Title	Happy birthday? An observational study
Authors(s)	Kelly, Gabrielle E., Kelleher, Cecily
Publication date	2018-09-27
Publication information	Kelly, Gabrielle E., and Cecily Kelleher. "Happy Birthday? An Observational Study." BMJ, September 27, 2018. https://doi.org/10.1136/jech-2018-210632.
Publisher	BMJ
Item record/more information	http://hdl.handle.net/10197/10557
Publisher's version (DOI)	10.1136/jech-2018-210632

Happy birthday? An observational study

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Word count:2872

1 Abstract

Background: Previous studies show contradictory findings on the relationship between birthday and deathday, in particular whether people postpone death until after their birthday. We examine the phenomenon in eight groups of famous people.

Methods: Birthday and deathday for the following groups were recorded: British Prime Ministers, U.S. presidents, Academy award best actor, best female actor, best director, Nobel prize winners, Wimbledon men's and ladies singles winners, all from when records began. For each group, the difference in days between the deathday and birthday was calculated. Under the hypothesis of no association one can expect the difference to have a uniform distribution. This is assessed using goodness-of-fit tests on a circle.

Results: All groups showed some departure from the uniform and it occurred around the birthday in all groups. British prime ministers, U.S. presidents, Academy award actors and directors, Nobel prize winners and Wimbledon men, show a 'dip' in deaths around the birthday. The length of the 'dip' varied between the groups and so they gave different p-values on different test statistics. For Academy award female actors and Wimbledon ladies there was rise in deaths before and after birthday. When Nobel prize winners were subdivided into their categories, Science and Literature had a 'dip' around the birthday, but not other categories.

Conclusions: We conclude 'something' happens to deathday around the birthday. Some groups of famous people show a 'dip' in death rate around the birthday while for others, particularly women, the association is in the opposite direction.

2 Introduction

Phillips[1] investigated how dying people react to one special event: their birthdays. He examined a number of anthologies of famous people and found a tendency to postpone death until after their birthday. There was a death dip before the birth month and a death rise thereafter in four separate samples. He examined the month of birth and month of death in *Four Hundred Notable Americans*[2]; three further samples were taken from American editions of *Who Was Who* for the years 1951-60, 1943-50 and 1897-1942[3] who also had their surnames listed in *The Foremost Families of the U.S.A*[4]. The members of the initial sample were further classified into 3 groups by fame and he found the more famous the group, the larger the death dip and death rise it produces. Phillips' explanation of the phenomenon was that a very famous person's birthday was celebrated publicly and they might receive a substantial amount of attention, gifts, and so on. Simon[5] studied the Phillips Phenomenon and found it to be real. However, he noted the means of identifying groups of people to whom it should apply remain unknown. Other authors investigated the related question as to whether death rates increase or decrease before, during or after symbolically important occasions such as holidays and ceremonial occasions including birthdays. The results of 18 such studies, since the early 1970's have been summarized, and it was reported that some studies but not others have found modest evidence of temporal effects[6]. One such study[7], examined over 2 million records of Swiss mortalities between 1969 and 2008. They concluded that for certain causes of death there was an "anniversary reaction" or "birthday blues" but not the death postponement hypothesis. However, of these 18 studies, only those of Zusne[8] and Angermeyer et al.[9] specifically examined famous people. Zusne found that whereas in men, the probability of death drops before the birthday and increases afterward, the opposite pattern occurs in women. Angermeyer et al. did not find a death dip or rise around the time of birthday and speculated this was because many of the people in their sample were scientists who might be less committed than other people to social conventions and ceremonies. A re-examination of Phillips' data[10] shows some aspects of his analysis to be questionable, including the lumping together of deaths that occur during the birthmonth, which does not distinguish deaths that occurred before the birthday from those that occurred afterward. They were unable to reproduce his results regarding a death 'dip' prior to the birthday. However, their analysis also involved a rather arbitrary grouping of days prior to and following the birthday. Therefore the question of an association between birthday and deathday in famous people has not been resolved. To investigate further, the birthdays and death days of famous people in different spheres of life are examined here. In all 8 groups are examined. These are British Prime Ministers, U.S. presidents, Wimbledon men's and ladies' singles winners, Academy award best actor, best female actor, best director and winners of the Nobel prize. Also, to investigate the conclusion of Angermeyer et al.[9] the Nobel prize winners are divided into their different categories and the phenomenon examined in each group separately.

3 Methods

The data, birth date and death date are readily available on the Worldwide Web. These were accessed on 1/9/2017. The Kolmogorov-Smirnov (K-S), Cramer-Von Mises (CVM) and Anderson-Darling (AD) are popular tests for testing whether a sample of n points come from a particular theoretical distribution. Here we count the number of days from last birthday to death (deathday – birthday). For simplicity of statistical analyses, it was assumed throughout that February has 28 days and a year has 365 days. Thus if the interval {last birthday, deathday} contains February 29, the difference may be out by 1 (if birthday or deathday fell on February 29 the difference is correct). The results presented in this paper will be only marginally affected by these modifications. We are interested in whether the difference is uniformly distributed. However, the difference in days is circular i.e. '0=365', so goodness-of-fit statistics need to be adapted for distributions on a circle.

These goodness-of-fit statistics depend heavily on the choice of reference point from which to measure difference. They give different results depending on whether differences are tested to come from, for example, a uniform distribution on [-182,182] or on [0,365]. Note also we are considering discrete distributions. We may convert the difference in days, deathday - birthday into angles. For a difference of t days this is $2\pi \times t/365$. So the differences are distributed on the unit circle, and the upper bound, 2π radians, and the lower bound, zero, are equivalent, as shown in Figure 1.

The analogues of the K-S statistic and CVM statistics for distributions on a circle are the Kuiper statistic and Watson statistic[11]. Freedman[12] adapted Watson's U_n^2 statistic for discrete distributions so it will be called the Watson-Freedman test. Both of these are invariant under rotations of the circle of differences. Several other statistics for testing uniformity on a circle have been proposed[11]. These include:

the Hodges-Ajne's test the intuition for which is: Regard the data as n points on a circle. Draw a line ℓ through the centre of the circle and count the number of points on each side of this line i.e. in the semicircle. By rotating the line ℓ about the centre, we find the minimum possible number of points on one side of this line=m. Small values of m will indicate a departure from uniformity;

Ajne's test, similar to the Hodges-Ajne's test, except instead of taking the minimum it takes the deviation of the number of points in each semicircle, generated by rotating the line ℓ through an angle θ, from n/2 and integrates over θ;

Rayleigh's test with intuition: This test assumes the mean direction μ and the concentration parameter κ differ from uniformity, where μ and κ are parameters of the von Mises probability density function (p.d.f.). This p.d.f. is symmetrical about μ. The mode is at μ. The point of minimum-the antimode - is at $\mu + \pi$. The greater the value of κ, the greater is the clustering around the mode. For our data we might envisage $\mu = \pi$ and thus an antimode at 0;

V' test[13] a modification of the Rayleigh test that can test for uniformity against an alternative with specified preferred direction a, and so increase its power. Our specified direction is 0 and we reject for large or small values of V';

Spacing tests[11] the first being the Range test that measures the length of the smallest arc which contains all the observations. Small values indicate clustering; the second is Rao's test in which the expected length of the distance between consecutive points on the circle is $2\pi/n$. Rao's test sums the deviations of these distances from $2\pi/n$.

Limited results are available on the optimum properties of these tests relevant to this study[11]. For alternatives where differences fall in an interval around 0 with probability p, and outside the interval with probability q, the Kuiper, Watson-Freedman and Ajne's tests are equally powerful. When the alternative is a von Mises population with small κ, the Watson-Freedman, Ajne and Rayleigh tests perform equally with Rao's test comparable to these for large κ.

4 Results

A graphical display of the results can be seen in Figure 2. The numbers falling into each group and results of the goodness-of-fit tests are shown in Table 1.

Statistic	British P.M.s (n=49)	U.S. presidents (n=34)	Actors (n=49)	Female actors (n=32)	Directors (n=39)	Nobel (n=583)	Wimb. Ladies (n=23)	Wimb. Men (n=34)
Kuiper	0.267	0.013	0.053	0.027	0.093	0.259	0.183	0.089
U^2_{WF}	0.111	0.025	0.016	0.084	0.055	0.120	0.231	0.235
Ajne	0.079	0.074	0.014	0.106	0.046	0.122	0.232	0.199
H-Ajne	0.326	0.033	0.041	0.069	0.197	0.146	0.107	0.083
Rayleigh	0.068	0.098	0.012	0.143	0.052	0.117	0.228	0.271
V′	0.029	0.148	0.307	0.414	0.022	0.024	0.047	0.118
Range	0.159	0.008	0.502	0.013	0.026	0.342	0.128	0.669
Rao	0.967	0.018	0.159	0.002	0.297	0.031	0.239	0.028

Table 1: P-values of eight test statistics applied to 8 groups. Numbers of deceased in each group since records began in parentheses.

Note: For the U.S. presidents the four who were assassinated were excluded.

The Watson-Freedman (U^2_{WF}), Ajne and Rayleigh tests gave similar results, with Kuiper not too dissimilar. From these we conclude the US Presidents, the actors, female actors and directors differ from uniformity with British p.m.'s borderline different.

The range test and Rao's test show some differences to these and also to each other. Every group gives a significant result on at least one test statistic.

For both the actors and directors the probability of a death drops before the birthday and increases afterwards. U.S. presidents showed the probability of a death drops before and increases quite some time after the birthday, as did the Wimbledon men, while for the British prime ministers this was also true to a lesser extent. The Nobel prize winners showed a short dip around the birthday. Female actors on the other hand showed an increased probability of death before and after the birthday, as did the Wimbledon ladies.

The disagreement of p-values varies across the groups and this can be partly attributed to some of the optimum properties of the test statistics that were noted in Section 3. These optimum properties are related to the length of the dip around the birthday.

The Nobel winners were subdivided into their categories: Science (Physics and Chemistry), Economics, Literature, Medicine and Peace and the numbers in each category are shown in Table 2. The data are shown in Figure 3.

The hypothesis of a uniform distribution of difference in birthday-deathday was then examined for each category and the results are displayed in Table 2.

Statistic	Science (n=237)	Economics (n=41)	Literature (n=95)	Medicine (n=148)	Peace (n=72)
Kuiper	0.082	0.880	0.620	1.000	0.762
U^2_{WF}	0.043	0.954	0.436	1.000	0.864
Ajne	0.052	0.894	0.378	0.978	0.828
H-Ajne	0.083	0.952	0.586	0.980	0.639
Rayleigh	0.049	0.934	0.348	0.992	0.912
V′	0.009	0.456	0.222	0.348	0.412
Range	0.962	0.913	0.051	0.918	0.022
Rao	0.918	0.379	0.060	0.556	0.010

Table 2: P-values of eight test statistics applied to Nobel prize categories. Numbers of deceased in each category since records began in brackets. Science comprises Physics and Chemistry.

Here Watson, Ajne and Rayleigh's tests are in agreement that only the Nobel Scientists differ from uniformity while Kuiper's test gives borderline significance. The range and Rao's tests pick out Literature and Peace prize winners as differing from uniformity. The Nobel chemists and physicists showed a similar pattern to each other in that there are fewer than expected deaths around the birthday. This was also true for a lesser extent for the Literature prize winners. Winners of the Peace prize did not depart from uniformity near the birthday.

It would be difficult to classify the groups examined here in order of fame. They are all famous in different spheres of life and are not comparable in this way.

One can say that for most groups, as the plots show- Figures 2 and 3, 'something' happens to deathday around the birthday. There can be many ways in which a distribution departs from the uniform. For some groups there was a sustained dip in deaths around the birthday, for others it was shorter, and again for others there was an increase in deaths around the birthday.

It was also investigated whether Benford’s law applied to these data. The paper is focusing on the period after the birthdate, so it may resemble Benford’s law for a second or third order digit. To this effect, days of survival after last birthday was plotted versus age at last birthday, but findings were negative.

The statistical packages SAS version 9.3 and R version 3.3.3 were used to analyze all data.

5 Discussion

The results show that the distribution of deathday-birthday is not uniform for specific groups of famous people. U.S. presidents, British prime ministers, Wimbledon men, Academy award winning actors and directors show a 'dip' in deaths before the birthday. For Academy award winning female actors and to a lesser extent, Wimbledon ladies, there was rise in deaths before and after birthday. When Nobel prize winners were further subdivided into their categories, the chemists and physicists showed a similar pattern to each other in that there were fewer than expected deaths near the birthday, also true for the Nobel Literature people.

Different test statistics give different results as the departure from uniformity varies over the groups. In those that exhibited a 'dip' at the birthday, the length and exact location of the 'dip' varied with the group. Optimum properties of the test statistics have been mainly concerned with testing uniformity against unimodal or multimodal distributions and there is no test statistic that is uniformly most powerful against all departures from uniformity. Although the use of different test statistics is not ideal, they do indicate different types of departure from uniformity.

This study is restricted to famous people and as such comparisons with many other studies on this topic are not appropriate. As noted above the birthdays of famous people may give rise to greater celebrations than the non-famous. However, it was not possible to establish if this was so and this will dilute the results of the study. In addition, for some people birthdays represent a psychologically stressful event, reminding them perhaps of impending mortality, or there may be anxiety associated with this milestone, and the excesses associated with its celebration are sometimes fatal. Again, it was not possible to establish this. No control group was used in this study but the large study of Adjacic-Gross et al. of Swiss people[7] showed an excess of deaths on the birthday indicating a relationship between birthday and deathday for non-famous people also, but not a death postponement. A limitation of the study is that some of the groups studied are relatively small as can be seen in Table's 1 and 2, and this may contribute to high p-values in some instances. This is compensated to some extent in that the phenomenon might be more pronounced in famous people and thus easier to detect effects, leading to lower p-values.

Unlike other studies, this study did not group days into arbitrary intervals but analyzed the exact difference between birthday and deathday. This has the advantage that any deviation from the hypothesis will be detected provided the deviation and sample size are large enough. In addition the circular from of the data is taken into account. A time series analysis with a pulse function at the birthday, as in Ajdacic-Gross et al.[7], who analyzed over 2 million Swiss records, could not be performed, because of small sample sizes. Our results do not differ from those of Phillips[1] that showed, when re-analysed[10], an unequal distribution of deathdays near the birthday. In relation to differences between men and women, our results agree with those of Zusne[8] in the case of Academy award female actors and to a lesser extent, Wimbledon ladies winners, in that there was a death rise near the birthday. These two groups are rather similar as can be seen in Figure 3. However, Zusne presented results only in graphical form and did not specify the method by which data points were aggregated. Our results do not agree with those of Angermeyer et al.[9] regarding scientists, but we note their analysis involved grouping of the days into somewhat arbitrary intervals, and thus some differences may be obscured.

In a related study[14], a peak in cardiac deaths was found among Chinese and Japanese Americans on the fourth of the month - an "unlucky" day in their cultures, consistent with the hypothesis that cardiac mortality increases on psychologically stressful occasions and could find no other explanation for the peak. However, questions still remain regarding positive or fatal psychosomatic processes and this is also true of deathday. A feasible study that would answer some of the questions raised above would be to identify terminally ill patients and ascertain the degree to which they welcomed/did not welcome their birthday and the extent of their desire to survive this event. This might then be correlated with the difference in days between birthday and deathday.

Finally we note, whilst the empirical data imply there is a connection between birthday and deathday and that there is some variability across cohorts and by gender, it must be speculative as to whether this is an inherently biological or a socio-cultural phenomenon or an interaction between these, in turn related to processes promoting longevity, including advantages of social position. All such accomplished people must have benefited from good fortune relative to others with similar capabilities. Politicians by definition must survive to middle age in order to attain power, whereas athletes must show potential in early youth and that level of fitness is protective for long-term health as demonstrated for instance by the Harvard Alumni study in the US[15]. Performers such as actors show variation in success according to age and sex, measured most obviously by birthdate. It has been shown previously that Hollywood Award winners of either sex have superior longevity to other performers[16]. Arguably the group most likely to be unaffected by social interactions are those exhibiting pure brainpower, the Nobel Laureates, and it had the most unimpressive p-values.

What is already known on this topic

Numerous studies that have explored the relation between birthday and deathday have reached mixed conclusions. Some studies have found a death 'dip' before the birthday consistent with postponement of death until after the birthday while other have found a death rise consistent with a 'birthday blues' hypothesis. A few studies have examined famous people in particular, for whom the phenomenon might be more pronounced and again findings differed. Questions have been raised regarding the methodology of these studies. Therefore we have examined 8 groups of people, famous in different spheres of life, and examined their relationship between birthday and deathday.

What this study adds

The birthday-deathday hypothesis has been examined for the first time using directional statistical methods. All of the groups of famous people showed that patterns of deathday changed around the birthday. For most of the groups there was a death dip prior to the birthday and a rise thereafter. However, for two of these, consisting entirely of women, the opposite was seen. Further research might focus on establishing how people viewed their birthday and establishing whether a psychophysiological mechanism enables people to postpone or hasten their own death.

Footnotes

Contributors: GEK designed the study, and conducted the data collection and management, analysis, interpretation of the data and preparation of the manuscript. CCK aided in the interpretation of data; in the writing of the report; and in the decision to submit the article for publication. GEK supervised the study and is the guarantor. The research conducted was independent of any involvement of sponsors. Both authors had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding: No funding.

Competing interest: None declared.

Ethical approval: Not required.

All data are publicly accessible, Data sharing: No additional

data available.

Transparency: The guarantor (GEK) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies are disclosed.

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Figure Legends.

Figure 1: Representation of differences deathday-birthday on a circle. Deathday=birthday is represented by the point at the right center. The π/2 point represents deathday three months after birthday.

Figure 2: Circle plot of (Deathday - Birthday) of 8 groups of famous people. The upper half of the circle represents deathday 'after' the birthday.

Figure 3: Circle plot of (Deathday - Birthday) of Nobel prize winners. The upper half of the circle represents deathday 'after' the birthday.

Figure 1

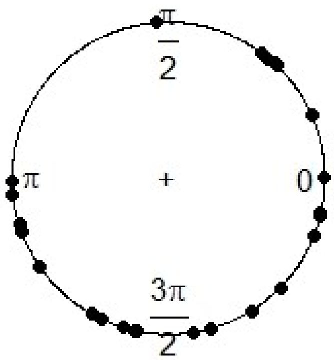

Figure 2

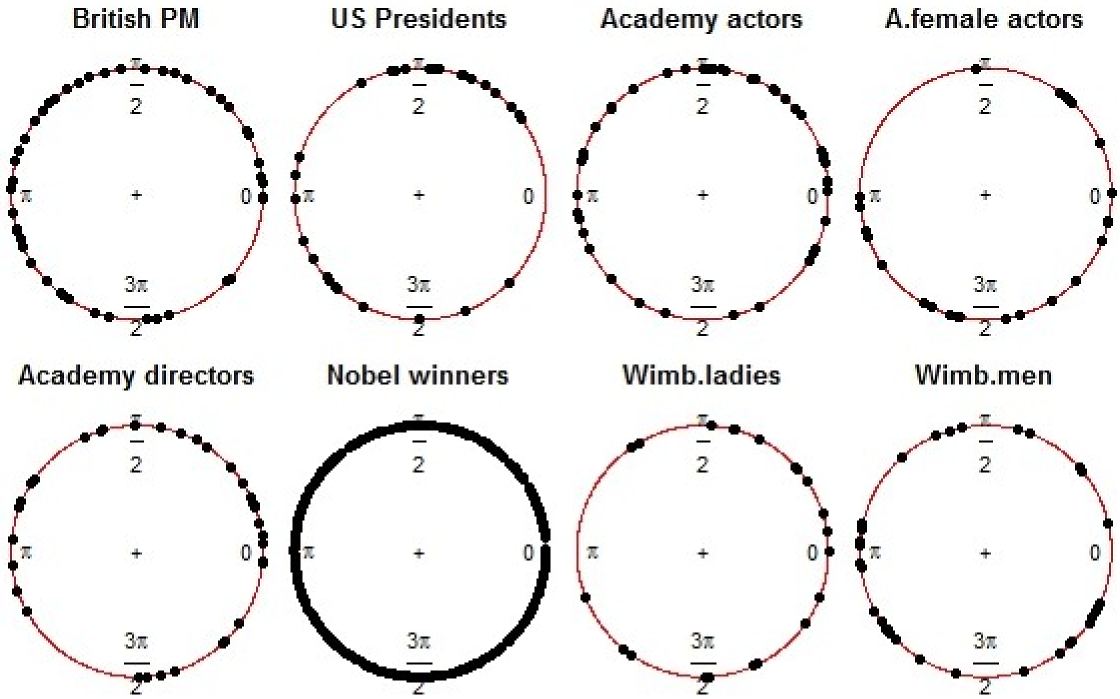

Figure 3