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Postponement of Death Until Symbolically Meaningful Occasions

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This study shows that mortality dips before a symbolically meaningful occasion and peaks just afterward. Mortality among Chinese (n = 1288) dips by 35.1% in the week before the Harvest Moon Festival and peaks by the same amount (34.6%) in the week after. We chose to study mortality among Chinese and a Chinese holiday for two reasons. First, the holiday moves around the calendar, thus allowing separation of the effects of the holiday from fixed, monthly mortality effects. Second, the holiday appeals strongly to one (experimental) group and not to others (which can be used as control groups). In terms of percentage, cerebrovascular diseases displayed the largest dip/peak pattern, followed by diseases of the heart, and then malignant neoplasms. The dip/peak mortality pattern does not appear in various non-Chinese control groups. The statistical significance of the findings was demonstrated with linear and curvilinear regression analysis and with two nonparametric tests. After testing alternative explanations for the findings, we concluded that the dip/peak pattern occurs because death can be briefly postponed until after the occurrence of a significant occasion. (JAMA. 1990;263:1947-1951)

IN THE long history of epidemiology, researchers have examined an increasingly wide range of causal factors; yet they have typically focused on the impact of physical, chemical, and biological aspects of the environment and neglected the effect of cultural factors on mortality. Even when epidemiologic research has examined cultural factors, as in the literature on life events, it has tended to emphasize negative aspects, such as being fired, divorced, retired, or bereaved.' ~ Thus, epidemiologic studies on the medical impact of positive life events are very rare.

In one of the few studies of this sort, Phillips and Kings sought to determine whether persons are able to prolong life until they have reached a symbolically meaningful event. Adapting techniques for investigating the short-term fluctuation of deaths around significant social occasions,5 9 Phillips and Kings chose to study a symbolically meaningful event that met two methodologic criteria: (1) the event was of great interest to one group and of little interest to another (thus allowing comparison of experimental vs control groups), and (2) the event moved around the Gregorian calendar (thus making it possible to disentangle the effect of the event from fixed, monthly mortality patterns! One symbolic event that meets both of these criteria is the Jewish holiday of Passover. Phillips and King showed that Jewish mortality fell sharply below the expected level just before Passover and rose by an equal amount above expected immediately afterward. In contrast, non-Jewish control groups showed no significant fluctuation of mortality around Passover. After testing alternative explanations for these findings, Phillips and King concluded that some Jews were briefly able to prolong life until after the Jewish holiday.

The above-mentioned findings were statistically significant, but they have not been replicated. It is a scientific truism that statistical significance alone is not sufficient to justify substantial confidence in the reliability of a finding. It is crucial that the finding be replicated also. As Karl Popper9 has noted, 'we do not even take our own observations quite seriously, or accept them as scientific observations, until we have repeated and tested them." To replicate the Passover study we sought an event that met the two criteria noted above, but involved a different cultural group, a different season, and a different genetic stock. Using Chinese informants we identified the Harvest Moon Festival (HMF) as a suitable occasion. Like Passover, the HMF moves around the Gregorian calendar and is of interest to one group, but not another. As in Passover, the HMF also involves a ceremonial meal celebrated at home (references 10 and 11 and personal communications with informants); on this occasion there are special foods and a gathering of the immediate family. The senior woman of the household takes charge of preparing an elaborate meal and, by custom, directs the work of the daughters and daughters-in-law. In general, Chinese families are male- centered, but on this holiday the central ceremonial role is assumed by women, most notably the senior woman of the house. Though falling out of favor with the younger generation, the HMF remains a significant holiday in the Chinese calendar.

Table 1.—Distribution of Deaths From Natural Causes Around the Harvest Moon Festival for Chinese Women and Two Control Groups, Califomia, 1960 Through 1984.

Week	Chinese	Jewish	Other
-12	44	138	308
-11	52	154	321
-10	55	153	319
-9	45	153	333
-8	56	126	315
-7	53	136	319
-6	61	163	287
-5	38	141	287
-4	46	143	323
-3	45	133	280
-2	55	145	342
-1	33	141	354
1	70	145	339
2	49	139	350
3	54	151	355
4	57	163	323
5	50	148	296
6	61	147	312
7	56	168	352
8	66	147	343
9	57	161	348
10	53	157	351
11	68	153	378
12	64	140	385

#For definition of sample, see text. The Jewish sample covers 1966 through 1984. expected numbers were determined from the curvilinear regression model described in the text. "Significant at .05, two-tailed t test, 21 df.

Unlike Passover, the HMF places great emphasis on the symbolic importance of old women (references 10 and 11 and personal communications with informants); indeed the festival is sometimes disparaged as "an old woman's holiday." This feature of the HMF allows the use of various "internal" control groups as well as "external" ones: the mortality of old Chinese women can be compared with the mortality of young Chinese women and of old Chinese men, as well as the mortality of non-Chinese persons. Given our hypothesis that the HMF influences mortality, the largest effect should be evident for old Chinese women. The availability of internal control groups is one reason why we chose to examine the HMF rather than the Chinese New Year (which is of widespread interest to the entire Chinese community). In addition, the HMF has a clearly defined beginning and end; in contrast, the beginning and end points of the Chinese New Year are blurred, because this holiday involves many events and preparatory activities that are spread over several weeks.

METHODS

We examined all computerized records of the deaths of Chinese in California. These data were available for 1960 through 1984 at the beginning of this study. Racial and ethnic status is coded on

the death certificate throughout this 25-year period, allowing separate analysis of the deaths of Chinese and non-Chinese. Only deaths from natural causes are examined.

In the earlier study of deaths around Passover,6 Jews formed the experimental group and Chinese formed one of the control groups. In the current study of deaths around the HMF, we reverse the procedure and use the Chinese as the experimental group and the Jews as one of the control groups. (Like the HMF, the Jewish High Holy Days occur in the fall, but there is no fixed relationship between the Chinese and Jewish holidays.) To ensure that our results were not an artifact of selecting Jews as a control group, we also used a second, larger control group that consisted of a 2% simple random sample of all deaths occurring in California (excluding all Chinese and excluding persons who could be identified as Jews). Thus, there is no overlap between the two control groups. As noted in reference 5, the information needed to identify Jewish mortality was not available prior to 1966; hence, the Jewish control group covers a somewhat shorter time period (1966 through 1984) than the Chinese group (1960 through 1984) or the 2% control sample (1960 through 1984).

To discover whether there is a dip in deaths among Chinese before the HMF and a peak thereafter, we estimated the trend in deaths in the 24-week period centered on the holiday and then measured the extent to which the deaths among Chinese diverged from this trend in the week before the holiday and in the week thereafter.5 During the study period, the date of the HMF varied from September 10 to October 8, with most of the holidays falling in September. During the 24-week period centered on September, a graph of mortality in California is shaped like a shallow "U," with the bottom of the "U" occurring in September. Thus, on theoretical grounds, a curvilinear regression model is preferable, and this is the main model to be used. We will also show, however, that our results are statistically significant when the linear model is used.

The significance of regression findings can be spuriously inflated by the ,statistical artifacts of heteroscedasticity and positive autocorrelation.55'3-" Standard tests " ~s revealed no evidence of heteroscedasticity. Although negative autocorrelation was found, this does not typically inflate the significance of findings.'3 Nonetheless, to ensure that our results were genuinely significant, we also used a revised regression model that displayed no evidence of autocorrelation. Unlike the ;standard model, which employed 24 data points, the revised model omitted the two data points associated with the weeks immediately surrounding the HMF.

Table 2.—Distribution of Deaths Among Chinese Women and Jewish Men One Week Before and One Week After Important Ceremonial Occasions for Major Disease Categories

RESULTS

Table 1 shows the mortality of Chinese women (aged 75 years and older) in the 24-week period centered on the HMF. Thirty- three deaths occurred in the week before this festival, compared with an estimate of 50.82 deaths expected in this period (the estimate being derived from a curvilinear regression analysis). Thus, old Chinese women die at a much lower rate than expected just before the HMF. The drop in deaths before the holiday (33 - 50.82 = - 17.82) is statistically significant at .015 (SE of estimate = 2.51; standardized residual=-2.34; P=.015, one-tailed t test, 21 d.~. A one-tailed t test is appropriate here because the direction of the effect was predicted to be the same as in the earlier paper on Jewish mortality. If a two-tailed t test is nonetheless preferred, the findings remain statistically significant (P = .030).

In strong contrast, mortality rises above expected in the week after the HMF. Seventy deaths occurred in week 1, compared with an estimate of 51.99 expected (SE of estimate=2.46; standardized residual=2.36; P=.014, onetailed t test, 21 df. (As noted above, a one-tailed t test is appropriate, but the results remain significant even if a twotailed t test is used [P = .028]). It is noteworthy that the preholiday drop in mortality (-17.82=33-50.82) closely matches the postholiday peak in deaths (18.01=70-51.99). This is consistent with the notion that the dip/peak effect is caused by a brief postponement of death until after the holiday.

The findings remain significant when linear rather than curvilinear regression estimates are used. The linear regression estimate of the number of deaths in the week before the HMF is 53.08

(standardized residual=-2.53; P<.01). In the week after the HMF the estimated number of deaths is 54.25 (standardized residual = 1.99; P<.05).

Two additional nonparametric tests3 also reveal the significance of the findings: (1) In the week before the HMF, mortality of old Chinese women is lower than in any other week in the 24-week study period. Conversely, the mortality of this group is higher in the week after the HMF than in any other week in the study period. Given the null hypothesis, the joint probability of these two findings is 1/24 x 1/23 = 0.0018. (2) One hundred three deaths occur in the 2-week period centered on the HMF. If the holiday has no effect on mortality, about half of these 103 deaths (51.5) should occur in week - 1 and half in week + 1. Instead, 33 deaths occur in week -1 and 70 in week + 1. The probability of 70 or more deaths under the null hypothesis is .0002 (binomial test; x ~70; n= 103; P=.5).

Thus, four different analyses (linear and curvilinear regression and two nonparametric tests) all indicate that the mortality of old Chinese women dips significantly before the HMF and peaks significantly thereafter.

Table 1 also displays the mortality of two control groups, which are matched in sex and age to the experimental group: (1) Jews and (2) a 2% simple random sample of all decedents (excluding Jews and Chinese). Neither control group displays a significant preholiday dip or postholiday peak. As noted earlier, the Jewish control group covers a somewhat shorter period of time (1966 through 1984) than the other groups under study (1960 through 1984). However, the nonexistence of the dip/peak effect among Jews and the existence of this effect among Chinese cannot be ascribed to the difference between the periods of time under study. When the Chinese data are reanalyzed for 1966 through 1984, the dip/peak phenomenon remains significant: mortality among Chinese drops by -16.97 before the holiday (t=-2.13; P<.025) and rises by 19.87 after the holiday (t=2.50; P<.025). Only the Chinese population produces a significant dip/peak effect around the HMF.

As noted earlier, old women play the central ceremonial role in the HMF; other groups are much less interested in the holiday. Our findings are consistent with this view: the dip/peak effect is not evident among old Chinese men or among younger Chinese women. Chinese men aged 75 years and older produce a nonsignificant peak in deaths prior to the holiday (3.71=89-85.29; t=.36; P value not significant, with 21 df) and a nonsignificant drop in deaths after the holiday (-17.01=70-87.01; t= - 1.64; P value not significant, with 21 df). Similarly, Chinese women younger than 75 years produced a nonsignificant drop in deaths before the holiday (- 5.30 = 76 - 81.30; t = - .76; P value not significant) and a nonsignificant drop in deaths thereafter (- 3.64 = 79 - 82.64; t = - .52; P value not significant). Only those who are ceremonially central to the HMF produce the dip/ peak effect. This result is parallel with that of Phillips and King,5 who found that the dip/peak effect around Passover was concentrated among Jewish men, who play the central ceremonial role in that holiday.

Table 2 examines mortality among Chinese around the HMF and mortality among Jews around Passover, for each of the three leading causes of death. For each ethnic group, we have focused on the demographic category that is ceremonially central to the holiday. To ensure comparability between diseases, we have expressed the size of the preholiday dip and the size of the postholiday peak in percentages. Thus, Table 2 shows that deaths from cerebrovascular diseases among Chinese drop by 65.1% below expected in the week before the HMF, whereas deaths from heart disease drop by 40. 8% before the holiday. The larger the difference between the postholiday peak and the preholiday dip, the greater the strength of the dip/peak phenomenon. Thus, one way to summarize the overall size of the dip/peak effect is to subtract the preholiday dip (expressed as a percentage) from the postholiday peak. Column 4 of Table 2 presents this measure of the dip/peak effect for Chinese, for each of the three leading causes of death. (The detailed International Classification of Diseases codes for these causes of death are as listed in Phillips and King's article [reference 5, Table 3].)

Table 2.—Distribution of Deaths Among Chinese Women and Jewish Men One Week Before and One Week After Important Ceremonial Occasions for Major Disease Categories

	Observed Deaths	Expected No. of Deaths	Observed - Expected (%) / Expected	Dip/Peak Index*
Old Chinese women				
Cerebrovascular diseases				
	3	8.5	64.7	142.5
Week -1	16	9.0	77.8	
Week +1				
Diseases of the heart				
	13	21.3	-39.0	75.2
Week -1	29	21.3	36.2	
Week +1				
Malignant neoplasms				
	9	10.6	-15.1	-11.5
Week -1	8	10.9	-26.6	
Week +1				
Jewish men				
Cerebrovascular diseases				
	3	8.7	- 65.5	94 9
Week -1	11	8.5	29.4	
Week +1				
Diseases of the heart				
	33	45 3	- 27.1	62.3
Week -1	61	45.1	35.2	
Week +1				
Malignant neoplasms				
	14	19.7	-28.9	46.1
Week -1	23	19.6	17.2	
Week +1				

*This index, which measures the strength of the dip/peak phenomenon, is calculated by subtracting the preholiday dip from the postholiday peak. Diseases are listed in order of the strength of the dip/peak phenomenon. See text for further details.

For mortality among Chinese women, the dip/peak around the HMF is strongest for cerebrovascular diseases, followed by heart diseases, and then by malignant neoplasms. Phillips and Kings found that these diseases are ranked in the same order for mortality among Jewish men around Passover. These findings are reproduced in Table 2. This similarity between the Jewish and Chinese mortality dip/peak effects is remarkable in view of the fact that one is comparing different ethnic groups, different sexes, different holidays, at different times of the year.

However, this similarity in mortality among Jews and Chinese does not extend to the less frequent causes of death; the two ethnic groups behave differently with respect to the residual

category of "all other natural causes of death." The Chinese produce a dip/peak effect for this category (%peak%dip=68.3) whereas the Jews do not (9topeak - %dip = -10.4).

COMMENT

This study has demonstrated that the dip/peak in mortality is not restricted to Jews and Passover, but also exists for a different genetic stock, a different cultural group, and a different symbolic occasion. These findings substantially increase confidence in the genuineness and generality of the dip/peak effect and suggest that the phenomenon may be associated with a variety of psychologically significant events. Indeed there is some preliminary evidence indicating that there is also a dip/peak around the observance of an individual's birthday or other personally meaningful occasionsPT

Alternative Explanations of the Findings

The above findings are consistent with the hypothesis that some people are able to prolong life briefly until after an occasion that is important to them. Several alternative explanations are inconsistent with the data.

Any stress or overeating associated with the holiday might account for the peak in deaths after the holiday, but could not account for the equally large dip in deaths before the holiday or the specificity of the effect to those playing the ceremonial role.

Low mortality before the holiday and high mortality thereafter cannot be an artifact of an upward trend in deaths, since the regression analysis corrects for linear and curvilinear trends in estimating the expected number of deaths under the null hypothesis.

It is true that the binomial testing procedure ignores the effect of a possible mortality trend over the 2-week study period. However, such a trend could not be very substantial over a brief period and even if it were, the binomial test would still reveal statistically significant findings. This is because of the strength of the dip/peak effect. Even if an unrealistically steep trend is assumed, so that under the null hypothesis 45% of deaths are expected to occur in week - 1 and 55% in week + 1, the observed results are still significant at .005 (binomial test; x ~70; n= 103; P=.55).

The HMF effect cannot be ascribed to a fixed, monthly pattern in mortality, but must be ascribed to the holiday instead. The characteristic HMF dip/peak pattern moves around the calendar as the holiday does, and this allows us to separate the effect of the holiday from the effect of fixed microseasonal and seasonal patterns.

The dip/peak effect cannot be ascribed to postponement of life-threatening surgery until the holiday is over. If this explanation were correct, the dip/ peak effect should be absent among those who did not experience surgery just prior to death. In fact, however, the no-surgery group produced a stronger dip before the holidays (-44.1%) than did the remainder of the sample (-3.7%). Similarly, the no-surgery group displayed a larger postholiday peak (57.9%) than did the rest of the sample (27.1%). (These data are for 1978 through 1984, since information on the surgical status of the decedent is unavailable for 1960 through 1977.)

The findings in this study are for natural causes only. Hence, one cannot ascribe the dip/peak effect to external causes of death like suicide, whose timing can easily be manipulated.

As noted earlier, findings can be rendered spuriously significant by the statistical artifacts of heteroscedasticity and autocorrelation. However, we found no evidence of heteroscedasticity.6 Although negative autocorrelation was found (Durbin-Watson statistic=2.94; P<.05), this type of correlation does not typically inflate the significance of findings; furthermore, our results remained significant when we eliminated this autocorrelation using the revised regression model described above.

We have assessed seven alternative explanations for the findings; none appear to fit the evidence at hand. At present, the best available explanation of the findings is that the deaths of some people are postponed until they have reached psychologically significant occasions. The mechanisms that

produce this postponement are not yet known but might include one or more of the following: more careful adherence to medication schedules, enhanced care by family or physicians, and some interaction of psychobiological processes yet to be identified.

Extent, Etiology, and Significance of the Dip/Peak Phenomenon

Extent.—This study and the study by Phillips and King have focused on occasions like the HMF that are meaningful to an entire group of people. Occasions like a golden wedding anniversary that have personal rather than group-wide significance could also be examined. Is there evidence that some people prolong life until the arrival of important wedding anniversaries or other personally meaningful occasions? If so, is the dip/peak phenomenon stronger for personal events than for religious or political ones? In general, it would be valuable to map the range of significant events and demographic groups associated with dip/peak phenomena and to compare the size of the dip/peak associated with each event and group.

Etiology.—The accumulated evidence indicates that the dip/peak phenomenon is now a valid field for laboratory and clinical investigation. Two general approaches are likely to prove fruitful: (1) comparison of the psychological and biochemical status of patients just before meaningful occasions, just after these occasions, and et neutral times, and (2) identification of the specific diseases that produce the strongest dip/peak effects (in contrast to the current study, which has examined very general disease categories). It is possible that these specific diseases may share a common factor (like hypertension); if so, this could shed light on the causal pathway that links psychological and biological events. In addition, investigations of this sort might throw light on the differential degree to which diseases are susceptible to social and psychological processes.

Significance.—The current study and the study by Phillips and King suggest some new directions for the study of mind-body processes, in both biostatistical and laboratory investigations. to date, much of the epidemiologic literature on life events and much of the psychoneuroimmunological literature has emphasized the effects of negative psychological stress on health.]~21 The current study suggests that positive psychological processes have beneficial effects on mortality. It may be fruitful to strive for a more balanced emphasis on positive and negative psychocultural processes in future studies of the topic.

On a practical level, the current study provides both an opportunity and a challenge for laboratory researchers. The challenge is to correct for the fact that important symbolic events have a pronounced short-term impact on mortality (and perhaps on health in general). Thus, researchers studying the effect of pharmacological agents or the rapidity of wound healing may experience erratic results if their study period happens to occur (1) just before a symbolic event, (2) just after such an event, or (3) in a period that straddles a symbolic event. The experimenter's problem will be exacerbated if the fraction of the experimental group that is anticipating a symbolic event differs from the equivalent fraction for the control group. (These fractions could be quite different, even with random assignment to experimental and control groups, if study groups were small.) In short, failure to correct for the presence of a symbolic event could result in confounding the effect of that event with the effect of the biochemical processes under study by the investigator. To accomplish the necessary correction, the biomedical researcher may need to learn more about meaningful events in the patient's life and culture.

The opportunity for the researcher is to use the dip/peak effect as a unique research site for studying the intersection between cultural, psychological, and biological processes. In general, it is easiest to clarify the relationship between processes if they change markedly over a short time period. This fortunate state of affairs occurs during. the period spanning a symbolic event. By studying mortality during this brief time, the investigator can seize an unusually good opportunity for understanding the very subtle relationships between culture, emotions, and health.

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letters August 8, 1990—Vol 264, No. 6

I read the article with great interest. I was born and raised in China, and I personally witnessed the postponement of death by family members and the sick alike. Family members may seek the postponement for certain occasions, eg, festivals or to avoid the unlucky dates of the lunar calendar. In the lunar calendar, some dates are considered to be black, or unlucky. The sick prefer not to die on those days, believing that they will suffer a worse life after death.

The other cause of postponement of death is that the dying person wants to see the fulfillment of a wish; he or she may long eagerly for a special beloved one to come home to say goodbye and take care of the burial ceremony. As soon as the beloved one arrives and utters some kind words, the sick person will die. Perhaps Phillips and Smith should try to document the postponement of death in rural China, not urban China, and not in San Diego, Calif. Rural China preserves the old traditions and superstitions, which would facilitate research.

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In Reply.—We appreciate Dr Man's providing evidence that supports our statistical findings on the postponement of death. These insights into Chinese cultural practices should prove valuable in generating additional lines of research. We should perhaps note one small inaccuracy in Dr Man's letter; we did not in fact restrict our computerized data set to San Diego Chinese but examined all deaths among Chinese throughout California from 1960 through 1984. We agree with Dr Man that a study of rural China would have been preferable, but computerized data on this area are not available, as far as we know.

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