

# Observation of the Long-term Effects of Lifestyle Intervention during Balneotherapy in Metabolic Syndrome

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**Keywords:** metabolic syndrome X; balneotherapy; cohort studies; life style

**Abstract – Objective.** Estimate the effect of lifestyle adjustment activities in patients with metabolic syndrome treated by prescribed balneotherapy. **Methods.** Observational pilot cohort study with 12-month follow-up after multidimensional lifestyle training (physical, dietary, educational) during 3-week standard stay in the spa town of Eugénie-les-Bains. **Results.** Of 145 eligible patients, 97 were included; 63 were followed and analysable. At inclusion all had  $\geq 3$  National cholesterol education program-Adult treatment panel III (NCEP-ATPIII) criteria defining metabolic syndrome, 76.2% were female, mean age was 61.2 years. At the end of follow-up (median: 10.4 months, Inter-Quartile Range: [6.7;11.4]), 48 of these 63 patients (76.2%) no longer had metabolic syndrome (95%CI [65.7;86.7]). These 48 patients without metabolic syndrome at the end of follow-up represented 49.5% of the 97 included (95%CI [39.5;59.4]). **Conclusions.** Future studies of lifestyle interventions taking advantage of the spa environment can be expected to find least one third of patients free of metabolic syndrome at the end of 12-month follow-up in the intervention group.

**Mots clés :** syndrome métabolique ; cure thermale ; étude de cohorte ; mode de vie

**Résumé – Observation des effets à long terme d'une intervention comportementale réalisée au cours d'une cure thermale dans le syndrome métabolique. Objectif.** Estimer l'effet attendu d'une prise en charge multidisciplinaire mise en place lors d'une cure thermale chez des patients présentant un syndrome métabolique. **Méthodes.** Cohorte observationnelle avec 12 mois de suivi après intervention multidimensionnelle durant une cure thermale à Eugénie-les-Bains. **Résultats.** Parmi 145 patients éligibles, 97 ont été inclus, 63 ont été suivis et analysés : à l'inclusion tous avaient  $\geq 3$  critères *National cholesterol education program-Adult treatment panel III* (NCEP-ATPIII) définissant le syndrome métabolique, 76,2 % étaient des femmes, l'âge moyen était 61,2 ans. À la fin du suivi (médiane : 10,4 mois, interquartile : [6,7;11,4]), 48 de ces 63 patients (76,2 %) ne présentaient plus de syndrome métabolique (95 % CI [65,7;86,7]). Ces 48 patients sans syndrome métabolique à la fin du suivi représentent 49,5% des 97 inclus (95 % CI [39,5;59,4]). **Conclusion.** Des études d'interventions comportementales durant une cure thermale peuvent s'attendre à trouver au moins un tiers des patients sans syndrome métabolique à la fin de 12 mois de suivi dans le groupe d'intervention.

**Abbreviations:** see end of article.

## 1. Introduction

Metabolic syndrome (MS) is a known risk factor for cardiovascular disease, diabetes<sup>[1]</sup> and mortality.<sup>[2, 3]</sup> The commonly used National cholesterol education program-Adult treatment

panel III (NCEP-ATPIII) criteria consider MS as the presence of at least three of either abdominal obesity, elevated triglycerides, reduced high density lipoprotein-cholesterol (HDL-C), hypertension, or hyperglycaemia.<sup>[4]</sup> Lifestyle intervention<sup>[5]</sup> addresses the underlying factors of MS.<sup>[4]</sup> Randomised controlled trials indicate

the efficacy of organised lifestyle modification as opposed to simple patient information,<sup>[6-8]</sup> which may be improved by multiple contacts.<sup>[9]</sup> Intervention can also be concentrated into a short period of time, often removing patients from their usual environment, but persistence is uncertain.<sup>[10]</sup>

In France, balneotherapy (baths, jets, *etc.*) administered over three weeks in accredited thermal institutions may be prescribed and reimbursed for certain medical conditions. However, there are few published reports of successful balneotherapy when used alone.<sup>[11]</sup> Lifestyle adjustments may be recommended, but rarely systematically, which may contribute to poor long-term impact. Taking advantage of the three weeks of standard spa therapy, lifestyle adjustment activities, both educational and physical, have been implemented in the spa town of Eugénie-les-Bains. Such a formalized integrated approach needs to be evaluated. However, before starting a randomized controlled trial, a pilot study was initiated to determine the effect that might be expected. This was an observational study that itself did not modify usual practice.

## 2. Methods

This pilot observational cohort study was performed at the spa resort of Eugénie-les-Bains, south-western France, that has implemented a multidisciplinary intervention program aimed at lifestyle adjustment. The multidisciplinary intervention involves different actors on site: the medical team (physicians, nurse and dieticians) have received training on MS lifestyle management; restaurant staff have been trained to prepare calorie-controlled meals and provided a menu containing 1400 kcal/day (Cuisine Minceur Active<sup>®</sup>); grocers have received nutritional training and the stores set-up to promote use of healthier food; self-catering accommodations have been provided with cooking appliances adapted to dietary recommendations (steam cooker *etc.*). Patients stay in hotels, rented apartments, or in campsites in and around Eugénie-les-Bains. Meals are taken in hotels, restaurants, or at home. Patients receive the standard balneotherapy treatments over a period of 21 days. Cooking classes, round table discussions on weight loss and improvement of MS, and seminars on diabetes, MS and life-style are organised. Three fitness trails, a sports centre (cardio-training), gymnastics classes, and activities such as rambling, Nordic walking *etc.* were organized and freely available. Though not mandatory, subjects are strongly encouraged to participate in activities.

For the study reported herein, participating physicians practicing at the spa centre prospectively included patients from July to November 2008. Inclusion criteria were: MS according to the NCEP-ATP III criteria (presence of  $\geq 3$ : umbilical waist circumference  $>102$  cm for men /  $>88$  cm for women, triglycerides  $\geq 1.5$  g/L, HDL-C  $<0.4$  g/L for men /  $<0.5$  g/L for women, fasting glycaemia  $\geq 1.10$  g/L, arterial blood pressure  $\geq 130/85$  mmHg),  $\geq 18$  years of age, body mass index (BMI)  $<40$ , fasting glycaemia  $<1.26$  g/L, with lab tests performed within  $[-100; +8]$  days of inclusion visit, able to be

followed over the study period, to understand the protocol and to fill-out the questionnaire, initiating balneotherapy for the indication “metabolic disease” (alone or combined with another indication), accepting to participate. Patients with a BMI  $\geq 40$  or fasting glycaemia  $\geq 1.26$  g/L were not included because these indicate morbid obesity or overt diabetes that require specific medical treatment. Patients with diabetes were excluded.

At inclusion the spa physician collected patient informed consent, their contact details and those of their general practitioner (GP), socio-demographic and morphological characteristics, MS criteria, previous medical history, concurrent medicinal treatments. After inclusion, patients filled-out a dietary habits questionnaire. Patients were to be followed-up, after inclusion by their GP, at 6 and 12 months. The coordinating centre contacted the GPs while patients were at Eugénie-les-Bains, informed them of the study, and requested their participation. If they agreed, they were sent a participation form. Patients whose GP declined to participate in the study were excluded from the study. Participating GPs were sent follow-up medical questionnaires, approximately one month before the 6- and 12-month follow-up dates, to collect data on weight, umbilical waist circumference, arterial blood pressure, and cardiovascular events occurring during the follow-up; lab test results if performed (triglycerides, cholesterol, glycaemia), and concurrent medicinal treatments were also recorded. Upon questionnaire return, physicians were paid the equivalent of a standard consultation. At the same follow-up time points, and independently of the medical questionnaire, patients were contacted by telephone to fill-out the same dietary habits questionnaire as at inclusion.

Data were analysed with SAS 9.2 (SAS institute, Irvine, CA). Data retrieved between 4 and 8 months after inclusion were considered for the 6-month data-point, and from 9 to 14 months for the 12-month data-point. The main investigation criterion was MS according to the NCEP-ATP III criteria, considered positive if at least three criteria were present, even if others were missing, and conversely so if three were not present. For sensitivity analyses, patients lost to follow-up or not followed-up were considered according to the maximal bias hypothesis, *i.e.* with MS. It was expected that 70 analysable patients would suffice to have appropriate precision to measure response rates. With 50% expected non-participation from GPs or loss to follow-up of patients, the number to include was 140 patients. Confidence intervals were built using Poisson distribution. Comparisons were made between follow-up periods with the appropriate tests. The study was approved by the regional ethics committee (*Comité de Protection des Personnes, Sud-Ouest et Outre Mer III*) and all gave written informed consent to the follow-up.

## 3. Results

Spa centre physicians identified 260 patients, of whom 145 were eligible. Corresponding GPs ( $n=140$ ) were contacted for follow-up and 94 accepted. Thus, 97 patients were included. During follow-up data was not provided for 22 patients, and for 12 patients

**Table I.** General description of included and analysed patients at inclusion.

	Included patients n=97	Analysed patients at inclusion, n=63
Gender – female, n (%)	75 (77.3)	48 (76.2)
Age in years, mean (SD)	60.4 (9.6)	61.2 (9.4)
Education		
primary	23 (23.7)	17 (27.0)
secondary or higher	74 (76.3)	46 (73.0)
Employment status, n (%)		
employed	32 (33.0)	20 (31.7)
retired	56 (57.7)	38 (60.3)
unemployed / invalid / other	9 (9.3)	5 (7.9)
Previous medical history – yes, n (%)		
cardiovascular	15 (15.5)	13 (20.6)
psychiatric	51 (52.6)	31 (49.2)
Main (+ secondary) indications for balneotherapy		
urological diseases and metabolic disorders	13 (13.4)	8 (12.7)
urological diseases and metabolic disorders (+ rheumatology)	27 (27.8)	19 (30.2)
rheumatology (+ urological diseases and metabolic disorders)	57 (58.8)	36 (57.1)
Previous history of balneotherapy – yes, n (%)	61 (62.9)	38 (60.3)

SD: standard deviation

insufficient data to conclude presence or absence of MS according to NCEP-ATP III were provided.

Thus, 63 patients (65% of included patients) were analysable for the presence of MS criteria. These were followed for a median 10.4 months (inter-quartile range, IQR: [6.7; 11.4]). For inclusion characteristics, there was no significant difference between eligible (n=145) and included (n=97) patients, nor between those included and those analysed (n=63; table I). At end of follow-up, 15 of the 63 analysable patients still had MS ( $\geq 3$  criteria), and 48 (76.2%; 95% confidence intervals, CI: [65.7; 86.7]) no longer had MS ( $p < 0.05$ ). These 48 MS-free patients represented 49.5% (95% CI: [39.5%; 59.4%]) of the 97 included in the study.

The proportion of patients presenting the individual MS criteria was significantly lower for all except fasting glycaemia. There was a significant reduction in the number of MS criteria per patient; ten patients (15.9%) no longer had any. There were also significant reductions in weight and BMI, increase in the number engaging in physical activities and the duration of these, as well as improvement in diet. A similar effect was found in both genders, although in men there was no significant difference in HDL-cholesterol (table II) or in triglycerides (1.81 g/L at end of follow-up, vs. 1.99 g/L at inclusion,  $p = 0.5$ ). No more than 4 patients initiated or discontinued medication during follow-up.

#### 4. Discussion

This pilot study of multidisciplinary lifestyle intervention for MS, with no added medicinal intervention, found a significant effect

after a median 10 months of follow-up with up to 76% of analysable patients no longer having the criteria for MS, or 49% of the patients included in the study.

Several points must be considered when interpreting this result. There is likely to be channelling of patients to prescribed balneotherapy as such treatment requires a certain degree of engagement and patients must attend all sessions of treatment for this to be reimbursed. It is therefore expected that patients would be motivated and this may translate into higher adherence and thus effectiveness. The new activities proposed during the multidimensional intervention may have had some long-lasting effect, but it cannot be excluded that the two telephone contacts made by the investigators during follow-up may have had an effect similar to repeated counselling, previously reported to increase efficacy of interventions in MS.<sup>[9]</sup> The exact contribution of balneotherapy itself is uncertain, but the three-week standard treatment does provide a break from the patients' routine life and a time when all these lifestyle-changing interventions can be initiated, explained, and reinforced. It is of note, however, that there was no significant change in patient quality of life over the study follow-up, possibly as they were not particularly impaired by the syndrome. Interestingly randomised controlled trials of lifestyle intervention using NCEP-ATP III criteria found similar results. In a study of female patients in South Korea, where intervention lasted 6 months with follow-up to one year, prevalence of MS was reduced to 40% at end of study.<sup>[7]</sup> In a second trial performed in Italy, that involved intervention over a year, prevalence of MS was halved (from 70 to 35%)<sup>[6]</sup>. One study performed in France recruited patients through screening for MS at a health centre

**Table II.** Description of populations regarding NCEP-ATP III criteria at inclusion and end of follow-up.

	Included patients n=97 ♀=75 ♂=22		Analysed patients n=63 ♀=48 ♂=15	
	At inclusion		At end of follow-up	
<b>Weight</b>				
missing data, n (%)	0	0	1 (1.6)	
men (kg), mean (SD)	99.7 (14.7)	98.6 (15.3)	95.0 (15.9)*	
women (kg), mean (SD)	85.5 (11.5)	86.6 (11.9)	83.9 (12.6)*	
<b>BMI</b>				
missing data, n (%)	0	0	1 (1.6)	
men, mean (SD)	32.8 (4.3)	31.9 (4.4)	30.8 (4.9)*	
women, mean (SD)	32.8 (3.6)	32.7 (3.4)	31.7 (3.7)*	
<b>Umbilical waist circumference</b>				
missing data, n (%)	0	0	7 (11.1)	
men – cm, mean (SD)	113.0 (10.5)	111.6 (10.7)	108.2 (14.3)*	
women – cm, mean (SD)	115.8 (9.8)	116.0 (10.2)	101.7 (10.3)*	
men >102 cm / women >88 cm, n (%)	97 (100.0)	63 (100.0)	45 (71.4)*	
<b>HDL-cholesterol</b>				
men – g/L, mean (SD)	0.46 (0.13)	0.49 (0.14)	0.49 (0.12)	
women – g/L, mean (SD)	0.47 (0.12)	0.47 (0.12)	0.53 (0.10)*	
men <0.4 g/L / women <0.5 g/L, n (%)	61 (62.9)	37 (58.7)	20 (31.7)*	
<b>Fasting glycaemia</b>				
g/L, mean (SD)	1.00 (0.13)	1.00 (0.13)	1.01 (0.21)	
≥1.10 g/L, n (%)	29 (29.9)	20 (31.7)	14 (22.2)	
<b>Triglycerides</b>				
g/L, mean (SD)	1.61 (0.66)	1.68 (0.70)	1.38 (0.53)*	
≥1.5 g/L, n (%)	51 (52.6)	37 (58.7)	19 (30.2)*	
<b>Arterial blood pressure, mmHg</b>				
systolic, mean (SD)	135.4 (7.1)	135.3 (7.7)	132.3 (13.2)*	
diastolic, mean (SD)	85.0 (4.9)	84.7 (5.3)	77.2 (7.2)*	
≥130/85, n (%)	78 (80.4)	49 (77.8)	8 (12.7)*	
<b>Number of ATP III criteria, n (%)</b>				
0	/	/	10 (15.9) <sup>†</sup>	
1	/	/	17 (27.0)	
2	/	/	21 (33.3)	
3	73 (75.3)	47 (74.6)	13 (20.6)	
4	23 (23.7)	15 (23.8)	2 (3.2)	
5	1 (1.0)	1 (1.6)	0	
Diet score, mean (SD)	79.1 (5.8)	79.5 (5.5)	82.1 (4.8)*	
<b>Physical activity</b>				
engaging, n (%)	54 (55.7)	36 (57.1)	47 (74.6)*	
duration – h/w, mean (SD)	2.1 (3.0)	2.2 (3.1)	4.3 (5.8)*	
<b>Medication</b>				
lipid modifying agents – ATC C10, n (%)	45 (46.4)	33 (52.4)	31 (49.2)	
anti-hypertensive agent – ATC C02, 03, 07, 08 or 09, n (%)	41 (42.3)	28 (44.4)	30 (47.6)	
analgesics – ATC N02, n (%)	17 (17.5)	11 (17.5)	5 (7.9)	

\*p&lt;0.05 analysed at end of follow-up vs. at inclusion

<sup>†</sup>overall p<0.05 analysed at end of follow-up vs. at inclusion

ATC: anatomical therapeutic chemical; BMI: body mass index; NCEP-ATP III: National Cholesterol Education Program-Adult Treatment Panel III; SD: standard deviation

and intervention essentially comprised patient education at the health centre with a subsequent visit to the GP. The result at 6 months of follow-up was that the proportion of patients presenting with NCEP-ATP III MS was halved.<sup>[12]</sup> Comparison of the study populations finds that a greater proportion of those in the present report presented with the waist circumference criterion whereas fewer presented with the blood pressure criterion (there was also a higher proportion of female patients and patients were older).<sup>[12]</sup> This could indicate additional channelling issues that restrict extrapolation to the general population, but this was not the aim of the present study. The results simply indicate the minimal effect that may be expected of the approach in future studies, which was that at the least a third of patients included would be MS-free (*i.e.* the lower limit of the 95% confidence intervals found in the sensitivity analysis). The effect is in fact likely to be higher as, at the end of follow-up, three-quarters of analysable patients had fewer than 3 of the NCEP-ATP III criteria that define MS. In conclusion, these results may help to design randomized studies of such structured interventions in the management of MS within the framework of spa therapy.

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**Abbreviations.** 95% CI: 95% confidence intervals; BMI: body mass index; GP: general practitioners; HDL-C: high-density lipoprotein cholesterol; IQR: interquartile range; MS: metabolic syndrome; NCEP-ATP III: National cholesterol education program-Adult treatment panel III.

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