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Birthday and date of death

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SUMMARY The relation between birthday and date of death has so far been studied from two different perspectives: birthdays were either conceived of as emotionally invested deadlines motivating people to ward off their death which causes a 'dip' in death rates before their birthday, or they were considered as stressful events leading to an increase of mortality on or after their birthday. Using a collection of biographies of famous people from the whole world and another of well-known Swiss citizens we tested hypotheses derived from these assumptions. Neither the 'death-dip' hypothesis nor the 'birthday stress' hypothesis was supported by our results.

Plato was alleged to have been born and to have died on the same date. This is also said to have happened to Buddha.[1] Recently one could read in the newspapers that James Hubert ('Eubie') Blake, a well known American ragtime pianist, had died just five days after his 100th birthday. Besides this anecdotal evidence, results of a few empirical studies suggest that there may be a relation between birthday and time of death.[2]

The literature offers two different perspectives on how birthdays may influence the date of death. Starting with Emile Durkheim's premise that there is a relation between the degree of integration of an individual in his society and the obligation that he/she feels to participate in the ceremonies of that society, Phillips and Feldman[2] suggested that persons who are highly integrated in their society might well postpone their death in order to participate in social occasions. Their close involvement would cause them to die 'postmaturely'. The result would be a fall in death rate before important occasions and, depending on the way in which death was postponed, a rise in death rate immediately afterwards. Birthdays were among the occasions taken into consideration by the authors. They investigated only the deaths of famous people on the grounds that the famous seemed more likely than ordinary people to postpone their dying on this account. 'A famous person's birthday is often publicly celebrated, and he may receive many gifts, much attention, and other tokens of respect. In contrast, an ordinary person receives much less attention on his birthday and may have less reason to look forward to it' (p. 679).

Phillips and Feldman analysed the data from several different samples of famous people, for example, those listed in *Four Hundred Notable Americans* and others named in three American editions of *Who's Who* with surnames also listed in *Foremost Families of the USA*. Phillips and Feldman's findings seemed to support their hypothesis that death occurred less frequently immediately before a birthday. They also observed a rise in death rate during the month of birth and the three following months. There was also a positive relation between the degree of celebrity and the size of reduction and subsequent increase in death rate.

In contrast to Phillips and Feldman's reasoning, Kunz and Summers[3] argued that if birthdays are important to notables because of public celebration, the occasion may also be important to non public persons who perceive the birthday as an important event. The imminent birthday may represent a goal providing the motivation to ward off death for a time, the birthday exercising a kind of pull. But having reached the objective, the pull subsides and death may supervene. Thus, any person who is well integrated into society would be less likely to experience death before his/her birthday. In order to test this hypothesis Kunz and Summers examined all obituaries printed in a Salt Lake City daily newspaper on randomly selected days during the course of one year. Their data indicate a very strong relation between birthday and time of death with only 8% dying in the quarter preceding their birthday while nearly half of them died in the first three months following it. This finding held good no matter whether death occurred after long illness or by accident. On the other hand, casualties during the Korean and Vietnam wars and homicides in the State of Michigan during the course of one year did not follow this pattern.

So far, birthday has been conceived of as an 'emotionally invested deadline'[4] that people want to keep to. But for some persons birthdays may have a different meaning. For them, birthdays may rather serve as markers and reminders of the relentless passage of time. For this reason birthdays may also represent significant, stressful events, and in some subtle way this may influence the general morale of some individuals, impairing their resistance to fatal disease. This 'birthday stress'[5] could, one might argue, cause an increase of mortality on or after birthdays (in contrast to the 'death dip' before birthdays hypothesised above).

So far, two studies have investigated the relation between birthday and date of death from this perspective. Both were based on mortality statistics for the general population. Alderson analysed the mortality figures for England and Wales for 1972. For persons aged 75 years and over he found a consistent tendency for deaths to occur more frequently in the month of birth and in the following three months. There was no suggestion of an excess of deaths during this period at younger ages.[5]

The role of 'birthday blues' in relation to the date of death of the elderly was also demonstrated by Barraclough and Shepherd.[6] This study was based on data on self-inflicted deaths from Portsmouth and West Sussex. For persons aged 75 years or more an excess of deaths could be observed in the 30 days before and after their birthday. There was no significant deviation from the expected number of deaths within the same time span in persons of age 74 or under.

Unfortunately, due to methodological limitations it is not easy to interpret the results of these studies. Some authors[2 5] have examined the relation between month and not day of death and birth. In so doing, they allowed a considerable amount of inaccuracy to creep in. Another factor which usually had been disregarded is the seasonal variation in death rates and birth rates which, as we shall be able to show, biases results in favour of the authors' hypotheses, as births are distributed differently from deaths with a peak several months earlier. Lastly, most samples used by other researchers were relatively small, making statistical analysis very liable to chance variation. Closer inspection of the data given by Phillips and Feldman raises doubts as to whether the 'death dip' phenomenon is really so clearly marked in the USA and England as they claim. We were unable in four of the five samples used by these authors to confirm statistically that a fall in death rate before birthday actually occurred. Furthermore, in a re-analysis of Alderson's data taking into account the relation between age and death rate Roger[7] was unable to confirm the findings presented in the original paper.

In view of the important theoretical implications we found it worthwhile to perform a new study while trying to avoid the methodological pitfalls just mentioned. From the literature reviewed above the following two hypotheses could be derived:

H_1: People postpone their death to witness their birthday, causing a 'death dip' before birthdays (and a corresponding 'death rise' after birthdays).

H_2: Due to 'birthday stress' the number of deaths increases after birthdays without a preceding decrease of deaths.

Since we were primarily interested in testing the first hypothesis we selected two samples of celebrities of varying degree following Phillip and Feldman's reasoning that among these people the 'death dip' phenomenon should be more pronounced than among ordinary people. Ideally, we also should have studied a sample of the latter. Unfortunately, this was not possible since, for reasons of confidentiality, mortality data providing the exact date of birth are not available in this country.

Method

Two sources of information were at our disposal:
(1) *Die Grossen* ('The Great'), four volumes edited by Fassmann[8] include biographical notes of 2580 famous persons from all epochs from all parts of the world. Of these, 40·8% are from Central Europe (Germany, Austria, Switzerland) which is, therefore, clearly overrepresented; 15·4% are from France, 11·8% from Great Britain, 20·9% from the remaining parts of Europe, 8·2% from North America, and 2·8% from other continents. With regard to the different epochs the selection is also biased: 41·2% of all persons included died during the 20th century, 33·3% during the 19th century, 11·1% during the 18th century, and 14·5% during earlier epochs. With 52·5% of the total, scientists are the best represented group (natural sciences 31·0%, humanities 17·4%). The second largest group consists of artists (28·9%), and the third largest of politicians and military persons (15·7%). The people listed are almost exclusively men (96·9%) and the median age at death is 70 years.
(2) While our first source includes famous people from all over the world, our second source is limited to one single country, Switzerland. The *Biographisches Lexikon verstorbener Schweizer* ('Swiss Biographical Encyclopedia'), eight volumes edited by the Schweizerische Industriebibliothek[9] include biographical notes of 2265 deceased citizens 'who should thus have a lasting memorial in a work of biography which demands serious attention'. Here, too, 98·5% of all persons included are men, and the median age at death is 72 years; 51·8% are scientists

(natural sciences 19·6%, humanities 18·3%, economics 13·3%), 26·0% entrepreneurs, 8·2% artists, and 8·0% politicians and military persons. All persons died during this century, 88·1% after 1940.

These two selections of famous people are based on different definitions of fame. This is clearly shown by the fact that both works have roughly the same number of entries, although the first draws its subjects not only from all over the world but also from past epochs, whereas the second deals only with people from Switzerland, most of whom died in the second half of this century. *Die Grossen* include only people of international or national importance, whereas the Swiss Biographical Encyclopedia deals also with people of regional or local importance.

The time-span in days between day of death and last birthday was determined after converting the dates to correspond with the Julian calendar. For persons living before 1582 we took the difference between Julian and Gregorian calendars into account. In order to obtain large enough groups we collapsed the time-spans into two-week intervals. As the year does not consist of a full number of weeks the −13th and +13th intervals encompass a slightly larger number of days (3·5%, and 7% in leap-years). When death occurred on the birthday itself, and this was on an even date, we allocated the case to the interval preceding the birthday; when this occurred on an odd date we allocated it to the period directly following the birthday.

To test our hypotheses we performed the procedure described by Phillips and Feldman modified for 26 time intervals (each of two weeks' duration). The following statistics were used to measure the 'death dip' (D) before a birthday:

$$D=(O_a-E_a)/N \text{ with } O_a=\sum_{i=-3}^{-2} N_i;\ E_a=2/26\cdot N$$

where O_a is the observed number of deaths during the time interval between and including the 6th and 3rd weeks before a birthday; E_a is the expected number of deaths for the same time interval, and N is the total number of deaths.

Somewhat analogous statistics were used to measure the 'death peak' (R) after a birthday:

$$R=(O_b-E_b)/N' \text{ with } O_b=\sum_{i=-1}^{-7} N_i;\ E_b=8/24\cdot N'$$

where O_b is the observed number of deaths during the two time intervals including birthday and the following six two-week intervals; E_b is the expected number of deaths during the same time period, and N' is the total number of deaths minus those who died during the two weeks before and after a birthday. On the basis of the confidence limits for a Poisson distribution we can give levels of significance for the above indices.

It should be noted that Phillips and Feldman used a particular—and, in our opinion, rather arbitrary—model for the distribution of deaths as a theoretical basis for these indices. Directly before the birthday there is a short sharp dip, then comes a more gradual and more prolonged rise in numbers of deaths. Other distribution models are, however, conceivable. The distribution of deaths could be perfectly symmetrical, and a sine or cubic function could provide a rough approximation to it. Or the fall and rise in deaths could have different gradients. In both these models, however, the mean value for the time before the birthday is different from that for the time after it, and in both periodicity can be shown. In addition to using Phillips and Feldman's indices, we therefore carried out *t* tests whereby we compared six pre-birthday intervals or 12, respectively, with the same number of post-birthday intervals. The results of this test, however, should be interpreted with caution since its use cannot be fully justified as the numbers of events in each category are not independent of one another.

We then tried to detect periodicity and the impact of preceding intervals on the number of events using a correlogram of the coefficient of serial correlation.[11] All models have in common that when the 'death dip' or 'death rise' is statistically significant, the number of deaths must show an uneven distribution. This we determined by means of the χ^2 goodness of fit test. Finally, in order to represent the distribution of deaths by a smooth curve, we fitted a polynomial of the order 0 to 5 by the least squares method. To test the birthday stress hypothesis—'death rise' after a birthday without a preceding 'death dip'—we carried out a *t* test comparing the six post-birthday intervals with all other intervals combined.

As we studied the distribution of deaths we very soon discovered seasonal variations in the occurrence of birthdays as well as of deaths.

Therefore, subsamples with either evenly distributed birthdays or evenly distributed dates of death were drawn using a random number generator.[12] Both subsamples were then analysed in the same manner as the original sample.

Results

Using data from *Die Grossen* we were unable to confirm Phillip and Feldman's findings of a 'death dip' in the month before and of a 'death rise' in the three months directly after a birthday (table). Examination of the indices derived in the way suggested by these authors showed no significant deviations. We also compared the mean number of deaths in the three pre-birthday months with that of three post-birthday

Distribution of deaths over time in relation to birthday

Time intervals (14 days) before (−) and after (+) birthday	*Die Grossen*									*Swiss Biographical Encyclopaedia*		
	Total			*Central Europe*			*≤ 65 years old*			*Total*		
	I	II	III	I	II	III	I	II	III	I	II	III
−13	96	77	77	32	22	21	43	26	29	79	72	71
−12	101	79	72	44	31	33	45	22	21	80	63	60
−11	103	93	91	45	33	37	31	25	23	87	71	67
−10	83	66	70	34	23	23	31	23	18	76	68	67
− 9	79	68	70	38	29	25	23	14	12	94	82	82
− 8	112	90	94	38	32	29	38	27	31	83	71	72
− 7	98	78	79	33	25	23	37	25	26	85	73	73
− 6	103	88	88	49	35	35	41	27	30	99	84	87
− 5	98	77	82	39	29	33	39	25	23	84	72	76
− 4	110	102	97	45	40	37	34	27	24	77	70	68
− 3	96	80	78	37	27	29	37	25	23	89	81	81
− 2	103	90	82	33	26	26	33	25	23	87	72	76
− 1	95	86	85	37	29	30	34	25	26	87	73	73
+ 1	114	81	88	53	31	39	43	20	21	87	80	78
+ 2	94	77	76	40	30	29	38	20	22	91	80	80
+ 3	85	71	69	39	28	31	38	24	23	90	79	73
+ 4	102	84	83	47	37	35	44	23	23	79	73	72
+ 5	121	101	98	40	31	29	45	32	32	88	79	76
+ 6	105	84	85	48	34	33	47	31	31	79	69	76
+ 7	97	83	82	33	23	22	45	31	31	91	79	81
+ 8	100	73	82	35	26	23	51	28	35	91	76	78
+ 9	100	83	88	37	31	31	42	29	30	90	78	71
+10	94	80	76	39	27	30	35	26	23	101	92	89
+11	89	77	78	37	29	27	35	21	24	87	72	78
+12	102	83	83	50	37	38	36	26	28	76	59	59
+13	100	77	76	43	32	31	35	23	18	108	93	89
Death dip (D)[1]	0·007	0·010	0·005	−0·004	−0·003	0·001	−0·001	0·006	−0·001	0·006	0·008	0·010
Death rise (R)[1]	0·010	0·007	0·07	0·020	0·006	0·016	0·029	0·007	0·014	0·002	0·005	0·005
χ^2 goodness of fit test	21·65	22·68	18·61	21·15	16·78	22·32	23·42	14·59	24·57	12·27	15·40	16·53
t_1 (H_0: $\bar{x}$ (−6, −1) = $\bar{x}$ (1,6)[2]	−0·46	0·76	0·44	−1·35	−0·32	−0·43	−3·07*	0·30	−0·22	0·41	−0·45	0·34
t_2 (H_0: $\bar{x}$ (−12, −1) = $\bar{x}$ (1,12)	−0·46	0·45	0·00	−0·91	−0·23	−0·28	−2·87*	−1·08	−1·79	−0·14	−0·27	−0·22
t_3(H_0: $\bar{x}$ (−12, −1/7,12) = $\bar{x}$(1,6)	−1·33	−0·31	−0·37	−2·32*	−1·30	−1·54	−1·93*	0·06	−0·03	0·26	−0·80	−0·50
Lag where coefficient of serial correlation exceeds 2σ-limit	14	—	—	13	—	18	15/20	16	16/17	—	—	—
Order of polynome accounting for the largest percentage of variance	2	2	2	5	3	3	3	3	3	1	1	1
F[3]	1·05	1·76	2·26	1·43	1·82	1·12	13·39*	2·18	3·86	3·68	2·71	3·01

I raw data; II adjusted for seasonal variation in births; III adjusted for seasonal variation in deaths
1 Modified formula of Phillips & Feldman (see text) [2] Reads: *t* test for null hypothesis that mean for 6 intervals before birthday equals mean for 6 intervals after birthday [3] Test variable for polynome fit (significance for polynome F 4·28) *Exceeds 5% significance

months (somewhat similar to Kunz and Summer's approach) but also failed to find a significant rise in deaths after birthdays. A negative result was obtained when we compared the total time before with the total time after a birthday. After adjustment for seasonal variation in births and deaths, the coefficient of serial correlation failed to reach the 2 σ-limit. We had no success in our attempt to represent the distribution of deaths as a smooth curve using polynomial fitting. Finally, comparing the six post-birthday intervals with the rest of the year, there was no significant increase in the number of deaths observed during this time period.

In a second step we analysed various subgroups of *Die Grossen*. On the whole, this yielded the same negative results. Neither for those dying after 1900, nor for those from Central European countries (Germany, Austria, and Switzerland), nor for the particularly famous did we find a significant relation between birthday and date of death. The last group was made up of those who had a whole chapter devoted to them in the encyclopaedia, whereas the less famous were dealt with in a few lines. Stratification by age also did not reveal any statistically significant findings after adjustment for seasonal variation in the distribution of births and deaths. (As an example of how the control for these effects can influence the results data for the under 65 year olds are presented in table.)

We now turn to the 'Swiss Biographical Encyclopaedia' which is based on a broader definition of fame than *Die Grossen*. The results are, however, similar as here, too, we failed to detect Phillips and Feldman's mortality pattern and, on the whole, obtained no statistically significant results using the other statistical methods mentioned above (table). It was only when we again examined the under 65s that, even after adjustment for seasonal variations of birthdays or dates of deaths, a significant increase of deaths during the 12 intervals after the birthday could be observed. However, this finding merits only a very cautious mention since in view of the multitude of statistical tests carried out for the various subgroups, an occasional significant result is not unexpected.

Discussion

Summarising our results, we have to state that we could not find a marked 'death dip' before birthdays with a corresponding 'death rise' after birthdays, as proposed and demonstrated empirically by Phillips and Feldman. An exclusive rise in the number of deaths immediately after a birthday without a preceding 'death dip', as proposed by the birthday stress hypothesis, also was not observed.

In the face of 'negative' results like ours one always has to think of the risk of type II errors, ie, that due to insufficient power of the statistical tests the a priori probability of obtaining significance was very small.[13] However, both our samples were considerably larger than those used in other studies (except Alderson's analysis of mortality statistics) and the number of cases did allow us to register effect sizes larger than 0·20 (for calculation, see Appendix). Therefore, we are quite certain that no medium or larger deviations from expected values existed in the populations from which our samples were drawn.

Another point to discuss is the composition of our samples. As mentioned in the introductory part of this paper, the essential idea behind the 'death dip' hypothesis, as proposed by Phillips and Feldman, is that people are committed to and controlled by social conventions—to the point of postponing their own deaths. It is important to note here that both our samples contained a high proportion of scientists (52·2% and 51·8%, respectively), that is, people presumably oriented to universalistic values and long-term goals. At least one question that remains open is whether these people are as committed to social conventions and conventional ceremonies as other people might be. As stated in the introductory section, both our samples were biased against the birthday stress hypothesis if one assumes that for ordinary people birthdays would more likely be negative events than for notable persons. A fairer test might have been to study a sample drawn from the general population—which, for reasons already mentioned, we were unable to do.

An important limitation of our study is that we could not differentiate between the various causes of death. For example, it was not possible to discriminate between natural deaths and self-inflicted deaths. It would also have been interesting to analyse separately deaths caused by acute diseases and those caused by attenuated diseases. The conclusion we reach from the analysis of our data is that a real relation between birthday and date of death does not seem to exist. A re-analysis of the data used by other researchers relying on our methods seems to be advisable and would give us a clearer perspective on this issue.

References

1 Geis G. Birthdays and time of death: A footnote. *Omega* 1982–83; **13:** 91–3.
2 Phillips DP, Feldman KA. A dip in deaths before ceremonial occasions: Some new relationships between social integration and mortality. *Am Sociol Rev* 1973; **38:** 678–96.
3 Kunz PR, Summers J. A time to die: A study of the relationship of birthdays and time of death. *Omega* 1979–80; **10:** 281–9.
4 Fischer HK, Barney MD. Psychogenic determination of time of illness or death by anniversary reactions and emotional deadlines. *Psychosomatics* 1972; **13:** 170–3.
5 Alderson M. Relationship between month of birth and month of death in the elderly. *Br J Prev Soc Med* 1975; **29:** 151–6.
6 Barraclough BM, Shepherd DM. 'Birthday blues': The association of birthday with self-inflicted death in the elderly. *Acta Psychiatr Scand* 1976; **54:** 146–9.
7 Roger JH. An explanation for the observed increase in mortality after a birthday in people over 75 years old. *Br J Prev Soc Med* 1977; **31:** 62–5.
8 Fassmann G (ed). *Die Grossen*. Stuttgart: Coron, 1979.
9 Schweizerische Industrie-Bibliothek. *Biographisches Lexikon verstorbener Schweizer*. In memoriam. Basel, 1947–82.
10 Ciba-Geigy AG. *Wissenschaftliche Tabellen*. Basel, 1980.
11 Box GEP, Jenkins GM. *Time series analysis: Forecasting and control*. San Francisco: Holden Day, 1970.
12 SPSS. *User's guide*. New York: McGraw-Hill, 1983.
13 Cohen J. *Statistical power analysis for the behavioral sciences*. New York: Academic Press, 1977.

Appendix

Estimation of the number of cases needed in order to confirm a 'dip' or a 'peak' in the distribution of deaths

1. The deaths in a time interval before or after a birthday are considered to follow a Poisson distribution. In order to be able to observe an effect in such an interval, that is, a number of deaths higher or lower than average, the observed number of deaths must lie beyond the confidence limits. These are determined by

$$\sum_{x}^{\infty} \frac{e^{-\lambda_1} \cdot \lambda_1^k}{k!} = \alpha \text{ or } \sum_{0}^{x} \frac{e^{-\lambda_\gamma} \cdot \lambda_\gamma^k}{k!} = \alpha \text{ .}$$

The following table shows how large an effect is when the observed number just exceeds the confidence limits.

n	p(α=0·01)	p(α=0·05)
50	35%	28%
75	27	24
100	24	20
150	20	17
200	18	14
250	16	12
500	12	9

n is the number of cases in one interval and p is the size of the effect that is just acceptable (expressed as percentage).

Since in our samples the number of cases per interval ranged from 20 to 100, effect sizes of *ca.* 30% should be detected.

2. A significant effect ('dip' or 'peak') is shown by the fact that the numbers of deaths before and after a birthday are unevenly distributed. The distribution can be judged even using the χ^2 goodness of fit test. The number of cases N necessary to demonstrate a deviation p (size of effect) in m intervals is given by the formula

$$\sum_{1}^{m} \frac{(Oi-Ei)^2}{Ei} \rightarrow \chi^2_{\upsilon} \quad (\upsilon=m-1).$$

The numbers of cases needed with 26 intervals are given in the following table:

p% \ m	2	4	6	10	15	20
10	29900	16250	11700	8060	6240	5330
20	7480	4070	2925	2015	1560	1330
30	3325	1810	1300	895	695	590
40	1870	1015	700	500	390	330

Assuming the duration of 'death dip' and 'death rise' of three intervals each, effect sizes of 20% should be detected in our study given the number of cases.

The table is based on the following calculations: With 26 intervals, the test variable must be greater than 47 (α=0·005). With an even distribution and normally distributed variation the following formula holds good

$$\frac{(Oi-Ei)^2}{Ei} \approx 1 \ .$$

And from this is derived

$$\sum_{1}^{m} \frac{(Oi-Ei)^2}{Ei} = (m-m^+) + \sum_{1}^{m^+} \frac{(Oj-Ej)^2}{Ej} \geqq \chi^2 = 47$$

where m^+ is the number of significantly deviating intervals, m the number of intervals, and N the total number of cases. For the deviating intervals

$$O_j = (1-p)\cdot E_j \text{with } E_j - E = \frac{N}{m}$$

and

$$\sum_{1}^{m^+} \frac{(Oj-E)^2}{E} = m^+ \cdot p^2 \cdot \frac{N}{m} \geqq \chi^2 - m + m^+$$

The number of cases necessary is, therefore,

$$N \geqq \frac{(\chi^2 - m + m^+)\cdot m}{m^+ \cdot p}$$