

How a Severe Winter Impacts on Individuals

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Abstract

The winter of 1977-78 was the worst, on the basis of both low temperatures and snow, on record in Illinois and many other areas of the Midwest. Representatives of 70 households in central Illinois participated in a detailed study of how the extreme cold and snow affected individuals. The average added cost was \$93 per individual, largely to residences and vehicles, and extrapolation of this to all Illinois citizens results in an estimated statewide cost in excess of \$1 billion. This was compounded by a wide variety of personal inconveniences, worries, extra work, and injuries. There were no deaths in the sampled group but 52 Illinoisans were killed by the 18 winter storms. For those living in rural areas beyond the city of their employment, costs and inconveniences were greater. The average individual cost was \$120, and rural dwellers experienced more travel problems, more delayed services, and more absences from school and work.

1. Introduction

The winter season of 1977-78 brought record cold and snowfall to most of Illinois. From late November to late March, 18 major winter storms occurred in Illinois, and newspapers were filled with stories of deaths, injuries, and major damages. Reports of added costs to industry, state and municipal governments, airlines, and utilities were commonplace, and these typically are the costs that first come to mind when one thinks of severe winter weather. Upon reflection, one can and should ask the question, "What did it cost individuals and families, not only in obvious direct ways, but also in subtle ways?"

In an effort to get an answer to that question, individuals from a group of 70 households located in a 1000 mi² area (2590 km²) of central Illinois were studied. The sample questioned included adults 21 to 62 years of age living in and around Champaign-Urbana, Illinois, which has 93 000 residents and is the home of the University of Illinois.

The Urbana weather records (among the oldest in Illinois, beginning in 1888 (Changnon and Boyd, 1963)) provide a basis for evaluating the winter's severity. The December 1977-February 1978 period was the coldest winter on record, averaging 20.2°F (-6.6°C), which was 8.5°F (4.7°C) below normal. Forty-six straight days (9 January to 24 February) had below freezing temperatures, also a new record. The November-March snowfall totaled 62.4 inches (158.5 cm), which was 42.0 inches (106.7 cm) above normal (303% of normal). This was the heaviest total in the 91-year record. Snow was on the ground continuously from 26 November-28 March—a new record. There were 10 snowstorms each producing more than 4 inches (10.2 cm), whereas two such storms are normal. Three were classed as blizzards. The single

heaviest one-storm total was 10.9 inches (27.7 cm) on 13 February, which ranked as the second greatest February storm, and the 8.7 inches (22.1 cm) on 5 December was the second heaviest December storm total. A major icestorm on 24-25 March deposited ice with up to one inch thickness on wires, trees, and streets. Of interest is that the prior winter, that of 1976-77, was almost as severe as that of 1977-78. For example, the study area's heating degree days during the October 1977-April 1978 period were 6456 (20% above average and a new record for the 1887-1978 period), whereas the October 1976-April 1977 total heating degree days were 6297, only 159 less than the record set one year later. These two back-to-back winters were the worst pair in central Illinois since records began in the middle of the nineteenth century. Some adjustments (such as lowered thermostats) were made in the 1977-78 winter as a result of the 1976-77 winter, and these in turn affected the degree of economic impact in 1977-78.

2. Sampling and analysis

The record winter of 1977-78 offered the potential for making an in-depth assessment of the individual and household economic costs, personal problems, and anxieties resulting from these great departures from normal. A detailed questionnaire was developed that sought household family information (size, marital status, and home location), employment status, economic losses, inconveniences (anxieties), and injuries. The responses were grouped into the categories listed in Table 1. No one in the sampled group experienced the death of a family member, although the winter produced an estimated 52 deaths in Illinois and six in the sampled area.

The sampled population was chosen from University of Illinois employees affiliated with the Illinois State Water Survey. The possible bias of the sample due to its size or employment status has not been assessed. However, it should be noted that the range of family incomes of the sampled group varied from \$7000 to \$43 000 per year, with most in the \$15 000 to \$25 000 range. The median annual income of \$18 800 is near the average for this university community.

Each individual reported on his (her) total household experiences, and the 70 sampled households included 195 persons. The sampling was done in April-May 1978, about two months after the winter ended, allowing a reasonable time to discover and measure all losses (such as dead shrubbery); yet before the many minor personal problems were forgotten. Results presented are based on the total sample and on a separation by locale consisting of the 159 who resided in the city of employment (Champaign-Urbana) and those 36 in the surround-

TABLE 1. Added costs of extreme winter conditions.

| | Percent ¹ | Total Cost | Average Cost Household ² | Per Person ² | Maximum Household Cost ² | Minimum Household Cost ² |
|---------------------------------|----------------------|------------|-------------------------------------|-------------------------|-------------------------------------|-------------------------------------|
| Residence Inside | | | | | | |
| Heating | 94 | \$4554 | \$ 69 | \$ 26 | \$230 | \$ 12 |
| Repairs | 13 | 1171 | 130 | 45 | 350 | 20 |
| Cleaning | 6 | 177 | 44 | 14 | 75 | 22 |
| Basement flooding | 3 | 220 | 110 | 37 | 120 | 100 |
| Residence Outside | | | | | | |
| Repairs | 31 | 2083 | 95 | 32 | 500 | 6 |
| Landscaping | 21 | 1039 | 69 | 25 | 210 | 10 |
| Snow Removal | 27 | 541 | 29 | 9 | 125 | 2 |
| Vehicles | | | | | | |
| Added maintenance | 26 | 976 | 54 | 18 | 160 | 15 |
| Repairs (nonaccident related) | 30 | 2363 | 113 | 40 | 585 | 3 |
| Towing | | | | | | |
| Repairs (due to accidents) | 9 | 158 | 26 | 8 | 50 | 5 |
| Repairs (due to accidents) | 13 | 1969 | 219 | 109 | 535 | 23 |
| Use of alternate transportation | 12 | 63 | 8 | 3 | 18 | 3 |
| Cleaning | 23 | 102 | 6 | 2 | 10 | 1 |
| New Possessions Acquired | | | | | | |
| Equipment | 19 | 189 | 15 | 5 | 60 | 4 |
| Clothing | 30 | 944 | 45 | 16 | 200 | 5 |
| Income Lost (absences) | 3 | 175 | 88 | 19 | 100 | 50 |
| Medical Costs | | | | | | |
| Doctors | 11 | 379 | 47 | 16 | 77 | 6 |
| Medicines | 4 | 35 | 12 | 3 | 20 | 1 |
| Hospitals | 0 | 0 | 0 | 0 | 0 | 0 |
| Social Costs | | | | | | |
| Unused tickets | 6 | 65 | 16 | 7 | 45 | 7 |
| Extra long-distance telephoning | 24 | 272 | 16 | 7 | 50 | 3 |
| Extra babysitting fees | 9 | 225 | 38 | 11 | 48 | 4 |
| Unscheduled use of motels | 13 | 280 | 31 | 9 | 100 | 14 |
| Extra Food Costs | 9 | 140 | 23 | 7 | 80 | 6 |

¹ Percent of the total (70) households.

² Costs based only on households with reported losses.

ing rural area, including small towns. The 159 in the city represent 0.2% of the total urban population.

The questionnaire used stressed the reporting only of "added costs" due solely to the abnormal cold and/or snow. Questions requested the reporting of differences between the costs (losses) of the 1977-78 winter and those of the winters prior to that of 1976-77 (also a very cold winter) in order to get a specific measure of the added costs or personal problems. For example, the cost of house heating (line 1, Table 1) was based on the difference between the cost of the 1977-78 winter and the average cost of three prior winters (1973-74, 1974-75, and 1975-76). Ninety-four percent reported higher heating costs, representing a total of \$4554 or \$69 more per household and \$26 more per person. The severity of several storms (five produced 6 inches (15.2 cm) or more snow and/or severe glaze) made special "above average" losses (or costs) and inconveniences generally easy for those sampled to identify. Most (65 of 70) of the sampled households had been in the community for 6 years or more and had records and a basis for making reasonable judgments for items that were "added costs related to the abnormal conditions." Certainly, their reporting on

inconveniences and injuries is probably somewhat biased, and these items are not easily attributable to the record values of snow and cold, as opposed to more normal conditions. It should be recognized that individuals, in answering this questionnaire, made certain subjective interpretations about their circumstances. This situation affects certain results; yet the estimation, quantification, and perception of the individual are key sources of impact information.

3. Results

A summary of the economic losses from the total sample of 70 households appears in Table 1. Examination of the total costs for each category reveals that the added heating cost of \$4554 was the largest single cost item, with high values also for residence and automobile repairs. Many households reported added costs for heating (94%), outside repairs (31%), vehicle repairs (nonaccident related, 30%), purchase of new clothing (30%), snow removal (27%), and added vehicle maintenance (26%).

Examination of Table 1 shows those polled reported losses in 22 categories. These clearly reflect the extremes

TABLE 2. Added inconveniences, efforts and injuries related to extreme winter conditions.

| | Percent of Total Sampled Reporting In Each Category | Average Number of Incidences ¹ |
|--|--|---|
| Travel | | |
| Delays in reaching destinations | 76 | 4 |
| Hazardous driving conditions | 50 | 3 |
| Car troubles (stuck, failure to start, etc.) | 16 | 2 |
| Garage or parking problems | 11 | 2 |
| Absences | | |
| Work | 56 | 3 |
| School | 32 | 6 |
| Missed Social Events | 30 | 2 |
| Cancelled Vacations | 33 | 1 |
| Missed Business Meetings | 11 | 3 |
| Missed Church Attendance | 6 | 2 |
| Pets (Walking, Sickness, Special Care) | 10 | 3 |
| Entrapment at Residence | | |
| Temper flares and arguments | 26 | 2 |
| Worries over food shortage | 8 | 1 |
| Extra Labor | | |
| Snow removal | 66 | 4 |
| Cleaning house | 7 | 3 |
| Scraping ice | 9 | 2 |
| Delayed Services | | |
| Postal delivery | 13 | 2 |
| Garbage removal | 10 | 7 |
| Injuries and Illness | | |
| Falls | 17 | 2 |
| Overwork | 6 | 1 |
| Colds or flu | 21 | 3 |
| Total, All causes | 37 | 4 |

¹ Based on those reporting occurrences.

of cold or snow and the greater costs related to travel, including the costs due to delays or absences due to restricted travel. The increased costs reported for residence heating ranged from 15% to 30% above the average cost. Since heating degree days were 20% above average and winds were normal, this indicates reasonable agreement. The heating costs were adjusted in the analysis since a rate adjustment was allowed during the winter. Total costs related to residences (\$9785) and to vehicles (\$5631) accounted for much (85%) of the total added costs (\$18 120). The total added cost of \$18 120 represents an average value of \$258 per household or \$93 per individual resulting from the winter extremes.

If these values are representative of the Champaign-Urbana population (93 300), then the local costs to indi-

viduals were in excess of \$8.6 million. A further extrapolation across the state of Illinois, most of which had similar record heavy snow and low temperature extremes, results in an added cost to individuals of \$1.05 billion. This, of course, does not include the unmeasured but sizeable costs to the street and highway departments, industries, and transportation systems. The added cost of \$258 per household represented 1.4% of the annual household income. The greatest total added cost for one household was \$951, with most in the \$100 to \$400 range.

Table 2 presents the reported inconveniences representing the personal hardships, frustrations, fears, anxieties, extra efforts, and injuries resulting from the winter's severity. For instance, 76% of those sampled reported problems of delays in reaching desired destinations, and the average number of delays due to the extreme weather conditions was four per person. More than 30% of those sampled reported that the winter extremes produced absences from school, missed social events, cancelled vacations, and forced entrapment in their residence. More than 50% reported hazardous driving conditions, work absences, and extra labor for snow removal. School absences were high, averaging six incidences for those households reporting such problems. Delayed garbage removal was also a frequent problem.

Review of the 21 personal problems reported in Table 2 gives ample evidence of how the winter extremes affected everyone, producing added anxieties to all. If the injuries-illness percentage (37%) of the sampled group applies statewide, then an estimated 4.2 million people in Illinois suffered as a result of the extreme cold and/or snow. As noted earlier, 52 died from the 1977-78 winter conditions, as compared to a long-term average of four deaths per year due to severe winter conditions (Changnon, 1969).

4. Comparison of impacts based on locale of residence (urban vs. rural)

The economic costs and personal problems reported by the 57 households in the city where the major employed person worked were compared with those of the 13 households beyond the city of employment, located in either rural areas or small rural communities. One could expect potential differences for the rural outsiders due to the longer travel to their occupation site.

Table 3 presents values comparing the urban and rural average costs for the more major items, generally those totaling over \$900 (see Table 1). The differences show that the outside (rural) household and resident had higher average costs for residence heating, inside house repairs, vehicle maintenance, vehicle repairs (non-accident), and income lost. The urban heat island may have modified the effect of the added cold on heating costs of the urban resident, and the added travel problems and poor road conditions also brought higher costs to the rural dweller. The major item for which the urban dweller experienced a higher average cost was that of accidents, an average of \$248 versus \$150 per rural household. This may have resulted from more driving

TABLE 3. Comparison of added costs for major items based on location of residences.

| | Average Household Cost, ¹ \$ | | | Average Cost Per Person, ¹ \$ | | |
|-----------------------|---|--------------------|---------------------|--|--------------------|---------------------|
| | City ² | Rural ² | Difference R - C | City ² | Rural ² | Difference R - C |
| Residence Inside | | | | | | |
| Heating | \$ 67 | \$ 80 | +\$ 13 | \$ 25 | \$ 29 | +\$ 4 |
| Repairs | 112 | 152 | + 40 | 33 | 68 | + 35 |
| Residence Outside | | | | | | |
| Repairs | 97 | 88 | - 9 | 35 | 28 | - 7 |
| Landscaping | 67 | 69 | + 2 | 24 | 26 | + 2 |
| Vehicles | | | | | | |
| Added Maintenance | 53 | 78 | + 25 | 18 | 22 | + 4 |
| Repairs (nonaccident) | 116 | 123 | + 7 | 39 | 44 | + 5 |
| Repairs (accident) | 248 | 150 | - 98 | 124 | 71 | - 53 |
| New Clothing Costs | 49 | 38 | - 11 | 18 | 14 | - 4 |
| Income Lost | 0 | 88 | + 88 | 0 | 19 | + 19 |

¹ Based only on those with losses or costs.

² City indicates residence inside the city of occupation; rural means residence beyond the city of occupation.

TABLE 4. Comparison of added inconveniences, efforts, and injuries for those residing in and outside the community of their occupation.

| | Percent of Those Residing Inside the City of Occupation | Percent of Those Residing Outside (rural) City of Occupation |
|--------------------------------|--|--|
| Travel | | |
| Delays in reaching destination | 70 | 100 ¹ |
| Hazardous driving conditions | 47 | 54 |
| Car troubles | 16 | 15 |
| Garage or parking problems | 11 | 15 |
| Absences | | |
| Work | 49 | 85 ¹ |
| School | 30 | 46 ¹ |
| Social events | 30 | 23 |
| Cancelled Vacations | 32 | 38 |
| Forced Entrapment in Residence | 33 | 31 |
| Temper and arguments | 26 | 23 |
| Worries over food | 8 | 8 |
| Extra Labor | | |
| Snow removal | 70 | 61 |
| Cleaning house | 7 | 8 |
| Scraping ice | 9 | 8 |
| Delayed Services | | |
| Postal delivery | 12 | 15 |
| Garbage removal | 9 | 38 ¹ |
| Injuries and Illness (causes) | | |
| Falls | 18 | 15 |
| Overwork | 7 | 0 |
| Colds and flu | 18 | 38 ¹ |
| Missed Church | 5 | 8 |

¹ Items of great difference.

on streets with greater vehicular congestion (and poor conditions) than did the rural dweller.

The total economic effect of the extreme winter resulted in an average cost of \$242 for the urban household, as compared to \$333 for the rural household. The extreme winter conditions were more costly to those living beyond the city of employment, largely through travel costs, lost earnings, and higher heating costs. The average cost per individual was \$86 for the urban dweller as opposed to \$120 for the rural dweller.

The urban and rural values for added inconveniences, extra labor, and injuries appear in Table 4. The major differences, based on items where the percentages differed by 10% or more as noted in column 2, revealed a greater frequency of problems for those in the rural or outside area. For instance, 100% of the rural residents reported delays in travel, whereas only 70% of the in-city residents did. Absences from work and school were also much more frequent events in the rural areas, as were illnesses due to colds and flu.

5. Conclusions

The extreme winter conditions of 1977-78 produced measurable added costs to households in central Illinois. The record winter temperatures and snowfall in central Illinois combined to cost each individual \$93. If this is considered as being representative of individual costs throughout Illinois (record or near record conditions prevailed everywhere), the estimated total cost to individuals in Illinois is \$1 billion dollars. This is compounded by a host of personal inconveniences, worries, extra work, and injuries. Many other costs are yet to be realized by the individual, such as higher taxes needed to cover costs to repair roads and structures. The magnitude of the costs to industries, transportation systems, communication and utility companies, and state and municipal governments for decreased taxes (lost work days and income) and street-highway care is unknown,

but undoubtedly is as sizeable as the cost to the individual. An economist calculated that the statewide work stoppages in one of the storms (26–27 January 1978) resulted in a decrease of \$4 million in state income taxes.

For those living in rural areas beyond the city of their employment, costs and inconveniences were much greater. The average cost to the rural individual was \$120, 40% higher than the average for the urban dweller. This resulted largely from travel related costs. The rural dweller and his family also experienced considerably more absences (work and school), poorer services, and more delays in travel.

Although the sampled area is but a pinpoint when considered on a national scale, the results help provide badly needed information about the kinds, and magnitudes, of impacts of weather on society.

References

- Changnon, S. A., 1969: Climatology of Severe Winter Storms in Illinois. *Bull. 53*, Ill. State Water Surv., Urbana, 45 pp.
 —, and G. R. Boyd, 1963: History of the Urbana Weather Station: 1888–1963. *Circ. 88*, Ill. State Water Surv., Urbana, 48 pp. ●

announcements¹

IUGG Tsunami meeting—Call for papers

The Tsunami Committee of the IUGG (International Union of Geodesy and Geophysics) will hold its biannual meeting in conjunction with the General Assembly of the IUGG in Canberra, Australia on 6–7 December 1979. The meeting will cover scientific, engineering, and socio-economic aspects of the tsunami problem. The first session will cover general tsunami theory, observations, historical information, statistics, and socio-economic problems. The second session will cover specific problems in propagation, run-up, and engineering applications. The third session will be concerned with numerical methods as applied to the tsunami problem and the last session will deal with experimental work and seismology related to tsunamis. Contributed papers should be limited to 15 min of material with a 5 min question period. Each session will end with a talk by the chairman summarizing recent progress in areas covered by the session. A special meeting will also be held on present and future contributions of the research community toward improving the tsunami warning system. One page abstracts of papers may be submitted to: Prof. Serge L. Soloviev, Chairman, IUGG Tsunami Committee, Academy of Science, USSR, Ulyanoskaya ul. 51,

Moscow 109004, USSR; or to: Dr. Harold G. Loomis, Secretary, Tsunami Committee, IUGG, Joint Institute for Marine and Atmospheric Research, 2525 Corra Rd., Honolulu, Hawaii 96822.

Directory of Federal women in science and engineering

The Task Force for Women in Science and Engineering has begun compiling a directory of Federal women in scientific and engineering jobs. Once compiled, the directory will be used in a variety of ways: to send out information to persons in the directory, to aid organizations in recruiting scientific and technical women, and to help locate women willing to speak about their careers in training courses or special programs. Federal women in the physical sciences, the biological and life sciences, the social and behavioral sciences, computer sciences, or mathematics, who are interested in being included in this nationwide directory, should write to: Joan Humphries, National Science Foundation, Room 517, 1800 G Street, N.W., Washington, D.C. 20550. Name, address, discipline, phone number, and agency should be included. Any FWP Managers should make sure that the scientific and technical women in their organizations know about the proposed directory. The task force members hope to have the directory ready for distribution by 1 June 1979.

¹ Notice of registration deadlines for meetings, workshops, and seminars, deadlines for submittal of abstracts or papers to be presented at meetings, and deadlines for grants, proposals, awards, nominations, and fellowships must be received at least three months prior to deadline dates.—*News Ed.*