Weather patients will come?

Daniel K B Ou, The-Phung To and David McD Taylor

ABSTRACT

Objectives: To determine whether weather conditions affect emergency department (ED) attendance and admissions from the ED.

Design and setting: A retrospective observational study in a large metropolitan ED.

Main outcome measures: ED attendance (total and via ambulance) and admissions to hospital from ED, as a function of weather variables.

Results: On warm, dry, sunny and good weather days there were significantly more ED attendances in total than there were on cool, rainy, dull and bad weather days, respectively ($P \leqslant 0.001$). There were significant correlations between ED attendance and temperature ($r = 0.36$, $P < 0.001$), rainfall ($r = -0.20$, $P < 0.001$) and hours of sunshine ($r = 0.17$, $P = 0.001$). Attendance via ambulance was not affected by weather variables. Admissions from the ED were positively correlated with temperature ($r = 0.15$, $P < 0.01$) and negatively correlated with rainfall ($r = -0.12$, $P = 0.02$).

Conclusions: As there is a clear relationship between weather conditions and ED attendance, incorporating meteorological forecasting into emergency medicine training may improve ED scheduling. To improve the morale of ED staff coping with an onslaught of patients on good weather days, the ED environment should simulate sunny weather, with swimming pools, sun lamps, palm trees and Beach Boys music.

MJA 2005; 183: 675–677

Most of us enjoy good weather! Most satisfying are warm temperatures, endless hours of sunshine and no rain. However, often heard within the burrows of the Emergency Department (ED) is the disgruntled physician lamenting the day's forecast of pristine weather, especially when the rest of the world seems to slacken off. These physicians resign themselves to a perfectly horrible day with an inundation of ED attendances because, anecdotally at least, "beautiful day" equates with "people doing silly things"!

We wondered whether weather was the culprit or whether these physicians were just plain jealous because they themselves were unable to bask their vitamin D-deprived selves in the sunshine.

A search of the medical literature revealed that in other parts of the world (United States, Norway, United Kingdom, and Argentina) weather had incited enough passion for studies to be conducted on this very topic.[1-8] While the hypotheses of these studies are similar, their results are conflicting. For example, one study[1] found that warm sunny weather resulted in a higher attendance of children with injuries, whereas another reported that weather was a minor factor in determining ED attendance.[2] A study by Diehl and colleagues,[3] investigating attendances at an ambulatory care centre in Texas, USA, found that higher temperatures were associated with more visits, and rainfall and freezing temperatures with fewer. The authors were so confident of their findings, they went as far as to develop an attendance prediction model.

Left somewhat dissatisfied with these inconsistent findings, we resorted to conducting our own weather study. We aimed to determine whether weather variables in Melbourne, Victoria, impacted significantly on attendances at our ED.

METHODS

We undertook a retrospective observational study in the ED of the Austin Hospital in Melbourne, a major metropolitan referral centre. The ED has about 40 000 attendances annually of people of all ages, largely drawn from residential suburbs in the north-east of Melbourne.

We retrieved Melbourne's daily weather details from the Bureau of Meteorology[9] for the 12-month period May 2004 – April 2005, inclusive and matched these with ED attendance and admission statistics. Definitions for the weather conditions used in this study are given in the footnote to Box 1.

Student's *t* test was used to compare ED attendances for days with differing weather conditions. Spearman's correlation test was used to examine correlations between ED and ambulance variables and weather variables (not normally distributed). SPSS for Windows software (version 11.5, SPSS Inc, Chicago, Ill, USA) was used for all data analysis (level of significance 0.05).

RESULTS

There were 40 813 ED attendances over the study period. Box 1 shows the mean number of attendances as a function of the various weather conditions. On days with better weather conditions there were significantly more ED attendances! It was also clear that, over the study period, there were 57% more "good days" than bad days. Furthermore, good days (comprising almost a third of all days) were encumbered with about a 10% increase in patient load.

Box 2 shows the correlations between continuous weather variables (temperature, rain and sunshine) and total ED attendances, ED attendances via ambulance, and admissions from the ED. Again, these findings indicate that the total number of attendances correlates significantly with all weather variables, especially temperature (correlation coefficient, 0.36).

No significant correlations were seen between ED attendances via ambulance and weather variables. Although admissions from the ED did correlate significantly with temperature and rainfall, the correlation coefficients were small. The negative correlation between each of the ED variables and rain confirms one registrar's observation that the more it "buckets down", the fewer people attend EDs.

Seasonal effects were also apparent with significantly different total monthly attendances over the year (ANOVA, $P < 0.001$). Attendance (mean [SD]) was lowest during

Austin Health, Heidelberg, VIC.
Daniel K B Ou, MB BS, Emergency Medicine Registrar; The-Phung To, BPharm, MClinPharm, Drug Use and Evaluation Pharmacist; David McD Taylor, MD, MPH, FACEM, Director, Emergency Medicine Research.
Reprints will not be available from the authors. Correspondence: Dr Daniel K B Ou, Austin Health, PO Box 5555, Heidelberg, VIC 3084. Daniel.Ou@austin.org.au

1 Weather conditions and emergency department attendances

Weather condition	Number of emergency department attendances		
	Mean (SD)	Mean difference (95% CI)	*P**
Cool days (*n* = 183)	108.3 (12.1)	7.0 (4.4–9.5)	< 0.001
Warm days (*n* = 182)	115.3 (12.8)		
Dull days (*n* = 185)	109.6 (12.2)	4.5 (1.8–7.1)	0.001
Sunny days (*n* = 80)	114.1 (13.3)		
Rainy day† (*n* = 130)	108.9 (12.9)	4.5 (1.8–7.3)	0.001
No rain† (*n* = 234)	113.4 (12.7)		
Bad day (*n* = 72)	106.0 (10.7)	10.0 (6.5–13.6)	< 0.001
Good day (*n* = 113)	116.0 (12.8)		

* Student's *t* test.
† One missing entry for rain. Weather conditions courtesy of the Bureau of Meteorology, Melbourne.

Cool day = Maximum temperature 19.8° C (annual daily median)
Warm day = Maximum temperature > 19.8° C
Dull day = 6.2 hours of sunshine (annual daily median)
Sunny day = > 6.2 hours of sunshine
Rainy day = > 0 mm of precipitation
Bad day = Rain *and* 19.8° C *and* 6.2 hours of sunshine
Good day = No rain *and* > 19.8° C *and* > 6.2 hours of sunshine ◆

winter (quietest month July: 105.5 [11.2] patients) and highest during summer (busiest month December: 118.7 [13.4] patients). Total attendance (mean [SD]) was also affected by holidays. It was highest on weekends and public holidays (117.9 [14.1] patients) and lowest on non-holidays (109.0 [11.4]). The mean difference was 8.9 (95% CI, 6.2–11.6) patients ($P < 0.001$).

DISCUSSION

It is clear that a strong relationship exists between weather conditions and attendance at our ED. The seasonal effects further support this indirectly. As ambulance attendances were not affected by the weather, we concluded that the attendance differences related to the "walking wounded".

Our results are sufficiently disturbing for us to recommend that ED managers consult the Bureau of Meteorology on a regular basis to aid in ED rostering. Or, if they are very efficient, they can catch the early morning forecast for an even more accurate daily roster. Alternatively, we pose the question of whether or not it would be appropriate to incorporate a unit of meteorological forecasting into the emergency medicine training program. Such measures would result in near perfect matching of staff and patient numbers, with considerable cost savings.

In the meantime, on those wet, cold, dull days that are undoubtedly overstaffed and boring, we recommend that ED staff stay indoors (in the ED) and watch TV, as this is probably just what many of their prospective patients are doing.

Of course, there is a downside to this staff–patient matching endeavour. It will mean that more staff will be working on days of good weather and will be rostered off during periods of inclemency. This is likely to have adverse

2 Correlations between weather variables and emergency department (ED) and ambulance variables

	Weather variable correlation coefficient for:*		
ED variable	Temperature (*P*)	Rain (*P*)	Sunshine (*P*)
Attendances (total)	0.36 (< 0.001)	–0.20 (< 0.001)	0.17 (0.001)
Attendances (via ambulance)	0.05 (0.38)	–0.001 (0.98)	0.04 (0.42)
Admissions from ED	0.15 (0.004)	–0.12 (0.02)	0.08 (0.13)

* Spearman's correlation test. ◆

repercussions for recruitment of ED staff. To counter this, we recommend that the ED environment be designed to reflect the joys of a great day outdoors. All ED ceilings should be painted "sky blue", sun lamps should blaze, and Beach Boys CDs should play continuously. Furthermore, an indoor swimming pool, complete with sand spit and coconut palms (artificial), should be established in all EDs.

However, could such recommendations be cosmetic and opportunistic, and what about global warming? Increasing concentrations of greenhouse gasses in the atmosphere are causing temperatures to rise, and an increase in the number of hot days is predicted.[10] Global warming is likely to affect human health through severe weather events, heat stress, and changing patterns of infectious diseases.[11] Herein may lie the future challenge for emergency medicine — to rise, with the temperature, to meet these expected trends. Thanks to global warming, emergency medicine is set to assume a preeminent position among medical specialties.

In the meantime, our results show that Melbourne's good weather days considerably outnumber its bad ones. While this is no surprise to Melburnians, we emphasise this finding to those north and west of the Murray river. Considerable ignorance regarding Melbourne's weather has resulted in derision and bad feeling between the states. Clearly, there is now no basis for Melburnians' weather complex.

Our study cannot explain why people on holiday flock to the ED. Perhaps our patients harbour some subconscious guilt about abiding in the "lucky country", and take every opportunity to ruin a beautiful day or a holiday with some form of perverse self-persecution? And what better place is there to do this but in the ED waiting room? Also, while it is doubtful that a relationship exists between holidays and the weather, the Bureau of Meteorology appears to be surreptitiously working to ensure that cold fronts emerge from the Antarctic by the last train home on Friday.

It may appear that the differences in patient attendance seen on days of different weather conditions (up to 10 patients per day), while statistically significant, may not be clinically significant. Casemix as well as absolute patient numbers affects how busy an ED becomes. Notwithstanding this, overcrowding is the most serious issue presently confronting EDs,[12] and the "good weather effect" may just tip the balance.

In conclusion, there is more than an iota of merit in the weather grievances of those discontented souls in the ED. We recommend further investigations into the exact nature of presenting ailments as a function of weather. This will confirm our riveting findings and better define why weather and ED attendance are so closely related.

COMPETING INTERESTS

We declare an impending investment in artificial coconut palms and an indoor swimming pool franchise. Profits will be used to support ailing greenhouse gas-producing industries. This will indirectly support the impending boom in emergency medicine.

REFERENCES

1 Macgregor DM. Effect of weather on attendance with injury at a paediatric emergency department. *Emerg Med J* 2003; 20: 204-205.
2 Christoffel KK. Effect of season and weather on pediatric emergency department use. *Am J Emerg Med* 1985; 3: 327-330.
3 Diehl AK, Morris MD, Mannis SA. Use of calendar and weather data to predict walk-in attendance. *South Med J* 1981; 74: 709-712.
4 Rusticucci M, Bettolli ML, de AH. Association between weather conditions and the number of patients at the emergency room in an Argentine hospital. *Int J Biometeorol* 2002; 46: 42-51.
5 Tollefsen NH, Dickstein K. [Are emergency admissions to medical departments dependent on weather?] [Norwegian]. *Tidsskr Nor Laegeforen* 2000; 120: 3678-3679.
6 Attia MW, Edward R. Effect of weather on the number and the nature of visits to a paediatric ED. *Am J Emerg Med* 1998; 16: 374-375.
7 Holleman DR Jr, Bowling RL, Gathy C. Predicting daily visits to a walk-in clinic and emergency department using calendar and weather data. *J Gen Intern Med* 1996; 11: 237-239.
8 Fatovich DM, Nagree Y, Sprivulis P. Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. *Emerg Med J* 2005; 22: 351-354.
9 Daily weather observations for Victoria. Australian Government Bureau of Meteorology. Available at: http://www.bom.gov.au/climate/dwo/IDCJDW0300.shtml (accessed Jun 2005).
10 Yoganathan D, Rom WN. Medical aspects of global warming [commentary]. *Am J Ind Med* 2001; 40: 199-210.
11 Epstein PR, Leaf A. Biological and medical implications of global warming. In: Rom WN, editor. Environmental and occupational medicine, 3rd ed. Philadelphia: Lippincott-Raven Publishers, 1998: 1625-1637.
12 Fatovich D. Emergency medicine. *BMJ* 2002; 324: 958-962.

(Received 12 Jun 2005, accepted 27 Oct 2005) ❑