SMOKING AND MORTALITY AMONG US ASTRONAUTS

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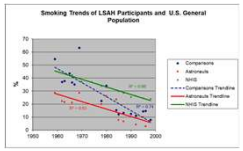
What effect has smoking history had on U.S. astronaut mortality?

Are astronauts as healthy as they should be, given who they are?

Astronauts have lower age-specific mortality risk than the U.S. general population from all natural causes of death, particularly cardiovascular disease and cancer. Yet, understanding if they are as healthy as their backgrounds predict they should be, requires that epidemiologists understand (and measure) all potentially confounding exposures in this cohort. **Tobacco smoking prevalence has been measured in the U.S. astronaut cohort, but its impact on mortality has not been previously assessed.** If smoking history has a negative impact on mortality, this could confound attempts to measure the relative health of astronauts.

Data: smoking prevalence by class + demographics

The Longitudinal Study of Astronaut Health (LSAH) Newsletter published the **prevalence of ever-smoking among select astronaut training cohorts between 1959 and 1998.**[1] The data do not include names of the smokers, but this information can be combined with (publicly available) **data about the training classes and/or individual astronaut lifetimes.**



Longitudinal Study of Astronaut Health data on smoking prevalence by class.[1]


Al Worden after Apollo 15

Exploring the possible: 3 analyses

The ideal analysis would compare the risk of death from natural causes among smokers to that of non-smokers to look for differences in age-specific incidence. Since the names of the individual smokers were not available, instead **we can define the possible range of effect of smoking on astronaut mortality through 3 analytics approaches:**


Wally Schirra smoking

Relative Risk

The simple relative risk calculation for a fixed-length follow-up period is:

$$RR = \frac{P(Death \mid Smoking)}{P(Death \mid No\ smoking)}$$

For a dataset with 25 years of post-selection follow-up and number of deaths *d*, we can compute the range of possible relative risks of death for ever-smokers by assuming that between 1 and (*d*-1) smokers died.


Alan Shepard in Mercury Mission Control

Mortality rate model simulation

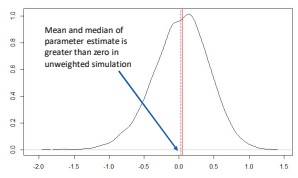
Again, we don't know who the smokers are, but we know the number of smokers in each class. We can therefore **randomly assign who the smoking individuals are** within each selection class and run a cohort study in the typical way. **If we do this 10,000 times, the central tendency of the smoking coefficient should center on the truth.**


Tom Stafford after Gemini 6

Mortality rate model simulation with inverse probability weighting

This method is the same as the Poisson model simulation, but with the added step of fitting a **propensity score model for** smoking status, and then using that score for **inverse probability weighting** to rebalance the groups and eliminate potential confounding from baseline differences and non-random treatment assignment in the true cohort. Like in the unweighted version, this process is repeated 10,000 times.

Smokers among the dead	RR	95% CI	
0	0.00	-	
1	0.94	0.00	3.05
2	2.34	0.68	3.99
3	4.68	3.12	6.23
4	9.35	7.70	11.01
5	23.38	21.27	25.50
6	Inf	-	



Mean MRR = 1.03 (95% CI = 0.46–2.27)

The simulations of the **weighted model centered on zero**, with a mean **MRR of 0.99 (95% CI = 0.40–2.38)**.

The effect of age and education were consistent with prior research on astronaut mortality, with age increasing risk and having a doctoral degree reducing risk. History of military service also reduced risk, by 40% in the regular Poisson model and 25% in the MSM.


Six of the Mercury Seven


A pack of cigarettes and ashtray at the CapCom's console, Mercury Mission Control

Conclusions and further work

Simple RR calculations suggest that **astronauts who were ever-smokers at the time of selection are plausibly at increased risk of natural-cause mortality in comparison to never-smokers.** The results of the Poisson incidence model simulation show a fairly wide range of possible effects, with the central tendency slightly positive. However, the **IPW model suggests that the potential increase in risk may be due to confounding by indication. However, a formal cohort study should be undertaken with detailed smoking history** to obtain definitive RRs. If this shows increased risks for smokers, these RRs should be used in on-going mortality surveillance.


Mercury Seven press conference; full ashtrays abound

References

1. National Aeronautics and Space Administration, The Longitudinal Study of Astronaut Health. Smoking Prevalence of LSAH Participants. 2001: Vol 10(2);1-2.
2. Images gathered from a discussion thread on astronaut smoking on collectSPACE.com: http://www.collectspace.com/ubb/Forum38/HTML/000441.html