

# Mortality in 13 French Cities During the August 2003 Heat Wave

Stéphanie Vandentorren, MD, Florence Suzan, MD, Sylvia Medina, MD, PhD, Mathilde Pascal, MSc, Adeline Maulpoix, MSc, Jean-Claude Cohen, MSc, and Martine Ledrans, MSc

We observed the daily trend in mortality rates during the 2003 heat wave in 13 of France's largest cities. Mortality data were collected from July 25 to September 15 each year from 1999 through 2003. The conjunction of a maximum temperature of 35°C and a minimum temperature of 20°C was exceptional in 7 cities. An excess mortality rate was observed in the 13 towns, with disparities from +4% (Lille) to +142% (Paris). (*Am J Public Health*. 2004;94:1518–1520)

Heat waves are known to be associated with an increase in mortality.<sup>1–3</sup> In the United States, an average of 400 deaths directly related to heat are recorded annually.<sup>4</sup> In France, the number of heat-related deaths had been poorly evaluated until 2003, when an unusual heat wave occurred. The Institut de Veille Sanitaire,<sup>5</sup> a French government public health agency, set up an observational study during the 2003

heat-wave period (August 1–19), which focused on the daily trend in mortality in 13 of France's largest cities (Bordeaux, Dijon, Grenoble, Le Mans, Lille, Lyon, Marseille, Nice, Paris, Poitiers, Rennes, Strasbourg, and Toulouse).

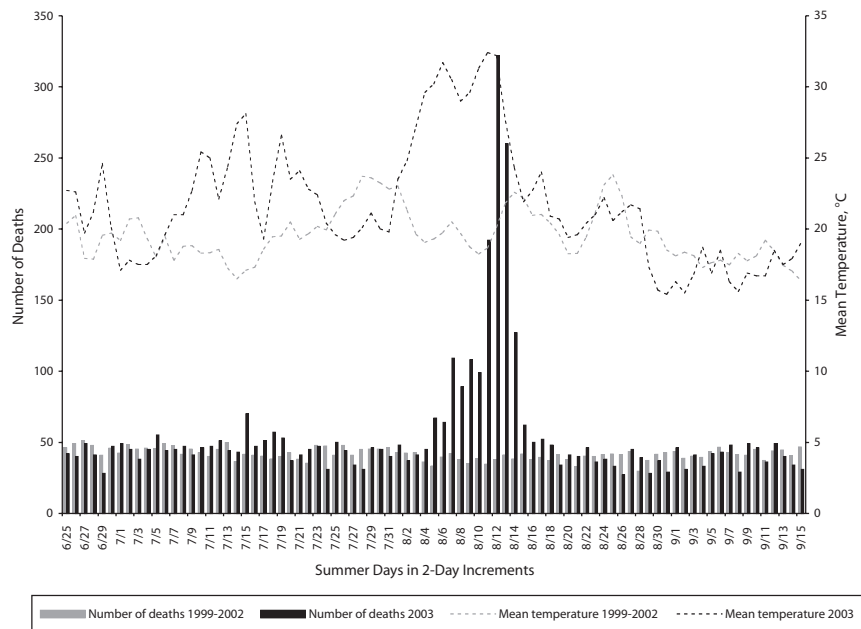
## METHODS

To compare epidemic curves, daily mortality rates were collected in 2 ways: via death certificates of all deaths, except fetal deaths (because of changes in their official definition since 2001<sup>6</sup>) and transcriptions (deaths of people living in other towns), from (1) the Birth and Death Registry Office and (2) the University Hospitals and the Hospital of Le Mans. Meteorologic data were obtained from the National Weather Service. The study was conducted from July 25 to September 15 of each year from 1999 to 2003 in the Birth and Death Registry Office and during the same seasonal period from 2002 to 2003 in the hospitals. Excess mortality rates were calculated as follows: (number of 2003 deaths – mean of 1999–2002 deaths)/mean of 1999–2002 deaths. For the hospital data, the reference year was 2002.

## RESULTS

The 2003 heat wave broke all records in France for more than 50 years, exceeding the temperatures observed in previous heat waves (1976, 1983, and 1994). The conjunction of a maximum temperature of 35°C and a minimum temperature of 20°C was exceptional in Bordeaux, Dijon, Le Mans, Lyon, Marseille, Paris, and Toulouse in terms of duration (9–15 consecutive days).

In the 13 cities, all the August 2003 mean daily deaths were higher than for August 1999–2002. In Paris (Figure 1), Bordeaux, Dijon, Le Mans, Lyon, and Poitiers, the number of daily deaths increased from August 6 to 8, 2003; reached their highest values on August 9 to 13, 2003; and returned to their usual range on August 15 and 16, 2003. A lag of 1 to 3 days between the start of the heat wave and the increase in the number of deaths was observed. The subsequent decrease in temperature and in the number of deaths was concomitant. An excess mortality rate during this period was always found—the minimum in Lille (+4%) and the maximum in Paris (+142%) (Table 1).



**FIGURE 1—Comparison of daily mortality rate and mean temperature in Paris, France, for the years 2003 and 1999 through 2002.**

**TABLE 1—Excess Mortality in 13 French Cities and in Hospitals Between August 1 and August 19, 2003, Compared With the Same Period in 1999–2002 for the City Deaths and in 2002 for the In-Hospital Deaths<sup>a</sup>**

City	2003 No. of City Deaths	Excess Mortality, %	2003 No. of In-Hospital Deaths	Excess Mortality, %
Bordeaux	318	43	228	53
Dijon	168	93	117	121
Grenoble	148	28	108	24
Le Mans	204	82	171	116
Lille	200	4	103	18
Lyon	447	80	300	95
Marseille	571	25	163	23
Nice	341	53	193	65
Paris	1854	142	1665	138
Poitiers	184	79	151	72
Rennes	156	36	95	38
Strasbourg	253	51	157	33
Toulouse	315	36	140	49

<sup>a</sup>City deaths do not include all the in-hospital deaths. Only patients who died in the university hospitals located in the city (not in the suburbs) were included in the 2 sources.

The increase of in-hospital deaths began between August 5 and 7, 2003, in most hospitals. An excess in-hospital mortality rate during the heat wave was noted in the 13 hospitals and was particularly marked in Dijon, Le Mans, Paris, and Lyon (Table 1).

## DISCUSSION

Our study described the trend in daily mortality rates during the 2003 heat wave (August 1–19) in 13 French cities. We worked on all causes of mortality because heat-related deaths raised the issue of defining criteria and lack of accuracy in death certification. The patterns of the 2003 epidemic curves (Birth and Death Registry Office and hospitals) were similar in each city. Prolonged exposure to hot temperatures and duration of the heat wave were probably the triggering factors for mortality. The 2003 mortality pattern was similar to the one observed during the 1976 heat wave but not to those seen in 1983 and 1994. An excess mortality rate

during the heat wave period was always found, even when a longer period of study (July 25 to September 15) was considered.

The excess mortality rates were particularly marked in Dijon, Paris, Le Mans, and Lyon. These cities are located in the central and eastern regions where the 2003 mean temperatures were especially high compared with the preceding years. Marseille, Nice, and Toulouse, located in the southern part of France, had fewer problems from the heat wave compared with towns that had similar temperatures in August 2003 but were not accustomed to very hot summers. These initial observations are currently being supplemented by analytic studies conducted by the Institut de Veille Sanitaire focusing on meteorology, pollution, and heat-related risk factors. Size of the city, the urban heat-island effect, socioeconomic characteristics, and cultural habits may be factors affecting mortality.<sup>2,3,7,8</sup> Air conditioning is not systematically used in France, even in retirement homes or hospitals.

The 2003 heat wave had a major effect: the overall excess mortality rate in France between August 1 and August 20 was estimated at 14 800 deaths.<sup>9</sup> Despite the aging of the population, the risk of mortality is decreasing, and, overall, the number of expected 2003 deaths should have been similar to the number of 2002 deaths in France.<sup>10</sup> Previous North American experiences have shown that preventive measures are efficient in reducing heat-related mortality.<sup>11–13</sup> Future French prevention programs will take into account the disparity of the heat wave effect and the specific characteristics identified in the studies focusing on the French heat wave. ■

### About the Authors

*Stéphanie Vandentorren, Sylvia Medina, Mathilde Pascal, Adeline Maulpoix, and Martine Ledrans are with the Department of Environmental Health, Institut de Veille Sanitaire, Saint Maurice, France. Florence Suzan is with the Department of Chronic Diseases, Institut de Veille Sanitaire. Jean-Claude Cohen is with the National Weather Service (Météo France).*

*Requests for reprints should be sent to Stéphanie Vandentorren, MD, Department of Environmental Health, Institut de Veille Sanitaire, 12 rue du Val d'Osne, 94415 Saint-Maurice cedex, France (e-mail: s.vandentorren@invs.sante.fr).*

*This brief was accepted April 15, 2004.*

### Contributors

S. Vandentorren and F. Suzan assisted with the study, completed the analyses, and led the writing of the brief.

S. Medina and M. Ledrans conceived the study and supervised all aspects of its implementation. A. Maulpoix assisted with the study. M. Pascal and J.-C. Cohen analyzed the meteorological data. All authors helped to conceptualize ideas, interpret findings, and review drafts of the brief.

### Acknowledgments

The authors are grateful to the Birth and Death Registry Offices of Bordeaux, Dijon, Grenoble, Le Mans, Lille, Lyon, Marseille, Nice, Paris, Poitiers, Rennes, Strasbourg, and Toulouse; to the heads of the University Hospitals of Bordeaux, Dijon, Grenoble, Lille, Lyon, Marseille, Nice, Paris, Poitiers, Rennes, Strasbourg, and Toulouse; and to the head of the Hospital of Le Mans for their mortality data transmission. The authors are indebted to Marianne Perez for her contribution to translation.

### Human Participant Protection

No protocol approval was needed for this study.

### References

- Basu R, Samet JM. Relation between elevated ambient temperature and mortality: a review of the epidemiologic evidence. *Epidemiol Rev.* 2002;24:190–202.
- Keatinge WR, Donaldson GC, Cordioli E, et al. Heat related mortality in warm and cold regions of Europe: observational study. *BMJ.* 2000;321:670–672.
- Curriero F, Heiner K, Samet J, Zeger S, Strug L, Patz J. Temperature and mortality in 11 cities of the eastern United States. *Am J Epidemiol.* 2002;155:80–87.
- Heat-related deaths—four states, July–August 2001, and United States, 1979–1999. *MMWR Morb Mortal Wkly Rep.* 2002;51:567–570.
- Impact sanitaire de la vague de chaleur d'août 2003 en France: bilan et perspectives [The health impact of the August 2003 heat wave in France: review and perspectives]. Institut de Veille Sanitaire Web site. Available at: <http://www.invs.sante.fr/recherche/index2.asp?txtQuery=impact+sanitaire+de+la+vague+de+chaleur>. Accessed November 25, 2003.
- Circulaire du 30 novembre 2001 relative à l'enregistrement à l'état civil et à la prise en charge des corps des enfants décédés avant la déclaration de naissance [November 30, 2001 circular regarding the recording of the deaths of infants who die before their birth certificates are recorded]. Available at: <http://www.sante.gouv.fr/adm/dagpb/bo/2001/01-50/a0503302.htm>. Accessed August 9, 2004.
- Clarke JF. Some effects of the urban structure on heat mortality. *Environ Res.* 1972;5:93–104.
- Landsberg HE. *The Urban Climate*. New York, NY: Academic Press Inc; 1981.
- Hemon D, Jouglu E. Surmortalité liée à la canicule 2003. Rapport d'étape (1-3). Estimation de la surmortalité et principales caractéristiques épidémiologiques. Available at: <http://www.inserm.fr/>. Accessed September 25, 2003.
- Desesquelles A, Richet-Mastain L. Bilan démographique 2003: stabilité des naissances, augmentation des décès. *INSEE Première.* 2004;948:1–4.

11. Smoyer KE. A comparative analysis of heat waves and associated mortality in St Louis, Missouri—1980 and 1995. *Int J Biometeorol.* 1998;42:44–50.
12. Weisskopf MG, Anderson HA, Foldy S, et al. Heat wave morbidity and mortality: Milwaukee, Wis, 1999 vs 1995: an improved response? *Am J Public Health.* 2002;92:830–833.
13. Naughton MP, Henderson A, Mirabelli MC, et al. Heat-related mortality during a 1999 heat wave in Chicago. *Am J Prev Med.* 2002;22:221–227.