es conditions Ge	nder Interven		% in the foo	d	
fed a high fa fen		at 2	% in the foo		>0%
oxidative str fer		sessiliflorus		months	-5.0%
Caenorhabditis	elegan			smonths	4.0%
e Til fer	male a articoso			6 months	7.0%
	ale acarbose	100	0 ppm 1	o months	8.0%
. IM 5 110		EXP			5
	ale La Val	100			21.000
e UM-HET3, TI fe	male acarbose	CATE	0 mg/kg 4	months	
THE LOCAL DESCRIPTION OF A			0 T g// 💻		8.0%
LUCETS III	real loss		gang/lat	D P P	9.0%
Se LIETS LIN	nale available		<u>ni ni ni ku</u>	4 months	39.0%
se ourra life	emale ac more			4 months	5.0%
ISE OMITTE LLI	nale administration			16 months	
	amale dedibyse	10	00 ppm	16 months	5.0%
Ise Of	male acarbose		100 PP		-30.8%
198 01	lange acchal	<u> </u>			30.8%
m caenorhabdit	is elegar acdh-1 and	metformin		70-88	
m caenorhabdit	ACE-inhibito	rs			22.0%
nan Swedes		hen 6	50 mg/100	froit	20.0%
t fly	acetaminor	ohen v	So martine	7.9 to 12.1 mo	4.0%
it fly	acetamino	hen 2	42 ug/ml	7.9 00 2212 (48.6%
SUS C57 BW/6		nhên			2.5%
cainorhabd	itto ere ta alon	pide (0.5 mM	1 day	12.5%
ut fue 80 gon R	Imale act azolan	ilde	1 mM	1 day	6.0%
it for gon R	Little Annual	HIGG	- 24		60.0%
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Camorhabi	ditis elegar actic a		Jed	to ne i 10 r	TO PAL
	yces cerev ace ic aci		Heeded	to mail 10 r	m 0.0
000	ALCAS CATAL BURLING				1.0 10/
Contraction of the local division of the loc	ry condition acetic aci	d	and 20	00, respectively	18.5%
	ry condition acetic acetic di ditis elegariacetic di		and the second second	respectively	24 7%
			E Designed and	a respectively.	1 c 21 0%
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IT GIVE THE		cornitine		da 16 months	
-hor 24	4 acetyl-1	carnitine			
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IT BITS TO A	R male acetyls	alicylic acid	cis 00001	M000005	
fruit fly Oregon-	R male acetyls	alicylic acid, Cu	cls 0001 M	, .00005 M	2.
fruit fly Oregon-	acetvis	salicylic acid, cu	012 10 00 4	0005 M	-6



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Contents

1 Abstract

The effects of 10 compounds on the life spans of over 60,000 worms were previously tested and published[1]. I replicated most of their calculations.

Then I extended them by calculating how much mean and maximum life spans changed, and their corresponding statistical p-values.

Some changes are statistically significant.

It seems to me that a dye named "Thioflavin T" worked best.

You know what that means.

A dye delayed (wait for it...) dying.

2 Methods

2.1 Replicating Calculations

The worm researchers published their raw-ish data and summaries1.

They basically look like...

Lab	Experimenter	aw lifespan data (with Compound	Species	Strain	Trial	Plate	DeathAge	Censor	Dead	Deethble	LogDeath
							DeathAge	Censor		DeathNo	LogDeath
DRISCOLL	DB	ALPHA_KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS_041315_B0_AF16_A-KET0-3	/	1	0		
DRISCOLL	DB	ALPHA_KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS_041315_B0_AF16_A-KET0-3	9	0	1	9	2.1972245773362196
DRISCOLL	DB	ALPHA_KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS_041315_B0_AF16_A-KET0-3	9	1	0		
DRISCOLL	DB	ALPHA_KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS_041315_B0_AF16_A-KET0-3	9	1	0		
DRISCOLL	DB	ALPHA_KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS_041315_B0_AF16_A-KET0-3	14	0	1	14	2.6390573296152584
DRISCOLL	DB	ALPHA KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS 041315 BO AF16 A-KETO-3	14	0	1	14	2.6390573296152584
DRISCOLL	DB	ALPHA KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS 041315 BO AF16 A-KETO-3	14	1	0		
DRISCOLL	DB	ALPHA KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS 041315 BO AF16 A-KETO-3	14	1	0	-	
DRISCOLL	DB	ALPHA KETO	C. BRIGGSAE	AF16	2015-Apr-13	DS 041315 BO AF16 A-KETO-3	14	1	0		
DRISCOLL		PHA KETO	C. BRIGGSAE	AF16	2015-Apr-12	36 A-KETO-3	14	1	0		
DRISC			BRIGGSAE	AF16	20	KETO-3	14			~	
						DS 091415 SG [U				21	3.04452243
	DG	PROPINE GALLATE	-						1	21	3.044522437723423
COLL			0.50.50.000			DS_091415_SG_U775 P		-0	1		
DRISCOLL	DG	PROPYL_GALLATE	C. ELEGANS	JO775	2015-Sep-14	DS_091415_SG_U775 PRP_GAL-1.1	20	0	1	23	3.135494215929149
DRISCOLL	DG	PROPYL_GALLATE	C. ELEGANS	JU775	2015-Sep-14	DS_091415_SG_JU775 PRP_GAL-1.1	23	0	1	23	3.135494215929149
DRISCOLL	DG	PROPYL_GALLATE	C. ELEGANS	JU775	2015-Sep-14	DS_091415_SG_JU775 PRP_GAL-1.1	23	0	1	23	3.135494215929149
DRISCOLL	DG	PROPYL_GALLATE	C. ELEGANS	JU775	2015-Sep-14	DS_091415_SG_JU775 PRP_GAL-1.1	23	0	1	23	3.135494215929149
ORISCOLL	DG	PROPYL GALLATE	C. ELEGANS	U775	2015-Sep-14	DS 091415 SG JU775 PRP GAL-1.1	23	0	1	23	3.135494215929149
DRISCOLL	DG	PROPYL GALLATE	C. ELEGANS	U775	2015-Sep-14	DS 091415 SG JU775 PRP GAL-1.1	23	0	1	23	3.135494215929149
DRISCOLL	DG	PROPYL GALLATE	C. ELEGANS	U775	2015-Sep-14	DS 091415 SG JU775 PRP GAL-1.1	23	0	1	23	3.135494215929149

and

Supplementary	Data 4: Summary	and statis	tics of all chemica	l intervention lifespa	an data by t	rial					
Compound	Species	Strain	Lab	Trial	Final N Ce		Mean Longevity	SEM	Kaplan-Meier Median	Lower 95%CI	Upper 95%Cl
ALPHA_KETO	C. BRIGGSAE	AF16	DRISCOLL	2015-Apr-13	61	44	27.01485935	0.6994016517	28	25	28
ALPHA_KETO	C. BRIGGSAE	AF16	DRISCOLL	2015-Jun-22	37	28	25.554258616	0.9692220551	25	23	28
ALPHA_KETO	C. BRIGGSAE	AF16	LITHGOW	2015-Mar-23	22	18	25.965864528	1.0879026321	25	25	30
ALPHA_KETO	C. BRIGGSAE	AF16	LITHGOW	2015-Mar-27	46	31	27.56701344	0.6659197858	28		
ALPHA_KETO	C. BRIGGSAE	AF16	LITHGOW	2015-Jul-27	45	64	28.351632506	0.951421105	28	25	30
ALPHA_KETO	C. BRIGGSAE	AF16	PHILLIPS	2015-May-29	32	73	23.166301775	1.0489461889	24	21	28
ALPHA_KETO	C. BRIGGSAE	AF16	PHILLIPS	2015-Jun-05	41	6.4	905	0.7973480338	26	21	28
ALPHA_KETO	C. BRIGGSAE	Litt	COLL	2015-Apr-13	6			0.5553925508		32	
ALPHA_KETO	C. BRIGGSAR			2015-Jun-22			34.786618	76907			
PHA_KETO	C De	104	PHIL	0015 M	0	27	36.008581749		58		38
KEIO	-	HK104	PHILLIPS		63	44	33.494325479	0.8305	▼ 35	33	38
VP-0	MIGGSAE	JU1348	DRISCOLL		68	22	21.129698357	0.6151595581	21	18	23
	C. BRIGGSAE	JU1348	DRISCOLL	2015-Jun-22	24	11	23.908256656	1.3620162842	23	21	25
VALPROIC_ACID		JU1348	LITHGOW	2015-Mar-23	19	20	21.384375	1.1577256355	21	16	25
VALPROIC_ACID		JU1348	LITHGOW	2015-Mar-27	44	26	21.556811498	0.8024867652	24	19	24
VALPROIC_ACID		JU1348	LITHGOW	2015-Jul-27	49	59	23.143070573	0.8203877511	23	21	25
VALPROIC_ACID		JU1348	PHILLIPS	2015-May-29	51	55	22.202092482	0.7595001457	21	19	24
VALPROIC_ACID		JU1348	PHILLIPS	2015-Jun-05	71	37	20.048543592	0.6268805442	21	17	24
VALPROIC_ACID		JU1348	PHILLIPS	2015-Jun-19	68	37	22.103152005	0.6441925849	21	19	24
VALPROIC_ACID	C. ELEGANS	JU775	DRISCOLL	2015-Apr-13	96	5	15.137678571	0.3864769547	14		

I wrote software that used their raw data to replicate their summary calculations of

- 1. the numbers of animals that died¹,
- 2. the numbers of animals that were censored,
- 3. mean longevities,
- 4. SEMs (sort of) and
- 5. Kaplan-Meier medians.

¹They called it "Final N".

2.2 Extending Calculations

The original paper reported mean and median² life spans.

That's good.

Other commonly reported statistics are changes in mean and maximum life span³, and p-values⁴. After replicating their mean and median life spans, I was confident I could

1. match data for

- (a) animals receiving a certain compound to
- (b) their corresponding control animals
- 2. and then calculate
 - (a) how much compounds changed life spans and
 - (b) the corresponding p-values⁵.

So I did.

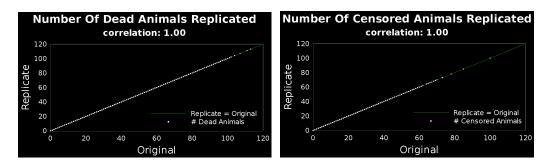
²Kaplan-Meier

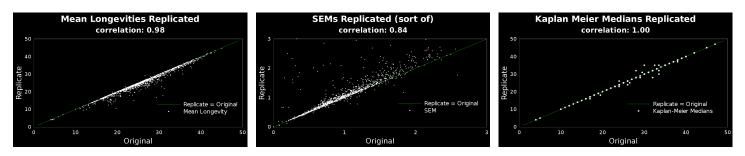
³When I calculated maximum life span, I considered how long the oldest 10% of animals lived. ⁴Statisticians and scientists use "p-values" to measure how "significant" differences are. Many think

p-values under 0.05 indicate a significant difference.

⁵I calculated p-values using Mann Whitney's U test. It works even with data that's not normally distributed. The logrank and cox methods may have worked well too.

3 Results

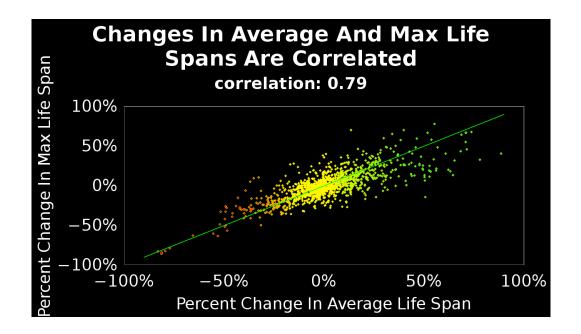




I replicated most of the original researchers' statistics with correlation coefficients of a perfect 1.00, or $close^{6}$.

But the correlation coefficient between our SEMs isn't as good as I'd like⁷.

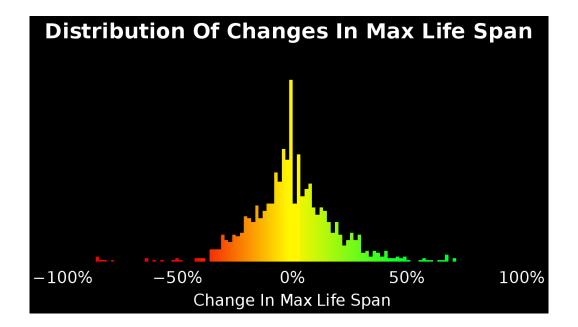
Changes in mean and max life span are mildly correlated⁸.



⁶That's good.

⁷It's only 0.84

⁸That correlation coefficient is 0.79.



Some changes in life span seemed significant.

Top 10: It's All Thioflavin T										
INTERVENTION	PERCENT CHANGE IN MEAN LIFE SPAN	MEAN P VALUE	PERCENT CHANGE IN MAXIMUM LIFE SPAN	MAX P VALUE	STRAIN					
Thioflavin T	88.6%	0.000	40.5%	0.077	my16					
Thioflavin T	78.1%	0.000	32.6%	0.077	my16					
Thioflavin T	73.8%	0.000	67.5%	0.139	my16					
Thioflavin T	71.6%	0.000	45.8%	0.047	my16					
Thioflavin T	71.2%	0.000	66.7%	0.096	my16					
Thioflavin T	71.0%	0.000	66.7%	0.096	my16					
Thioflavin T	70.9%	0.000	55.2%	0.006	my16					
Thioflavin T	68.8%	0.000	64.1%	0.000	my16					
Thioflavin T	68.4%	0.000	43.5%	0.03	ju775					
Thioflavin T	65.4%	0.000	31.5%	0.128	my16					

4 Discussion

I wrote a paper similar to this[4].

These results are consistent with it, and with those from analyzing my ginormous spread sheet of life span experiments⁹.

I'm basically satisfied, but "in this the best of all possible worlds"¹⁰, our SEMs would be closer.

I guessed the original researchers used "SEM" as an abbreviation of "Standard Error of the Mean".

If they meant something else, that might explain why we got different SEMs.

I hope Thioflavin T is tested in mammals, and for safety in people.

Ideally, soon.

⁹It's the world's biggest collection of normalized results from life span experiments[5,6]. ¹⁰Candide

5 Questions For The Original Researchers

- 1. Was "SEM" an abbreviation for Standard Error of the Mean?
- 2. What doses were used in the "Supplementary Data 9: Raw lifespan (chemicals) dataset" [7]?
- 3. Would it be OK to publish the raw data for the 30,000 screened compounds [8]?

6 Conclusion

Many of the original researchers statistics are replicable.

It seems to me that a dye named Thioflavin T is the big winner. At least in the "MY16" strain of C. Elegans.

You know what that means. A dye delayed dying. ;-)

7 Funding

No money was involved.

I donated my time and skillz because I was interested, and it seemed worthwhile.

8 References

1. Lucanic, M. et al. Impact of genetic background and experimental reproducibility on identifying chemical compounds with robust longevity effects. Nat. Commun. 8, 14256 doi: 10.1038/ncomms14256 (2017).

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5321775/

- 2. C. Elegans Life Span Experiments Replicated and Extended http://morse.kiwi.nz/kingsley/lib/exe/fetch.php?media=:science:c_elegans_experiments_replicated_and_ extended.pdf
- 3. C. Elegans Life Span Experiments Replicated and Extended http://morse.kiwi.nz/kingsley/lib/exe/fetch.php?media=:science:c_elegans_experiments_replicated_and_ extended.pdf
- 4. C. Elegans Life Span Experiments Replicated and Extended http://morse.kiwi.nz/kingsley/lib/exe/fetch.php?media=:science:c_elegans_experiments_replicated_and_ extended.pdf
- 5. Kingsley's Big Spread Sheet Of Life Span Experiments http://morse.kiwi.nz/kingsley/lib/exe/fetch.php?media=:science:opportunity.6.pdf
- 6. Results from data-mining Kingsley's Big Spread Sheet o' Life Span Experiments http://morse.kiwi.nz/kingsley/doku.php?id=science:kingsleys_big_spread_sheet_of_life_ span_experiments
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