

The Health Hazards of Saunas and Spas and How to Minimize Them

ABSTRACT

Background: The rapidly increasing number of spas, hot tubs, and saunas intensifies the potentials for deaths from hyperthermia and drowning.

Methods: I analyzed 54 such deaths reported to me by 55 medical examiners and coroners in the United States and 104 deaths reported to the US Consumer Product Safety Commission (CPSC).

Results: Only seven of the 158 deaths analyzed occurred in saunas. All of the remaining deaths occurred in spas, jacuzzis, or hot tubs, which were far more numerous. The chief risk factors identified were alcohol ingestion, heart disease, seizure disorders, and cocaine ingestion (alone or in combination with alcohol ingestion). These factors accounted for 71 or 44.7% of the 159 fatalities. Of these risk factors, alcohol represented 38%; heart disease, 31%; seizure disorders, 17%; and cocaine ingestion, alone or in combination with alcohol, 14%. Sixty-one of the 151 spa-associated deaths occurred in children under 12 years of age. Accidental drownings from uncovered or improperly covered spas and, to a lesser extent, entrapment by suction, were the chief causes of childhood drownings.

Conclusions: Children and older persons who have heart disease or seizure disorders or who use alcohol or cocaine are especially vulnerable. Recommended preventive measures include shortening the time of exposure, lowering the temperature, establishing safety standards for covers and for baffles for suction outlets, and using warning notices. (*Am J Public Health*. 1991;81:1034-1037)

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Introduction

The "dry" or Finnish Sauna is an enclosure large enough for two to eight or more persons; it generally has no active ventilation, is heated by electricity, gas, or other means; temperatures are maintained at 70°C to 90°C, but often can be raised up to 100°C. Spas are large bath tubs or small pools made of synthetic materials; they have equipment that heats, recirculates, and disinfects the water and usually has jets of water or air or both. Hot tubs are similar to spas, but they are made of wood and their recirculating water may or may not have jets of water or air. The water in both spas and hot tubs is heated to about 40°C, but may go even higher. Health hazards from hot tubs are similar to those from spas. In this article the term "spas" includes hot tubs, but does not include the smaller jetted bath tubs that are emptied after each use.

The exact number of saunas in the United States is not known. The Sauna Society of America estimates the number at about 1 million (personal communication from V.S. Choslowsky, President, Sauna Society of America, Sept. 1988). More accurate estimates are available for spas and hot tubs; one of the trade associations placed the number at about 1.8 million in 1988 (personal communication from Larry E. Paulick, Sr., vice-president, National Spa and Pool Institute, Alexandria, Va, Dec. 5, 1988). A trade publication placed the number that are sold annually at 250 000 (personal communication from Kathleen Bedenbaugh, editor, Aqua Magazine, Harcourt-Brace Jovanovich Publications, Santa Anna, Ca, Oct. 1988). Thus there would be millions of monthly exposures to the hazards of hyperthermia and drowning. To reduce the risks from these exposures, voluntary

standards have been developed by several organizations. One of these, Underwriters Laboratories' Standard 875 for Electric Saunas requires the use of the following warning sign: "Do not exceed 30 minutes in sauna. Persons with poor health should consult physician before using sauna." Because (as noted below) a 30-minute exposure has been found to be unsafe for some persons, and because there is so little information available on mortality in saunas and spas in the United States, I undertook a literature review and then attempted to collect information on deaths associated with spas and saunas.

Literature Review

According to Kauppinen and Vuori,¹ warmth induces a feeling of euphoria, relaxation, and tranquility in many persons. Sorri discussed saunas in a regular issue of the *Annals of Clinical Research*² and in a special issue of the same journal,³ which includes two editorials and 16 articles on the Finnish sauna. The author states that bathing in a sauna is a pleasant and relaxing experience, which combines psychic, physical, and social pleasures; reduces aggressive behavior; and enables bathers to forget the common pressures of everyday life. He also feels that the nature of the experience makes it difficult to define objective scientific methods of measurement.

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The increased pressure from the water results in peripheral vasodilation, profuse perspiration with a decrease in the extracellular blood volume, an increased viscosity of the blood, an increase in hematocrit with shortened clotting time, and a 20% increase in the consumption of oxygen.¹ The electrocardiographic (ECG) changes include a T-wave depression, ventricular and supraventricular extrasystoles, and a deep S wave.⁴ Thus the possibility of cardiac arrest exists. This would be especially true for persons with preexisting heart disease or those on medications that influence cardiac rhythms. The combination of peripheral vasodilation and decreased blood volume from the loss of fluids reduces the cerebral blood flow and increases the likelihood of syncope. Three out of 60 subjects using a Finnish Sauna for 20 minutes at a temperature of 80°C to 90°C fainted; a fourth, a 63-year-old, apparently healthy, man, developed an angina attack; his ECG tracings showed ventricular and extraventricular extrasystoles, which persisted for a half hour after he left the sauna.⁴ Jokinen et al.⁵ studying children found that of 61 children that had a 10-minute exposure in a sauna, two developed vasovagal collapses.

Diabetics receiving subcutaneous injections of insulin may absorb their insulin much more rapidly because of the peripheral vasodilation. Khogali and Gales⁶ feel that "it is quite common for patients with heat stroke to have diabetes, as though they are predisposed. . . . Since diabetics often exhibit postural hypotension due to faulty baroreflexes it is conceivable that this could be responsible for the relatively poor adjustments in vasculature of various body regions." Sweating abnormalities and neuropathy of the autonomic nervous system also are common to diabetics. Hormonal activity resulting in increased secretions of catecholamines and an increased sympathomimetic activity have been reported.

Because in the sauna and spa the testicles, which are normally below internal body temperature, are exposed to temperatures well above normal body temperature, the possibility of impaired spermatogenesis exists. B. J. Procope, as quoted by Kauppinen and Vuori¹ stated that intensive sauna bathing, repeated six to eight times within a 2-week period, caused a reduction in the number of sperm cells in 12 medical students accustomed to the sauna. Brown-Woodman, also quoted by Kauppinen and Vuori, reported that even a single 20-minute exposure to a sauna at 80°C decreased the number of sperm cells

starting 1 week after the bathing and lasting for 5 weeks. He found that there were no changes in the morphology; but ultrastructural changes of the sperm cell were observed.

Questions of potential teratologic effects on the developing fetus when pregnant women are exposed to the hyperthermia of the sauna and the possibility that such exposure might induce labor prematurely in women approaching full term, have also been raised. Edwards⁷ in a fairly extensive review of the clinical significance of experimental studies on hyperthermia as a teratogen, found that "the species known to be affected include birds, all the common laboratory animals, farm animals, and primates. It would be remarkable if it were not also a human teratogen." He concluded that because there is very strong evidence that hyperthermia is a human teratogen more study is required to fully determine the nature and extent of this risk to prenatal development. He thought that an elevation of 1.5°C to 2.5°C above the species' normal temperature could result in a heat-induced teratogenic effect.

Vaha-Eskeli and Erkkola⁸ after reviewing some of the literature and testing 23 pregnant women, concluded that at least, as practiced in Finland, hyperthermia was not teratogenic. The authors did, however, comment that in Finland it is commonly believed that sauna bathing could be used to induce labor in postterm women. In their study of the effect of thermal stress on 23 women who were 36 weeks pregnant, they found that 5 of the women had occasional uterine contractions, although 1 of the 5 experienced the contractions before, as well as after, the sauna exposure.

Method

After a preliminary telephone poll of 16 US medical examiners and coroners, a questionnaire (available from the author) requesting information on the number and type of deaths associated with saunas, spas, and hot tubs and related risk factors noted during the past 5 years was sent to 184 members of the National Association of Medical Examiners. The members were selected on a subjective basis from the entire list of 654 members. When several different members were from the same office, the chief or director, rather than deputies, assistants, or consulting pathologists was chosen. In addition, wide geographic distribution coupled with representation from urban and rural areas and

from hot and cold climates were factors in the selection. To supplement these factors, a medical examiner who was a long-time member of the association and familiar with many of its members personally chose about 10 or 12 whom he considered experienced and well trained.

A total of 55 responses were received. These were followed up by telephone interviews with 20 of the 55 for more complete and detailed information. Thirty-two of the 55 respondents indicated that they could remember no fatalities during the preceding 5 years (from November 1988).

The Consumer Product Safety Commission (CPSC) has a program called the Medical Examiners and Coroners Alert Program asking medical examiners and coroners to report deaths to the CPSC. Reports of such deaths in saunas and spas were obtained from the CPSC for the period of January 1, 1986 to November 4, 1988. The reports did not include all states in the United States for the entire period, nor did those reporting necessarily include all cases in their jurisdiction.

Results

Age distribution. Only 15% of the deaths reported in my survey (all in spas), were in children under 12 years of age, compared with 52% reported to the CPSC (Table 1). This discrepancy could reflect the fact that the reports to the CPSC were more recent, most of them prepared in 1987 and 1988 when a larger number of spas were sold to private residences than to public facilities and athletic clubs, which are much less likely to have children present. The author's poll went back 5 years from 1988 when the number of private spas was lower.

Duration of exposure. Ten of the 24 jurisdictions reporting fatalities in my survey recorded the length of exposure to the spa prior to death. In four cases the exposure was more than 30 minutes; in four more, it was 10 to 20 minutes; and in two it was less than 10 minutes.

Risk Factors. Risk factors were reported in 45% of the deaths (Table 2). Alcohol ingestion and heart disease were the chief factors associated with the fatalities. Seizure disorders and cocaine ingestion either alone, or cocaine combined with alcohol, accounted for additional risk factors. In many deaths the presence or absence of risk factors was either unknown or unrecorded.

TABLE 1—Age Distribution of Spa and Sauna Fatalities

| Age | SPAS CPSC ^a | | SPAS EP Survey ^b | | SAUNAS EP Survey ^b | |
|-----------|------------------------|------|-----------------------------|------|-------------------------------|------|
| | N | % | N | % | N | % |
| 0-2 y | 36 | 35% | 2 | 4% | 0 | 0% |
| 2-11 y | 18 | 17% | 5 | 11% | 0 | 0% |
| 12-65 y | 31 | 30% | 29 | 62% | 2 | 29% |
| over 65 y | 19 | 18% | 9 | 19% | 5 | 71% |
| Unknown | 0 | 0% | 2 | 4% | 0 | 0% |
| Total | 104 | 100% | 47 | 100% | 7 | 100% |

^aUS Consumer Product Safety Commission reports, Jan 1, 1986, to Nov 4, 1988.
^bReports to the author from 55 county and state medical examiners and coroners, Nov 1988.

TABLE 2—Risk Factors Reported as Associated with Spa and Sauna Deaths

| | SPAS CPSC ^a | SPAS ^b | SAUNAS ^b | TOTAL |
|-------------------|------------------------|-------------------|---------------------|--------------------------|
| Alcohol | 10 | 15 | 2 | 27 |
| Heart Disease | 10 | 8 | 4 | 22 |
| Seizures | 6 | 6 | | 12 |
| Cocaine | 1 | 2 | | 3 |
| Cocaine & alcohol | 3 | 4 | | 7 |
| Total Reported | 30 | 35 | 6 | 71 (44.65%) ^c |

^aConsumer Product Safety Commission's death certificate reports from their Medical Examiners and Coroners Alert Program. In only 50 of the 104 deaths were the risk factors checked as present or unknown. In the others, no mention was made of them.
^bAuthor's poll of 55 medical examiners or coroners. In this poll, obesity was recorded in association with heart disease or alcohol in 8 cases.
^c $\frac{71}{104+55} \times 100 = 44.65\%$

Discussion

The chief physiological differences between spas and saunas relate to the more rapid transfer of heat from water than from air. The jet currents in the spa further enhance the heat transfer and the evaporative cooling effects of perspiration that occur in the dry sauna do not occur when most of the body is under water in spas. Although the transfer of heat is more rapid in spas than in saunas, the gradient of heat is less. Water in spas is generally not above 40°C, which is in contrast to the 80°C or 90°C temperature of the Finnish sauna or the 50°C temperature of the steam room or Japanese sauna.

In addition to the problems of hyperthermia the hazard of drowning exists in spas. Infants can accidentally fall into the spa and drown when the spa is not adequately covered; or older children can become entrapped if the powerful outflow suction is not properly shielded. As noted in Table 2, over half of the 104 deaths reported to the CPSC were in children under 12 years of age. Shinaberger et al.⁹ in

a study of 74 deaths of young children in California spas found that the major factors involved were lack of supervision, access to the spas, neuromotor handicaps, and entrapment by suction.

Syncope is a hazard for adults. Hyperthermia may induce syncope, particularly in persons with heart disease or alcohol or drug ingestion. Even without these factors, staying in the spa too long or allowing the temperature to rise beyond safe limits can cause syncope.

The greater likelihood of narrowed arteriosclerotic blood vessels in the heart and brain of the elderly poses a risk, especially if they are perspiring profusely and, as a result, become dehydrated and have increased blood viscosity. Alcohol or cocaine, medications that affect the heart or the temperature-regulating mechanism or that result in drowsiness are more likely to be present in adults. Trying to sober up or counter a hangover by "sweating it out" can be a perilous activity. Ylikhari et al.¹⁰ noted that in Finland, which has a population of 4.8 million, the consumption of alcohol has been esti-

mated to be a contributing factor in 20 to 25 sauna-related deaths each year. He felt that alcohol intoxication and particularly the hangover phase exposes a person to cardiac arrhythmias and that the sauna may further increase the arrhythmia risk because of enhanced adrenergic activity.

The length of stay in a sauna or spa is important. The heating switch on some electrically heated saunas is set to go off automatically after 30 minutes, and one of the standards (currently under revision) cautions against exceeding 30 minutes. However, Sohar et al.⁴ found even 20 minutes to be too long for 4 of his 60 subjects as noted above. The New York City Health Department requires posting a notice in public saunas, steam rooms, and spas with the following warning: "Use . . . should not exceed 15 minutes. Excessive exposure can be harmful to health" (personal communication, November 1987, between the commissioner of the New York City Health Department and the chair of the CPSC). The president of the Institute for Health Promotion Research in Finland who has done research and had an unusually extensive experience with saunas stated that "—even 10 minutes may be too long a sauna exposure for some individuals." In 2 of the 10 fatalities in the author's survey where the time was recorded the time was less than 10 minutes. Studies to determine how long pregnant women can safely remain in a spa found that the length of time varied with the temperature of the water.¹¹ However, using 38.9°C as a potentially teratogenic temperature, Harvey et al.¹¹ found that in a hot tub with water at 39°C it took the women 15 to 25 minutes (mean 23.0 minutes) to reach a body temperature of 38.9°C. When the water temperature was 41.1°C it took the women 10 to 30 minutes (mean 18.5 minutes). In a sauna at 81.4°C all 20 women felt sufficient discomfort (dizziness, tingling in hands, rapid pulse, irregular heart beat, and stomach pain) to leave before their temperature rose to 38.9°C. The subjects in the 39°C hot tubs began to leave because of discomfort after 10 minutes; those in the 41.1°C tub left after 5 minutes. Those who elected to remain because they did not experience any discomfort required the above noted times to have their temperatures reach 38.9°C.

Spas, sometimes marketed through discount stores at cut rates are often purchased by families with small children. The combination of inadequately supervised children and the use of cheaper models with substandard covers and poorly shielded suction outlets could result in ac-

cidental drowning. Mandatory, rather than voluntary, safety standards for covers and baffles might decrease this hazard. Many of the standards developed by several organizations need to be revised, and for all compliance is now voluntary. Standards have been formulated by Underwriters Laboratories¹² and the National Spa and Pool Institute.¹³ The Centers for Disease Control of the US Department of Health and Human Services has also published some recommended health and safety guidelines for public spas and hot tubs.¹⁴ A few state or local jurisdictions have adopted some of these standards (with or without recent revisions) as requirements for public facilities; they may also enforce them. However, most official agencies have taken no action. Moreover, the current mandatory standards of most official agencies cover only public and not private residential facilities. The CPSC has the authority and responsibility to promulgate mandatory standards for both public and private saunas and spas but, as of December 1990, has not done so.

Both the author's survey and the CPSC data suffer from incomplete information: the total population at risk, total number of associated deaths, and the number, type and frequency of use are not known. The sparse response rate to my survey as well as its lack of complete coverage means that many deaths and many risk factors may have been overlooked. A more thorough and complete study is needed, preferably a prospective one, to obtain a more accurate and complete picture of the problem.

Nevertheless, even the limited data presented here suggest that a public health

problem exists and that the problem can be corrected through appropriate actions by the CPSC and official health agencies.

Persons with heart disease, hypertension, seizure disorders, diabetes, or significant obesity; persons who have ingested alcohol, narcotic drugs, or medications that can result in drowsiness or interfere with the body's temperature-regulating mechanism; or persons who are over 65 years of age must limit their stays in saunas or spas to 5 or at the most 10 minutes at a time. Similar precautions should be observed by women in the first trimester of pregnancy. Even healthy adults would be well advised not to stay in for more than 10 to 15 minutes at a time.

Automatic controls, limiting air and water temperatures to 80°C for the Finnish Sauna, 50°C for the steam room, and 40°C for the water temperature in the spas should be required as should effective covers for spas and proper baffles or shields for suction outlets. □

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References

1. Kauppinen K, Vuori I. Man in the sauna. *Ann Clin Res.* 1986;173-185.
2. Sorri P. The sauna and sauna bathing habits—a psychoanalytical point of view. *Ann Clin Res.* 1988;236-239.
3. Vuori I, Heiddi V, eds. Special issue on sauna. *Ann Clin Res.* 1988;20:215-294.
4. Sohar E, Shoenfeld Y, Ohry A, Cabili S. Effects of exposure to Finnish sauna. *Isr J Med Sci.* 1976;12:1275-1282.
5. Jokinen E, Valinaki I, Antilla K, Seppanen A, Tuominen J; Children in sauna: cardiovascular adjustment. *Pediatrics.* 1990;86:282-288.
6. Kohgali M, Gales JRS. Editors' comments. In: Kohgali M, Hales JRS, eds. *Heat Stroke and Temperature Regulation.* Sydney, Australia: Academic Press (Harcourt-Brace Jovanovich); 1983;XIII-XVI.
7. Edwards MJ. Hyperthermia as a teratogen: a review of experimental studies and their clinical significance. *Teratogenesis Carcinog Mutagen.* 1986;6:563-582.
8. Vaha-Eskeli K, Erkkola R. The sauna and pregnancy. *Ann Clin Res.* 1988;20:279-282.
9. Shinaberger CS, Anderson CL, Kraus JF. Young children who drown in hot tubs, spas, and whirlpools in California: A 26-year survey. *Am J Public Health.* 1990;80:613-614.
10. Ylikhari R, Heikkinen E, Soukas A. The sauna and alcohol. *Ann Clin Res.* 1988;20:287-291.
11. Harvey SMA, McRorie MM, Smith DW. Suggested limits to the use of the hot tub and sauna by pregnant women. *Can Med Assoc J.* 125:50-53.
12. Underwriters Laboratories. *Standard for Electric Sauna Heating Equipment, UL # 875, 4th Rev & UL Standard # 1563 for Electric Hot Tubs, Spas and Associated Equipment.* 2nd ed. Santa Clara, Calif.; 1989.
13. National Spa and Pool Institute (NSPI). *Standards for Permanently Installed Public Spas, NSPI 2, 1989; Standards for Permanently Installed Residential Spas, NSPI 3, 1989; Standards for Portable Spas, NSPI 6, 1989.* (These NSPI Standards were under revision as of Dec. 1990) Alexandria, Va: NSPI.
14. *Suggested Health and Safety Guidelines for Public Spas & Hot Tubs.* 2nd ed. Atlanta, Ga: Centers for Disease Control; 1985.