
AN OBSERVATION ON HEALTH EFFECTS OF HAMAM (TURKISH BATH)

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Introduction

As a similar traditional but still widely in use procedure, Sauna's physiological and health effects have been more intensively investigated, even though the claims for beneficial effects of hamam are a lot, this is not the case for hamam. Through the 20th century, one could hardly find any documented evidence concerning the effects of hamam on human. It is only very recently that hygienic conditions and risk of mycological contamination in hamams have been reported.

Considering the above mentioned facts, we planned a study to evaluate the physiological effects of a classical hamam session in healthy subjects. We also aimed to investigate the possible biochemical mechanisms of expected effects by measuring the Nitrate/Nitrite (NN) and Beta-Endorphin (BE) production.

Materials and Methods

Apparently healthy volunteers were asked to take part in the study during their visit to Çemberlitaş Hamam, one of oldest historical hamams in Istanbul still in use, which was built in 1584 by the great architect of Ottoman Empire, Mimar Sinan [cichocki]. Only the volunteers without previous or present serious disease, and who were not on prescription drugs were enrolled. Recruited subjects were not regular hamam users and their last hamam visit was at least a week ago. A total of 15 volunteers, 8 females and 7 males (mean age 25 years ; range 23-54) were admitted to the study. The demographic characteristics of the study participants have been summarized in Table 1.

Study has been carried out according to Helsinki Declaration. All subjects gave written informed consent for participation in the study.

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Total ; Male/Female	15 ; 10/5
Age, years (Mean, Min-Max)	25 (23-54)
Weight, kg (Mean, Min-Max)	70 (50-82)
Height, cm (Mean, Min-Max)	170 (157-186)
BMI, kg/cm ² (Mean, Min-Max)	23.9 (19.11-27)

Table 1. Subjects Demographics

After 15-30 minutes of rest in the entrance hall of the hamam, subjects underwent a classical hamam ritual; consisted of 20-30 minutes stay depending on the desire of the each subject in *hararet* (the hottest part of a hamam) in lying supine position on the belly stone. Then they experienced a kese massage ; scrubbing the skin during a bracing massage lasting about 10 to 15 minutes. Later, this procedure was followed by a foam massage for another 15 minutes, ending up a washing up period thoroughly with lukewarm water. The total time spent in the session was about an hour. Subjects returned to entrance of hamam where all measurements and blood sampling have been carried out before and after the session.

Blood pressure (BP), sublingual temperature (ST), heart rate (HR), respiration rate (RT), bodily pain and psychological status were monitored during the study. Beta-Endorphin (BE) and Nitrate/Nitrite (NN) levels were determined before and 1 and 15 minutes after the session. HR and RT were measured by an experienced physician and a nurse. Bodily pain was evaluated on a visual analog scale (VAS) 0-100 mm, where 0 indicates that subject is pain free and 100 having maximal pain. To assess the psychological status, we have used the Likert scale (a rating scale from 1 to 5) to measure the strength of agreement with the statement "I am psychologically relaxed at the moment" : 1- strongly disagree, 2- somewhat disagree, 3- undecided, 4- somewhat agree, 5- strongly agree.

A 10 ml of venous blood sample were obtained before and after the session, for BE and NN determination. Blood samples were centrifuged, aliquoted and stored frozen at -20°C. Beta-endorphin immunoreactivity was quantified by direct and specific radioimmunoassay. Antiserum was raised in rabbit, radioactive tracer was prepared from human beta-endorphin and Na¹²⁵I, the crossreactions with BE-related peptides were also determined. For human plasma 100 µl aliquots were assayed without previous extraction and the bound/unbound radioactivity was separated by the second antibody method. Serum Nitrate/Nitrite levels (stable *in vivo* markers of NO production) were measured. Serum nitrate was reduced to nitrite by *Escherichia coli* nitrate reductase and measured by a colorimetric assay (Greiss reaction SIGMA).

The evaluations of continuous variables which are distributed normally were made with the *paired-t test*. Variables that do not show a normal distribution were made with the *Wilcoxon Signed Ranks Test*. Statistical significance was accepted for $p < 0.05$ for results that were two tailed. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 11.5.

Results

Mean Beta-Endorphin levels before the hamam entry was 12.01 mfol/ml (SD, 5.95) and did not change significantly after the hamam ritual : 12.12 (SD, 5.98) ($p=0.4$).

Mean Nitrate/Nitrite levels before the hamam entry was 0.769U/L (SD, 0.197) and did not change significantly after the hamam ritual : 0.818U/L (SD, 0.201) ($p=0.3$). These results are shown in Table 2.

	Nitrate/Nitrite (U/L)		Beta-Endorphin (mfol/ml)	
	Before	After	Before	After
Mean (SD)	0.769 (0.197)	0.818 (0.201)	12.01 (5.2)	12.12 (5.98)
Median	0.69	0.78	12.20	13.70
(Min-Max)	(0.49-1.04)	(0.53-1.29)	(2.00-18.70)	(1.30-20.80)
Significance (2-tailed) ^a	$p=0.496$		$p=0.842$	

Table 2. Nitric oxide and Beta-Endorphin levels before and after the classical hamam (Turkish bath) session

SD : Standard Deviation, a : Wilcoxon Signed Ranks Test (based on negative ranks)

Mean systolic blood pressure was 119.3 mm/Hg (SD, 8.8 mm/Hg) before hamam and 116 mm/Hg (SD, 12.9 mm/Hg) after hamam. This slight decrease was not statistically significant ($p=0.207$). Mean diastolic blood pressure was 76.7 mm/Hg (SD, 7.2 mm/Hg) before hamam and 74 mm/Hg (SD, 10.7 mm/Hg) after hamam. Again this slight decrease was not statistically significant ($p=0.334$). Mean respiration rate was 19.8 respiration/min (SD, 3.9) before and 20.1 (SD, 3.9) after the hamam session. This slight increase in respiration rate was not statistically significant ($p=0.756$). Mean sublingual temperature before hamam was 36.5°C (SD, 0.42°C) and after hamam 37.1°C (SD, 0.49°C). This rise in sublingual temperature was in physiological range, but was statistically significant ($p< 0.001$). Mean heart rate was 84.5 beats/min (SD, 11.1 bpm) before and 94.3 beats/min after (SD, 13.1). This small increase of heart rate in physiological range was statistically significant ($p=0.014$). These results are summarized in Table 3.

	Systolic Blood Pressure mmHg		Diastolic Blood Pressure mmHg		Sublingual Temperature °C		Heart Rate beats/min		Respiration Rate respiration/mn	
	Before	After	Before	After	Before	After	Before	After	Before	After
Mean	119.3	116	76.7	74	36.5	37.1	84.5	94.3	19.8	20.1
(SD)	-8.83	-12.98	-7.23	-10.55	-0.42	-0.49	-11.09	-13.06	-3.93	-2.78
(SEM)	-2.28	-3.35	-1.86	-2.72	-0.1	-0.12	-2.86	-3.37	-1.01	-0.72
Significance ^a	$p=0.207$		$p=0.334$		$p<0.001$		$p=0.014$		$p=0.756$	

Table 3. The results of physiological measurements before and after hamam session

SD : Standard Deviation, SEM : Standard Error Mean. a : Paired t-test.

Mean bodily pain score (VAS, 0-100) was 18.8 (SD, 14.9) before the hamam indicating that subjects were pain free and significantly decreased to 7.1 (SD, 6.3) after the hamam ($p=0.003$). Mean psychological status score (Likert scale, 1 to 5) was 4 (SD, 0.9) before the hamam use and significantly increased to 4.7 (SD, 0.5) thereafter ($p=0.003$). These results are summarized in Table 4.

	Bodily Pain, VAS (1-100 mm)		Psychological Status, Likert (1-5)	
	Before	After	Before	After
Mean	18.8	7.1	4	4.7
(SD)	-14.93	-6.29	-0.92	-0.45
(SEM)	-3.85	-1.62	-0.23	-0.11
Significance ^a	$p=0.003$		$p=0.003$	

Table 4. The results of bodily pain and psychological status scores before and after hamam session

SD : Standard Deviation, SEM : Standard Error Mean, a : Paired t-test.

Discussion

Classical hamam session caused a significant decrease in mean bodily pain scores (VAS) and a significant improvement in psychological scores (Likert Scale) indicating a pain relieving and a mental relaxing effect in healthy individuals. These effects are expected due to the thermal factors (high humidity and temperature) of hamam medium and the other physical factors of the ritual procedures such as massage, foaming and water pouring that follow the hyperthermic stay in the main room of hamam (*hararet*). This assumption can be justified with the other results of our study we have found ; statistically significant slight increases in sublingual temperature and in heart rate. These changes occurred within physiological ranges and can be taken as indicators of a mild hyperthermia that developed during stay in the *hararet*. Moist heat exposure, massage treatment and warm water application are all known to induce above mentioned effects that were seen after the hamam ritual.

After the classical hamam use we have found no significant change in the serum levels of BE and NN (as an indicator of NO production), although we found significant improvement in bodily pain and psychological status. NO and BE have been taken as markers of possible biochemical mechanisms of mental and physical relaxing effects as well as cardiovascular effects such as vasodilatation that are expected to occur.

Nitric oxide (NO) is a diffusible, multifunctional, transcellular messenger which has been implicated in numerous physiological and pathological conditions. NO is widely utilized as a signaling molecule in cells throughout the body, carrying out numerous roles but most notably regulating local vascular tone and blood flow. In general, it is presumed that NO will cause local vasodilatation, thus increasing oxygen delivery. In our study, expected thermal vasodilatation due to heat of the "*hararet*" during hamam ritual did not seem to be

related an increase production of NO. In a study, it has been claimed that sauna therapy, which allows thermal vasodilatation and improves vascular endothelial dysfunction may induce NO production. But, we could not demonstrate such an increase of NO production, since we have found no significant change in NN levels after hamam exposure.

Beta-endorphin (BE), a neuropeptide consisting of 31 amino-acids, is a derivative of pro-opiomelanocortin (POMC). POMC is the precursor to ACTH as well as to other bioactive peptide hormones, such as the opioid peptide BE, and alpha-MSH, which plays an active role in skin pigmentation. The family of endorphins comprises alpha-, beta-, gamma-, and sigma-endorphins ; of these, BE plays an outstanding role in the mechanisms of pain. BE effectively reduces pain, alters hunger and sex hormone levels. Laughing increases BE levels in the brain. In addition to physical exercise, several forms of physical therapy and electrotherapy may increase serum BE levels. But, contradictory data are available about the effect of heat on BE levels. No significant change in serum BE levels was reported following 1 hour sauna therapy of 12 healthy volunteers, again an other study reported variable BE changes (no significant effect) in 11 healthy women after a Finnish sauna bath. We have also not measured significant change in BE plasma levels in healthy persons from both genders. By contrast, Vesconi and co-workers reported increased BE levels following sauna therapy. According to the data of Kukkonen and colleagues although BE levels in healthy subjects did not change in 80 centigrade heat and following steam therapy, 100 centigrade heat increased BE levels. Concerning the effects of sauna bath on BE levels although they are not conclusive, our study did not yield evidence that Turkish bath has effects on BE.

Whilst our results did not show changes in NN and BE, sauna bathing has been shown to induce changes in these biomarkers. However, the thermal conditions are different in sauna than hamam ; the air temperature in sauna is about 80 to 90°C ; which is higher than hamam where it would range between 35-45°C and the relative humidity of sauna medium is about 40-60 %, whereas it is as high as 100 % in hamam. Furthermore the other treatments (scrubbing, foam massage and water pouring) which are included in the hamam session are not comparable with sauna procedures.

So, the observed effects of the traditional Turkish Hamam procedure, pain reducing and mental relaxation effects do not seem related to any change in the measured biomarkers. We could speculate from these results in two ways ; firstly the well being sense of human is not consequently occurs parallel or is not a consequence of the production of the biochemical markers in the plasma. Secondly, if any elevation of BE occurred in cerebrospinal fluid did not get into the plasma or the first part of the ritual (in which the heating effect plays major role) caused an elevation on the examined BE and NN, but later during scrubbing and foaming and cooling with lukewarm water, measured levels of hormone and biologic messenger might be decreased that we could not demonstrate any change.

Even though we could not demonstrate significant changes in BE levels and NN levels (NO production) the subjects continued to feel better after the procedure. Here other mechanisms might be involved. For instance gate-control theory in pain perception may provide an explanation of the pain-relieving effect of hamam. Body surface is stimulated

by heat, humidity, “kese” massage, foaming and poured water successively. All these stimuli could decrease the pain sensation in the study subjects. Mental relaxation may be a secondary phenomenon and is probably the result of this effect. Other biochemical markers involved in pain sensation would be another option to explain the hamam effects on pain and psychological status. Finally, hamam session presumably has not caused a stress at all, since in the literature, it is a well known fact that the stress causes an augmentation in BE level.

We have found significant increases although slight in heart rate and in body temperature indicating a passive warming of the body during hamam bathing. Systolic and diastolic blood pressure lowered after hamam session most probably again due to thermal effect, but this was very small and not significant. After the Hamam intervention, neither the respiration rate nor the blood pressure has significantly changed and only a parallel slight physiological increase of heart rate and body temperature has been observed. We assumed that the first part of the ritual ceremony (in which the heating effect plays main role) caused an elevation in body temperature and heart rate, but during later procedures such as scrubbing, foaming, massaging and cooling with lukewarm water counterbalanced this effect and kept them in physiological levels. Or an exceptional hypothesis here could be postulated that besides the thermal effects, scrubbing the skin may lead a release of substance P thus in turn is resulting a vasodilatation. This assumption could also explain the mild decrease measured in blood pressure when the subjects left *hararet*, the main component of a hamam where all procedures have been performed.

Indeed the study itself has limitations in methodology and yielded limited results, but it is the first study ever on the topic. As an observational study with no control group, our study did not allow us to clarify the above mentioned assumptions. Since no follow up data are available, it remains unclear how long it takes for the effects to fade (which could be within as little as one hour or two), and because of the lack of a comparison, there is, of course, no evidence that people who visit a hamam do better than those who don't.

Conclusion

A Turkish bath session is associated with few, yet expected physiological changes : a slight increase in core temperature and heart rate and a distinct feeling of relaxation indicating the thermal effects of hamam session. It is unclear yet if these effects are associated with BE and NN release. Hamam ritual seems to be a safe traditional thermal, physical and hydrological procedure (see below).

A classical traditional hamam ritual has statistically significant health effects in healthy individuals :

- a pain relieving effect,
- a mental relaxing effect,
- a slight increase in heart rate,

- a slight increase in sublingual temperature.

A classical traditional hamam ritual has no significant effect in healthy individuals on :

- blood pressure (systolic and diastolic),
- respiration rate,
- serum β -Endorphin levels,
- serum Nitrate/Nitrite levels.

Effects of a Classical Hamam (Turkish bath) Session

References

1. Barna I, Koenig JI. Effects of mediobasal hypothalamic lesion on immunoreactive ACTH/beta-endorphin levels in cerebrospinal fluid, in discrete brain regions, in plasma, and in pituitary of the rat. *Brain Res* 1992;593:69-76.
2. Bender T, Karagülle MZ, Balint GP, Gutenbrunner C, Balint PV, Sukenik S. Hydrotherapy, balneotherapy, and spa treatment in pain management. *Rheumatol Int* 2005;25:220–224.
3. Bender T, Nagy G, Barna I, Tefner I, Kadas E, Geher P. The effect of physical therapy on beta-endorphin levels. *Eur J Appl Physiol* 2007;100:371-82.
4. Brown-CG. Nitric oxide and mitochondrial respiration. *Biochem Biophys Acta* 1999;1411:351-369.
5. Bussien JP, Gaillard RC, Nussberger J, Waeber B, Hofbauer KG, Turnill D, Brogger R, Brunner HR. Haemodynamic role of vasopressin released during Finnish sauna. *Acta Endocrinol (Copenh)* 1986;112:166-71.
6. Charmandari E, Tsigos C, Chrousos G. Endocrinology of the stress response. *Annu Rev Physiol* 2005;67:259-84.
7. Cichocki N. Continuity and Change in Turkish Bathing Culture in Istanbul: The Life Story of the Cemberlitas Hamam. *Turkish Studies* 2005;6:93-112.
8. Erns E. Massage Therapy for Low Back Pain. A Systematic Review. *J Pain Symptom Manage* 1999;17:65–69.
9. Fleming WJ. The Physiology of the Turkish Bath: Being an Experimental Inquiry into the Effects of Hot Dry Air upon Man. *J Anat Physiol* 1879;13(Pt 4):454-64.
10. Garratt GC. On the Sequence of Certain Changes in the Urine produced by Exercise and by Turkish Baths. *J Physiol* 1898;23:150-62.
11. Goksugur N, Karabay O, Kocoglu E. Mycological flora of the Hammams, traditional Turkish bath. *Mycoses* 2006;49:411-4.
12. Green LC, Wagner DA, Glogowski J, Skipper PL, Wishnok JS, Tannenbaum SR. Analysis of nitrate, nitrite and ^{15}N nitrate in biological fluids. *Anal Biochem* 1982;126:131-138.
13. Gunther R, Egg D, Klein D, Kocsis F, Altmann H. DNA metabolism in lymphocytes of experimental subjects during thermotherapy (sauna, Turkish bath). *Z Rheumatol* 1983;42:343-5.
14. Hannuksela M, Ellahham S. Benefits and risks of sauna bathing. *Am J Med* 2001;110:118–126.

15. Harbach H, Hempelmann G, Matejec R. Differenzierte hypophysäre Proopiomelanocortin-Reaktion beim stress. *Deutsche Zeitschrift für Sportmed* 2006;57:73-81.
16. Holden JE, Jeong Y, Forrest JM. The endogenous opioid system and clinical pain management. *AACN Clin Issues* 2005;16:291-301.
17. Ikeda Y, Biro S, Kamogawa Y, Yoshifuku S, Eto H, Orihara K, Yu B, Kihara T, Miyata M, Hamasaki S, Otsuji Y, Minagoe S, Tei C. Repeated sauna therapy increases arterial endothelial nitric oxide synthase expression and nitric oxide production in cardiomyopathic hamsters. *Circ J* 2005;69:722-9.
18. Johansen O, Brox J, Flaten MA. Placebo and Nocebo responses, cortisol, and circulating beta-endorphin. *Psychosom Med* 2003;65:786-90.
19. Kandela P. Sketches from The Lancet. Turkish baths. *Lancet*. 1999; 353(9152):601.
20. Kandela P. The rise and fall of the Turkish bath in Victorian England. *Int J Dermatol* 2000; 39:70-4.
21. Karagülle MZ, Tütüncü ZN, Özer N. Die traditionellen und empirischen Kurortbehandlungsverfahren in der Türkei. *Phys Rehab Kur Med* 1995;5:106-108.
22. Karagülle MZ. Turkish bath ; as a day spa from the past. Presentations of the International Balneology Conference. 1-2 April 2005, Szeged, Hungary. Available from: http://www.ismh-direct.net/upload/ismh/document/nemz_balneo_konf_2005_eloadasok/Hungarian_turkish/02_ZKaragulle.ppt
23. Kukkonen-Harjula K, Oja P, Laustiola K, Vuori I, Jolkkonen J, Siitonen S, Vapaatalo H. Haemodynamic and hormonal responses to heat exposure in a Finnish sauna bath. *Eur J Appl Occup Physiol* 1989;58:543-50.
24. Kurt E, Bavbek S, Pasaoglu G, Abadoglu O, Misirliligil Z. Use of alternative medicines by allergic patients in Turkey. *Allergol Immunopathol (Madr)* 2004;32:289-94.
25. Laatikainen T. Response of plasma endorphins, prolactin and catecholamines in women to intense heat in a sauna. *Eur J Appl Physiol Occup Physiol* 1988;57:98-102.
26. Laraqui CE, Caubet A, Benghalem A, Laraqui O, Zahrathaddi A, Curtes JP, Verger C. Hygiene, working conditions and professional risks in the Moorish «hammams» in Marrakech *Sante* 2000;10:19-26.
27. Loeser JD, Melzack R. Pain: an overview. *Lancet* 1999;353(9164):1607-9.
28. Magee RA. Cardiac Clinico-Pathological Conference in 1882: An Historical Vignette. *Heart Lung and Circulation* 2004;13:322-325.
29. Morhenn VB. Firm stroking of human skin leads to vasodilatation possibly due to the release of substance P. *J Dermatol Sci* 2000;22:138-44.
30. Przewlocki R, Przewlocka B. Opioids in chronic pain. *Eur J Pharmacol* 2001;19:429:79-91.
31. Robinson V, Brosseau L, Casimiro L, Judd M, Shea B, Wells G, Tugwell P. Thermotherapy for treating rheumatoid arthritis. *The Cochrane Database of Systematic Reviews* 2002, Issue 2. Art. No.: CD002826. DOI: 10.1002/14651858.CD002826.
32. Shepard CH. Insanity and the Turkish bath. *JAMA* 1900;34:604-6
33. Stoddart JC. Heat hyperpyrexia following a turkish bath. *Br Med J* 1958;1(5068):443-4.
34. Terzioğlu A. Das türkische Bad. *Apotheker Journal* 1981;13:60-1.
35. The Turkish bath in Europe. *Lancet* 1860;76:43.
36. Vescovi PP, Gerra G, Pioli G, Pedrazonni M, Maninetti L, Passeri M. Circulating opioid peptides during thermal stress. *Horm Metab Res* 1990;22:44-6.
37. Yılmazkaya O. *Turkish Baths*, Istanbul. 2003.