **Effects of Balneotherapy on Serum Interleukine-2 Receptors, Inflammation Markers and Cortisol Levels in Knee Osteoarthritis**  
Alp A, Yurtkuran M, Ilcol YO.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 04, 2007

#### **Randomized Controlled Clinical Trials**

- **A randomized, controlled trial of balneotherapy in the treatment of patients with primary fibromyalgia syndrome**  
Yurtkuran M, Celiktas M.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 04, 1996
- **Investigation of the effects of pool-based exercise on fibromyalgia syndrome**  
Altan L, Bingöl U, Aykaç M, Koç Z, Yurtkuran M.  
*Rheumatol Int* 2004 Sep;24(5):272-7.
- **A randomized, controlled study of balneotherapy in patients with rheumatoid arthritis**  
Yurtkuran M, Yurtkuran MA, Dilek K, Güllülü M, Karakoç Y, Özbek L, Bingöl Ü.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 03, 1999
- **Improvement of the clinical outcome in Ankylosing spondylitis by balneotherapy**  
Yurtkuran M, Ay A, Karakoç Y.  
*Joint Bone Spine* 2005 Jul;72(4):303-8.
- **The effect of balneotherapy on patients with ankylosing spondylitis**  
Altan L, Bingöl U, Aslan M, Yurtkuran M.  
*Scand J Rheumatol* 2006 Jul-Aug;35(4):283-9.
- **Balneotherapy and tap water therapy in the treatment of knee osteoarthritis**  
Yurtkuran M, Yurtkuran M, Alp A, Nasırcılar A, Bingöl U, Altan L, Sarpdere.  
*Rheumatol Int* 2006 Nov;27(1):19-27
- **Evaluation of hormonal response and ultrasonic changes in the heel bone by aquatic exercise in sedentary postmenopausal women**  
Ay A, Yurtkuran M.  
*Am J Phys Med Rehabil* 2003 Dec;82(12):942-9.
- **Influence of aquatic and weight-bearing exercises on quantitative ultrasound variables in postmenopausal women**  
Ay A, Yurtkuran M.  
*Am J Phys Med Rehabil* 2005 Jan;84(1):52-61.

#### **Review**

- **Evaluation of the Spa Therapy in Atatürk Balneotherapy and Rehabilitation Center**  
Yurtkuran M, Ay A, Bingöl Ü, Altan L.  
*Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin* 06, 2005

### **Department of Physical Medicine and Rehabilitation of Medical Faculty of Kocatepe University, Afyon**

The studies that were performed by Department of Physical Medicine and Rehabilitation of Medical Faculty of Kocatepe University, Afyon and published in English in rheumatologic journals in last years are dealt with the effectiveness and efficacy of balneotherapy and mudpack therapy in fibromyalgia and knee osteoarthritis patients with positive results. These are listed in the table 6.

**Table 6 : Randomized Controlled Clinical Trials published in English by the authors from Department of Physical Medicine and Rehabilitation of Medical Faculty of Kocatepe University in Afyon**

- **The effects of balneotherapy on fibromyalgia patients**  
Evcik D, Kizilay B, Gökçen E.  
*Rheumatol Int* 2002 Jun;22(2):56-9.
- **The efficacy of balneotherapy and mud-pack therapy in patients with knee osteoarthritis**  
Evcik D, Kavuncu V, Yeter A, Yigit I.  
*Joint Bone Spine* 2007 Jan;74(1):60-5.
- **Effectiveness of aquatic therapy in the treatment of fibromyalgia syndrome : a randomized controlled open study**  
Evcik D, Yigit I, Pusak H, Kavuncu V.  
*Rheumatol Int* 2008 Jul;28(9):885-90.

### **Departments with Balneological Interest**

Each of Departments of Physical Medicine and Rehabilitation of Medical Faculty of Pamukkale University, Denizli and Gulhane Military Medical Academy, Ankara, Department of Physical Therapy and Rehabilitation, Health Institution of Higher Education, Dumlupinar University, Kütahya and Department of Dermatology of Medical Faculty of Cumhuriyet University, Sivas (see Table 2) has published a paper in English related balneology since the turn of new century. A dermatological study reported from Cumhuriyet University Dermatology Department in Sivas reported the therapeutic effect of a spa therapy course on psoriasis at a unique spa called Kangal Fish Spa. Other studies from Ankara, Kütahya and Denizli are again yielded some evidence on the effects on pain and quality of life in various rheumatic conditions and chemical effects on inflammatory mediators in fibromyalgia (Table 7).

**Table 7 : Studies published in English by the authors from various Departments with Balneological interest of Medical Faculties of Universities in Turkey**

- **Kangal hot spring with fish and psoriasis treatment**  
Ozçelik S, Polat HH, Akyol M, Yalçın AN, Ozçelik D, Marufihah M.  
*J Dermatol* 2000 Jun;27(6):386-90.
- **Comparison of a generic and a disease specific quality of life scale to assess a comprehensive spa therapy program for knee osteoarthritis**  
Yilmaz B, Goktepe AS, Alaca R, Mohur H, Kayar AH.  
*Joint Bone Spine* 2004 Nov;71(6):563-6.



- **The effect of combined therapy (spa and physical therapy) on pain in various chronic diseases**

Cimbiz A, Bayazit V, Hallaceli H, Cavlak U.

*Complement Ther Med* 2005 Dec;13(4):244-50.

- **Effects of balneotherapy on serum IL-1, PGE2 and LTB4 levels in fibromyalgia patients**

Ardıç F, Ozgen M, Aybek H, Rota S, Cubukçu D, Gökgöz A.

*Rheumatol Int* 2007 Mar;27(5):441-6.

### Journals

A total of 33 reports, papers or articles have been published in German (6 publications) and in English (27 publications) in a total of 12 various peer-reviewed journals. One of these journals has no impact factor and is not indexed except and one is indexed in Science Citations Index Expanded (SCIE) and the rest (10) are indexed in Medline of which are mostly having relatively small impact factors between 1 and 2 in 2008 (Table 8).

**Table 8 : Journals and their characteristics where Turkish balneological articles have been published in German and English last two decades**

Journal Name	Indexed in	Impact Factor (2008)	No of papers	Language	Medical Field
Physikalische Medizin Rehabilitationsmedizin Kurortmedizin	SCIE	0.976	10	English and German	Spa Medicine Physical Medicine and Rehabilitation
Clinical Rheumatology	MEDLINE	1.559	1	English	Rheumatology
Joint Bone Spine	MEDLINE	1.953	3	English	Rheumatology and Orthopedics
Rheumatology (Oxford)	MEDLINE	4.136	1	English	Rheumatology
Rheumatology International	MEDLINE	1.327	8	English	Rheumatology
Scandinavian Journal of Rheumatology	MEDLINE	2.345	1	English	Rheumatology
Complementary Therapies in Medicine	MEDLINE	1.841	1	English	Complementary and Alternative Medicine
Forsch Komplementärmed Klass Naturheilkd (Forschende Komplementmedizin)	MEDLINE	1.152	1	English and German	Complementary and Alternative Medicine

Journal Name	Indexed in	Impact Factor (2008)	No of papers	Language	Medical Field
Journal of Alternative and Complementary Medicine	MEDLINE	1.628	2	English	Complementary and Alternative Medicine
NATURAMED	None	None	2	German	Complementary and Alternative Medicine
American Journal of Physical Medicine & Rehabilitation	MEDLINE	1.695	2	English	Physical Medicine and Rehabilitation
Journal of Dermatology	MEDLINE	1.175	1	English	Dermatology

## Conclusions

The recent balneological research in Turkey that has been carried out in the university academic units originated mainly from the two centers ; Department of Medical Ecology and Hydroclimatology of Istanbul Medical Faculty of Istanbul University and Atatürk Balneotherapy and Rehabilitation Center of Uludag University in Bursa. The other two departments of Medical Ecology and Hydroclimatology and the Department of Physical Medicine and Rehabilitation of Medical Faculty of Kocatepe University in Afyon have also appeared with their intensive research activities in the first decade of the years of 2000. While as the education and training centers the Medical Ecology and Hydroclimatology departments are concentrated in the research on a wide range of scientific topics in balneology such as animal studies, mechanisms of effect studies, effects of different spa packages, effects of bathing and/or drinking cures and specific effects of Sulfur, CO<sub>2</sub> and NaCl (salty and brine) waters, as a University Balneological research center, Atatürk Balneotherapy and Rehabilitation Center of Uludag University in Bursa has gained a reputation by conducting the relevant randomized controlled trials evaluating the effects of balneotherapy in majority of rheumatic conditions including rheumatoid arthritis and ankylosing spondylitis. It is interesting to note that the results of the balneological research conducted in Turkish academic institutions have been increasingly published in two different foreign languages earlier and a few in German and mostly and lately in English. This phenomenon not only reflects the willingness of the authors sharing the evidence in international scientific arena with international experts but also helps to improve the quality of research methodology in medical balneology and hydroclimatology in Turkey which is not an internal challenge [6], rather an international one [12,13].

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10. Şen U, Karagülle MZ, Karagülle M. The Efficacy of Peloidotherapy on Knee Osteoarthritis. *Romatizma* 2007; 22:55-9 (in Turkish).
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