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## Effects of sauna on flexibility, muscle strength and cortisol level in people with allergic rhinitis

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## Effects of sauna on flexibility, muscle strength and cortisol level in people with allergic rhinitis

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**Kunbootsri N, Arrayawichanon P, Chainunsmith S, Kanpittaya J, Sawanyawisut K, Auvichayapat P, Janyacharoen T. Effects of sauna on flexibility, strength and cortisol level in people with allergic rhinitis. Chula Med J 2013 Jan - Feb; 57(1): 39 - 48**

**Backgrounds** : Nowadays, the role of thermotherapy has been increase for therapeutic purposes. Sauna is known as a heat modality for relaxation, skin circulation, flexibility and pain reduction. It should be useful to alter muscle activity and reduce stress in people with allergic rhinitis. The advantage of sauna is muscle relaxation and increase of blood flow. It would be useful to know the effects of sauna in altering muscle and cortisol level in people with allergic rhinitis in order to determine suitable alternative treatment. However, none of studies has reported the effect of sauna on flexibility, muscle strength and cortisol level in people with allergic rhinitis. Therefore, sauna was the one type of alternative treatment for patients in the future.

**Objective** : The aim of this study was to investigate effects of sauna on flexibility, strength and cortisol level in people with allergic rhinitis.

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- Setting** : Faculty of Associated Medical Sciences, Khon Kaen University, Khon Kaen, Thailand
- Design** : Randomized-controlled trial
- Methodology** : Twenty-six allergic rhinitis volunteers aged 18 - 30 years old were diagnosed based on history, physical examination and positive reaction from skin prick test. Subjects were randomly assigned either into experimental sauna group or control group. Control group ( $n = 13$ ; 7 women, 6 men) received education about self-care and avoidance of allergen. Sauna group ( $n = 13$ ; 7 women, 6 men) had sauna for a six-week period, 3 days per week, with 6 sets of 5 minutes per set per day, totaling 30 minutes. Each 5 minute set was alternated with a 5-min period of rest. Cortisol level, strength and flexibility were measured at the beginning, then at three and six weeks.
- Results** : There was a statistically significant increase in flexibility ( $p = 0.042$ ) and strength ( $p = 0.048$ ) after 6 weeks of sauna compared with the control group. On the contrary, there was a statistically significant decrease in cortisol level ( $p = 0.004$ ) after 3 weeks of sauna compared with the control group, with a rise to baseline after 6 weeks.
- Conclusion** : Sauna can reduce stress hormone in short term, and increase in trunk flexibility and back strength in people with allergic rhinitis.
- Keywords** : Strength, flexibility, cortisol level, allergic rhinitis, sauna.

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นฤพนธ์ ชันธุ์บุตรศรี, ปรีดา อารยาวิชานนท์, เสกสันต์ ชัยนันต์สมิทธิ, จตุรัตน์ กันต์พิทยา, กิตติศักดิ์ สวรรยาวิสุทธิ, ภาวดี เอื้อวิชญาแพทย์, ทวีศักดิ์ จรรยาเจริญ. ผลของการอบไอร้อนต่อความอ่อนตัว ความแข็งแรงของกล้ามเนื้อและระดับคอर्टิซอลในคนที่ เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้. จุฬาลงกรณ์เวชสาร 2556 ม.ค. - ก.พ.;57(1): 39 - 48

- บทนำ** : ในปัจจุบันนี้มีการนำความร้อนมาใช้เพื่อวัตถุประสงค์ในแง่การรักษาแพร่หลายขึ้น และเป็นที่ยอมรับกันว่าชาวน้ำเป็นการรักษาด้วยความร้อนชนิดหนึ่งซึ่งช่วยทำให้เกิดการผ่อนคลาย การไหลเวียนเลือดบริเวณผิวหนัง ความยืดหยุ่น และการลดความเจ็บปวด ซึ่งผู้ที่ เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้มีจำนวนมากขึ้นและได้รับการรักษาด้วยยาเป็นหลัก ชาวน้ำจึงมีประโยชน์ในการเปลี่ยนแปลงการทำงานของกล้ามเนื้อ และช่วยลดภาวะเครียดในคนไทยที่เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้ ชาวน้ำมีประโยชน์ในการผ่อนคลายกล้ามเนื้อและช่วยเพิ่มการไหลเวียนเลือด อย่างไรก็ตาม ยังไม่มีรายงานวิจัยใด ๆ ที่ทำการศึกษามลของชาวน้ำต่อการเปลี่ยนแปลงการทำงานของกล้ามเนื้อและระดับคอर्टิซอลในคนไทยที่เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้เลยดังนั้นหากชาวน้ำมีประโยชน์ต่อผู้ป่วยดังกล่าวก็จะเป็นการรักษาทางเลือกที่มีประโยชน์ต่อไปในอนาคต
- วัตถุประสงค์** : วัตถุประสงค์ของการศึกษาในครั้งนี้เพื่อศึกษามลของชาวน้ำต่อความยืดหยุ่น ความแข็งแรงและระดับฮอร์โมนคอติซอลในคนไทยที่เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้
- สถานที่ที่ทำการศึกษา** : คณะเทคนิคการแพทย์ มหาวิทยาลัยขอนแก่น จังหวัดขอนแก่น ประเทศไทย
- รูปแบบการวิจัย** : การวิจัยแบบสุ่ม
- วิธีการศึกษา** : อาสาสมัครที่เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้จำนวน 26 คน อายุ 18 - 30 ปี ได้รับการวินิจฉัยจากแพทย์จากการตรวจร่างกายและซักประวัติและให้ผลบวกในการทดสอบภูมิแพ้ทางผิวหนัง อาสาสมัครจะถูกสุ่มออกเป็น 2 กลุ่ม คือกลุ่มทดลองหรือกลุ่มชาวน้ำและกลุ่มควบคุม กลุ่มควบคุม (จำนวน 13 คน เพศหญิง 7 คน เพศชาย 6 คน) ได้รับความรู้ในการการปฏิบัติตัวและหลีกเลี่ยงจากสารก่อภูมิแพ้ กลุ่มชาวน้ำ (จำนวน 13 คน เพศหญิง 7 คน เพศชาย 6 คน) จะเข้าชาวน้ำเป็นเวลา 5 นาที สลับกับพัก 5 นาที ต่อครั้ง จำนวน 6 ครั้งต่อวัน 3 วันต่อสัปดาห์เป็นเวลา 6 สัปดาห์ ก่อนการศึกษาจะเก็บข้อมูลเบื้องต้นของระดับฮอร์โมนคอติซอล, ความแข็งแรงและความยืดหยุ่น และหลังจากนั้นวัดที่ 3 สัปดาห์และวัด 6 สัปดาห์

- ผลการศึกษา** : จากการศึกษพบว่ามีการเพิ่มขึ้นอย่างมีนัยสำคัญของสถิติของความยืดหยุ่น ( $p = 0.042$ ) และความแข็งแรง ( $p = 0.048$ ) หลังจากชวาวน่า 6 สัปดาห์ เทียบกับกลุ่มควบคุมในทางตรงข้ามมีการลดลงอย่างมีนัยสำคัญทางสถิติของระดับคอรัติซอล ( $p = 0.004$ ) หลังจากชวาวน่า 3 สัปดาห์เทียบกับกลุ่มควบคุมและกลับสู่ระดับปกติหลังจาก 6 สัปดาห์
- วิจารณ์และสรุปผล** : การเข้าชวาวน่าเพียงระยะเวลาสั้นสามารถลดความเครียดและเพิ่มความแข็งแรงและความยืดหยุ่นในคนไทยที่เป็นโรคโพรงจมูกอักเสบจากภูมิแพ้
- คำสำคัญ** : ความแข็งแรง, ความยืดหยุ่น, ระดับคอรัติซอล, โรคโพรงจมูกอักเสบจากภูมิแพ้, ชวาวน่า.

Allergic rhinitis is an inflammatory respiratory disease. The main symptoms are rhinorrhea, sneezing, pruritus and congestion triggered by allergen. These symptoms will attack the body when exposed to allergen such as, pollen, mite and dust. Baraniuk JN<sup>(1)</sup> described that allergen will be deposited on the respiratory cell and affects the immune system. Especially, immunoglobulin E binds to mast cells and releases inflammatory mediators such as, histamine, prostaglandins and bradykinin which result in gland secret mucous. Allergic rhinitis is one of the chronic diseases associated with stress and anxiety that increases the cortisol level. Buske-Kirschbaum A<sup>(2)</sup> showed an increase in salivary cortisol after stress tests in seasonal allergic rhinitis. Moreover, muscle contraction from stress and anxiety can cause muscle tightness. Treatment of allergic rhinitis has two routes. The usual treatments are combined with avoidance of allergen, pharmacotherapy, immunotherapy and education.<sup>(3)</sup> However, alternative treatments such as botanical and acupuncture have been reported in recent years. Sauna is one of the alternative treatments. Sauna has dry air and a high temperature. The recommended temperature is 80 to 100 degrees Celsius.<sup>(4)</sup> The advantage of sauna is muscle relaxation and increase of blood flow. It would be useful to know whether sauna can alter muscle and change cortisol level in people with allergic rhinitis and determine suitable alternative treatment. None of studies, however, has reported the effect of sauna on flexibility, muscle strength and cortisol level in people with allergic rhinitis. Thus, the aim of this study was to investigate effects of sauna on flexibility, strength and cortisol level in people with allergic rhinitis.

## Methods

The present research is a randomized-controlled trial conducted at the Department of Physical Therapy, Faculty of Associated Medical Science, Khon Kaen University, Thailand.

### Subjects

Twenty-six chronic allergic rhinitis (mild degree) volunteers aged 18-30 years old recruited from Srinagarind Hospital were diagnosed by the doctor based on history and physical examination. All participants showed positive result of skin prick test. They were informed about the nature and risks of the experimental procedures, and all gave their consent before participating the experiment.

### Study design

The study was designed as a double blind randomized controlled trial in which subjects randomly received sauna or control group. Subjects refrained from any drug using or medicine caffeine and alcohol 4 weeks prior to participate in this study. Anthropometric measurements (height, body weight, body mass index) with blood pressure and heart rate were performed. The subjects were randomly assigned to control and experimental or sauna groups. The control group ( $n = 13$ ; 7 women, 6 men) received education about self care and normal activity of daily living, no regularly exercises and avoidance of allergen. The experimental or sauna group ( $n = 13$ ; 7 women, 6 men) received sauna program. Data were collected at the beginning and after the third week and the sixth week of sauna, respectively. The study has been approved by the Khon Kaen University's Ethics Committee (HE531449) and it is conformed to the standards set by the Declaration of Helsinki.

### Outcome measurement

Primary outcome measurement measured cortisol level and secondary outcome measurement measured muscle strength and flexibility. All parameters were measured at the before of program, after 3 weeks and 6 weeks, respectively.

### Sauna program

Subjects had sauna at fitness center, Faculty of Associated Medical Sciences, Khon Kaen University, Khon Kaen, Thailand. The temperature of sauna was maintained at 80 to 90 degrees Celsius. The participants rested for 15 min before sauna. The subjects had sauna over a six-week period, 3 days per week, with 6 sets of 5 minutes per set per day, totaling 30 minutes. Each 5-minute set was alternated with a 5-min period of rest.

### Flexibility measurement

Subjects performed long sitting with straight knees, feet together to the wall of flexometer. The subjects moved arms forward with both hands above the flexometer, trunk in a forward bending position until limit motion and sustained for 2 sec. The investigator measured from zero scale to the tip of middle finger. Each subject performed 2 times and the highest score in centimeter (cm) was chosen.

### Leg strength measurement

Subjects stood on base of Back leg dynamometer (TKK 5002; Japan) without support, trunk slightly forwarded in bending position at 30 degrees. Both hands were held on hand bar at knee level, right hand in pronation and left hand in supination. Subjects forced the hand bar up by straight legs. Subjects performed 2 times; the highest score in kilogram (Kg) was chosen.

### Serum cortisol

Blood sample was collected by a medical technologist for 3 ml at the same time in the afternoon, and sent to clinical chemistry laboratory at Srinagarind Hospital. Serum cortisol concentration was assessed by radioimmunoassays in ug/dl.<sup>(5)</sup>

### Statistical analysis

Statistical analysis was performed by SPSS version 16. The data were expressed as mean  $\pm$  SD. Paired simple *t*-test was applied for differences from baseline. We could not guarantee that baseline values would be the same between groups, so ANCOVA was employed in this study to adjust differences in baseline values for comparison between groups. Statistical significance was accepted at  $p < 0.05$ .

### Results

There were 26 allergic rhinitis patients, 12 males and 14 females participated in this study. All subjects had positive skin prick test results. There was no significantly difference of anthropometric and baseline characteristics of both groups observed in this study (Table 1).

There was a statistically significant difference in cortisol level from baseline and after 3 weeks of sauna ( $p = 0.004$ ). This rose to baseline after 6 weeks, while there was no change in the control group (Table 2).

There was an increase in trunk flexibility in both groups. However, the sauna group showed a statistically significant increase in trunk flexibility and back strength after 6 weeks ( $p = 0.042, 0.048$ ), while there was no change in the control group (Table 2).



**Table 1.** Anthropometric and baseline characteristics of subjects.

| Variables                       | Control group | Experimental group |
|---------------------------------|---------------|--------------------|
|                                 | n = 13        | n = 13             |
| Gender (male/female)Age (years) | 6/726.6 ± 3.0 | 6/726.0 ± 2.5      |
| Weight (kg)                     | 56.1 ± 8.6    | 60.9 ± 17.0        |
| Height (cm)                     | 165.0 ± 6.2   | 166.0 ± 11.1       |
| BMI                             | 20.3 ± 2.0    | 21.8 ± 4.6         |
| SBP (mmHg)                      | 110.0 ± 12.6  | 109.1 ± 19.4       |
| DBP (mmHg)                      | 69.2 ± 7.8    | 70.2 ± 12.5        |
| HR (beat/minute)                | 77.7 ± 11.9   | 77.7 ± 10.3        |

**Note:** Values are mean ± SD, kg; kilogram, cm; centrimetre, BMI; body mass index, SBP; systolic blood pressure, DBP; diastolic blood pressure, mmHg; millimetremercury, HR; heart rate

**Table 2.** Comparison of outcome variables between baseline, after 3 weeks and after 6 weeks in control and experimental groups.

| Variables              | Group        | Baseline    | 3 <sup>rd</sup> week | 6 <sup>th</sup> week |
|------------------------|--------------|-------------|----------------------|----------------------|
| Cortisol level (ug/dl) | Control      | 10.9 ± 4.4  | 13.4 ± 7.2           | 12.9 ± 7.2           |
|                        | Experimental | 11.1 ± 7.0  | 5.6 ± 4.4*           | 13.1 ± 5.3           |
| Flexibility (cm)       | Control      | -1.4 ± 1.2  | -4.0 ± 2.3           | -4.1 ± 1.4           |
|                        | Experimental | 1.4 ± 1.1   | 3.4 ± 2.2            | 5.5 ± 1.8*           |
| Strength (kg)          | Control      | 90.5 ± 35.0 | 85.5 ± 27.0          | 85.8 ± 30.9          |
|                        | Experimental | 90.3 ± 46.9 | 95.1 ± 10.5          | 102.4 ± 34.7*        |

**Note :** Values are mean ± SD, ug/dl; microgram per desilitre, cm; centrimetre, kg; kilogram

\* Significant differences from corresponding baseline (p <0.05)

## Discussion

The aim of this study was to investigate effects of sauna on flexibility, strength and cortisol level in people with allergic rhinitis. We measured flexibility, strength and cortisol level at rest after exposed to sauna at the same time in the afternoon. The main findings of the present study are: flexibility and strength increased after six weeks of repeated sauna, and cortisol level decreased after three weeks of sauna and returned to baseline after six weeks.

To our knowledge, the effects of heat stress included increased skin blood flow, increased cardiac output, increased oxygenation, increased adenosine triphosphatase (ATPase), and increased glycogenesis. It has been showed that there was an increase in flexibility after six weeks of sauna. Actually, the factors influencing skeletal muscle relaxation include the rate of fall in Calcium ion (Ca<sup>2+</sup>) transient, and the rate of cross-bridge detachment.<sup>(6)</sup> Muscle

relaxation accelerates at high temperature.<sup>(7)</sup> In this study, the effects of sauna decreased tension of the skin from increased skin blood flow and muscular temperature. Due to the response to heat stress, it released nitric oxide (NO) from endothelial of skin vessels.<sup>(8)</sup> Moreover, whole body heat increased muscle oxygenation and adenosine triphosphate (ATP) turnover rate in the muscle which led to increase of cross-bridge detachment, and muscle relaxation. Besides the factors mentioned above, there are many factors related to muscle relaxation such as the central nervous system.

There was a decrease of cortisol level due to the relaxation after three weeks of sauna, and an increase to baseline after six weeks. According to our knowledge, cortisol hormone is a steroid hormone released from the adrenal gland, and it responds to stress. Cortisol hormone functions in increasing blood glucose by gluconeogenesis, suppressing the immune system and assisting fat and protein metabolism. Cortisol hormone has diurnal rhythm which peaks in the morning and bottoms in the afternoon. Besides the diurnal rhythm of cortisol hormone, the change of cortisol level depends on many factors, including caffeine, sleep deprivation, intense and prolonged exercise, and chronic illness. Cortisol level after heat stress is controversial.<sup>(9)</sup> Some studies showed an increase in cortisol level, but some studies showed a decrease or no change in cortisol level. There are many reasons of increasing cortisol level such as varied temperatures. Many studies showed high cortisol level in moderate temperature (45 - 60 degrees Celsius),<sup>(10 - 12)</sup> and other studies presented a decrease in cortisol level at higher temperatures (80 -100 degrees Celsius)<sup>(13, 14)</sup> and the

temperature in the present study is 80 degrees Celsius. Moreover, the different conditions of participants also showed differences in cortisol level. The present study shows a decrease in cortisol level after 3 weeks of 80-degree Celsius of sauna and a return to baseline after 6 weeks of sauna. At the sixth week, this time was the examination time of subjects it may be affected to cortisol level because of stress of subjects. However, in the control group, cortisol level increase in the 3<sup>rd</sup> week it was no reason of this occurred, it may be depended on activity of subjects. That was the one of limitation of this study, researchers could not control the activity of all subjects all times.

Surprisingly, the present study shows a statistical increase in the strength of the leg muscle after 6 weeks of sauna. In contrast, a previous study showed that 1 repetition of maximum (RM) leg press strength was significantly decreased following sauna, but muscular power (vertical jump) increased significantly after acute heat exposure.<sup>(15)</sup> Generally, the factor causing the increase of strength includes muscle contraction against load. Although the mechanism of increased leg muscle strength after sauna is unclear, we can describe from the result of the present study that an increase in muscular temperature may increase extensibility of the muscular units, decrease muscle viscosity and smooth contractions.<sup>(16)</sup>

The limitation of the present study was a small number of participants, and we could not control stress in all participants. However, we were able to arrange the same time of blood sample collection in the afternoon, and we also had the same technician collecting blood sample. The level of cortisol is not only caused by physiological stress but also by

psychological stress. Most participants were students and they had stress from their final exam which took place during the last week of sauna. We cannot exactly point out the biochemical mechanism, but we based our conclusion on previous studies and knowledge. There was no adverse event during the course of this study.

### Conclusion

In conclusion, sauna can increase trunk flexibility, back strength and reduce stress hormone in short duration in people with allergic rhinitis. However, sauna is the one choice of alternative treatment for patients with allergic rhinitis, from the present study almost of subjects had not depend on medicinal used.

### Acknowledgements

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