☑ Fact-Checked Science

PAPER CHECK · SPACE WEATHER AND HEALTH

Geomagnetic activity and deaths: the R = 0.72 reproduces, but it tracks falling death rates

A 2026 preprint on SSRN groups the years of each solar cycle and finds that average geomagnetic activity and the world's death rate correlate at R = 0.72, negatively early in the cycle and positively later [1 Abstract]. S0 News took it to show that storms first lower and then raise mortality [2 00:02:14–00:02:26]. Only the abstract could be read, so we rebuilt the calculation from public data: all three numbers reproduce, and a straight falling line grouped the same way scores almost as high, because death rates fell steadily after 1950 [3][5].

By Fact-Checked Science · Published October 25, 2026

OUR ANALYSIS marks our own reasoning and calculations, which here include the whole re-run, and the verdicts are our assessment. Of the preprint [1] we could read only the abstract: SSRN blocked our tools and showed our browser a bot check that we did not bypass, and the abstract deposited with Crossref is cut off mid-sentence. It is cited as Abstract, and the episode [2] by time in the video. Everything else about the preprint's numbers is our re-analysis of the public data in the numbered sources.

The number is right, but it mostly measures falling death rates

OUR ASSESSMENT

0.718

the preprint's R, rebuilt from public data: 12 averages drawn from 74 years of geomagnetic activity and world death rates, by our re-run [5][3]

0.69

the same calculation with a straight line falling 0.1 per 1,000 a year in place of the death rate, by our re-run

1 in 5

synthetic death rates with the world's own trend and year-to-year noise, but no solar signal, that reach 0.718 or more, by our re-run

THE CLAIMS

MISLEADING

Mortality tracks Ap, R = 0.72

The preprint: "Overall, for the 12-year average solar cycle, there is a strong positive correlation, with a correlation coefficient of 0.72." [1 Abstract]

The number is right: from GFZ's Ap index, the UN's death rates and SILSO's dates of solar minima, we get 0.718, over 12 averages [5][3] and [6]. But a straight falling line grouped the same way gives 0.69, and death rates with that trend and no solar signal reach 0.718 one time in five. With the trend removed, a weak 0.60 is left, which trend-free noise matches about 1 time in 12, by our re-run. See section 4.

UNSUPPORTED

Link flips with the cycle phase

The preprint: "However, the relationship between the Ap index and the mortality rate depends on the phase of the average solar cycle." [1 Abstract]

Its evidence, −0.84 for years 1–4 and 0.89 for years 5–12, reproduces, from 4 and 8 averages; −0.84 on four points isn't significant even by the textbook test (p = 0.16). A straight line gives −0.91 and 0.85, so any steadily falling series shows this flip, and ending the growth phase a year later turns −0.84 into −0.31. What lifts the 0.89 above the line is China's famine of 1959–61: without it, 0.70, by our re-run. See section 4.

MISLEADING

Linked again in science journals

The presenter: "mortality in solar storms get linked up here for about the 10th time in the science journals" [2 00:02:10]

Studies in journals have linked geomagnetic activity with deaths, with small and mixed results [8][9]. This item isn't one of them: it is a preprint on SSRN, not peer reviewed [1]. We can't check the episode's count. See section 5.

UNSUPPORTED

Storms cut deaths early in cycle

The presenter: "It shows that during the growth phase of the solar cycle, solar storms actually help drop mortality." [2 00:02:14]

The preprint reports a correlation across four averages, not an effect [1 Abstract]. A straight line reproduces it (−0.91), and the COVID-19 years, the first three of cycle 25, strengthen it: without them it is −0.63 (p = 0.37). Year by year, changes in Ap and in the death rate in these years show no clear relation (r = −0.19, 28 years, p = 0.35), by our re-run. See section 4.

OVERSTATED

Big storms raise deaths at peak

The presenter: "But once the sunspots are kicking, the big storms increase mortality significantly." [2 00:02:21]

Daily studies find slightly more deaths on days of high geomagnetic activity, a fraction of 1% per standard deviation [8], but we found nothing showing a large rise once the Sun is active. The preprint's 0.89 covers years 5–12, maximum through minimum, from yearly averages of Ap rather than storms, with no test of significance [1 Abstract]. A straight line gives 0.85 over the same 8 averages, and without China's famine of 1959–61, which coincided with the stormy peak of cycle 19, it is 0.70, by our re-run. See section 4.

UNCONFIRMED

Cosmic-ray peak at minimum worse

The presenter: "what the author may not know is the cosmic ray peak at sunspot minimum is actually even worse" [2 00:02:30]

The timing is right: cosmic rays reaching Earth peak near solar minimum [10 p. 1][7]. Two ecological studies tie them to deaths. In São Paulo, death rates were higher in solar-minimum years than in maximum years in many age and cause groups, from many separate tests, though simple correlations were not significant [10 pp. 2–3]; in Lithuania, monthly deaths correlated weakly with neutron counts (r = 0.234) [11 Abstract]. World death rates don't confirm it (r = −0.04 to −0.14, 67 years), by our re-run, and we found no study that weighs cosmic rays at minimum against storms at maximum, which "even worse" implies. See section 6.

1 · THE PREPRINT

A correlation of averages, posted on SSRN and not peer reviewed

Vladimir Belkin's preprint follows "a methodological approach based on the work of A. L. Chizhevsky": it numbers the years of each solar cycle, groups the years by number, and compares each group's average geomagnetic activity with its average world death rate over 1950–2023 [1 Abstract]. It was posted on SSRN in 2026, its record was deposited with Crossref on October 21, and it has not been peer reviewed [1].

What we could read: the abstract, and only the abstract

SSRN answered our tools with a block page, and our browser with a "Verify you are human" check that we did not try to pass; we found no other copy. The abstract deposited with Crossref is cut off mid-sentence, at "The projected global mortality rates are 8." [1 Abstract] So we can't see the preprint's tables, figures, caveats or forecast. Everything else about the preprint's numbers on this page is our own re-analysis of public data, marked OUR ANALYSIS.

In the preprint's words Sentences 4, 6 and 7 of its abstract, verbatim.

> *"Overall, for the 12-year average solar cycle, there is a strong positive correlation, with a correlation coefficient of 0.72."*
>
> Belkin (2026) [1 Abstract]

> *"For years 1-4 of the average solar cycle (the growth phase), there is a strong negative correlation, with a correlation coefficient of-0.84."*
>
> Belkin (2026) [1 Abstract]

> *"Following the solar magnetic polarity reversal, for years 5-12 of the average solar cycle, the relationship becomes a strong positive correlation, with a correlation coefficient of 0.89."*
>
> Belkin (2026) [1 Abstract]

The data it names

Geomagnetic activity is the Ap index, a daily measure of how much Earth's field is disturbed, which GFZ Potsdam compiles [5]; the abstract doesn't say whose series it used. Mortality is "the number of deaths per 1,000 people in the global population", the crude death rate, from "The latest available UN database", with estimates to 2023 [1 Abstract], which we take to be the UN's World Population Prospects 2024 [3], the data our re-run reproduces it with. The abstract claims correlations; it says nothing about storms causing deaths [1 Abstract].

Its author's other postings

The author's public ORCID record lists 40 postings on SSRN since 2020, this one included. Nearly all the others relate solar or geomagnetic activity to economic series, among them world GDP, the price of gold and the U.S. Federal Reserve's rate, some in both Russian and English versions. This is the only one on mortality [15].

2 · THE RE-RUN

Rebuilt from public data, all three numbers come out the same

We rebuilt the calculation from GFZ's Ap index, the UN's world death rates and the dates of solar minima from SILSO, the sunspot-number data center at the Royal Observatory of Belgium [5][3] and [6]. One way of numbering the years reproduces all three published coefficients to the second decimal.

STEP 1

Activity

Average GFZ's daily Ap index over each year from 1950 to 2023; every day is in the record [5].

STEP 2

Deaths

Take the UN's world crude death rate for the same 74 years [3].

STEP 3

Number the years

Count from the year after each solar minimum, using SILSO's dates: 1944, 1954, 1964, 1976, 1986, 1996, 2008 and 2019 [6]. So 1955 is year 1 of cycle 19, and 2020 year 1 of cycle 25.

STEP 4

Average and correlate

Average each year number's activity and death rate, and correlate the 12 averages: all of them, years 1–4 and years 5–12 [1 Abstract].

YEARS 1–12 OUR ANALYSIS

0.718

Pearson r across 12 averages of 74 years; the preprint gives 0.72 [1 Abstract]. Textbook p = 0.009.

YEARS 1–4 OUR ANALYSIS

−0.838

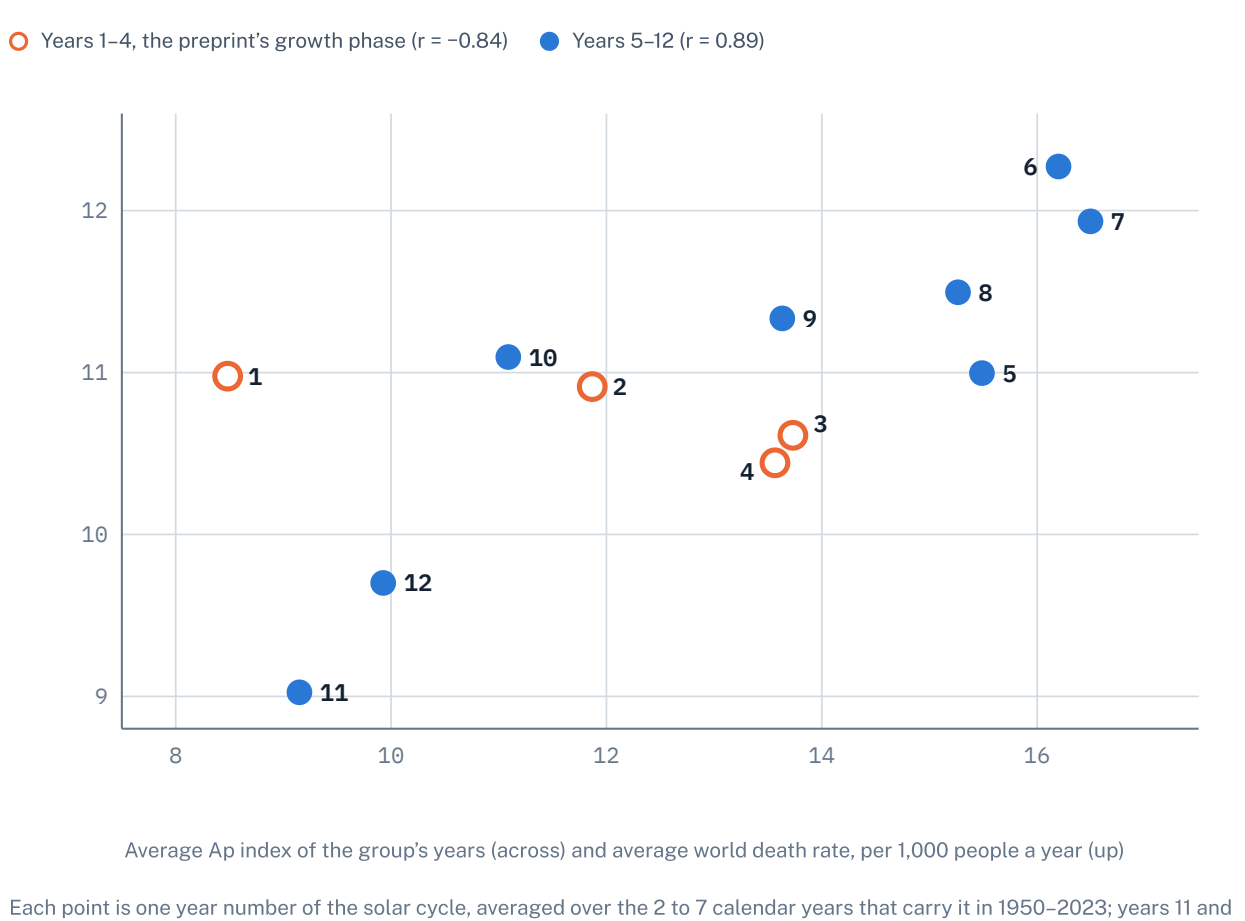
across 4 averages of 28 years; the preprint gives −0.84. Textbook p = 0.16, not significant.

YEARS 5–12 OUR ANALYSIS

0.889

across 8 averages of 46 years; the preprint gives 0.89. Textbook p = 0.003.

The 12 data points behind R = 0.72 OUR ANALYSIS



Each point is one year number of the solar cycle, averaged over the 2 to 7 calendar years that carry it in 1950–2023; years 11 and 12 hold only 3 and 2 years. Across all 12, r = 0.72. Our analysis of GFZ's Ap index (CC BY 4.0) and the UN's World Population Prospects 2024 (CC BY 3.0 IGO), with the years numbered from SILSO's dates of solar minima [5][3] and [6].

OUR ANALYSIS

Points, not years

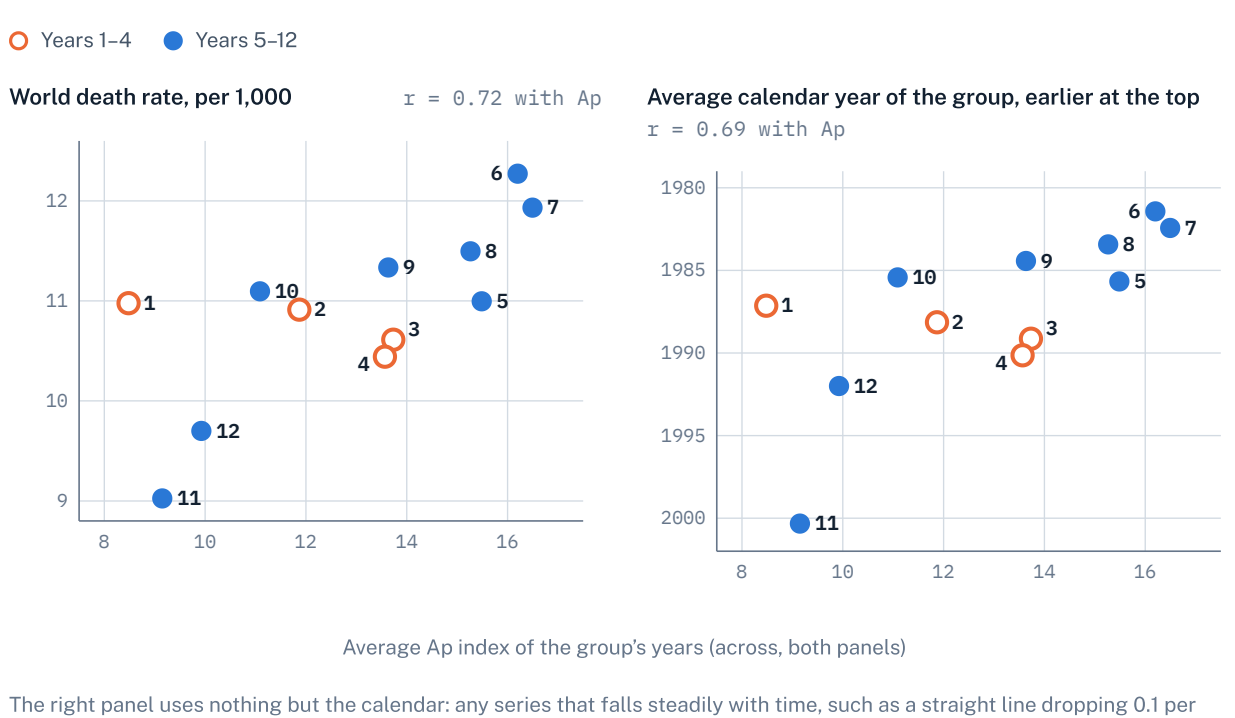
Each coefficient rests on averages, not on years: 12 points for 0.72, 4 for −0.84 and 8 for 0.89. The textbook test treats the points as independent. They aren't: every average is drawn from the same steadily falling series, as the next section shows, so even these p-values overstate the evidence. And −0.84 on four points could easily arise by chance (p = 0.16).

3 · WHY

A straight line gives almost the same answer

The world's death rate fell from 19.4 per 1,000 in 1950 to 7.5 in 2019 [3]. Group the years the preprint's way, and each group's average mostly records how early its years are.

The death rate and the calendar give the same pattern OUR ANALYSIS



The right panel uses nothing but the calendar: any series that falls steadily with time, such as a straight line dropping 0.1 per 1,000 a year, would score the same 0.69. Our analysis of GFZ's Ap index (CC BY 4.0) and the UN's World Population Prospects 2024 (CC BY 3.0 IGO), with the years numbered from SILSO's dates [5][3] and [6].

OUR ANALYSIS

How the groups line up

The record starts in 1950, which is year 6 of cycle 18. So groups 6 to 10 each get one of the early 1950s, when the world's death rate was 17.4–19.4 per 1,000, and groups 1 to 4 each get one of the years 2020–23, when it was below 9 [3]. Groups 11 and 12 hold only the five late years of the three longest cycles: 1975, 2007 and 2019; 1976 and 2008. The groups' average calendar years run from 1981 for group 6 to 2000 for group 11.

Geomagnetic activity peaks in groups 5 to 8 and is lowest in groups 1, 11 and 12 [5]. So the early, high-mortality groups are also the active ones, and the correlation across all 12 comes out at 0.72. Within the growth phase, each year 4 is three years later than its year 1, so the death rate is lower by the trend alone while Ap climbs out of the minimum: −0.84.

OUR ANALYSIS

Not aging

Is this an artifact of aging populations? No. An age-standardized death rate, which we computed from the UN's deaths and population by single year of age, gives 0.73, −0.85 and 0.89; life expectancy, read the other way up, gives 0.72, −0.84 and 0.88 [3]. Both improved steadily too. The decline comes from what the UN calls the shift "towards longer lives and smaller families, a process known as the 'demographic transition'" [4 p. 1]; age structure only changes how the crude rate shows it.

OUR ANALYSIS

What the trend leaves over: mostly a famine

The group averages sit furthest above the trend in groups 5, 6 and 7, by 0.12, 0.33 and 0.18 per 1,000. Those groups hold 1959, 1960 and 1961: China's death rate in the UN's estimates rose from 18.2 per 1,000 in 1958 to 29.8 in 1960, lifting the world's from 16.0 to 18.1 [3], during the famine that Ashton and colleagues date to 1958–61 [14]. They are years 5 to 7 of cycle 19, the strongest sunspot cycle on record [6], and 1960 has the highest yearly Ap of 1950–2023, 23.7 [5]. Without the three famine years, the 0.72 falls to 0.49 (12 averages of 71 years, p = 0.10).

4 · THE TESTS

Take out the trend and the shocks, and what is left is small and could be chance

We ran the checks a correlation like this needs: remove the trend, leave out shocks that have nothing to do with the Sun, compare the result with death rates that carry no solar signal, and look at the years one by one.

The same method, other choices OUR ANALYSIS

VARIANT	YEARS 1–12 (12 POINTS)	YEARS 1–4 (4)	YEARS 5–12 (8)
As published: death rate, 1950–2023	**0.72**	**−0.84**	**0.89**
A straight falling line in place of deaths	0.69	−0.91	0.85
Without the COVID-19 years, 2020–22	0.67	−0.63	0.89
Without the famine years, 1959–61	0.49	−0.84	0.70
Without both	0.43	−0.63	0.70
Age-standardized death rate	0.73	−0.85	0.89
Death rate minus its smooth trend	0.60	−0.47	0.77
The same, with the trend fitted without 1959–61 and 2020–22, which are left out	0.61	−0.59	0.75
Year-to-year changes in both Ap and the death rate	0.21	−0.18	0.42
The record starting in 1970	0.25	−0.72	0.19
Growth phase as years 1–5, the rest years 6–12 (5 and 7 averages)	–	−0.31	0.93

Our re-run [5][3] and [6]. The smooth trend is a fourth-degree polynomial; degrees 2 and 3 give the same to within 0.06. Year-to-year changes, 1951–2023, take the trend out too, but they lose power when the shared variation is slow, as an 11-year cycle is: "prewhitening and especially first-differencing decrease power in the common situations where low-frequency (slowly changing) processes are important sources of covariation" [13]. Their textbook p-values are 0.51, 0.82 and 0.30.

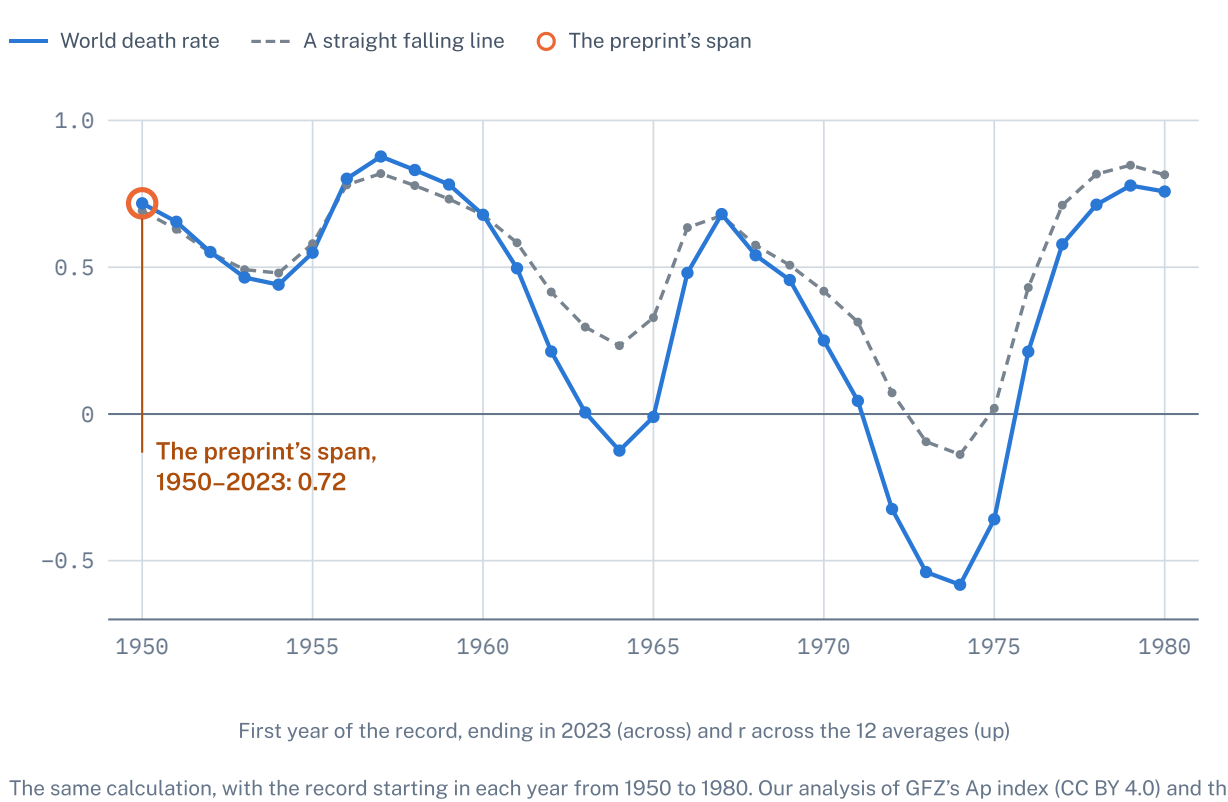
OUR ANALYSIS

What is left after the trend

With the trend removed, 0.60 remains, and 0.61 with the famine and COVID-19 years left out. It is small: without those years, the 12 averages of what is left span only 0.18 per 1,000, under 2% of the death rate. And noise like the death rate's own departures from its trend, with no trend and no solar signal, reaches 0.60 in 7–9% of runs, about 1 time in 12; it reaches the years 5–12 value, 0.75–0.77, in 6–9%, and the growth-phase −0.47 to −0.59 in 26–32% (20,000 runs in each of three versions).

The noise rarely gives all three at once, about 1 run in 300, but the growth-phase part of that pattern rests on single years: leaving out 1965 as well, the year-1 group's largest departure from the trend, turns −0.59 into +0.88. And even what is left is 4 to 14 times larger than the 263-city study's effects would produce (section 7).

Where the record starts decides the answer OUR ANALYSIS

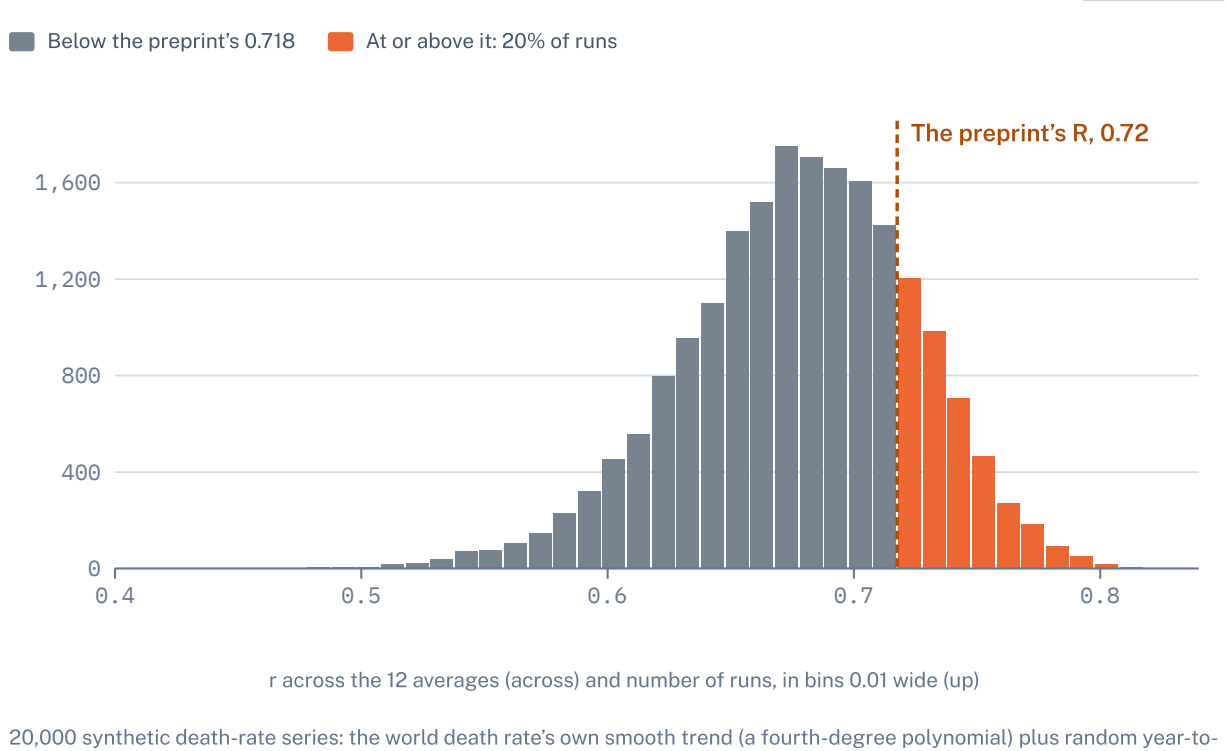


The same calculation, with the record starting in each year from 1950 to 1980. Our analysis of GFZ's Ap index (CC BY 4.0) and the UN's World Population Prospects 2024 (CC BY 3.0 IGO), with the years numbered from SILSO's dates [5][3] and [6].

OUR ANALYSIS

Starting the record in any year from 1950 to 1980 moves the preprint's R from −0.58 to +0.88, and its growth-phase value from −0.84 to +0.96, positive for 8 of the 31 start years. A straight line moves almost in step: across the 31 start years the two curves correlate at 0.985. The start year, not mortality, sets most of the number.

Death rates with no solar signal score about as high OUR ANALYSIS



20,000 synthetic death-rate series: the world death rate's own smooth trend (a fourth-degree polynomial) plus random year-to-year noise like its departures from that trend (lag-1 correlation 0.51, standard deviation 0.38 per 1,000), with the real Ap and the real numbering of the years. Our analysis [5][3] and [6].

20%

of these runs reach the preprint's 0.718 or more; 18–20% across our four versions, two of which resample the real departures, famine and pandemic included

0.68

their median: what the trend alone delivers

0.60–0.75

the middle 90% of these runs

OUR ANALYSIS

The same runs reach the growth-phase −0.84 more than half the time (58–62%), but the 0.89 for years 5–12 only about 1 time in 20 (4.6–5.6%), and all three values together about 1 time in 50 (1.8–2.2%). What lifts the 0.89 is China's famine in years 5–7: without it, 0.70, below the straight line's 0.85.

We also shuffled whole solar cycles, and shifted the solar record in time against the death rates, as tests of solar–terrestrial claims often do. Both rate even a straight line as unusual here (p = 0.007 and 0.05 for the line), because moving the cycles changes which years fall in each group, so they can't separate a link from the trend, and we don't use them as evidence.

Year by year

OUR ANALYSIS

No averaging, no clear link

Without any averaging, Ap and the death rate correlate at 0.47 over 74 years, largely because both were lower in recent decades [5][3]. Both series change slowly, which leaves about 15 independent points and p = 0.09 [13]. Against the death rate with its trend removed, r is about 0.2 (74 years, about 34–42 independent points, p ≈ 0.2), and 0.06 without the famine and COVID-19 years (68 years, p = 0.63). Year-to-year changes give 0.21 (73 years, p = 0.08), and −0.02 without the changes into and out of those years (65 years, p = 0.88).

The pandemic years

The UN's world death rate rose from 7.47 per 1,000 in 2019 to 8.06 in 2020 and 8.77 in 2021, then fell to 7.76 [3]. Life expectancy at birth "fell to 70.9 years, down from 72.6 in 2019" [4 p. 10], and the WHO estimates 14.83 million excess deaths in 2020–21 [12]. These are years 1 to 3 of cycle 25. The UN's latest estimates fold in WHO's excess deaths "through 2021", and complete registrations of deaths by age and sex were available "for 2023 for five countries covering one per cent of deaths" [4 p. 52].

5 · THE EPISODE

A preprint called a journal, and a correlation read as cause

S0 News gave the preprint 41 seconds [2 00:02:06–00:02:47]. Its four statements about it, beside what the preprint and our re-run show:

THE EPISODE	THE PREPRINT	OUR RE-RUN AND THE LITERATURE	VERDICT
"mortality in solar storms get linked up here for about the 10th time in the science journals" [2 00:02:10]	A preprint on SSRN, not peer reviewed [1]	Journal studies of geomagnetic activity and deaths exist, with small and mixed results [8][9]; this isn't one of them	MISLEADING
"It shows that during the growth phase of the solar cycle, solar storms actually help drop mortality." [2 00:02:14]	A correlation of −0.84 across four averages, with no claim of cause [1 Abstract]	A straight line gives −0.91; the COVID-19 years strengthen it; no clear relation year by year	UNSUPPORTED
"But once the sunspots are kicking, the big storms increase mortality significantly." [2 00:02:21]	0.89 across eight averages of years 5–12, from yearly averages of Ap; no significance test reported [1 Abstract]	Daily studies find slightly more deaths on stormy days, a fraction of 1% [8]; a straight line gives 0.85, and without the famine years 0.70	OVERSTATED
"what the author may not know is the cosmic ray peak at sunspot minimum is actually even worse" [2 00:02:30]	Nothing on cosmic rays [1 Abstract]	Cosmic rays do peak near minimum; two ecological studies tie them to deaths, and world death rates don't confirm it (section 6)	UNCONFIRMED

The presenter also calls the author "a statistician" [2 00:02:26]; his ORCID record lists him as a leading researcher at the Chelyabinsk branch of the Institute of Economics of the Ural Branch of the Russian Academy of Sciences from 1990 to 2019 [15]. Transcript wording is quoted as it appears, including "get linked".

6 · COSMIC RAYS

Cosmic rays do peak near solar minimum. World deaths don't.

When the Sun is quiet, more galactic cosmic rays reach Earth: "In solar maxima epochs … GCR penetration becomes lower in the Earth's atmosphere, and higher during solar minima" [10 p. 1]. The presenter is right about the timing. The question is whether it costs lives.

São Paulo, 1951–2012

An "ecological/populational retrospective study" compared yearly cosmic-ray ionization with the city's death rates [10 p. 1]. Simple correlations were not significant: "CRII and number of sunspots were not significantly correlated with mortality rates" [10 p. 2]. Regressions adjusted for age, sex and year, and t-tests of solar-minimum against solar-maximum years in many age and cause groups, found higher rates when cosmic rays were high [10 p. 3]. The authors warn that "another unpredicted agent could have exerted its effects on the observed outcomes" [10 p. 7].

Lithuania, 1989–2013

A study of 1,050,503 deaths in 300 months correlated monthly deaths of nine kinds with solar and geomagnetic indices and neutron-monitor counts: "The total deaths distribution was inversely related to SA (r=−0.31, p<0.0001) and correlated with CRA (neutron) activity (r=0.234, p<0.0001)". The authors concluded that "Most groups of deaths are related to space weather component activity" [11 Abstract]. It is one country, with many comparisons, in monthly series several of which trend over the years, as stroke deaths rose and heart-disease deaths fell [11 Abstract].

OUR ANALYSIS

The world's death rates against the cosmic-ray record

The Oulu Cosmic Ray Station publishes a yearly measure of how strongly the Sun shields Earth from cosmic rays, the modulation potential; its lowest values, meaning the most cosmic rays, fall in 2009 and 2018–21 [7]. With the trend and the famine and COVID-19 years taken out, its correlation with the world's death rate is −0.04 to −0.14 across our versions (67 years, p ≥ 0.28): the sign the presenter's idea predicts, but far too weak to tell from chance. Around the seven solar minima of 1950–2023, the age-standardized death rate ran slightly below its trend, not above it (−0.11 against +0.04 per 1,000; 21 years at and next to minima, against 53) [3].

With both shocks left in, the correlation is +0.10 to +0.18 (73 years), because the famine, at a cosmic-ray low (the modulation potential was 941 and 899 MV in 1959 and 1960, among the highest of the record), outweighs the pandemic, at the cosmic-ray peak of 2019–21. Leave in the pandemic years alone and it becomes −0.21 to −0.25 (70 years): a look that did so would credit cosmic rays with COVID-19's deaths.

Modulation potential: the reconstruction of Usoskin and colleagues, from neutron monitors around the world, as published by the Oulu Cosmic Ray Station of the Sodankylä Geophysical Observatory, University of Oulu, used with acknowledgement [7]. We don't chart it or the sunspot numbers, whose terms are non-commercial.

7 · THE WIDER EVIDENCE

Where effects have been measured, they are a fraction of 1%

A large study of storms and deaths, in 263 U.S. cities, found slightly more deaths on days of higher geomagnetic activity: per standard deviation of the Kp index, "a 0.13 and 0.31% increase in total deaths" in winter and fall, and up to 0.47% after allowing for air pollution [8].

OUR ANALYSIS

A scale check

Take that at face value. The preprint's quietest group, year 1, and its stormiest, year 7, differ by 0.74 standard deviations of daily Kp, by our count from GFZ's data [5]. At the 263-city rates, that is 0.10–0.35% more deaths. The two groups' average death rates differ by 8.7%, about 25 to 90 times that, even if every association in the 263-city study were causal [8]; the 12 averages span 36%. Even the gap left after the trend, 1.3% of the death rate between those two groups, is 4 to 14 times the 263-city effect.

An early test of the same idea

In 1975, a study of U.S. deaths from all causes, heart disease and stroke against the Ap index, daily for 1964–66 and monthly for 1964–71, concluded: "The data did not support previous assertions by Soviet researchers of an association between solar activity and cardiovascular mortality." [9]

On this site

Our check of a 2026 review of storms and the brain rated its claim that storms affect seizures, sleep, cognition and mood Overstated, and covers the 263-city study and a large study of strokes: Storms, auroras and the brain. Our check of a video's claim that solar cycles can be tied to crime, terrorism, wars, revolutions and the rise of populism rated it Unsupported: The Sun and wars, crime and revolutions.

8 · LIMITS

What this check can't tell us

The abstract only

We couldn't read the preprint's data, tables, figures, caveats or forecast, or how it describes its own method [1].

A numbering we inferred

Ours is the numbering that reproduces all three coefficients to the second decimal; another method matching all three would be a remarkable coincidence, but we can't confirm it [1 Abstract].

Modelled death rates

The UN's yearly world estimates are modelled for many countries and years, especially the latest: for 2023, complete registrations of deaths by age and sex covered 1% of deaths [4 p. 52], so the preprint's "precise mortality rate estimates" are largely modelled ones [1 Abstract]. Year-by-year tests on them can't detect small effects, for or against.

Yearly, worldwide averages

An effect lasting days, or confined to some places or causes of death, wouldn't show in yearly world totals; the preprint's method can't detect one either [8].

A proxy for cosmic rays

The modulation potential is a global index from the neutron-monitor network, not anyone's dose [7].

One preprint

We checked this preprint's method, not the whole literature on space weather and health; see our check of a 2026 review.

What would change these verdicts

01

The full text showing that the preprint removed the trend, or tested its correlations against a null that keeps the trend, and still found them clearly.

02

A link that survives removing the trend, in daily or monthly deaths across many countries, with the analysis fixed before the data are seen.

03

For cosmic rays, a study comparing deaths at solar minimum and maximum in many places that separates cosmic rays from season, weather and trend.

These follow the rules of our out-of-sample test of a solar–earthquake claim: freeze the method before scoring, test against a null that keeps the data's trends, and hold back data.

9 · READ IT YOURSELF

The script and the numbers

Every number on this page that is ours comes from one script, run on the public data.

PY **rerun.py**
The whole re-run: the numbering, the 12 averages, the age-standardized rates, the variants, the start-year scan, the tests against synthetic death rates and against trend-free noise, the year-by-year and cosmic-ray checks, and the scale check · 52 KB

CSV **annual_series.csv**
Each year, 1950–2023: average Ap, the death rate, our age-standardized rates, life expectancy, China's death rate and the year's number in its cycle · 4 KB [5][3]

CSV **cycle_year_groups.csv**
The 12 averages behind the charts in sections 2 and 3 · 1 KB [5][3]

Run it

It needs only Python 3. Make a folder with four subfolders and save into them: `gfz-kp/` GFZ's Kp_ap_Ap_SN_F107_since_1932.txt [5]; `silso/` SILSO's TableCyclesMiMa.txt [6]; `un-wpp2024/` the UN's demographic indicators, deaths by age and population by age, about 125 MB together, under their own file names [3]; and `oulu/` the Oulu station's Phi_Table_2017.txt [7]. Then run `python3 -I rerun.py <folder>`. It prints every number of ours on this page in about a minute; add a second folder name to have it write the CSV files too. GFZ and the Oulu station update their files, so a fresh download can differ slightly in the latest years.

Related checks

UNSUPPORTED The Sun and wars, crime and revolutions The Disaster Cycle, Fact-Checked

Sources

Bracketed numbers refer to this list. For the preprint [1], Abstract means the abstract deposited with Crossref, the only part we could read. For the episode [2], times are positions in the video (hours:minutes:seconds). For the other sources, p. gives a page of the cited work and Abstract its abstract; where only an abstract or a record was read, the entry says so. Links checked October 25, 2026.

1 Belkin, V. (2026). Heliodemography: Global Mortality Rate and Geomagnetic Ap Index (1950–2023): R = 0.72. SSRN preprint (abstract page), deposited with Crossref on October 21, 2026; not peer reviewed. Crossref lists a CC BY 4.0 licence for it; SSRN's own page, which we could not open, may say more. Abstract only: SSRN blocked our tools and showed our browser a bot check that we did not bypass, and we read the abstract deposited with Crossref, which is cut off mid-sentence.

2 SpaceWeatherNews (S0) (October 24, 2026). Earth Field Chaos, Solar Storm Deaths | S0 News Oct.24.2026. YouTube video. Quoted from the automatically generated transcript; times are positions in the video. The label "Solar Storm Mortality" is the episode's own, on its link to the preprint in the video's description.

3 United Nations, Department of Economic and Social Affairs, Population Division (2024). World Population Prospects 2024, Online Edition: demographic indicators (crude death rate, life expectancy at birth) and deaths and population by single year of age, for the world and each country, 1950–2023, as CSV files, read October 25, 2026. Made available under CC BY 3.0 IGO, as its download page states. The age-standardized death rates on this page are our own, computed from these files.

4 United Nations (2024). World Population Prospects 2024: Summary of Results. UN DESA/POP/2024/TR/NO. 9. New York: United Nations. Its figures and tables are under CC BY 3.0 IGO. We read the pages cited; p. gives its printed page.

5 Matzka, J., Bronkalla, O., Tornow, K., Elger, K., and Stolle, C. (2021). Geomagnetic Kp index, version 1.0. GFZ Data Services. The daily Ap and Kp indices from GFZ's file Kp_ap_Ap_SN_F107_since_1932.txt, read October 25, 2026. CC BY 4.0. The indices are described in Matzka, J., Stolle, C., Yamazaki, Y., Bronkalla, O., and Morschhauser, A. (2021). The geomagnetic Kp index and derived indices of geomagnetic activity, *Space Weather* 19(5), e2020SW002641.

6 WDC-SILSO, Royal Observatory of Belgium, Brussels. Solar cycles: minima and maxima of the 13-month smoothed sunspot number, version 2, read October 25, 2026. CC BY-NC 4.0; only the dates of the minima and the size of cycle 19's maximum are used here. The sunspot number is described in Clette, F., and Lefèvre, L. (2016). The new sunspot number: assembling all corrections, *Solar Physics* 291, 2629–2651.

7 Usoskin, I. G., Gil, A., Kovaltsov, G. A., Mishev, A. L., and Mikhailov, V. V. (2017). Heliospheric modulation of cosmic rays during the neutron monitor era: calibration using PAMELA data for 2006–2010. *Journal of Geophysical Research: Space Physics* 122(4), 3875–3887. We read the abstract and used the yearly values of its reconstruction as the Oulu Cosmic Ray Station of the Sodankylä Geophysical Observatory, University of Oulu, publishes and updates them (Phi_Table_2017.txt, read October 25, 2026), for research and non-commercial use with acknowledgement.

8 Zilli Vieira, C. L., Alvares, D., Blomberg, A., Schwartz, J., Coull, B., Huang, S., and Koutrakis, P. (2019). Geomagnetic disturbances driven by solar activity enhance total and cardiovascular mortality risk in 263 U.S. cities. *Environmental Health* 18, 83. CC BY 4.0. We read the abstract; cited as on our check Storms, auroras and the brain.

9 Feinleib, M., Rogot, E., and Sturrock, P. A. (1975). Solar activity and mortality in the United States. *International Journal of Epidemiology* 4(3), 227–229. We read the abstract (PubMed 1184274).

10 Vieira, C. L. Z., Janot-Pacheco, E., Lage, C., Pacini, A., Koutrakis, P., Cury, P. R., Shaodan, H., Pereira, L. A., and Saldiva, P. H. N. (2018). Long-term association between the intensity of cosmic rays and mortality rates in the city of Sao Paulo. *Environmental Research Letters* 13(2), 024009. CC BY 3.0. We read the full text; p. gives a page of the article.

11 Stoupel, E., Petrauskiene, J., Kalediene, R., Sauliune, S., Abramson, E., and Shochat, T. (2015). Space weather and human deaths distribution: 25 years' observation (Lithuania, 1989–2013). *Journal of Basic and Clinical Physiology and Pharmacology* 26(5), 433–441. We read the abstract.

12 Msemburi, W., Karlinsky, A., Knutson, V., Aleshin-Guendel, S., Chatterji, S., and Wakefield, J. (2023). The WHO estimates of excess mortality associated with the COVID-19 pandemic. *Nature* 613, 130–137. CC BY 4.0. We read the abstract.

13 Pyper, B. J., and Peterman, R. M. (1998). Comparison of methods to account for autocorrelation in correlation analyses of fish data. *Canadian Journal of Fisheries and Aquatic Sciences* 55(9), 2127–2140. We read the abstract.

14 Ashton, B., Hill, K., Piazza, A., and Zeitz, R. (1984). Famine in China, 1958–61. *Population and Development Review* 10(4), 613–645. We read only its bibliographic record; the death rates on this page are the UN's estimates.

15 Belkin, V. ORCID record 0000-0003-0670-0721, public record (employment and works), read October 25 and 26, 2026.

METHOD

How this was checked

On October 25, 2026, we checked every statement, number and quotation on this page against its source. Of the preprint we could read only the abstract deposited with Crossref: SSRN blocked our tools and showed our browser a bot check that we did not bypass, and we found no other copy [1]. We rebuilt the preprint's calculation from GFZ Potsdam's Ap index, the UN's World Population Prospects 2024 and SILSO's dates of solar minima, and reproduced its three coefficients to the second decimal [5][3] and [6]. We checked the episode's statements against its automatically generated transcript [2] and read the other sources: one study in full, six in abstract, the UN's report at the pages cited, four sets of data and two records, about 15 items in all.

After the page was built, a second reviewer who hadn't seen the drafting re-ran the script, which reproduced every number, checked the chart marks against its output and checked every quotation and reference. The changes that followed: a year-to-year test that set Ap's levels against changes in the death rate, which could not detect the link it was used to rule out, gave way to the direct result after removing the trend, tested against trend-free noise; the synthetic-data test is reported for all three of the preprint's values, not only the first; the São Paulo study is described as comparing solar minima with maxima, as it did; the author's other postings are counted correctly; two of the episode's claims are rated Overstated and Unconfirmed rather than Unsupported, in the light of the daily and ecological studies the page cites; and a dozen smaller fixes.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They include the whole re-run: the numbering of the years that reproduces the preprint, the 12 averages, the straight-line comparison, the age-standardized death rates we computed from the UN's data, the variants without the famine and pandemic years, the detrended correlations, the start-year scan, the synthetic death rates with no solar signal and the trend-free noise, the year-by-year tests, the cosmic-ray comparison and the scale comparison with the 263-city study.

Our script, rerun.py, is hosted under Read it yourself and prints every number of ours on this page from the downloaded data; its random runs are seeded, so it reproduces exactly. We could not check the preprint's own data, tables, figures, caveats or forecast, or whether its numbering of the years is the one we found; that all three coefficients agree to the second decimal makes it very likely. We redrew no figure from the preprint, which we could not see; the four charts are our own.

This page was researched and written with Claude, an AI assistant made by Anthropic, and then re-checked against its sources in a separate verification pass.

The verdicts on this page

MISLEADING	Contains something true but leaves a false impression, usually by leaving out key context.
OVERSTATED	Has some basis but claims much more than the evidence supports.
UNSUPPORTED	No evidence we could find backs it up, though it hasn't been strictly disproven.
UNCONFIRMED	Rests on a preliminary result that hasn't been confirmed.

All ten verdicts, and how we check

CORRECTIONS

Corrections and changes

If we get something wrong, we fix it and record the change below with the date. If a correction changes a verdict, the log says what the old verdict was.

Change log

Oct 25, 2026	Published on factchecked.science after a full check against the sources. Built from our re-run of the preprint's calculation on public data (GFZ's Ap index, the UN's World Population Prospects 2024 and SILSO's dates of solar minima), the preprint's abstract, the only part we could read, and the S0 News episode of October 24, 2026: six claims rated on the site's scale, two of them the preprint's own, with four charts drawn from our own re-analysis.

Fact-Checked Science is independent. It isn't affiliated with the channels, presenters or authors whose claims it checks.

Last updated Oct 25, 2026