



“What’s in the plot?”

**A future vision for environmental health research and
analyses in South Africa**

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7 March 2016

“What’s in the plot?”

So, what’s this talk really about? There are two take-home messages:

- We should be critical of our study designs and study results: be real
- We should be forward-thinking about new approaches to data options

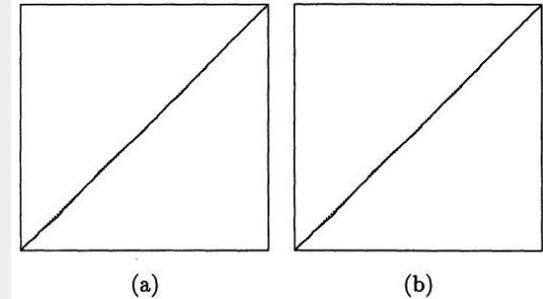
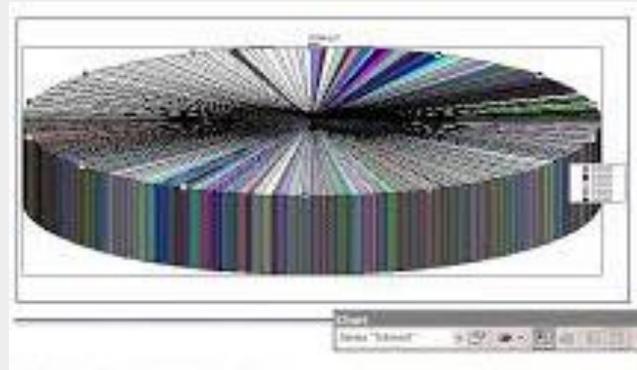
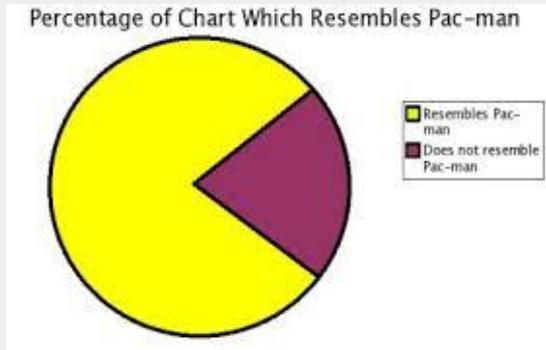


Figure 1. SRQ Plots of T_i/T_n (Vertical Axes) Against i/n (Horizontal Axes) for the Gibbs Sampler (a) and an Alternating Gibbs/Independence Sampler (b) for the Pump Failure Data Based on Runs of Length 5,000. Lines through the origin with unit slope are shown dashed; axis ranges are from 0 to 1 for all axes.

TALK OUTLINE



- Environmental health 101
- Some of the big environmental health studies/papers
- Epidemiological environmental health study designs
 - Examples with a local flavour, let's be real
- Possible solutions – research for evidence-based decision-making
- Challenges and opportunities to take us to a new level of environmental health research in South Africa

ENVIRONMENTAL HEALTH 101

- Environmental health is the branch of public health that is concerned with all aspects of the natural and built environment that may affect human health.
- Environmental health and environmental protection are related.
 - Environmental health services
 - Environmental health practitioners
- Environmental epidemiology, toxicology and exposure science



DOES ENV HEALTH RESEARCH MAKE IT INTO THE TOP 100 MOST CITED PAPERS OF ALL TIME?

Rank	Authors	Title	Journal	Volume	Pages	Year	Times cited
1	Lowry, O. H., Rosebrough, N. J., Farr, A. L. & Randall, R. J.	Protein measurement with the folin phenol reagent.	<i>J. Biol. Chem.</i>	193	265–275	1951	305148
2	Laemmli, U. K.	Cleavage of structural proteins during the assembly	<i>Nature</i>	227	680–685	1970	213005
3	Bradford, M. M.	A rapid and sensitive method for the quantitation of	<i>Anal. Biochem.</i>	72	248–254	1976	155530
4	Sanger, F., Nicklen, S. & Coulson, A. R.	DNA sequencing with chain-terminating inhibitors.	<i>Proc. Natl Acad. Sci. USA</i>	74	5463–5467	1977	65335
5	Chomczynski, P. & Sacchi, N.	Single-step method of RNA isolation by acid guanid	<i>Anal. Biochem.</i>	162	156–159	1987	60397
6	Towbin, H., Staehelin, T. & Gordon, J.	Electrophoretic transfer of proteins from polyacryl	<i>Proc. Natl Acad. Sci. USA</i>	76	4350–435	1979	53349
7	Lee, C., Yang, W. & Parr, R. G.	Development of the Colle-Salvetti correlation-ener	<i>Phys. Rev. B</i>	37	785–789	1988	46702
8	Becke, A. D.	Density-functional thermochemistry. III. The role of	<i>J. Chem. Phys.</i>	98	5648–565	1993	46145
9	Folch, J., Lees, M. & Stanley, G. H. S.	A simple method for the isolation and purification of	<i>J. Biol. Chem.</i>	226	497–509	1957	45131
10	Thompson, J. D., Higgins, D. G. & Gibson, T. J	Clustal W: improving the sensitivity of progressive	<i>Nucleic Acids Res.</i>	22	4673–468	1994	40289
11	Kaplan, E. L. & Meier, P.	Nonparametric estimation from incomplete observe	<i>J. Am. Stat. Assoc.</i>	53	457–481	1958	38600
12	Altschul, S. F., Gish, W., Miller, W., Myers, E. W. & Lipman	Basic local alignment search tool.	<i>J. Mol. Biol.</i>	215	403–410	1990	38380
13	Sheldrick, G. M.	A short history of SHELX.	<i>Acta Crystallogr. A</i>	64	112–122	2008	37978
14	Altschul, S. F. et al.	Gapped BLAST and PSI-BLAST: A new generatio	<i>Nucleic Acids Res.</i>	25	3389–340	1997	36410
15	Murashige, T. & Skoog, F.	A revised medium for rapid growth and bio assays	<i>Physiol. Plant.</i>	15	473–497	1962	36132
16	Perdew, J. P., Burke, K. & Ernzerhof, M.	Generalized gradient approximation made simple.	<i>Phys. Rev. Lett.</i>	77	3865–386	1996	35405
17	Folstein, M. F., Folstein, S. E. & McHugh, P. R.	"Mini-mental state": A practical method for gradin	<i>J. Psychiatr. Res.</i>	12	189–198	1975	34532
18	Bligh, E. G. & Dyer, W. J.	A rapid method of total lipid extraction and purific	<i>Can. J. Biochem. Physiol.</i>	37	911–917	1959	32131
19	Southern, E. M.	Detection of specific sequences among DNA fragm	<i>J. Mol. Biol.</i>	98	503	1975	31904
20	Saitou, N. & Nei, M.	The neighbor-joining method: A new method for re	<i>Mol. Biol. Evol.</i>	4	406–425	1987	30176
21	Livak, K. J. & Schmittgen, T. D.	Analysis of relative gene expression data using rea	<i>Methods</i>	25	402–408	2001	28870
22	Shannon, R. D.	Revised effective ionic radii and systematic studies of inter	<i>Acta Crystallogr. A</i>	32	751–767	1976	28658
23	Otwinowski, Z. & Minor, W.	Processing of X-ray diffraction data collected in oscillatio	<i>Method. Enzymol. A</i>	276	307–326	1997	28647
24	Cox, D. R.	Regression models and life-tables.	<i>J. R. Stat. Soc., B</i>	34	187–220	1972	28439
25	Becke, A. D.	Density-functional exchange-energy approximation with co	<i>Phys. Rev. A</i>	38	3098–310	1988	26475

Numbers from Thomson Reuters; extracted 7 October 2014

BIG ENVIRONMENTAL HEALTH STUDIES

International

Cholera and exposure pathways

JOHN SNOW AND THE BROAD STREET PUMP ON THE TRAIL OF AN EPIDEMIC



By Kathleen Tuthill, Illustrated by Rupert Van Wyk

British doctor John Snow couldn't convince other doctors and scientists that cholera, a deadly disease, was spread when people drank contaminated water until a mother washed her baby's diaper in a town well in 1854 and touched off an epidemic that killed 616 people.



Dr. Snow, an obstetrician with an interest in many aspects of medical science, had long believed that water contaminated by sewage was the cause of cholera. Cholera is an intestinal disease that can cause death within hours after the first symptoms of vomiting or diarrhea. Snow published an article in 1849 outlining his theory, but doctors and scientists thought he was on the wrong track and stuck with the popular belief of the time that cholera was caused by breathing vapors or a "miasma in the atmosphere".

The first cases of cholera in England were reported in 1831, about the time Dr. Snow was finishing up his medical studies at the age of eighteen. Between 1831 and 1854, tens of thousands of people in England died of cholera. Although Dr. Snow was deeply involved in experiments using a new technique, known as anesthesia, to deliver babies, he was also fascinated with researching his theory on how cholera spread.

CHOLERA IS PRONOUNCED
KOL-cr-uh.

CONTAMINATED MEANS
IMPURE, HARMFUL,
AND UNUSABLE.

MIASMA MEANS A BAD
ATMOSPHERE; GERMS OR
BAD SMELLS OR
POLLUTANTS IN
THE AIR.

ICK.



BIG ENVIRONMENTAL STUDIES / PAPERS

International

Harvard Six
Cities Study

The New England Journal of Medicine

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Volume 329

DECEMBER 9, 1993

Number 24

AN ASSOCIATION BETWEEN AIR POLLUTION AND MORTALITY IN SIX U.S. CITIES

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JOHN D. SPENGLER, PH.D., JAMES H. WARE, PH.D., MARTHA E. FAY, M.P.H.,
BENJAMIN G. FERRIS, JR., M.D., AND FRANK E. SPEIZER, M.D.

Abstract Background. Recent studies have reported associations between particulate air pollution and daily mortality rates. Population-based, cross-sectional studies of metropolitan areas in the United States have also found associations between particulate air pollution and annual mortality rates, but these studies have been criticized, in part because they did not directly control for cigarette smoking and other health risks.

Methods. In this prospective cohort study, we estimated the effects of air pollution on mortality, while controlling for individual risk factors. Survival analysis, including Cox proportional-hazards regression modeling, was conducted with data from a 14-to-16-year mortality follow-up of 8111 adults in six U.S. cities.

Results. Mortality rates were most strongly associated with cigarette smoking. After adjusting for smoking and

other risk factors, we observed statistically significant and robust associations between air pollution and mortality. The adjusted mortality-rate ratio for the most polluted of the cities as compared with the least polluted was 1.26 (95 percent confidence interval, 1.08 to 1.47). Air pollution was positively associated with death from lung cancer and cardiopulmonary disease but not with death from other causes considered together. Mortality was most strongly associated with air pollution with fine particulates, including sulfates.

Conclusions. Although the effects of other, unmeasured risk factors cannot be excluded with certainty, these results suggest that fine-particulate air pollution, or a more complex pollution mixture associated with fine particulate matter, contributes to excess mortality in certain U.S. cities. (N Engl J Med 1993;329:1753-9.)

BIG ENVIRONMENTAL STUDIES / PAPERS

Local flavour

Vaal Air Pollution Study

[S Afr Med J](#). 1992 Jun 6;81(11):550-6.

Preliminary results of exposure measurements and health effects of the Vaal Triangle Air Pollution Health Study.

[Terblanche AP](#)¹, [Opperman L](#), [Nel CM](#), [Reinach SG](#), [Tosen G](#), [Cadman A](#).

Author information

Abstract

The aim of the Vaal Triangle Air Pollution Health Study is to assess the adequacy of South Africa's air pollution control programme to protect human health. It is a longitudinal study of children aged 8-12 years which will evaluate exposure and effects of outdoor and indoor air pollution levels on the health of more than 10,000 white and black children living in Vanderbijlpark, Sasolburg, Vereeniging, Meyerton, Randvaal, and the Sebokeng/Sharpeville areas (Lekoa), Transvaal, RSA. Extensive data on outdoor and indoor levels of air pollution as well as personal exposures to total suspended particulate matter were collected. Preliminary results indicate that the levels of particulate matter exceed the USA health standards. A health questionnaire administered to 10,187 white children indicated that during the past year 65.9% had suffered from upper respiratory tract illnesses (URI) such as sinusitis, rhinitis and hay fever and 28.9% from lower respiratory tract illnesses (LRI) such as bronchitis, chronic cough and chronic chest illnesses. Parents who perceived that the air pollution in the region is serious had a higher reporting rate of URI/LRI for their children than parents who considered the air pollution not to be serious (77.4% v. 56.8% respectively for URI and 24.1% v. 16.3% respectively for LRI). The effect of this recall bias will be evaluated in later analyses. A statistically significant higher prevalence of LRI was reported in children exposed to parental smoking (25.7% for households where both parents smoked v. 20.8% in households without parental smoking) (odds ratio (OR) 1.32 (1.2-1.5)).(ABSTRACT TRUNCATED AT 250 WORDS)

PMID: 1598646 [PubMed - indexed for MEDLINE]

BIG ENVIRONMENTAL STUDIES / PAPERS

Local flavour

Polokwane
ISAAC Study

[Health Place](#). 2008 Jun;14(2):323-35. Epub 2007 Aug 9.

Association between children's household living conditions and eczema in the Polokwane area, South Africa.

[Wichmann J¹](#), [Wolvaardt JE](#), [Maritz C](#), [Voyi KV](#).

⊕ **Author information**

Abstract

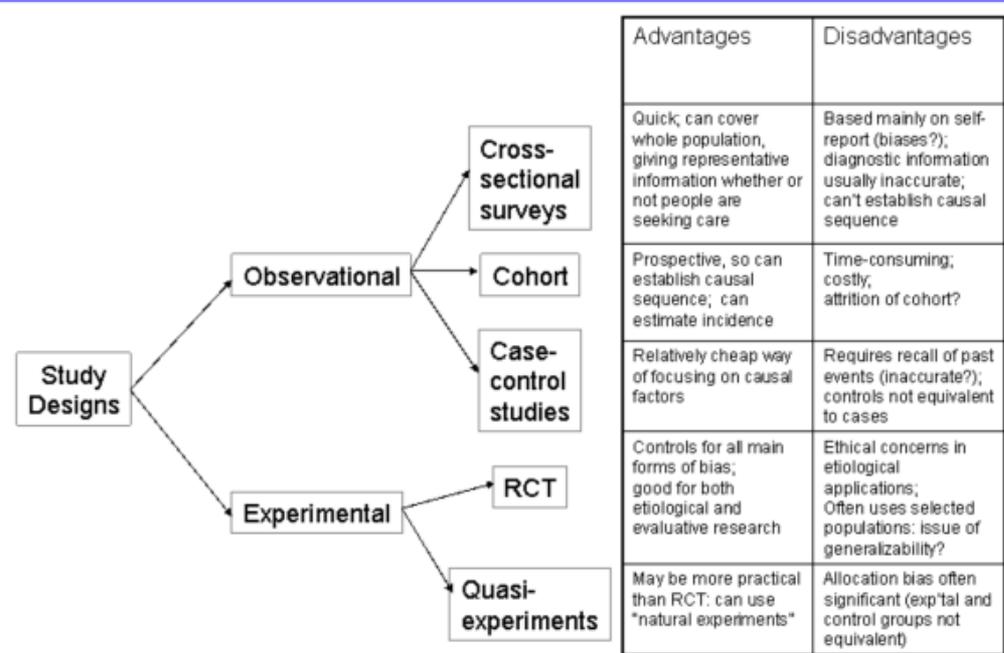
The aim of the study was to determine the 12-month prevalence of eczema symptoms (ES), the prevalence of ever having had eczema (EE), and potential risk factors among 6-7-year-old children within a 60km radius of Polokwane city centre, Limpopo Province, South Africa. This study applied the International Study of Asthma and Allergies in Childhood (ISAAC) Phase III protocol. It was conducted during August 2004 (winter) and February 2005 (summer). Among the 2437 participants, the 12-month prevalence of ES (17%) was much lower than the prevalence of EE (38%). The multivariate logistic regression model revealed that the likelihood of having ES was significantly increased by 43% in rural areas, and by 54% when exposed to environmental tobacco smoke (ETS) at home. The model also revealed that the likelihood of EE significantly increased with ETS exposure at home (37%), and by the use of coal, paraffin, gas and/or electricity for cooking (28%). Living in a formal house significantly decreased the likelihood of EE by 23%. Eczema appears to be a substantial public health problem in the Polokwane area. It is hoped that future studies will scrutinize these results in more detail, to inform and influence policy decisions, and form a basis for a health-promotion intervention in the community.

PMID: 17881278 [PubMed - indexed for MEDLINE]

EPIDEMIOLOGICAL STUDY DESIGNS

- Making the right choice when carrying out research
- Think about the type and level of sophistication and certainty required
- Work through the Bradford Hill criteria of causation¹

Summary of designs, showing advantages and disadvantages of each:



¹Hill, Austin Bradford (1965). "The Environment and Disease: Association or Causation?". *Proceedings of the Royal Society of Medicine* 58 (5): 295–300.

FROM THE JOHNS HOPKINS PEW ENVIRONMENTAL HEALTH COMMISSION REPORT: AMERICA'S ENVIRONMENTAL HEALTH GAP-WHY THE COUNTRY NEEDS A NATIONWIDE HEALTH TRACKING NETWORK (2000)

Foreword by Commission Chairman Lowell Weicker, Jr.

With the mapping of the human genome, we are on the verge of a new wave of advances in health. With this remarkable achievement, researchers will be able to shed new light on the links between genetic predisposition and such factors as behavior and exposures to pollutants in the environment in order to prevent many of the chronic diseases that today cause so much suffering.

But there is a catch. We must have the basic information about the health of Americans and our environment before we can make the fullest use of this exciting genetic knowledge. The way to get this basic data is to track it—systematically, comprehensively, on a coordinated basis at all levels from the local community to the nation as a whole. We have to track what and where the hazards are in the environment, whether people are at risk from exposures to these hazards, and the health of our communities. Our information about environmental factors must run as deep and be as comprehensive as our knowledge of the genome.

This report examines our current public health response capabilities to environmental threats, and recommends the establishment of a Nationwide Health Tracking Network. The Pew Environmental Health Commission was charged with developing a blueprint to rebuild the nation's public health defenses against environmental threats. We know there are pollutants entering our air and water each year with suspected or known adverse effects on the health of our communities. What we are limited in knowing is if there is a link between that pollution and the increases we are seeing in chronic diseases because we aren't tracking environmental health factors.

POSSIBLE SOLUTIONS

- Use big data
- Use public data
- Use existing data (improved)
- Get access to routinely collected data
- Have data disaggregated spatially and temporally
- Large investment for large studies sometimes
- Small studies for specific questions



POSSIBLE SOLUTIONS

National Public Health Institute of South Africa

The mandate of the NAPHISA is to conduct disease and injury surveillance, and to provide specialized public health services, public health interventions, training and research directed towards the major health challenges affecting the population of the country.

4 No. 39392 GOVERNMENT GAZETTE, 11 NOVEMBER 2015

GOVERNMENT NOTICES • GOEWERMENTSKENNISGEWINGS

NO. 1092 DEPARTMENT OF HEALTH 11 NOVEMBER 2015

REPUBLIC OF SOUTH AFRICA

NATIONAL PUBLIC HEALTH INSTITUTE OF SOUTH AFRICA BILL

[As introduced in the National Assembly (proposed section 75); explanatory summary of Bill published in Government Gazette 39392 of 11 November 2015. The English text is the official text of the Bill]

POSSIBLE SOLUTIONS

- Nationally coordinated research programmes
- Collaboration between researchers
- Sharing resources
- Reducing duplication



CHALLENGES FOR THIS FUTURE VISION

- Competition
- Limited resources
- Performance assessment
- Computing power
- Computing and biostatistical skills
- Human capacity
- Willingness
- Relinquishing roles



OPPORTUNITIES AND BENEFITS

- Use big data sets for strong conclusions
- Provide sound evidence for decision and policy-making
 - “Interpreted data, not reported data”
- Solve big environmental health problems
 - Look at the detail, spot the anomalies, detective work
 - Identify the big trends for tracking disease
- Inform preventive behavioural campaigns and evidence that interventions will work

Dream it, Believe it, Live it

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