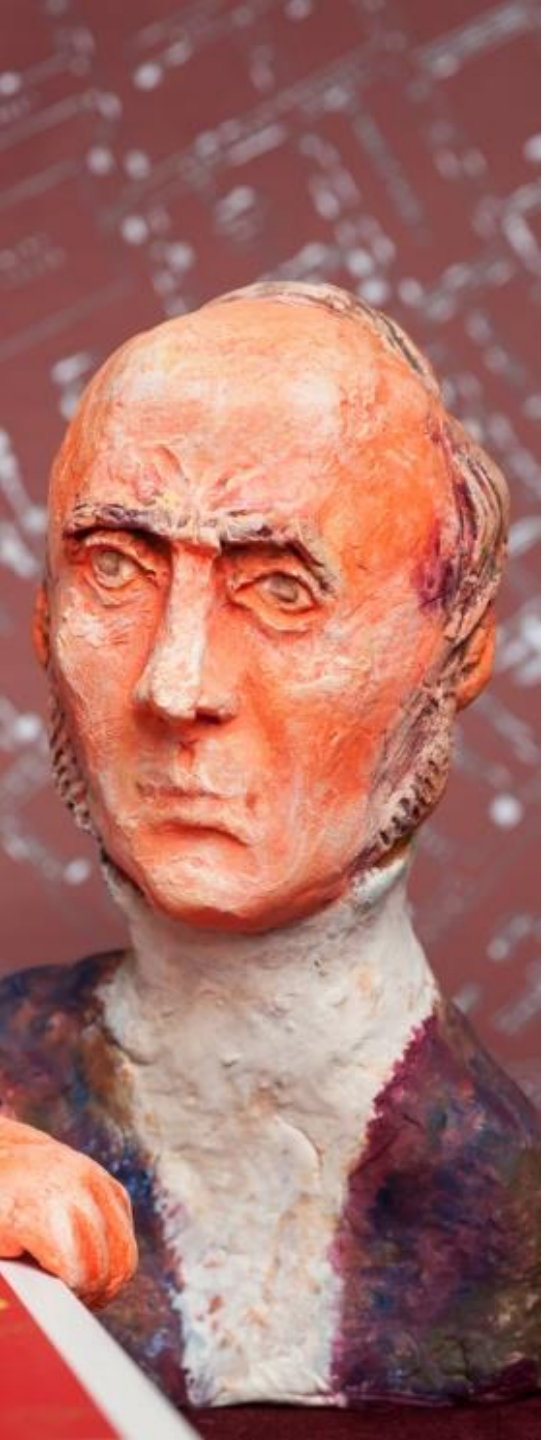


환경역학 연구에서 시공간 분석의 활용

2019년 2월 9일(토)

황 승 식

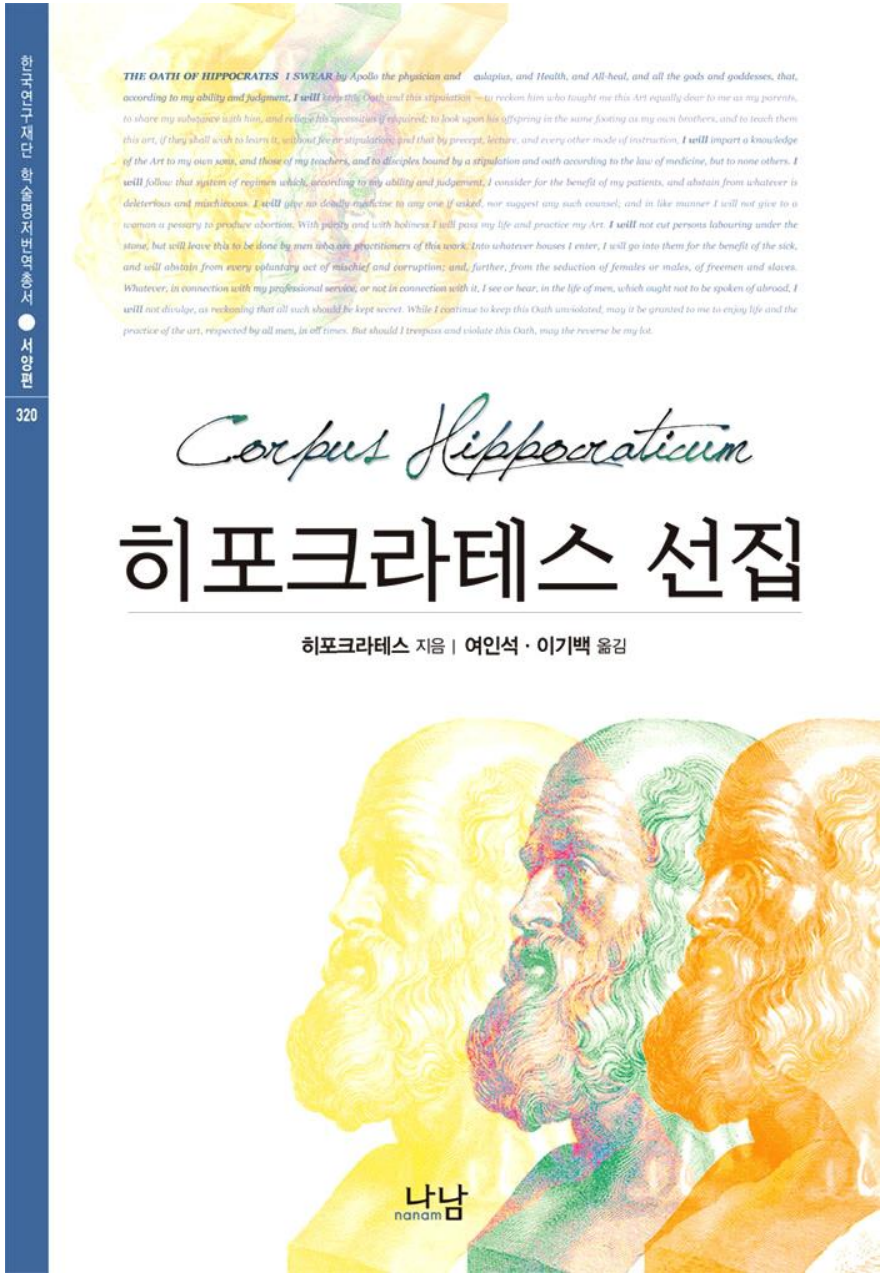
서울대학교 보건대학원 보건학과

cyberdoc@snu.ac.kr

차례

1. 공간 자료 분석의 역사와 현황
2. 공간 역학의 원리와 기회
3. 공간 역학 연구 설계
4. 공간 역학 연구 사례

1. 공간 자료 분석의 역사와 현황



"의술을 올바로 추구하고자 하는 자는 다음과 같이 행해야 한다. 먼저 한 해의 **계절**들 각각이 무슨 영향을 미칠 수 있는지를 고려해야 한다. (중략) 또한 찬 바람과 더운 바람, 특히 모든 사람에게 공통적인 **바람**과 각 지방에 특유한 바람도 고려해야 한다. **물**들의 성질에 대해서도 고려해야 한다. (중략) 그래서 어떤 의사가 낯선 나라에 도착하면, 그는 그 곳의 **위치**에, 다시 말해 그 곳이 바람과 태양의 떠오름에 대해 어떻게 위치하고 있는지에 주의를 기울여야 한다. (하략)"

- 히포크라테스, '공기, 물, 장소에 관하여' 중.

- "Airs, Waters, and Places"
  - Hippocrates

- "Place, Space, and Health"
  - Nancy Krieger (*Epidemiology*, 2003)

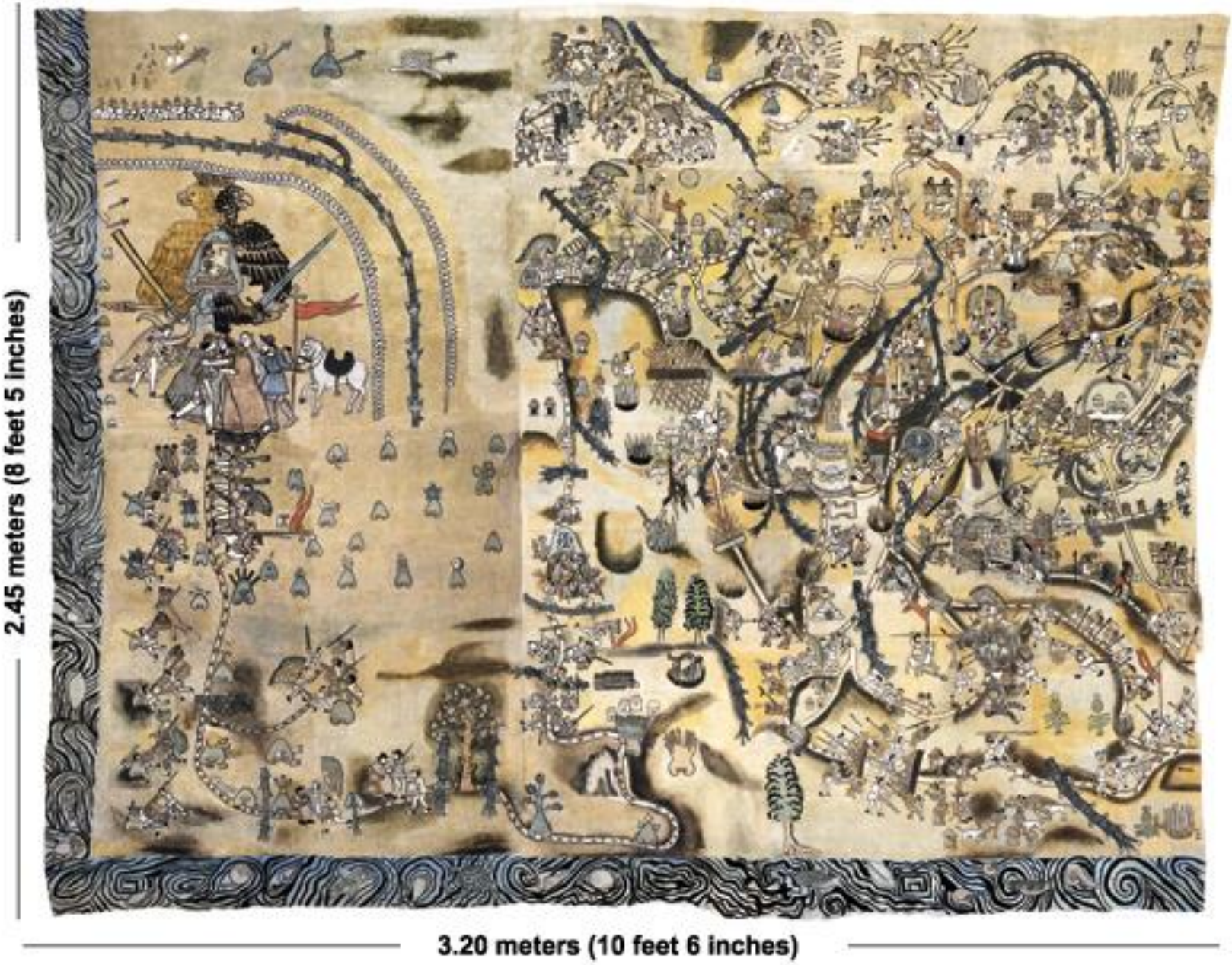
COMMENTARY

Place, Space, and Health: GIS and Epidemiology

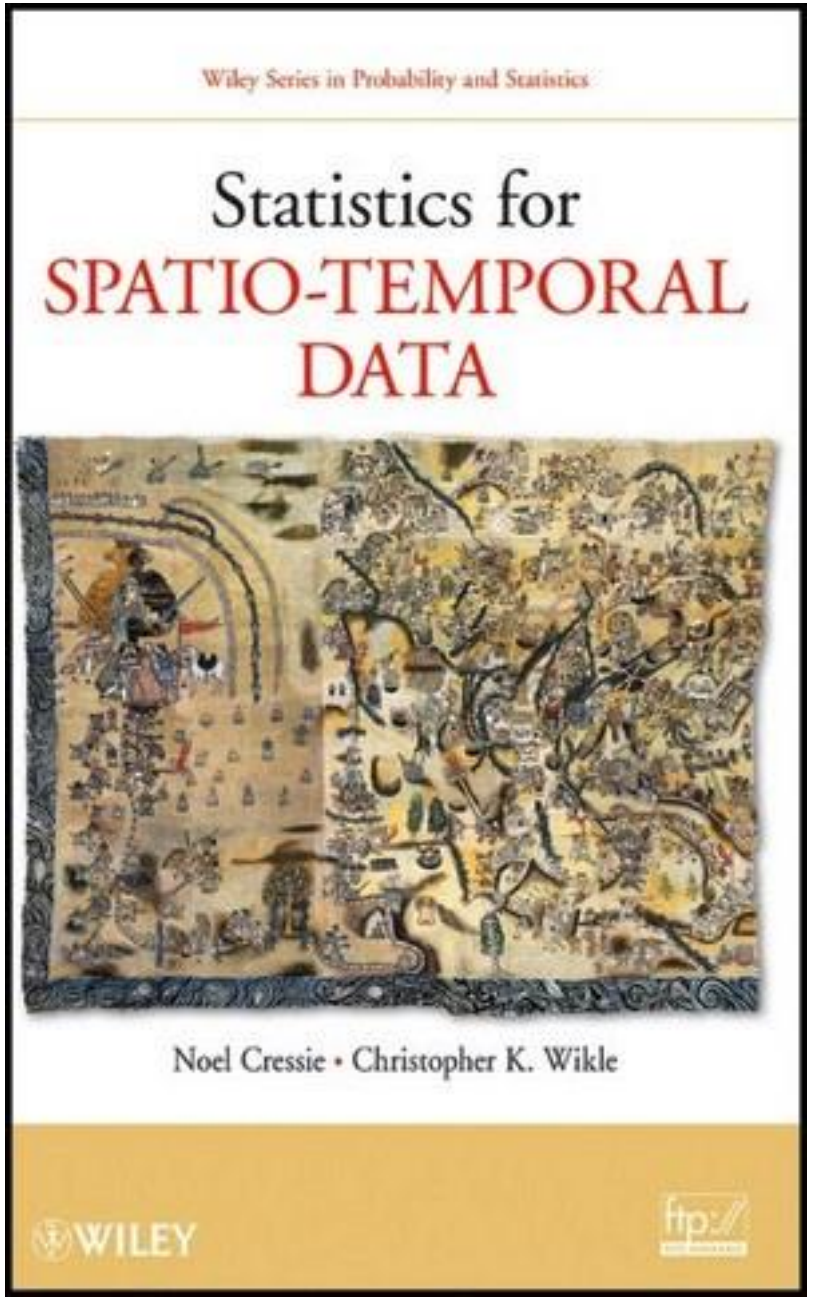
Nancy Krieger

Place. Area. Neighborhood. Latitude. Longitude. Distance. These geographic terms are increasingly finding their way into the epidemiologic literature, as advances in geographic information system (GIS) technology make it ever easier to connect spatially referenced physical and social phenomena to population patterns of health, disease, and well-being.[1-3]

Indeed, links between location and health have long captured the imagination of perceptive observers. Consider the Hippocratic treatise, "Airs, Waters, and Places," written about 2,400 years ago, which roundly (and rather deterministically) declared: "You will find, as a general rule, that the constitutions and habits of a people follows the nature of the land where they live."[4, p. 168] Early 19th century research decisive to epidemiology's development as a discipline[5] likewise looked to geography to discern etiologic clues.



Lienzo de Quauhquechollan ca. 1530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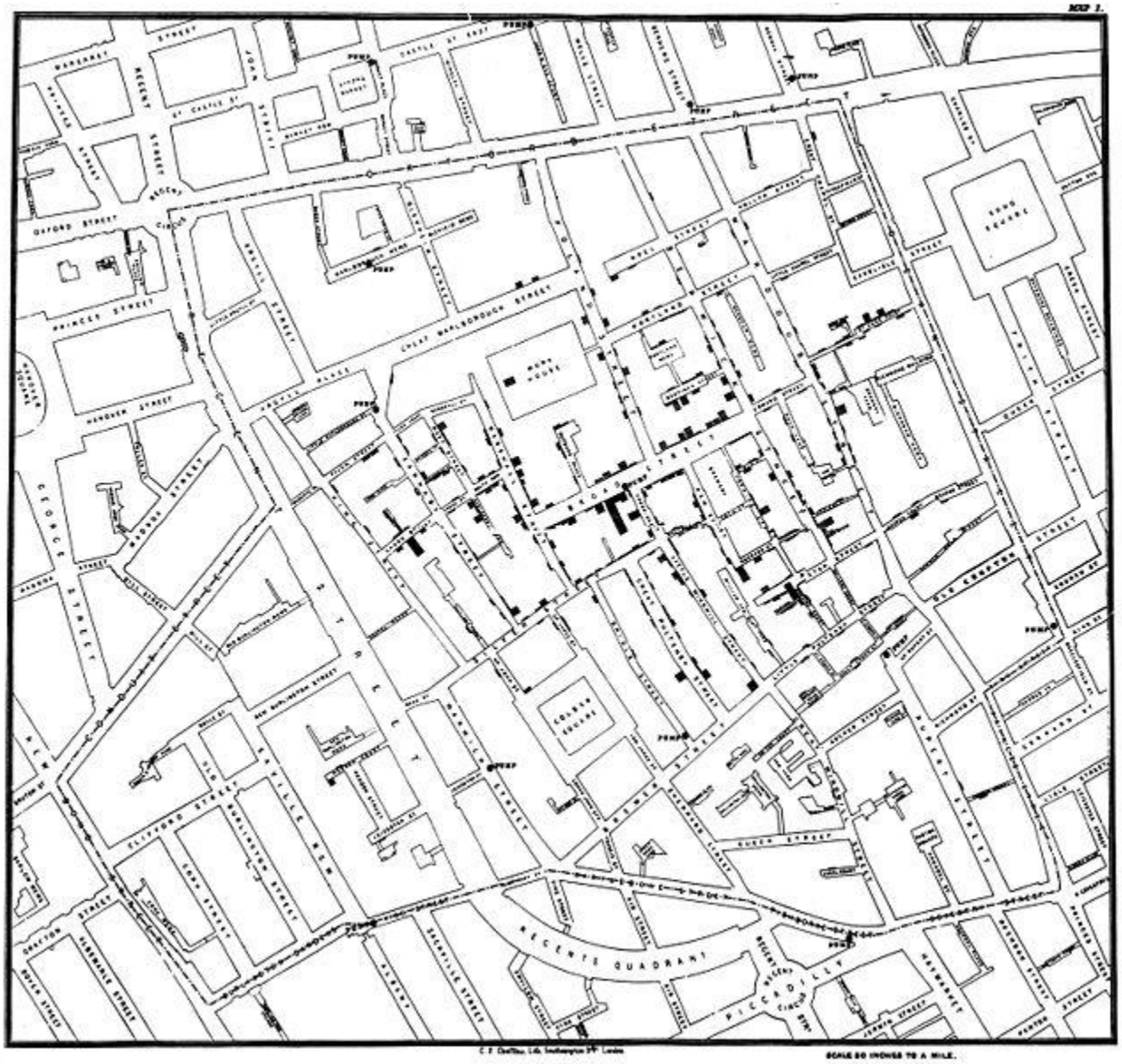
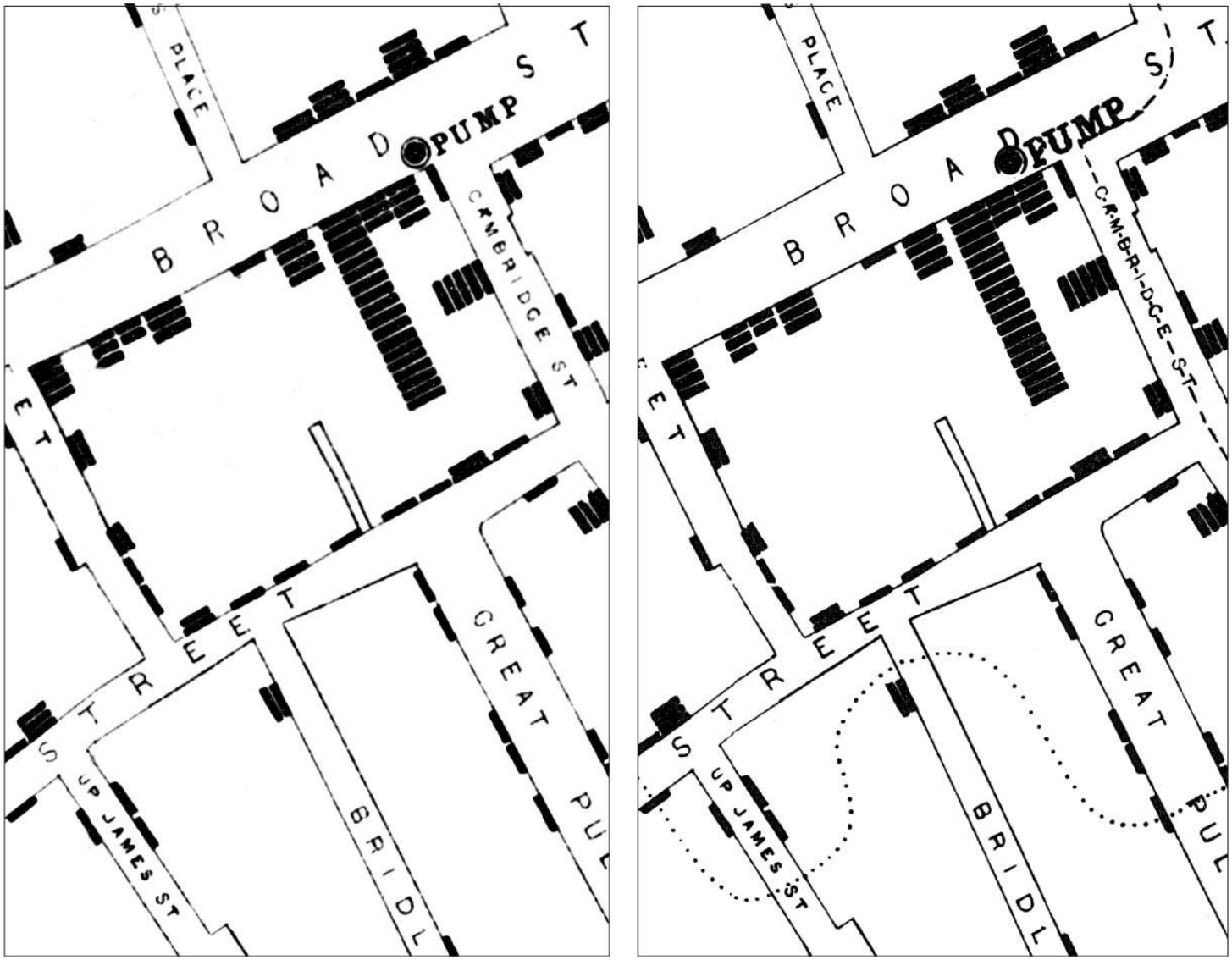
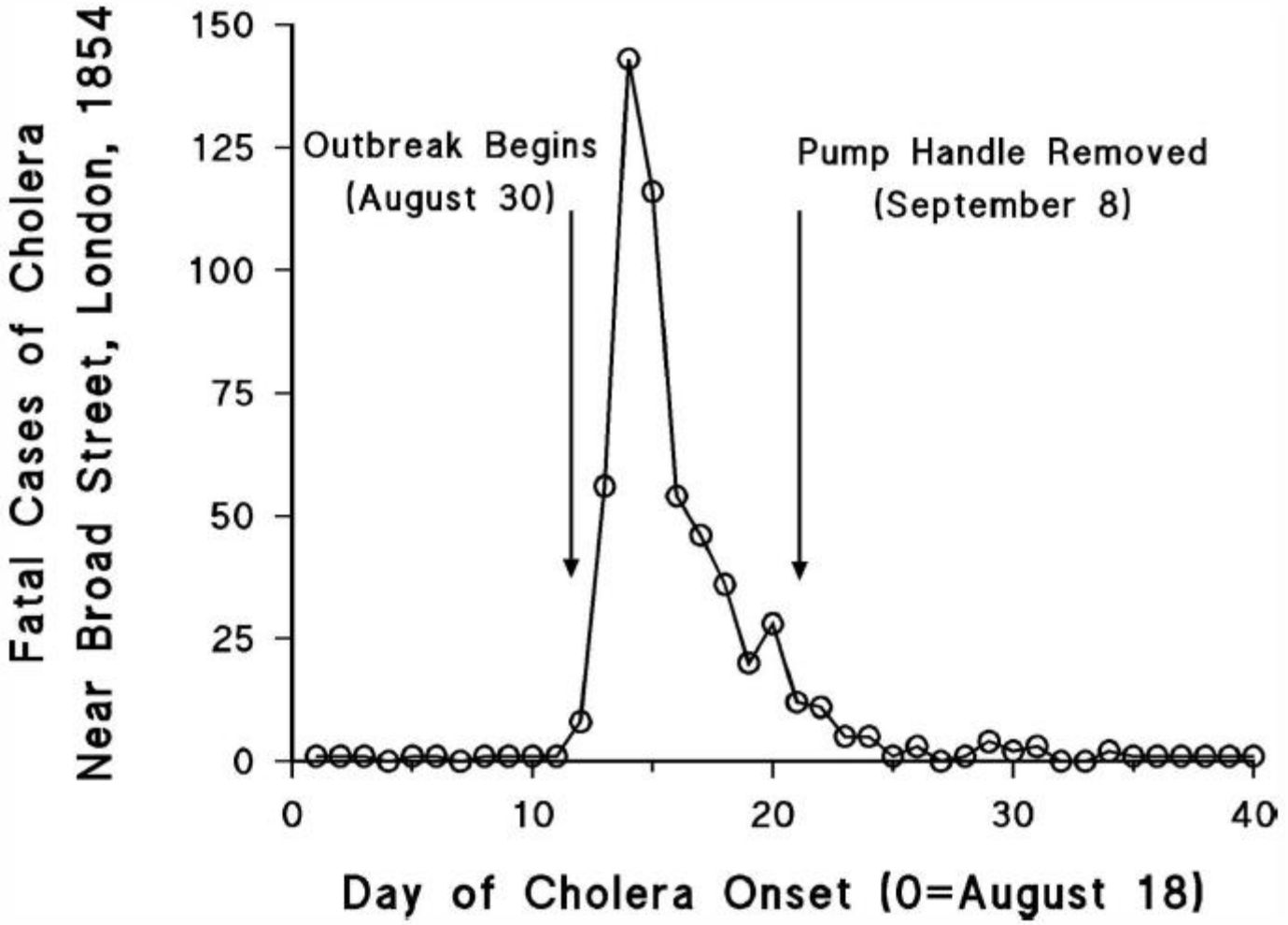


Original map by Dr. John Snow showing the clusters of cholera cases in the London epidemic of 1854


PLACE
BROAD ST
PUMP
CAMBRIDGE ST
GREAT
BRIDL
UP JAMES ST


Fatal Cases of Cholera
Near Broad Street, London, 1854
150
125
100
75
50
25
0
Outbreak Begins
(August 30)
Pump Handle Removed
(September 8)
0
10
20
30
40
Day of Cholera Onset (0=August 18)

Dr. John Snow (1813~1858)

John Snow memorial and public house

John Snow memorial pl

york.ac.uk/healthsciences/news-and-events/news/2017/js-memorial-pump

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Descendants of pioneering 19th Century York doctor who beat cholera to unveil memorial

Posted on 10 March 2017

A memorial is to be unveiled next week in honour of the pioneering York doctor who identified that cholera is a waterborne disease.

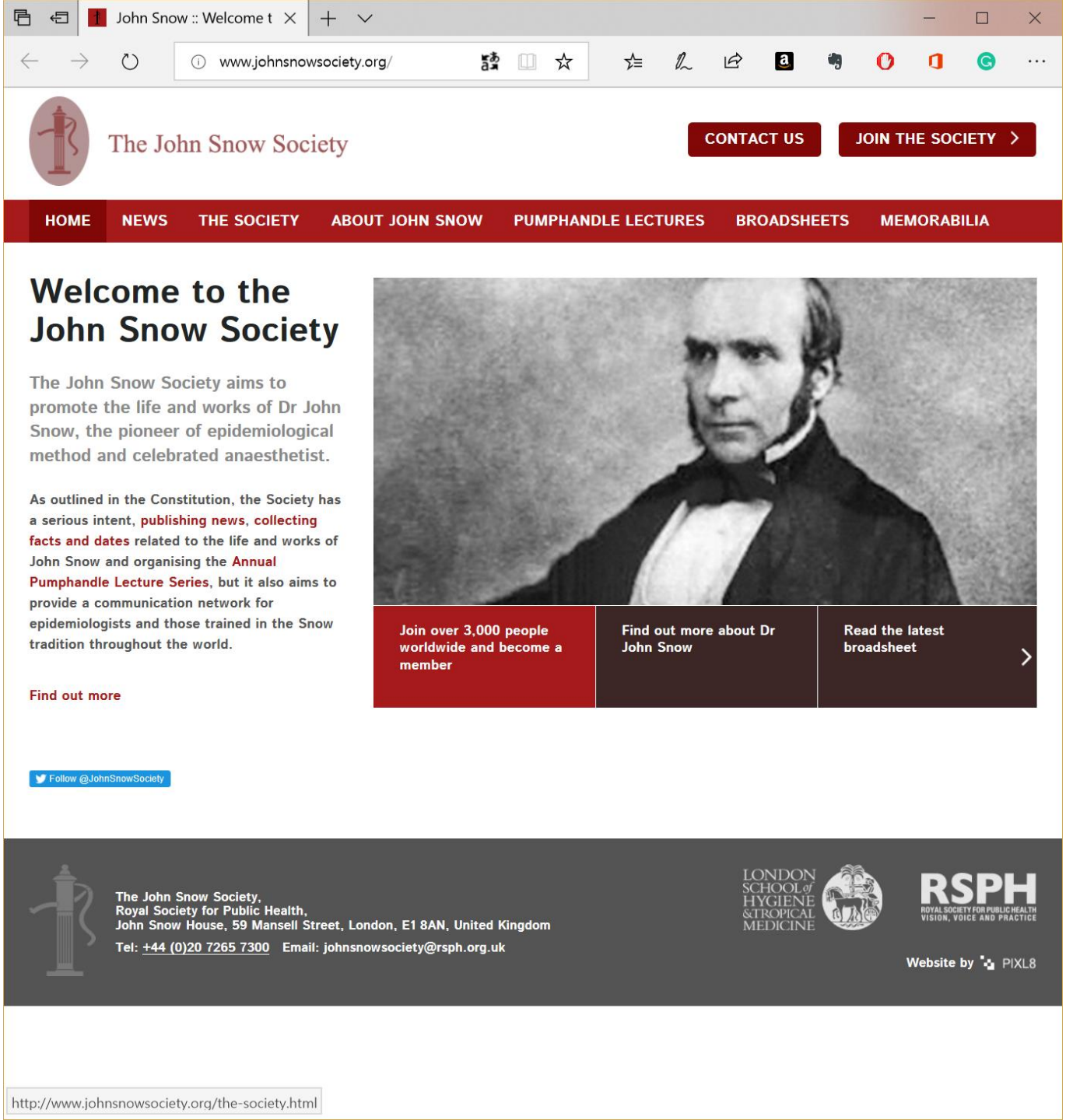
Dr John Snow is considered one of the fathers of modern epidemiology, in part because of his work in tracing the source of a cholera outbreak in Soho, London, in 1854. The only recognition of his achievements in his home town of York is a small blue plaque in North Street – noting that Dr Snow was born there.

HANDLE REMOVED

An initiative, led by York Civic Trust, York Medical Society and the University of York, is ensuring that York has a more fitting memorial in North Street Gardens.

Descendants of Dr Snow, including his great-great-nephew, Geoff Snow, will attend the unveiling of a new memorial, a Victorian water pump, on 15 March.

The water pump, with its handle removed, signifies the event in London in 1854 when Dr Snow persuaded the authorities to remove the handle from the street pump he was convinced was the source of the cholera epidemic.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THE SOCIETY
ABOUT JOHN SNOW
PUMPHANDLE LECTURES
BROADSHEETS
MEMORABILIA
Welcome to the John Snow Society
The John Snow Society aims to promote the life and works of Dr John Snow, the pioneer of epidemiological method and celebrated anaesthetist.
As outlined in the Constitution, the Society has a serious intent, publishing news, collecting facts and dates related to the life and works of John Snow and organising the Annual Pumphandle Lecture Series, but it also aims to provide a communication network for epidemiologists and those trained in the Snow tradition throughout the world.
Find out more
Join over 3,000 people worldwide and become a member
Find out more about Dr John Snow
Read the latest broadsheet
Follow @JohnSnowSociety
The John Snow Society,
Royal Society for Public Health,
John Snow House, 59 Mansell Street, London, E1 8AN, United Kingdom
Tel: +44 (0)20 7265 7300 Email: johnsnowsociety@rsph.org.uk
LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE
RSPH
ROYAL SOCIETY FOR PUBLIC HEALTH
VISION, VOICE AND PRACTICE
Website by PIXL8
http://www.johnsnowsociety.org/the-society.html

John Snow :: Memorabi

www.johnsnowsociety.org/memorabilia

The John Snow Society

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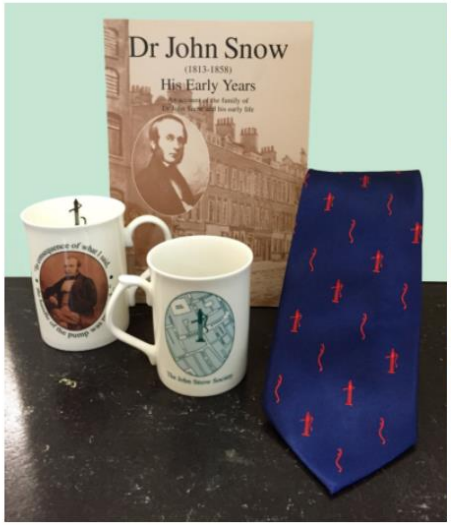
Memorabilia

Take a look at the John Snow memorabilia items we have for sale



Mugs £10 (not inc. postage)

Ties £15 (not inc. postage)

Books £10 (not inc. postage)

If you wish to purchase any memorabilia items please email us stating your order and a delivery address.

If you would like to pay with card please include a phone number so that we can contact you to arrange payment. Cheques and cash can be sent through the post to John Snow Society, RSPH, 59 Mansell Street, London, E1 8AN.

All items will be charged £4 for delivery within Europe and £5 for delivery outside of the UK.

The John Snow Society,
Royal Society for Public Health,
John Snow House, 59 Mansell Street, London, E1 8AN, United Kingdom
Tel: +44 (0)20 7265 7300 Email: johnsnowsociety@rsph.org.uk

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

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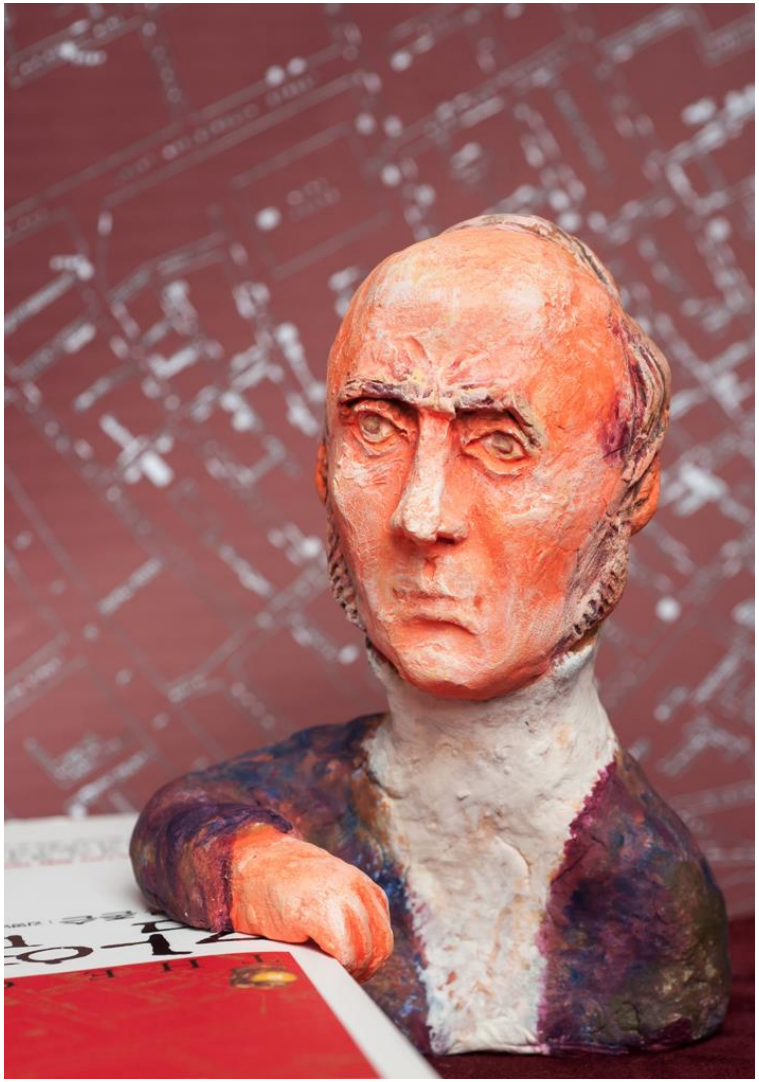
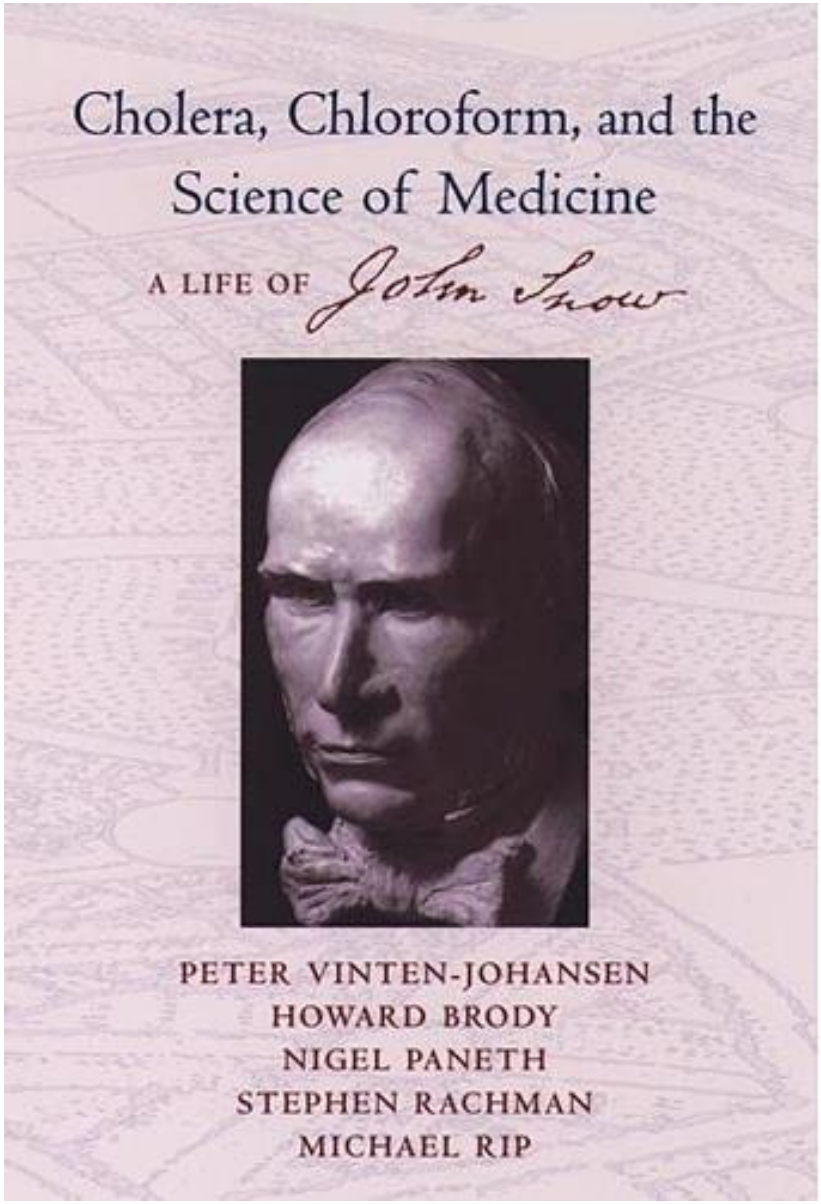
[김태권의 인간극장] 전염병과 대결한 존 스노 (1813~1858)



한때는 콜레라가 미아스마라는 독기 때문에 생긴다고 했다. 그런데 본디 미아스마란 '공동체를 오염시키는 개인의 죄'를 이르는 그리스말이었다. 옛날에는 전염병을 개인 탓으로 돌렸던 것이다.

젊은 의사 존 스노가 역사를 바꾸었다. 19세기 중반 런던에 콜레라가 돌자 한집 한집 꼼꼼한 조사 끝에 환자 통계 지도를 그려 오염된 물이 병의 원인임을 알아냈다. 황승식 교수(인하대 의대)는 "원인균조차 발견되기 전에 정확한 데이터에 근거해 콜레라 유행의 원인을 밝힌 존 스노는 현대 역학의 아버지라 불린다"며 그의 업적을 기린다. 오늘날 건강은 개인만이 아니라 국가가 함께 책임지는 문제다. 그래야 근대국가다.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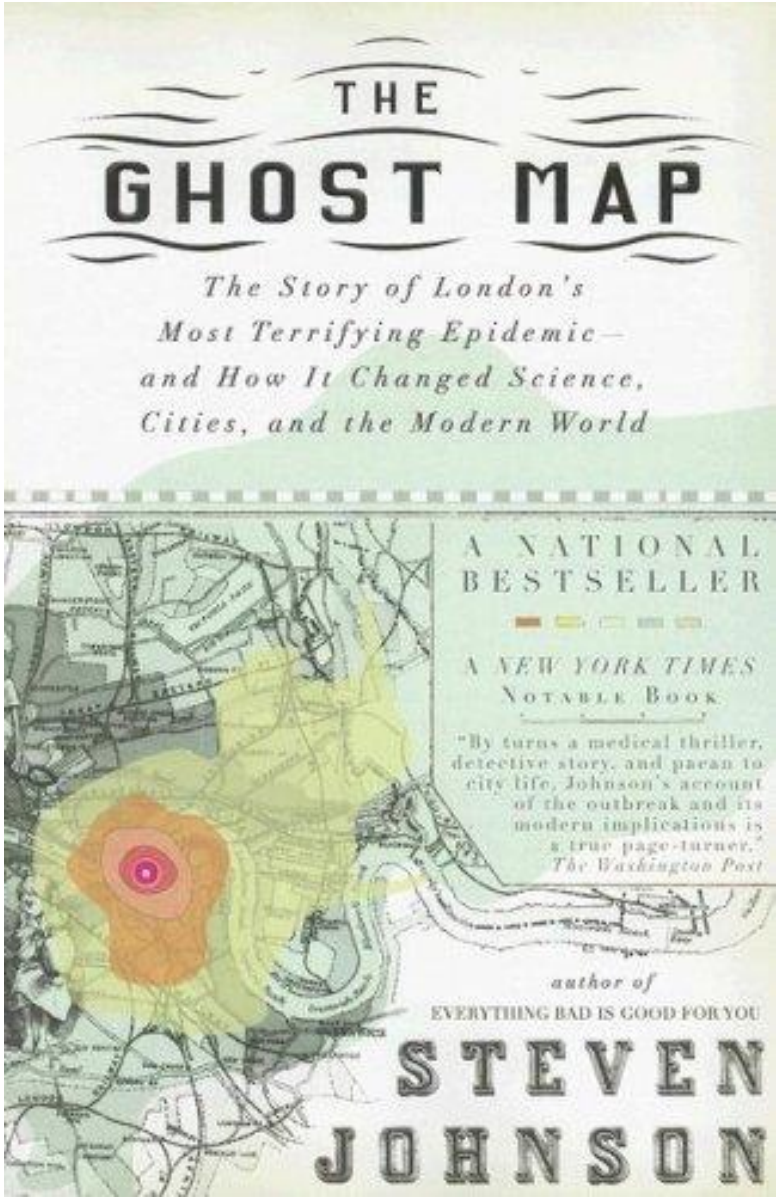
A LIFE OF John Snow
PETER VINTEN-JOHANSEN
HOWARD BRODY
NIGEL PANETH
STEPHEN RACHMAN
MICHAEL RIP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대규모 전염병의 도전과 현대 도시문명의 미래

감염지도

스티븐 존슨 | 김명남 옮김

세계화한 도시의 원형 19세기 런던에서 감염된 도시의 출구를 찾는다!

고병원성 AI, 광우병, 말라리아…
전염병의 대반격에 직면한 21세기
타성에서 탈피한 새로운 감염지도는 어떻게 만들어야 하는가?

감영사

2019-02-09

세상을 바꾼 의학의 10대 발견

- 의학의 탄생
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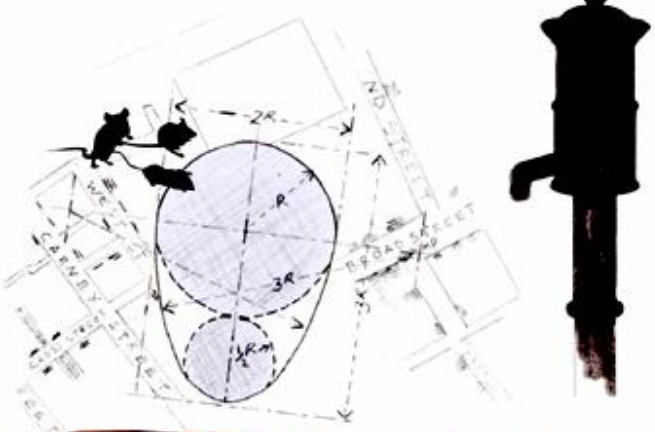
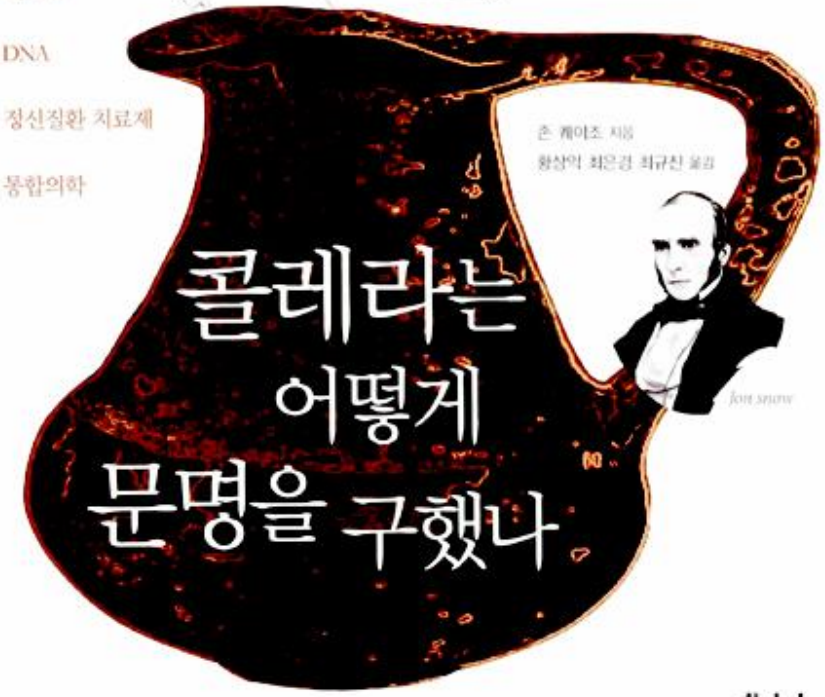
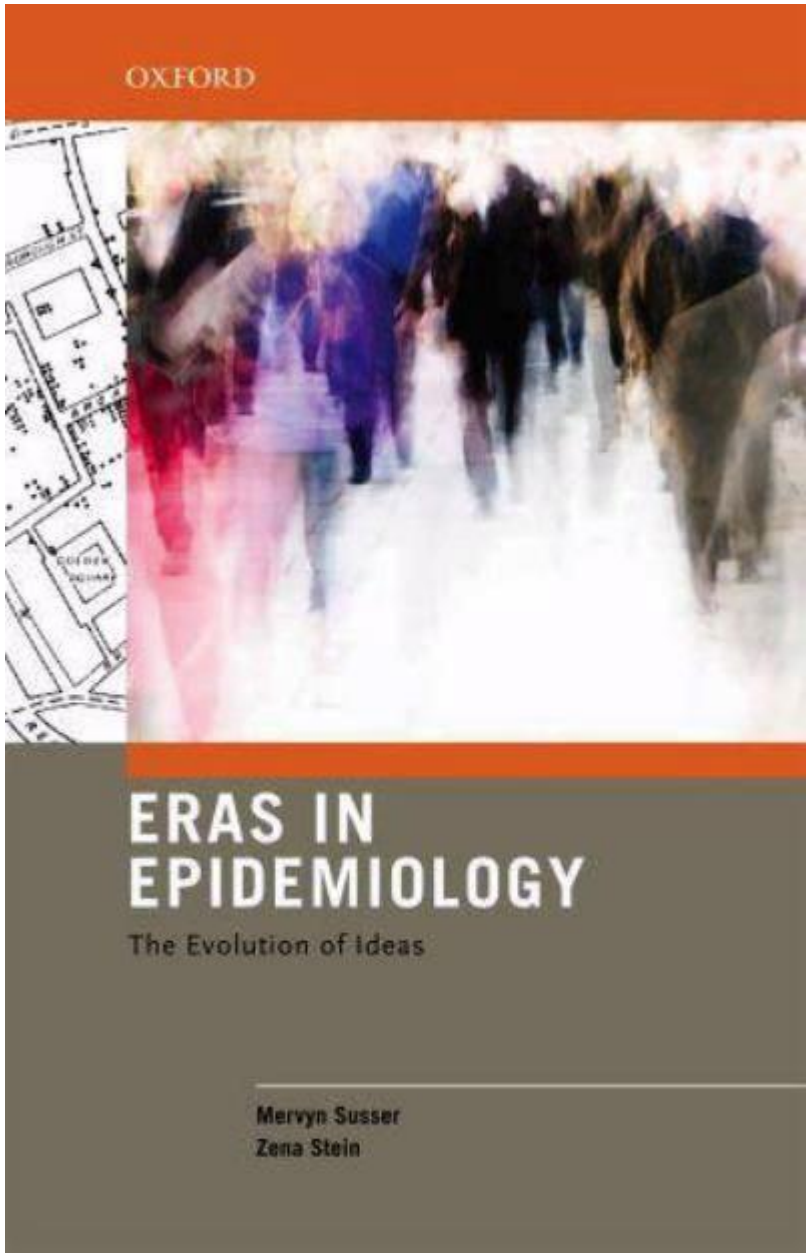
- 세균 마취
- 엑스선
- 백신
- 항생제
- DNA
- 정신질환 치료제
- 통합의학





민음사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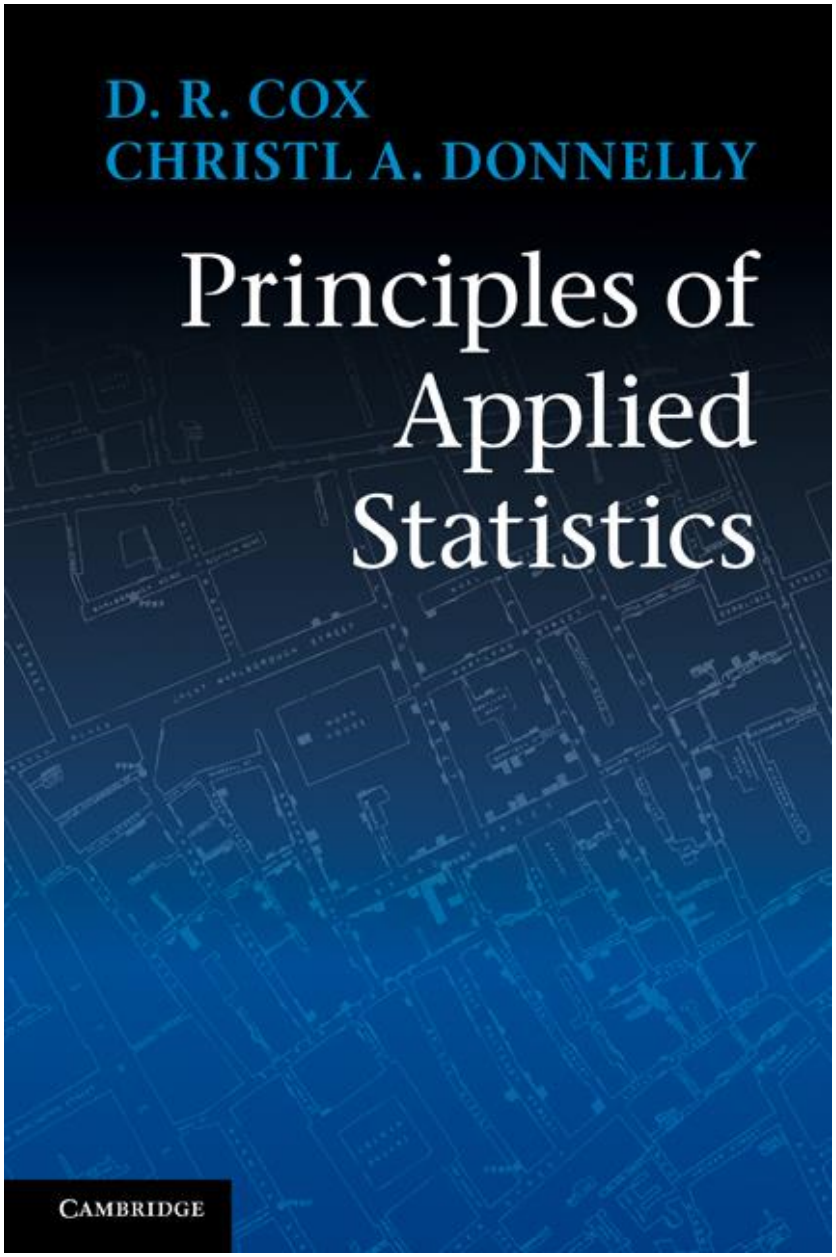
ERAS IN EPIDEMIOLOGY
The Evolution of Ideas
Mervyn Susser
Zena Stein


D. R. COX
CHRISTL A. DONNELLY
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John Snow's cholera ×

www.theguardian.com/news/datablog/interactive/2013/mar/15/cholera-map-john-snow-

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John Snow's cholera map of London recreated

What would John Snow's famous cholera map look like on a modern map of London, using modern mapping tools? The map changed what we know about germs and disease – and created a new way of looking at the world. With the help of mapping tool CartoDB and using the Stamen style maps, this is how it looks with larger circles representing more deaths. What do you think?

- Debate and download the data behind this map

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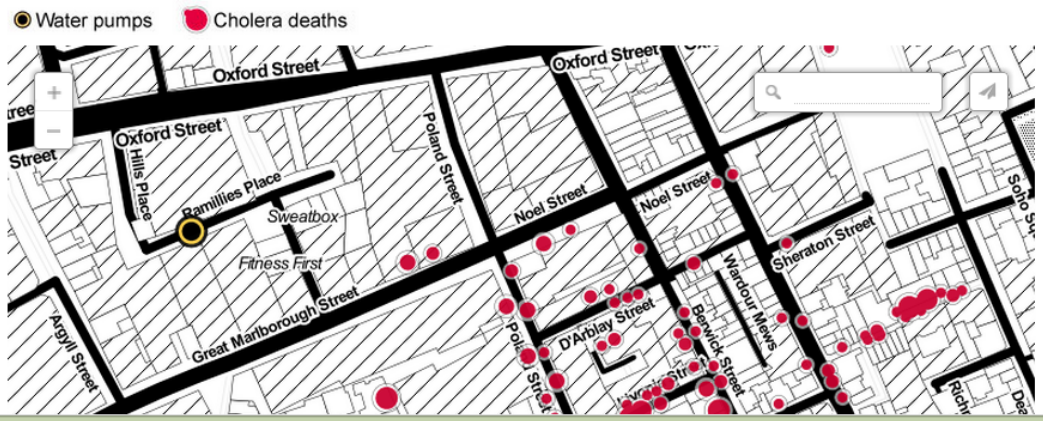
Simon Rogers
theguardian.com, Friday 15 March 2013 09.29 GMT



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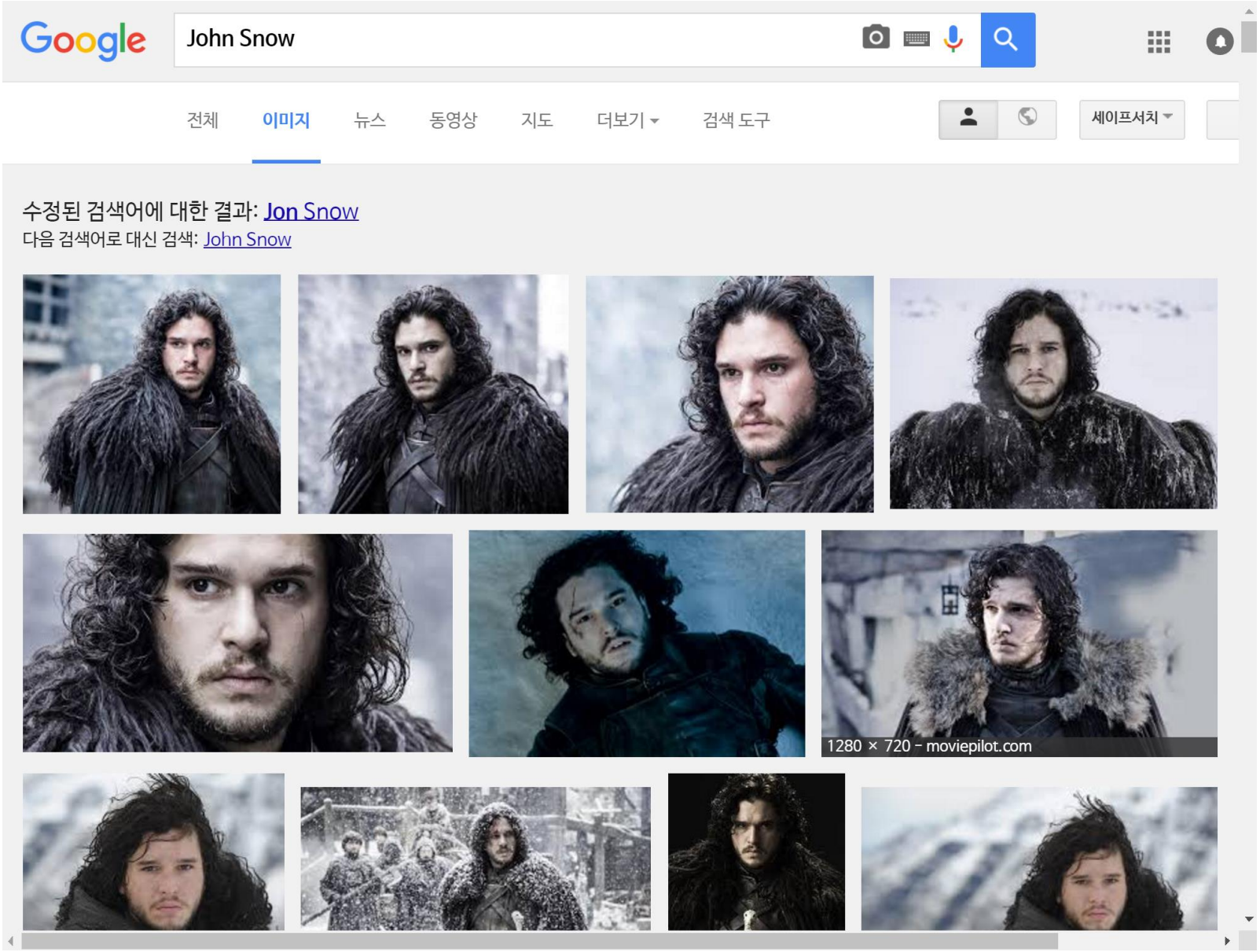
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다음 검색어로 대신 검색: John Snow
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A Review of Spatial Methods in Epidemiology, 2000–2010

Amy H. Auchincloss,[1] Samson Y. Gebreab,[2] Christina Mair,[3] and Ana V. Diez Roux[2]

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[2]Department of Epidemiology, University of Michigan School of Public Health, Ann Arbor, Michigan 48109; email: samsong@umich.edu, adiezrou@umich.edu

[3]Prevention Research Center, University of California, Berkeley, California 94704; email: cmair@prev.org

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This article's doi: 10.1146/annurev-publhealth-031811-124655

0163-7525/12/0421-0107$20.00

Keywords

geographic information systems, epidemiologic methods, spatial distribution, geography, space-time clustering

Abstract

Understanding the impact of place on health is a key element of epidemiologic investigation, and numerous tools are being employed for analysis of spatial health-related data. This review documents the huge

Table 1 Articles published January 1, 2000 through February 28, 2011, in seven target journals and number (and percent) of articles that utilized a spatial analysis method (see search criteria in text)

Journal name	Stage 1 All citations *N*	Stage 2 After applying broad search terms *N*	%	Stage 3 Selected for inclusion *N*	%
American Journal of Epidemiology	3,239	1,225	38%	52	2%
American Journal of Public Health	3,442	1,293	38%	30	1%
Annals of Epidemiology	1,228	415	34%	21	2%
Epidemiology	1,177	419	36%	44	4%
European Journal of Epidemiology	1,290	570	44%	11	1%
International Journal of Epidemiology	1,466	712	49%	15	1%
Journal of Epidemiology and Community Health	1,921	1,007	52%	34	2%
Total	13,763	5,641	41%	207	1%

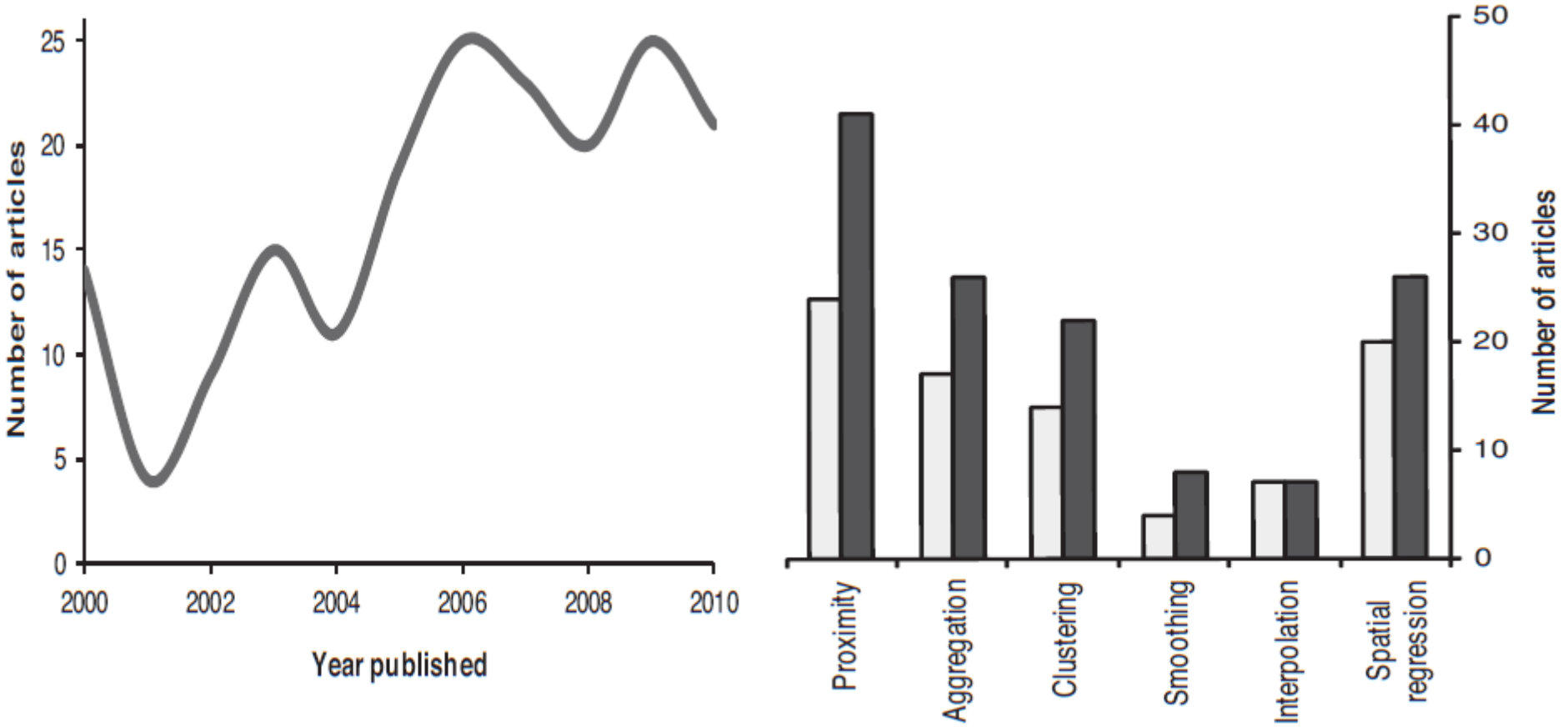

Figure 1

Number of articles using spatial methods, total by year and total for first part of decade and second part of decade (2000–2011).

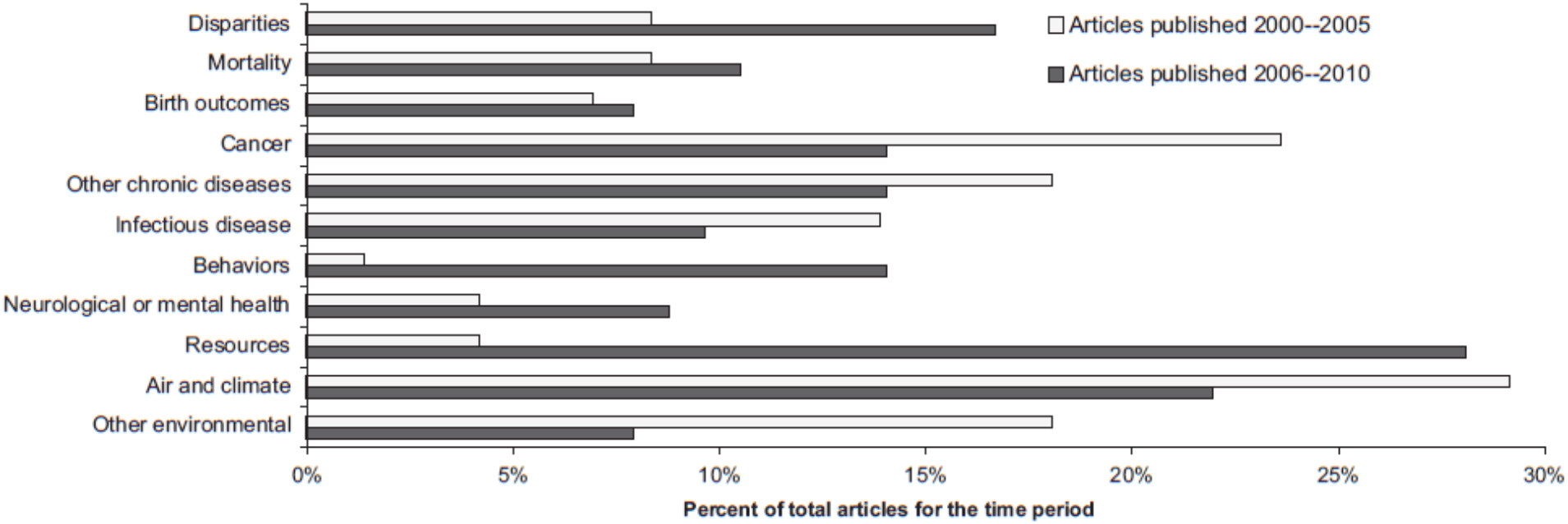

Figure 2

Percent of total articles using spatial methods by substantive topic and publication during the first (2000–2005) and second parts of decade (2006–2010). "Resources" category includes health care, food and physical activity environments, facility location analyses, etc.; "Other environmental" includes toxic waste, pesticides, electromagnetic fields, etc.

2. 공간 역학의 원리와 기회

Contents lists available at ScienceDirect

Spatial and Spatio-temporal Epidemiology

journal homepage: www.elsevier.com/locate/sste

Review Article

Spatio-temporal epidemiology: Principles and opportunities

Jaymie R. Meliker *, Chantel D. Sloan

Graduate Program in Public Health, Department of Preventive Medicine, Stony Brook University, HSC L3 Rm 071, Stony Brook, NY 11794-8338, USA

ARTICLE INFO

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Accepted 5 October 2010

Keywords:
Geographic information systems
Global positioning systems
Residential mobility
Small area analysis
Space–time clustering
Uncertainty

ABSTRACT

Space–time analysis of disease data has historically involved the search for patterns in aggregated data to identify how regions of high and low risk change through time. Space–time analysis of aggregated data has great value, but represents only a subset of space–time epidemiologic applications. Technological advances for tracking and mapping individuals (e.g., global positioning systems) have introduced mobile populations as an important element in space–time epidemiology. We review five domains critical to the developing field of spatio-temporal epidemiology: (1) spatio-temporal epidemiologic theory, (2) selection of appropriate spatial scale of analysis, (3) choice of spatial/spatio-temporal method for pattern identification, (4) individual-level exposure assessment in epidemiologic studies, and (5) assessment and consideration of locational and attribute uncertainty. This review provides an introduction to principles of space–time epidemiology and highlights future research opportunities.

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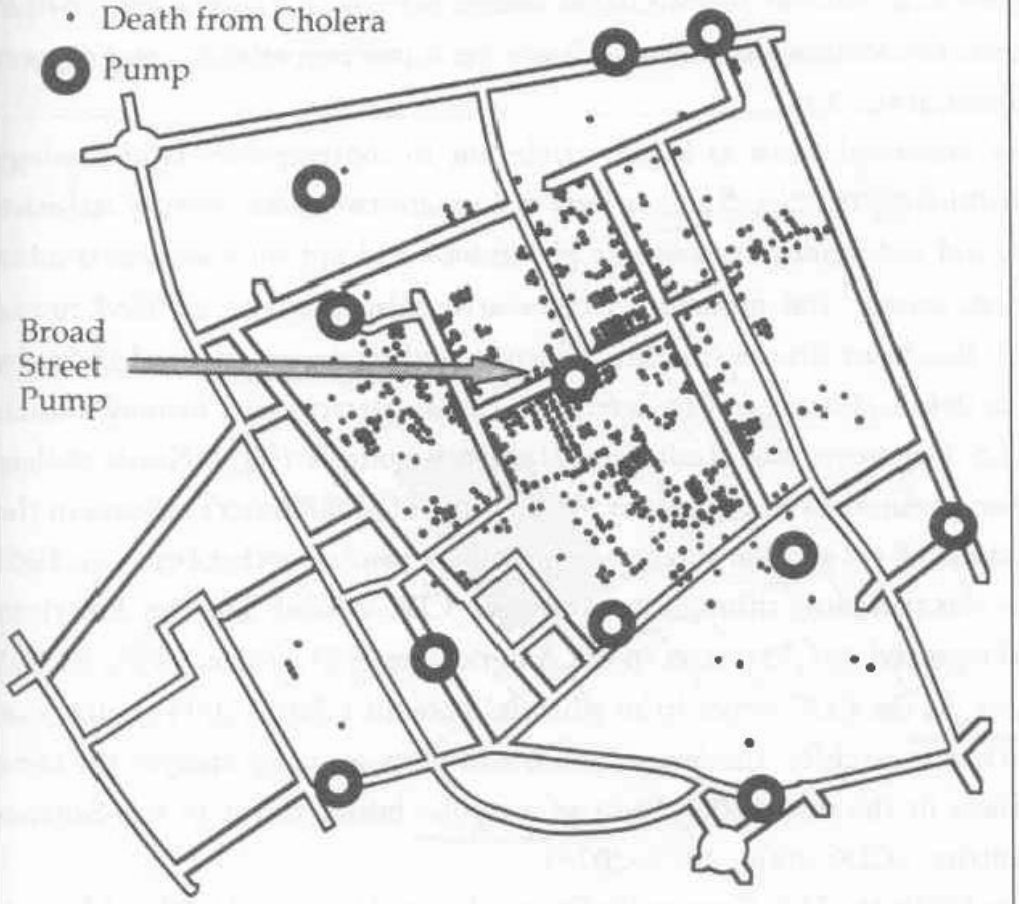
  - 만성 질환의 공간 분석이 과거 거주 및 고용에 대한 풍부한 이동 기록으로 확대
  - 시공간 역학 연구 진행을 위해 질병 생물학 이해가 중요
- 기회
  - 시공간 역학 분석에서 질병 생물학에 기반한 더 나은 전략 개발

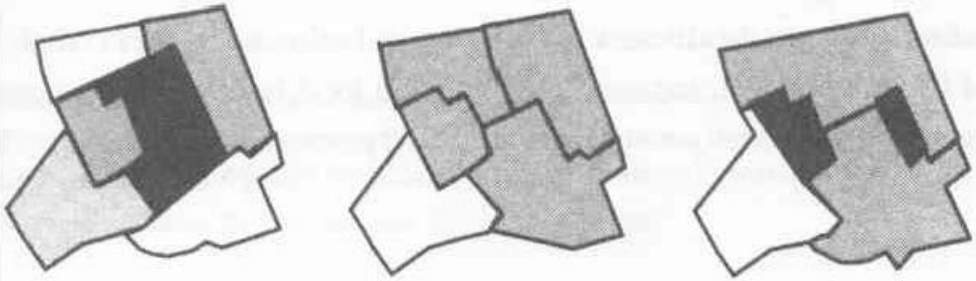
분야: 적절한 분석 척도 선택

- 원리
  - 지리적 단위로 합친 데이터는 작은 건수 문제, 변경 가능 지역 문제(modifiable area unit problem, MAUP), 생태학적 오류, 시간에 따른 지리적 단위 경계 변경으로 고생스러움.
  - 질병 과정 이론이 분석을 위한 공간 척도 선택 지침이 되어야 함.
  - 개인 단위 추론을 위해, 개인 수준 데이터를 이용해야 함.
  - 개인 수준 및 집합 데이터 모두 질병 위험 지도 표현에 이용 가능.
- 기회
  - 개인 수준 데이터 분석 확대를 위해 개인 정보 보호된 공간 위치 데이터 공유를 위한 프로토콜 개발
  - 분석 척도에서 언제 어떻게 집합 데이터가 접근 가능한지 지침과 규정 확인

Snow's Dot Map



Areal Aggregations and Density Symbols



분야: 유형 식별을 위한 기법 선택

- 원리
  - 귀무 가설 아래 알려진 위험 요인 설명을 위한 유형 분석이 새로운 원인 요인 발굴 가능
  - 공간 유형 분석을 위한 통계량은 많음. 개별 데이터셋에서 적절한 통계량 선택은 간단하지 않음.
  - 이동 인구집단에서 유형 탐지를 위해 새로운 통계량이 개발 중.
- 기회
  - 사용자가 주어진 데이터셋에 가장 적절한 통계량 선택이 가능한 접근 개발
  - 이동 기록을 설명할 통계량 개발 지속

분야: 노출 평가

- 원리
  - GIS가 환경 오염 노출 추정에 중요
  - GIS 기반 농도 추정을 통해 노출 추정 개선을 위해 원격 탐사 데이터나 이동 모형과 같은 다른 자료원과 연계 가능
  - 개인 기반 장기간 노출 추정은 환경 오염과 이동 기록에서 시공간 동학 협력 확대로 증가
- 기회
  - 환경 오염에서 시공간 데이터셋을 개발 유지하여 연구자가 연구 때마다 한 땀 한 땀 이을 필요가 없게 해야 함.
  - 이동이나 환경 오염의 시공간 데이터 기록 통합이 가치 있고 적절한 상황 확인

분야: 지역 및 속성 불확실성

- 원리
  - 시간에 따른 지역 및 속성의 불확실성 정량화로 시공간 역학 분석 개선
  - 정량화한 후 불확실성은 시공간 분석, 노출 평가, 역학적 분석으로 전파 가능
- 기회
  - 연구자가 시공간 역학 분석에서 불확실성의 영향을 평가할 수 있는 접근 방법 개발
  - 공간 유형 분석, 노출 평가, 역학적 분석에서 불확실성 확산 기법 개발 지속

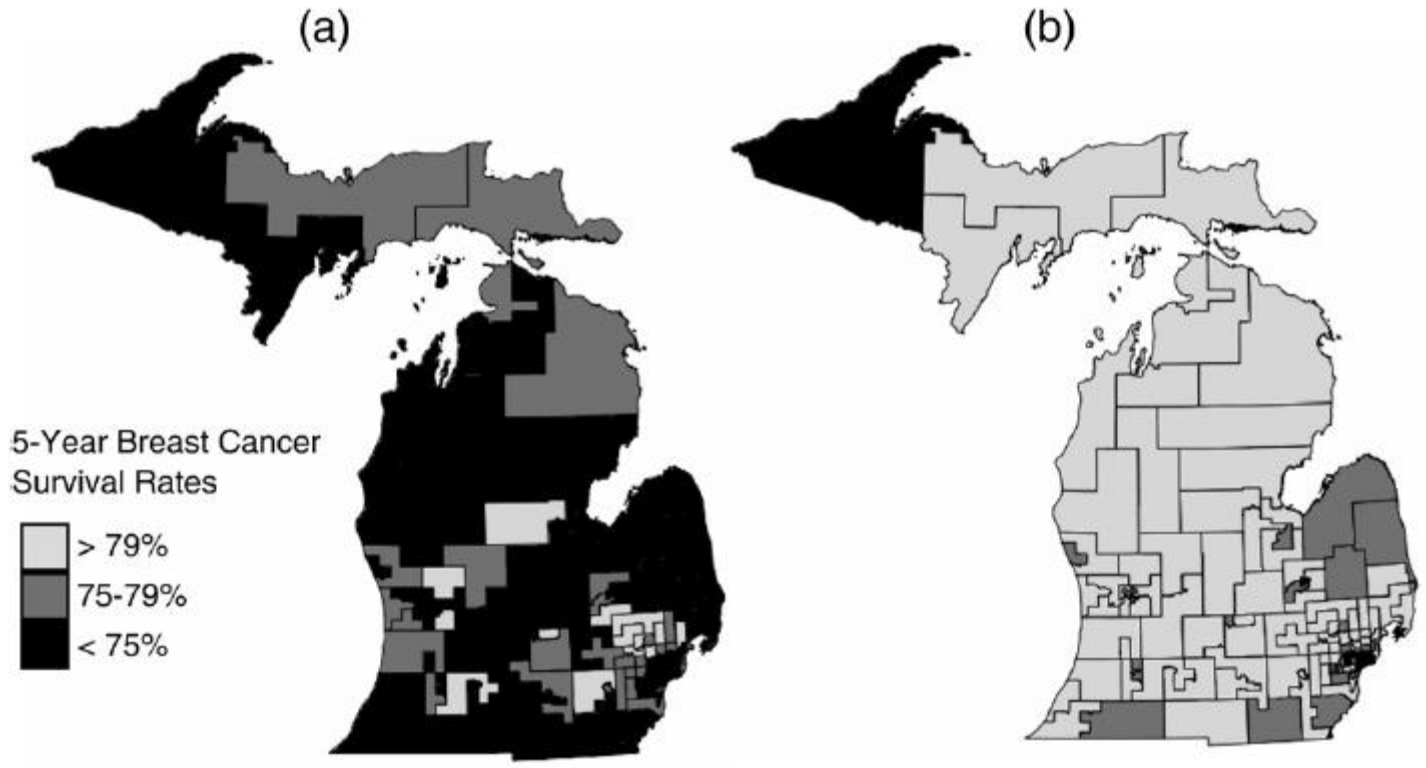


Fig. 1. Five-year survival rates for breast cancer in Michigan state house congressional districts in (a) 1988 and (b) 1996.

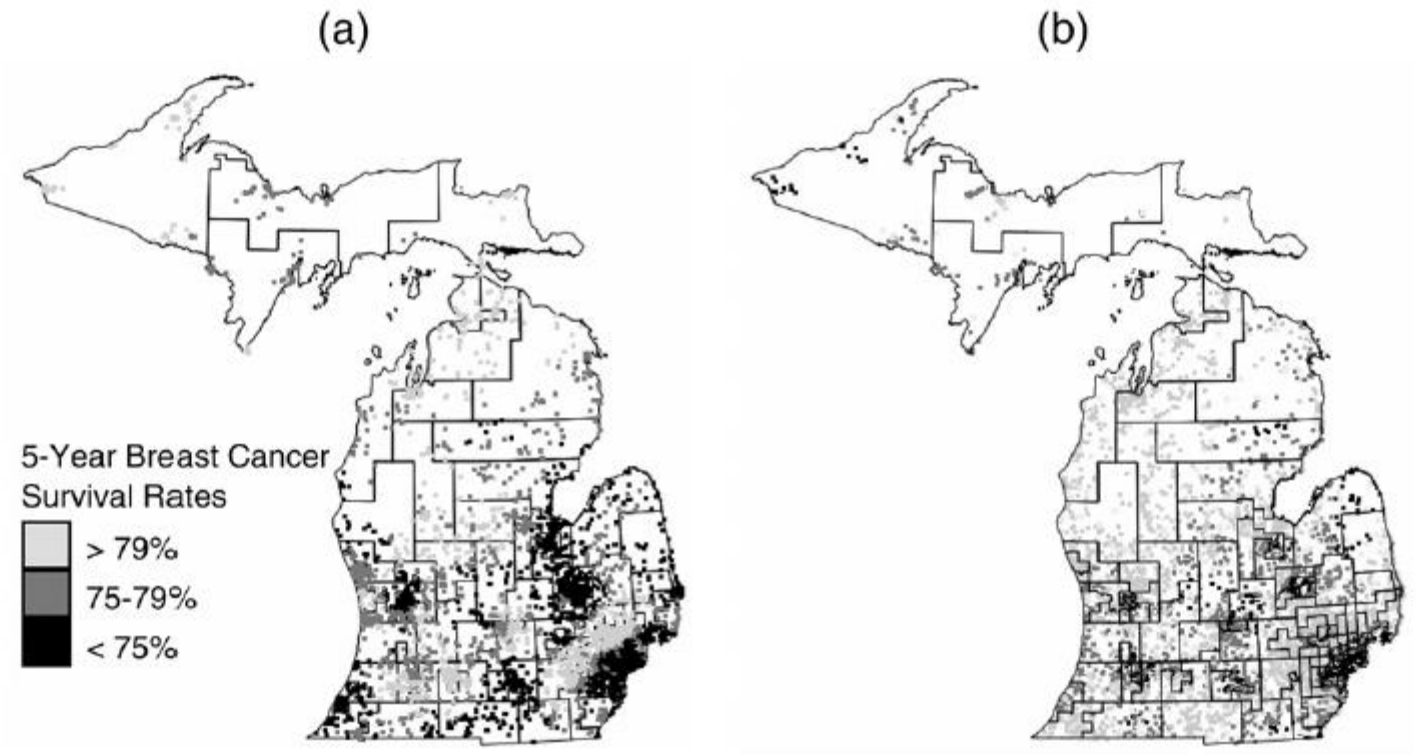
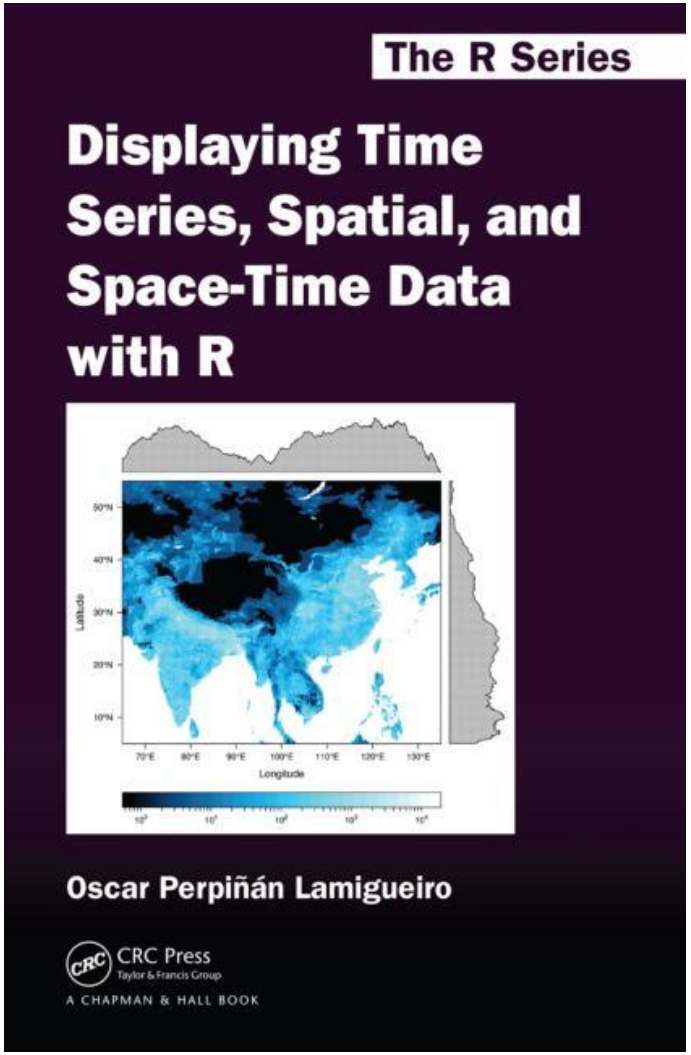


Fig. 2. Five-year survival rates for breast cancer in (a) 1988 and (b) 1996 using individual case locations. Rate estimates calculated as a proportion of 5-year survivors among $k = 200$ nearest neighbors of each breast cancer case. Locations joggled to protect confidentiality.

기술역학에서
시간/공간/시공간 자료의 시각화



Displaying time serie ×

https://oscarperpinan.github.io/spacetime-vis/

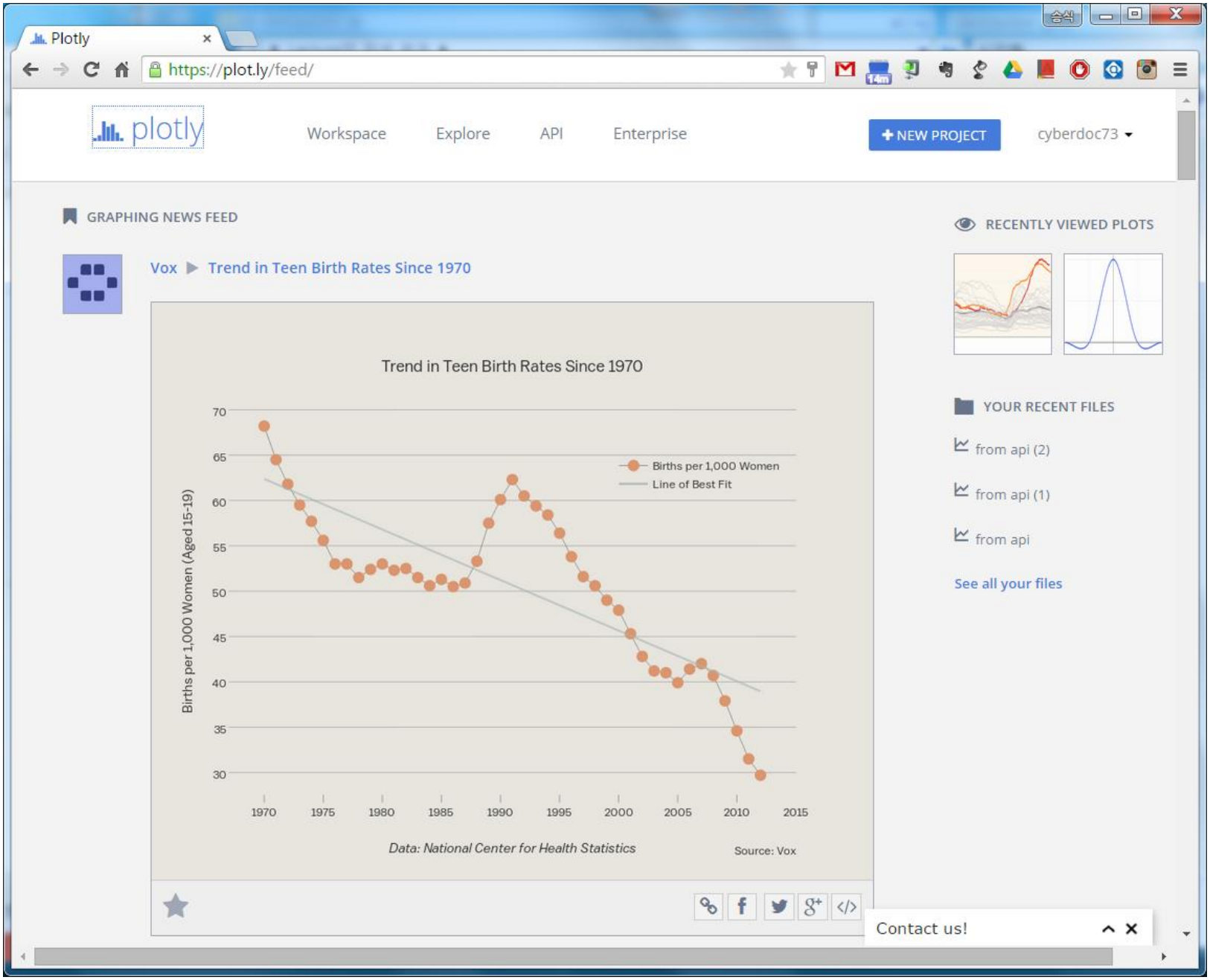
Displaying time series, spatial and space−time data with R

This is the accompanying website of the book published with Chapman&Hall/CRC, a project created and maintained by Oscar Perpiñán Lamigueiro. View the Project on GitHub.

Focusing on the exploration of data with visual methods, **Displaying Time Series, Spatial, and Space−Time Data with R** presents methods and R code for producing high−quality graphics of time series, spatial, and space−time data. Practical examples using real−world datasets help you understand how to apply the methods and code. The book illustrates how to display a dataset starting with an easy and direct approach and progressively adding improvements that involve more complexity. Each of the book's three parts is devoted to different types of data. In each part, the chapters are grouped according to the various visualization methods or data characteristics.

Along with the main graphics from the text, this website offers access to the datasets used in the examples as well as the full R code. This combination of freely available code and data enables you to practice with the methods and modify the code to suit your own needs.

Time Series


Plotly
https://plot.ly/feed/
plotly
Workspace
Explore
API
Enterprise
+ NEW PROJECT
cyberdoc73
GRAPHING NEWS FEED
Vox ▶ Trend in Teen Birth Rates Since 1970
Trend in Teen Birth Rates Since 1970
Births per 1,000 Women (Aged 15-19)
Births per 1,000 Women
Line of Best Fit
70
65
60
55
50
45
40
35
30
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Data: National Center for Health Statistics
Source: Vox
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from api (1)
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Satellite time-lapse shows changes on the ground

MAY 19 2015 | MAPPING | TAGS: SATELLITE, TIME-LAPSE

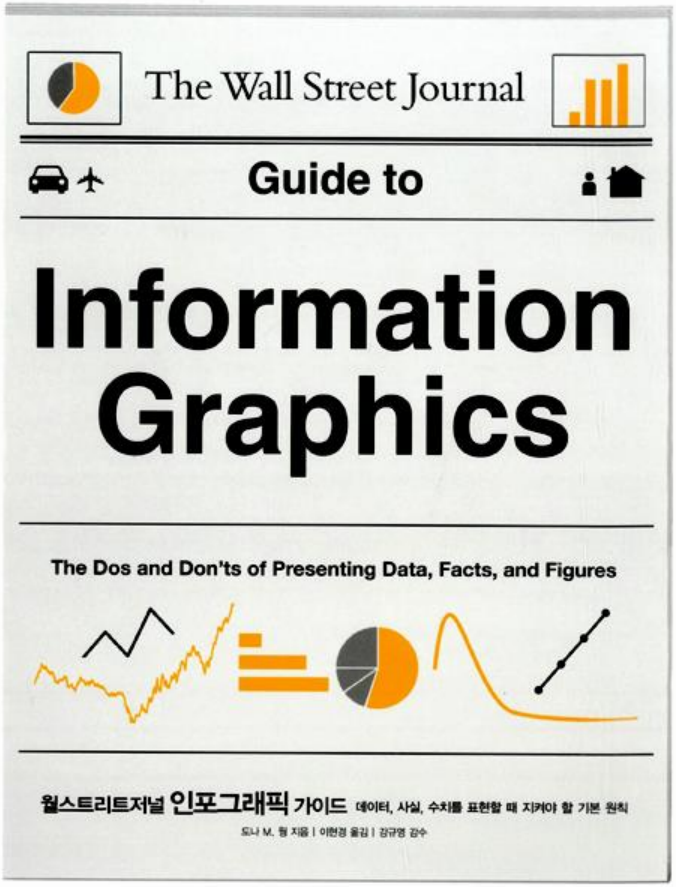
Since the 1970s, NASA has used satellites to take pictures of the Earth's surface. This is an ongoing process, so when you string together the photos and play them out like a flip book, you see dramatic changes where cities boom, bodies of water dry up, and forests disappear. This is the motivation behind Earthshots, available for viewing via USGS.

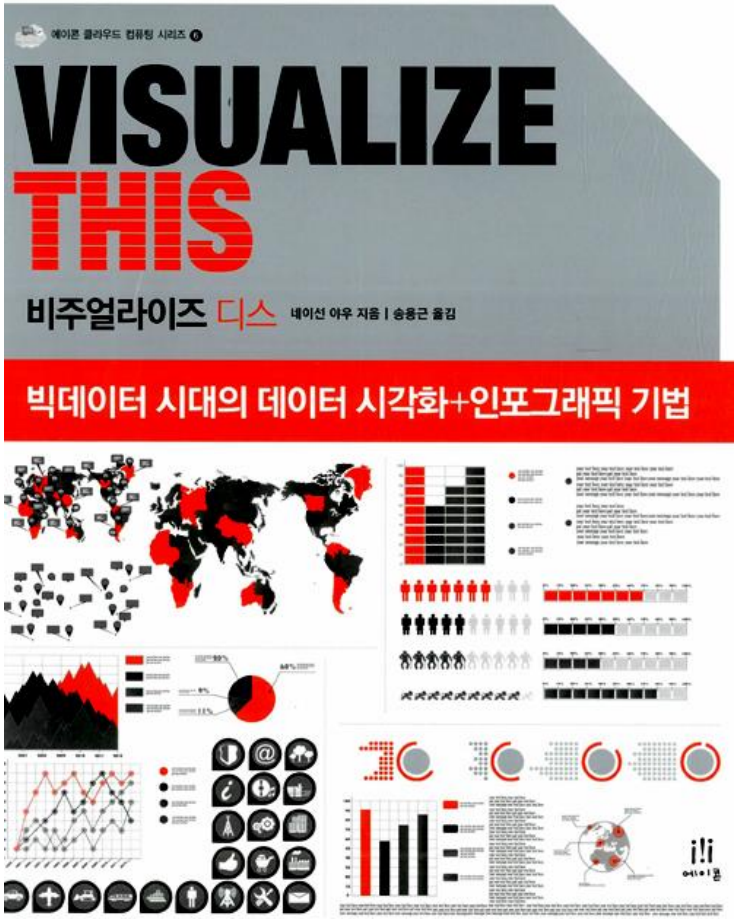
CONTINUE READING

PROJECTS

Where Subway Dominates Its Sandwich Place Competition, Basically Everywhere

As of this writing, there are over 27,000 Subway restaurants in the United States and about 16,000 locations in other countries, putting the total count at around 43,000. In contrast,...


The Wall Street Journal
Guide to
Information Graphics
The Dos and Don'ts of Presenting Data, Facts, and Figures
월스트리트저널 인포그래픽 가이드 데이터, 사실, 수치를 표현할 때 지켜야 할 기본 원칙
도나 M. 팅 지음 | 이현경 옮김 | 강규영 감수


VISUALIZE THIS
비주얼라이즈 디스
네이선 야우 지음 | 송용근 옮김
빅데이터 시대의 데이터 시각화+인포그래픽 기법

기술역학에서 공간자료

- 공간 역학
  - 질병 지도화, 지리적 상관성 연구, 질병 군집을 아울러,
  - 환경, 행동, 사회인구학적 위험 요인과 관련된 질병의 지리적 변이를 기술하고 분석
- 지난 수 십 년간 지리적 역학 연구의 발전은 컴퓨터, GIS, 공간 통계의 발전에 기인
- 많은 국가에서 고해상도 보건지리 데이터와 환경 데이터 산출 → 소지역 규모의 공간 분석 촉진
- 소지역 질병 위험도는 랜덤 요소의 영향이 크므로, 질병 위험을 '평탄(smooth)'하게 추정하는 베이지언(Bayesian) 통계를 이용하여 해결

- 기대 환례가 매우 적은 경우는 고위험 지역 선별 민감도가 떨어져 제한적
- 데이터 질도 결정적인 문제 → 데이터 오류가 연구 대상 특정 지역에서 명백한 질병 초과 위험 결과 초래
- 행정구역과 같은 인위적 경계가 부정확한 결과 초래 → MAUP : 공간 역학 연구 설계의 근본적 문제점

3. 공간 역학 연구 설계

연구 설계

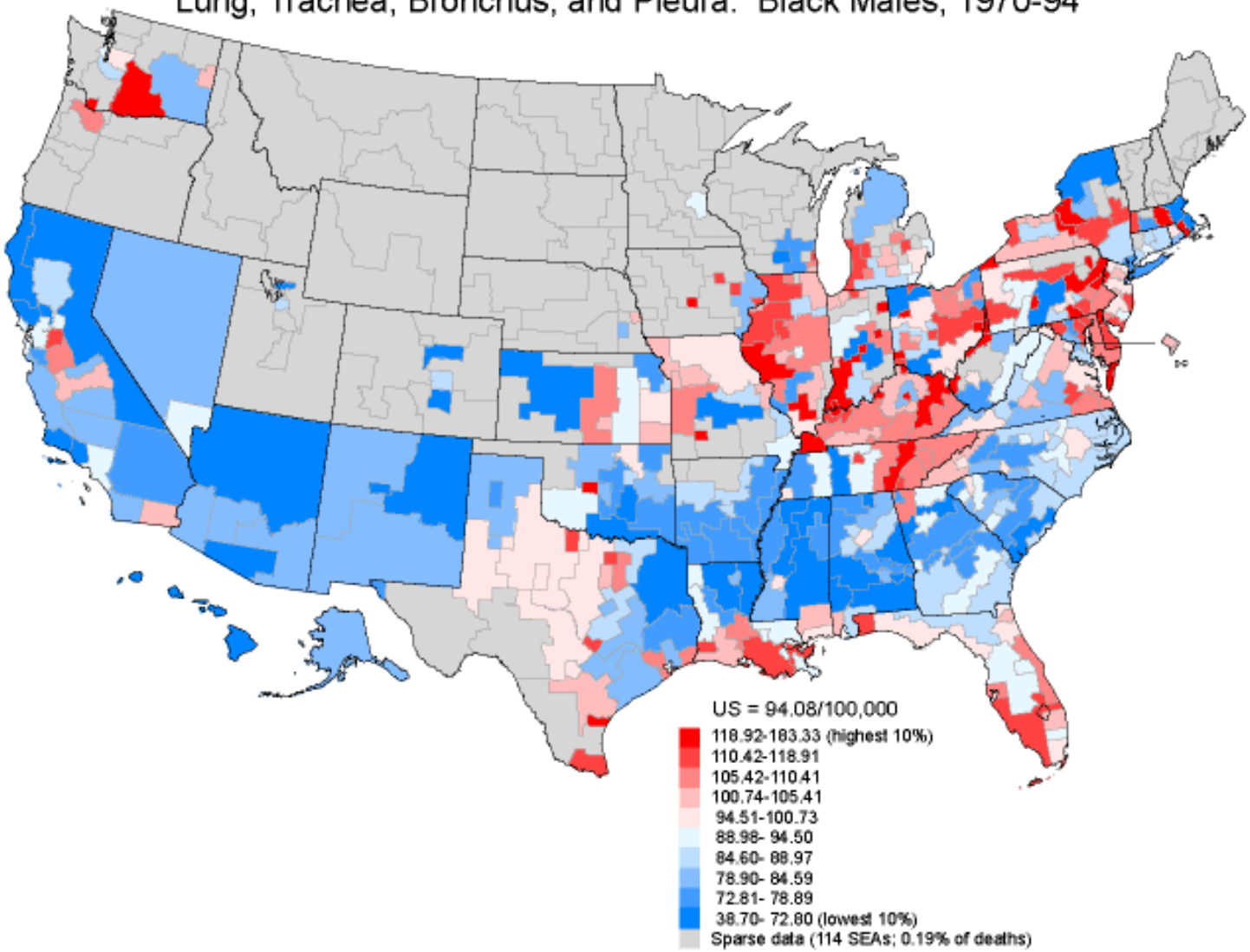
- 공간 역학 주요 연구 유형
  - 질병 지도화(Disease mapping) : 기술 연구
  - 지리적 상관성 연구(Geographical correlation studies) : 지리적 단위 비교 생태학적 연구
  - 군집 탐색(Cluster detection)
  - '오염원' 연구('Point source' studies) : 인과성 입증 근거 추가

질병 지도화 연구

- 질병 지도화에 근거한 기술 연구로 시간에 따른 질병 패턴의 변화를 파악 가능
- 질병 지도화는 노출과 질병 관련성에 대한 최초 가설 탐색에 유용
  - IARC 암 발생 및 암 사망 지도
  - US NCI 암 사망 지도
    (http://www3.cancer.gov/atlasplus/type.html)
    - 암 발생 패턴과 주요 제조업 산업단지 위치와의 생태학적 연구에 유용

Cancer Mortality Rates by State Economic Area (Age-adjusted 1970 US Population)

Lung, Trachea, Bronchus, and Pleura: Black Males, 1970-94



Thomas Mason, Robert Hoover, and Joseph Fraumeni examine a U.S. cancer mortality map in 1977.

- 정확한 소지역 질병 지도는 산출하고 해석하기 매우 어려움.
  - Small Area Health Statistics Unit (SAHSU)는 영국에서 선거구 단위 소지역 분석 결과, 환경적 요인과 전립샘암 발생의 지역적 변이 관련성 발견 못함 ← 잠재기간과 이주 요인 해석에 주의
- 소지역 질병 지도화에서 통계적 기법 선택은 매우 중요
  - 역학 연구 질병 위험 추정으로 표준화 발생 또는 사망비(standardized incidence or mortality ratio; SIR, SMR)를 주로 이용

- $SMR_i = O_i / E_i$
  - 관찰값과 기대값은 각각 푸아송 분포 가정
  - 기대값은 해당 지역 일반인구에서 연령, 성별 사망률(발생률)을 적용하여 산출
- 소지역 단위 드문 질환 연구의 경우 정확도 문제 발생
- 두 지역의 표준화비를 직접 비교 불가능
  - 이론적으로는 맞지만, 두 지역 인구집단 연령별, 성별 인구구조가 극도로 다르지 않는 이상 실제 비교 가능
  - 오히려 소지역 단위의 경우 직접 표준화율의 오류 큼.

지리적 상관성 연구

- 개인 수준보다 집단 수준으로 묶인 인구집단 정보를 이용한 연구로, 노출과 질병의 요약 통계량의 관련성 분석

$$y_i \sim \text{Poisson}(r_i E_i)$$
$$\log r_i = b_0 + \sum_k b_k X_{ik}$$

  - 인과성 추론 전 단계에서 가설 생성 목적 이용

그림 5 역학 연구의 위상학
Figure 5 Typology of Studies

		노출	
		x (개인 수준 측정)	X (집단 수준 측정)
결과	y (개인 수준 측정)	(y, x) 전통적 위험 요인 연구	(y, X) 다수준 연구
	Y (집단 수준 측정)	(Y, x)*	(Y, X) 생태학적 연구

* 이 유형의 연구를 현 상태로 특징짓기는 불가능하다. 실제적으로는 X가 단순히 x의 중심 경향이 되므로 생태학적 연구는 (Y, X)의 형태를 띠게 될 것이다. 만일 Y의 분해가 가능하여, y를 관찰할 수 있다면 이 때는 (y, x)와 같게 될 것이다.

출처: Subramanian SV, Jones K, Kaddour A, Krieger N. Revisiting Robinson: The perils of individualistic and ecologic fallacy. *Int J Epidemiol* 2009;38(2):342-360.

오염원 연구

- SAHSU 프로그램에서 공장과 같은 오염원과 건강 위험 탐색 연구 수행
  - 확산 모형 등으로 노출 범위 정의
  - 현재 노출 상태만 이용 가능한 경우, 만성 질환 평가에 어렵다는 제한점.
  - 확산 모형으로 수은 노출과 신장병 사망 연구 결과, 모형화한 대기중 수은 농도가 높을수록 신장병 사망 위험이 높음을 보고.

Rapid Inquiry Facility

- 영국 Small Area Health Statistics Unit에서 개발
- 환경 노출과 관련된 건강 위험 평가에 대한 통계, 공간 분석, 공간 역학 통합
- EU와 미국 CDC에서도 활용
  - European Health and Environment Information System for Exposure and Disease Mapping and Risk Assessment project
  - Environmental Public Health Tracking program
- 비주얼 베이직 어플리케이션으로 ESRI ArcGIS 9 버전 이상에서 작동

- 지역코드가 붙은 외부 공개 데이터베이스와 연계 장점
- 사용자 정의 거리 밴드, 지역, 하나 이상 점 또는 지역의 노출원에서 발생률과 비교 위험도 산출
- 직접 표준화율과 간접 표준화율 지도 제작
- Empirical Bayesian 추정 비교 위험도 산출 및 smoothing
- 공간 불확정성 시각화 기능 및 INLA/WinBUGS나 SaTScan과 통합 개발 진행중
- 윈도 기반, 무료 배포

Rapid Inquiry Facility | Sr

www.sahsu.org/content/rapid-inquiry-facility

Small Area Health Statistics Unit

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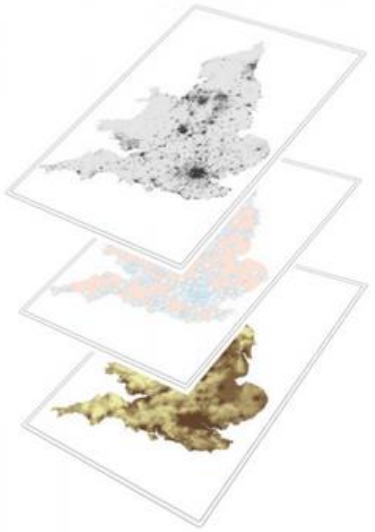
Our Research

- SAHSU Research and Policy
- Rapid Inquiry Facility
- Environment and Health Atlas

Rapid Inquiry Facility

The Rapid Inquiry Facility (RIF) is a freely available software application that supports two types of environmental health activities: disease mapping studies and risk analysis studies. It was designed to help epidemiologists and public health researchers to rapidly investigate potential environmental hazards, especially those related to industrial sites. The tool uses health, environmental, socio-economic, population and geographic data to calculate risks in relation to sources of exposure and to generate maps.

Disease mapping studies are used to visualise mortality or morbidity rates and risks across an area. They are used to explore spatial patterns of health outcomes; identify potential issues regarding data quality by geographical area; and identify areas which need additional study.



Risk analysis studies are used to provide an initial investigation into whether a suspected source of some particular exposure is having an impact on health in a local population. The tool can generate standardised rates and relative risks for a set of health outcomes. The RIF allows for full flexibility in the selection of a range of ages; a time frame specifying an era for data set collections; and a geographic area.

The software application was originally developed in the late 1990s by SAHSU staff. The RIF was further developed as part of the EUROHEIS and EUROHEIS2 http://www.euroheis.org/ projects, funded by the European Commission's Directorate for General Health and Consumer Protection. The aim of these projects was to improve health information and analysis in order to assess relationships between environmental pollution and disease.

The RIF also received funding from the US Center for Disease Control (CDC) as part of the [US] Environment and Health Public Tracking Program (http://www.cdc.gov/nceh/tracking/). As an example, the State of Utah Department of Health used the RIF to investigate the perceived excess of leukaemia in relation to oil refineries in Utah [3]. The CDC support enabled modifications to the RIF to increase its functionality, ease of use and versatility.

질병 군집 탐색

- 질병 군집은 특정 인구집단에서 비슷한 또는 관련 있는 질병의 결집(aggregation)을 의미
  - 해당 시기, 지역, 작업장이나 클럽과 같은 하위 인구집단, 심지어 같은 약을 복용한 집단에서 발생하는 환자 숫자로 시작
  - 미국에서는 매년 1000건 이상 군집 보고
  - 군집 탐색은 비용과 시간이 많이 들며, 군집 발생과 원인이 명확하지 않은 경우 많은 고려가 필요

군집 탐색 설계

- 일반적 단계
  1. 환례 및 가능한 위험 요인 관련 군집 보고서의 원천 자료에 대한 정보 수집
  2. 보고 자료의 평가
     1. 환례와 진단명 검증,
     2. 위험 인구집단과 군집의 시공간 범위 특성화 및 정의, 적절한 참조 인구집단 선정,
     3. 질병 군집 평가에 특화된 기법을 이용하여 생물학적 및 통계적 초과 위험 가능성 결정
  3. 군집 생성 가설에 기초한 역학 연구 수행 가능성 평가
  4. 원인 연구(etiologic) 수행

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports / Vol. 62 / No. 8
September 27, 2013

Investigating Suspected Cancer Clusters and Responding to Community Concerns

Guidelines from CDC and the Council of State and Territorial Epidemiologists

RESEARCH

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 10, No. 5, May 2004

Syndromic Surveillance in Public Health Practice, New York City

Richard Heffernan,* Farzad Mostashari,* Debjani Das,* Adam Karpati,*
Martin Kulldorff,† and Don Weiss*

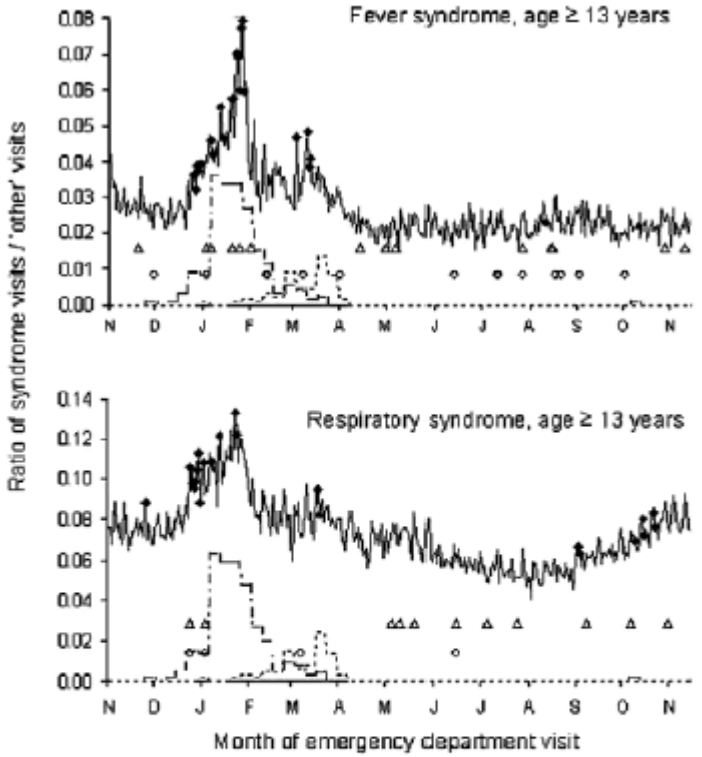


Figure 1. Trends in emergency department visits for fever and respiratory syndromes, New York City, November 1, 2001–November 14, 2002. Plots show the daily ratio of syndrome visits to other (noninfectious disease) visits. ♦, citywide signal; Δ, spatial signal by hospital; ❍, spatial signal by patient's home zip code; – · – , influenza A; ------- , influenza B isolates (weekly number identified in New York City residents by World Health Organization collaborating laboratories).

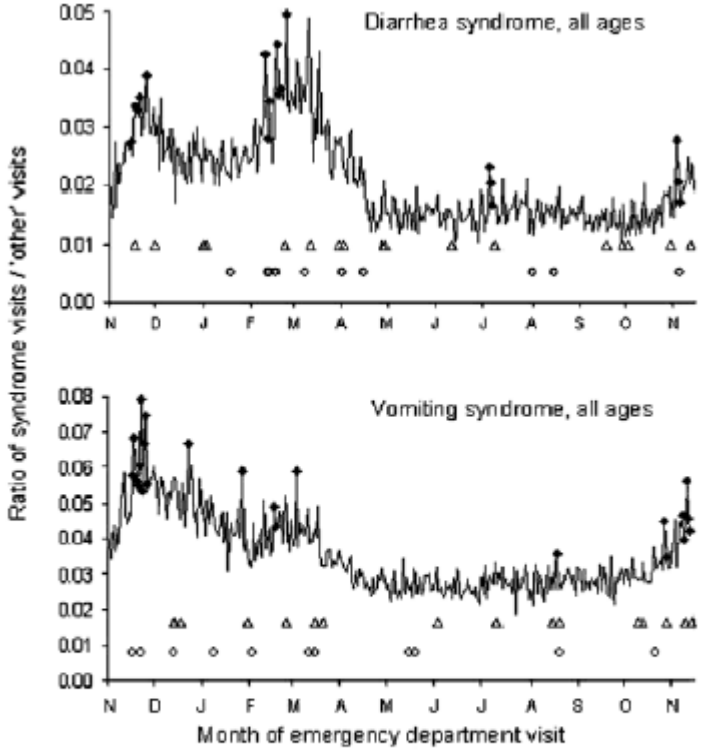


Figure 2. Trends in emergency department visits for diarrhea and vomiting syndromes, New York City, November 1, 2001–November 14, 2002. Plots show the daily ratio of syndrome visits to other (noninfectious disease) visits. ♦ = citywide signal; Δ = spatial signal by hospital; ❍ = spatial signal by patient's home zip code.

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Advance Access publication 15 July 2004

International Journal of Epidemiology 2004;**33**:1329–1336
doi:10.1093/ije/dyh266

INFECTIOUS DISEASES

Population survey to determine risk factors for *Mycobacterium leprae* transmission and infection

Mirjam I Bakker,[1] Mochammad Hatta,[2] Agnes Kwenang,[2] William R Faber,[3] Stella M van Beers,[1] Paul R Klatser[1] and Linda Oskam[1]

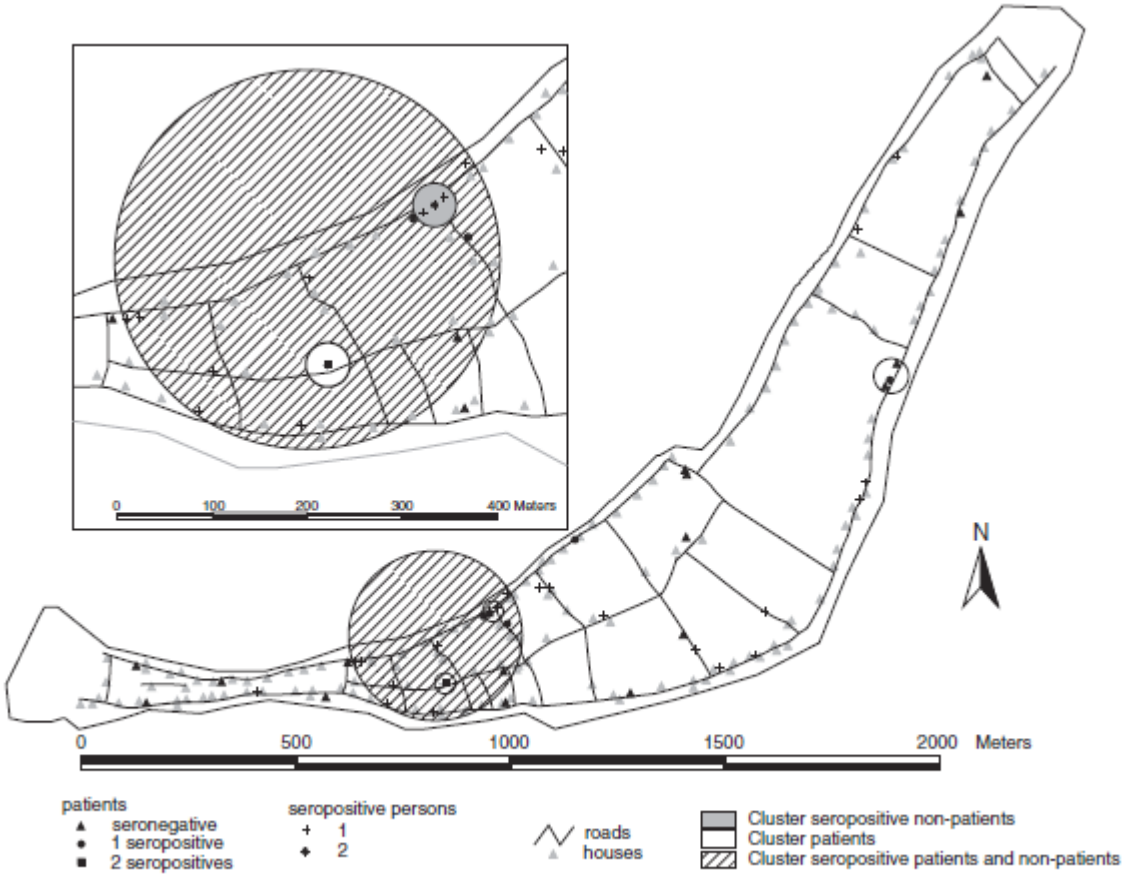

Figure 1 Map of Sapuka and detailed map showing the houses of the patients, seropositive persons, and significant clusters (only one-third of the other houses is shown)

Spatial and Spatio-temporal Epidemiology 23 (2017) 47–57

Contents lists available at ScienceDirect

Spatial and Spatio-temporal Epidemiology

journal homepage: www.elsevier.com/locate/sste

SpatialEpiApp: A Shiny web application for the analysis of spatial and spatio-temporal disease data

Paula Moraga

Centre for Health Informatics, Computing and Statistics (CHICAS), Lancaster Medical School, Lancaster University, Lancaster, LA1 4YW, United Kingdom

ARTICLE INFO

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Shiny
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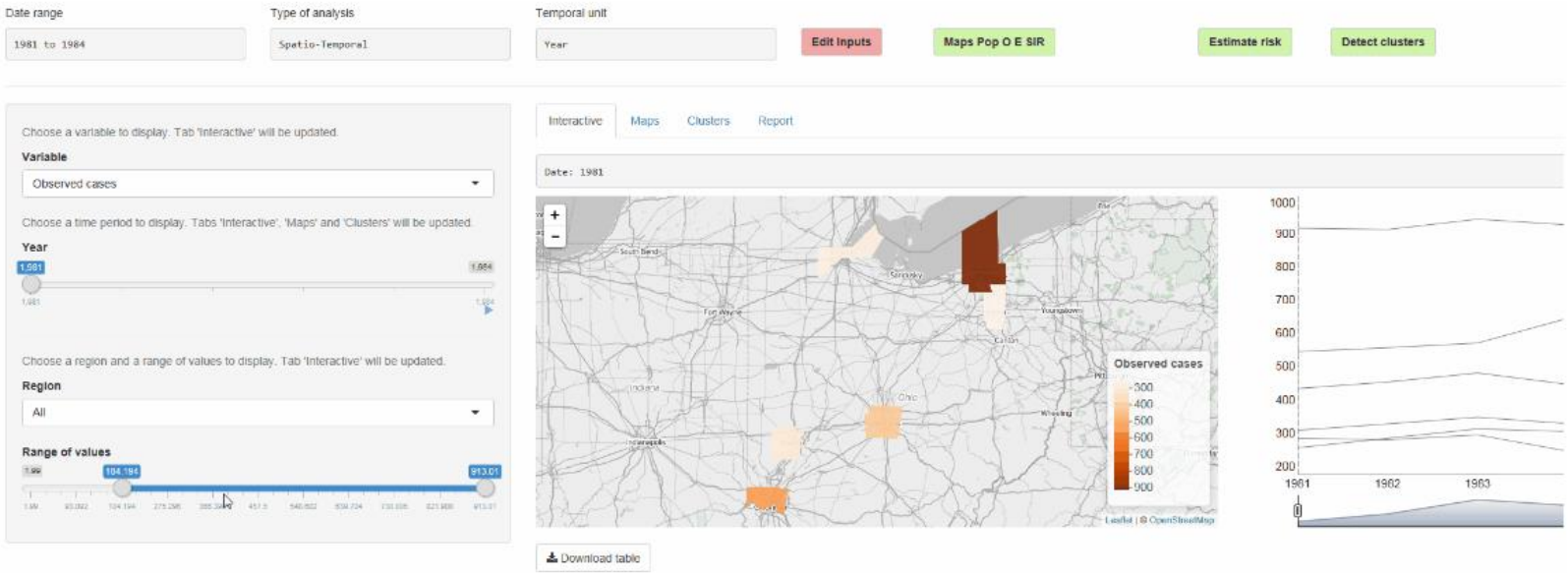
ABSTRACT

During last years, public health surveillance has been facilitated by the existence of several packages implementing statistical methods for the analysis of spatial and spatio-temporal disease data. However, these methods are still inaccesible for many researchers lacking the adequate programming skills to effectively use the required software. In this paper we present SpatialEpiApp, a Shiny web application that integrate two of the most common approaches in health surveillance: disease mapping and detection of clusters. SpatialEpiApp is easy to use and does not require any programming knowledge. Given information about the cases, population and optionally covariates for each of the areas and dates of study, the application allows to fit Bayesian models to obtain disease risk estimates and their uncertainty by using R-INLA, and to detect disease clusters by using SaTScan. The application allows user interaction and the creation of interactive data visualizations and reports showing the analyses performed.

SOFTWARE

SpatialEpiApp



SpatialEpiApp is a Shiny web application that allows to visualize spatial and spatio-temporal disease data, estimate disease risk and detect clusters. The application incorporates modules for

- Disease risk estimation using INLA
- Detection of clusters using the scan statistics implemented in SaTScan
- Interactive visualizations such as maps supporting padding and zooming and tables that allow for filtering
- Generation of reports containing the analyses performed

DOWNLOAD MANUAL

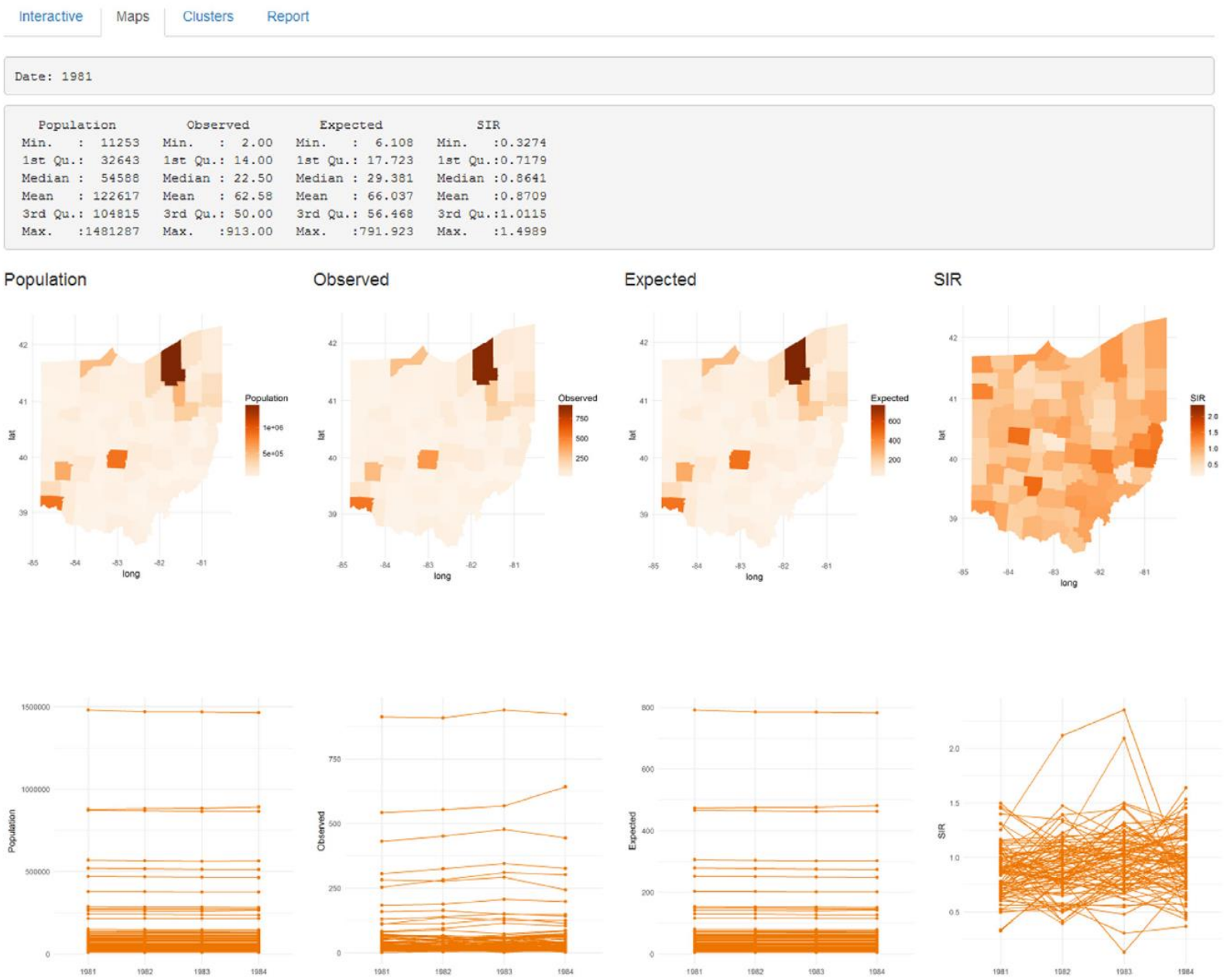
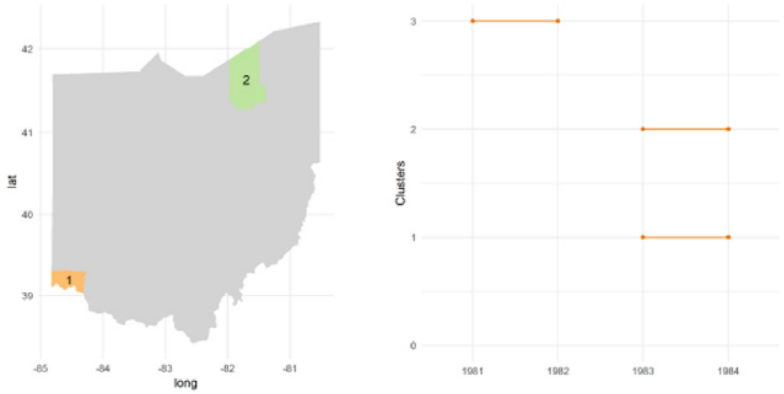


Fig. 3. Maps tab. Results correspond to the Ohio example.

Interactive | Maps | Clusters | Report

Date: 1984



Show 25 entries

Search:

Cluster	Central area	No. areas	Start date	End date	Risk in / Risk out	LLR	p-value	Areas
1	Hamilton	1	1983	1984	1.32	41.75818	1.23e-14	Hamilton
2	Cuyahoga	1	1983	1984	1.21	28.87297	1.04e-09	Cuyahoga
3	Belmont	5	1981	1982	1.30	10.54458	1.06e-02	Guernsey, Monroe, Harrison, Belmont, Jefferson
Cluster	Central area	No. areas	Start date	End date	Risk in / Risk ou	LLR	p-value	Areas

Showing 1 to 3 of 3 entries

Previous 1 Next

Fig. 4. Clusters tab. Results correspond to the Ohio example.

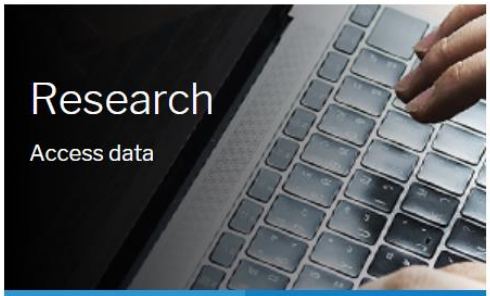
4. 공간 역학 연구 사례

Dartmouth Atlas Project

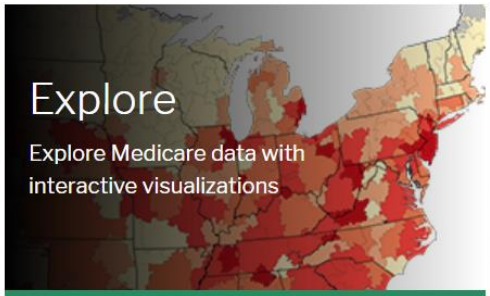
Home | Data | Publications | About | Contact

Understanding of the Efficiency and Effectiveness of the Health Care System

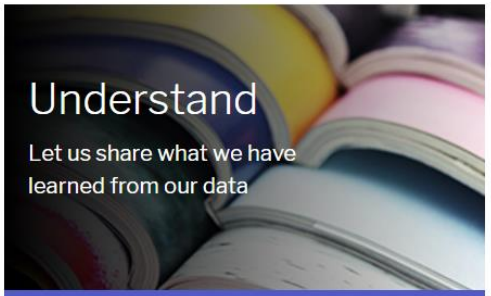
For more than 20 years, the Dartmouth Atlas Project has documented glaring variations in how medical resources are distributed and used in the United States. The project uses Medicare data to provide information and analysis about national, regional, and local markets, as well as hospitals and their affiliated physicians. This research has helped policymakers, the media, health care analysts and others improve their understanding of our health care system and forms the foundation for many of the ongoing efforts to improve health and health systems across America.



Research Data | Methods



Interactive Apps



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h·well 국민건강보험 National Health Insurance Corporation

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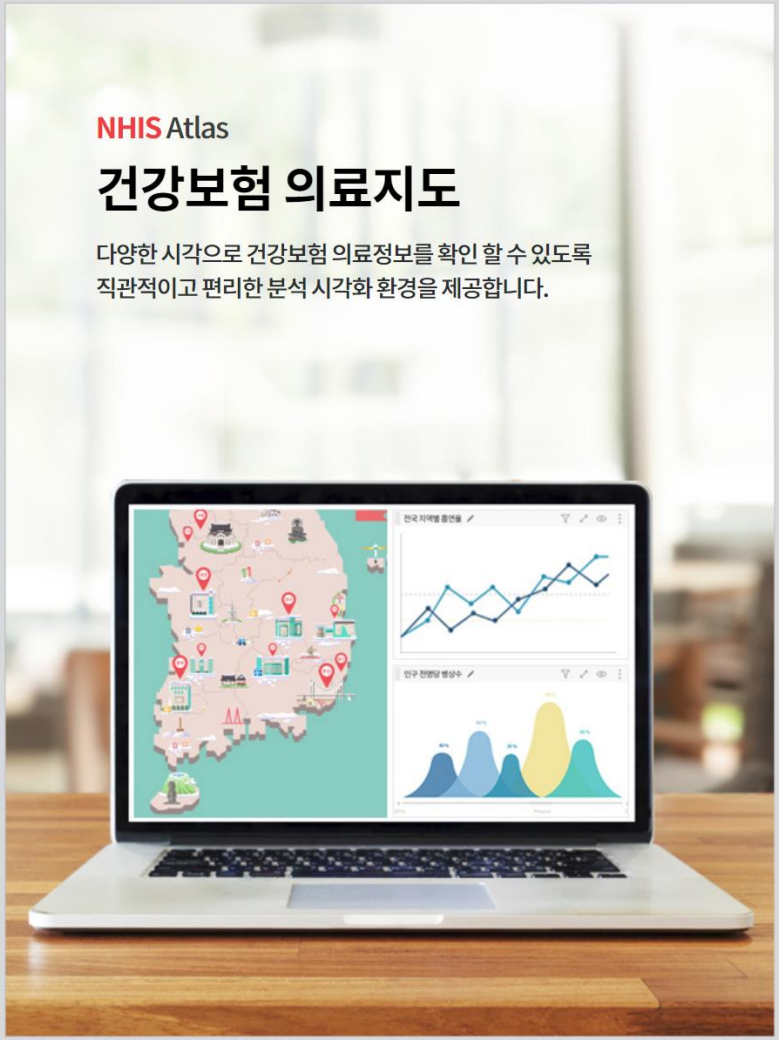


서비스 소개

건강보험 의료지도의
서비스 활용 목적 및 배경
살펴보기

전체 지표보기

총 100여개로 구성된
전체 의료지표를 각 영역별로
구분하여 한눈에 보기

지표의 활용

주요 건강지표의 핵심 정보를
직관적으로 이해할 수 있는
카드뉴스 보기

자료 다운로드

건강보험 의료지도
활용 메뉴얼 및 의료정보
자료 다운로드

의료지도 서비스

기본특성, 의료자원, 의료이용, 건강결과로 이어지는
의료정보의 시각화 데이터 제공 및 다차원 분석이 가능한
직관적인 사용자 분석 환경 제공

자주하는 질문

더보기

- 타이틀 551
- 타이틀 550
- TITLE 527
- TITLE 528
- TITLE 529

문의하기

묻고답하기로 이동

(26464) 강원도 원주시 건강로 32(반곡동) 국민건강보험공단 | 고객상담전화: 1577-1000

ORIGINAL ARTICLE

Korean J Intern Med 2014;29:183-190
http://dx.doi.org/10.3904/kjim.2014.29.2.183

KJIM

Impact of outdoor air pollution on the incidence of tuberculosis in the Seoul metropolitan area, South Korea

Seung-sik Hwang[1], Sungchan Kang[1], Ji-Young Lee[1], Ji Sun Lee[2], Hee Jin Kim[3], Sung Koo Han[2], and Jae-Joon Yim[2]

[1]Department of Social and Preventive Medicine, Inha University School of Medicine, Incheon; [2]Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Seoul National University College of Medicine, Seoul; [3]Korean Institute of Tuberculosis, Osong, Korea

Background/Aims: Although indoor air pollution is a well-known risk factor for tuberculosis (TB), the possible link between outdoor air pollution and TB development has not been examined fully. We assessed the impact of outdoor air pollution on TB development in the Seoul metropolitan area, South Korea.

Methods: The mean concentrations of ambient particulate matter (PM) with an aerodynamic diameter ≤ 10 μm (PM_{10}), O_3, CO, NO_2, and SO_2 levels in Seoul, between January 1, 1997 and December 31, 2006, were determined. Furthermore, their association with the risk of developing TB after adjusting for socioeconomic

The Korean Journal of Applied Statistics (2013)
00(0), 1–??

Spatial clustering method via generalized lasso

Eunjung Song · Hosik Choi · Seungsik Hwang · Woojoo Lee[1]

Department of Statistics, Inha University

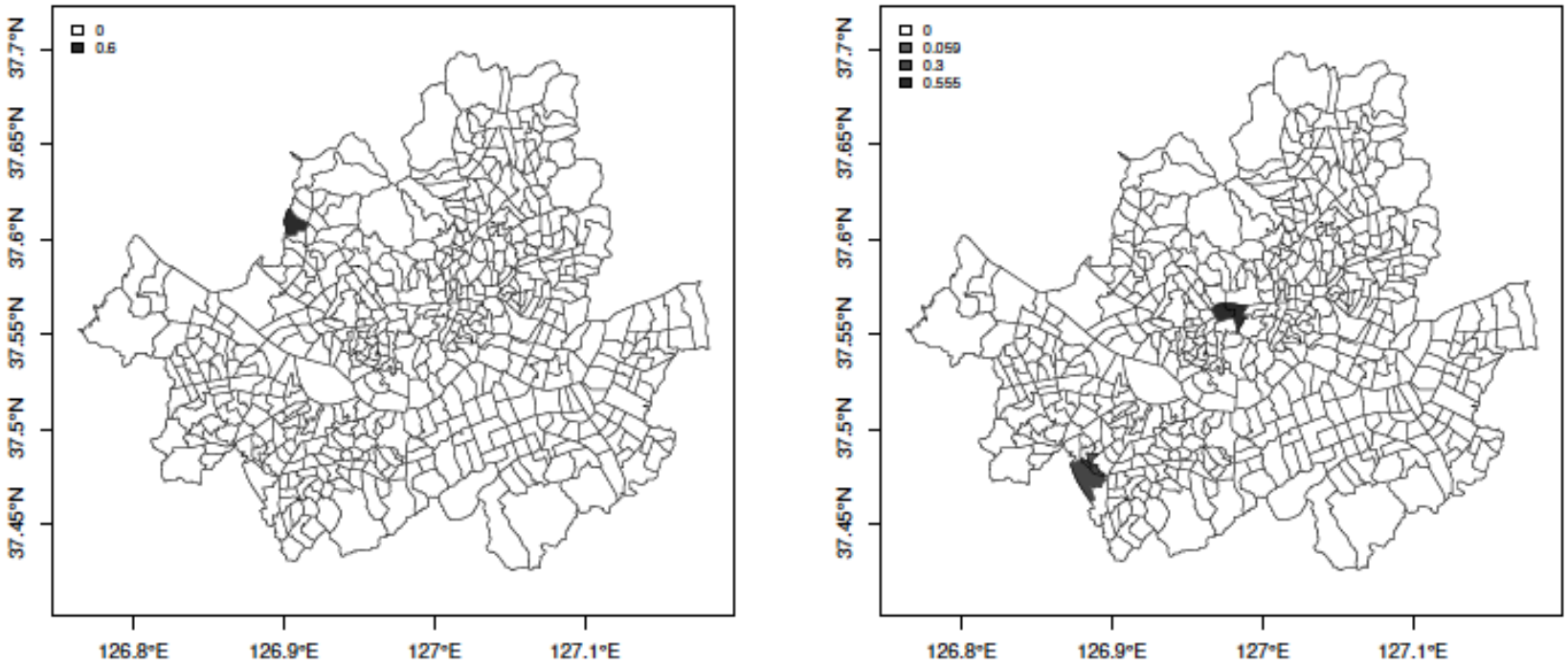
(Received 0000; accepted 0000)

요 약

In this paper, we propose a penalized likelihood method for detecting spatial cluster. The basic idea is that we can find areas having similar characteristic because the fused lasso , a special case of generalized lasso, encourages mean between the neighboring areas to be similarly estimated. To optimize the objective function, genlasso is exploited. But solutions of the objective function depend on a tuning parameter, we select it by using Wang's BIC. Also this method can easily add not only categorical variables but also continuous variables to regression model unlike existing methods. Lastly, we apply our proposed method to the Seoul tuberculosis data.

Keywords: spatial clustering, generalized lasso, lasso, fused lasso

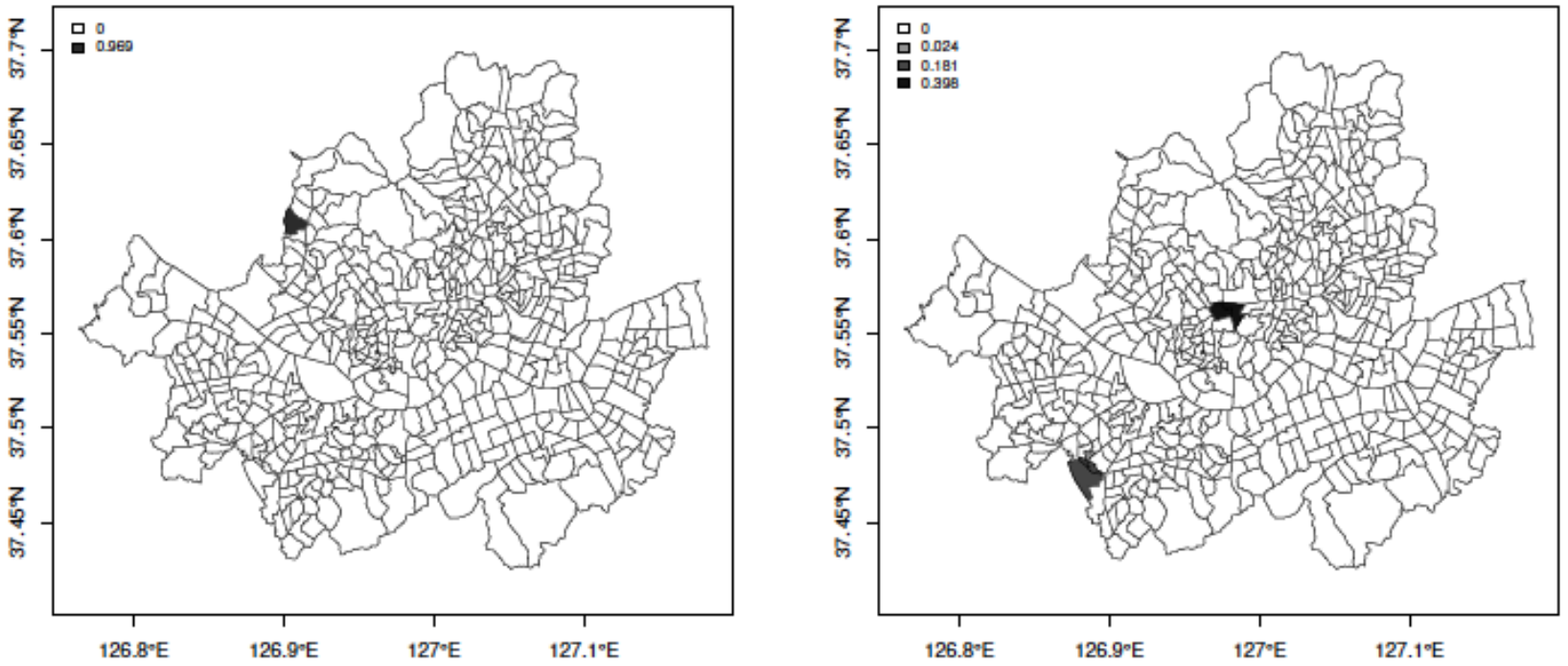
결과



(a) 남자 (b) 여자

그림 4.2. 설명변수를 이용하지 않았을 때 genlasso 분석 결과

결과



(a) 남자 (b) 여자

그림 4.3. 설명변수로 보정한 후 결핵군집

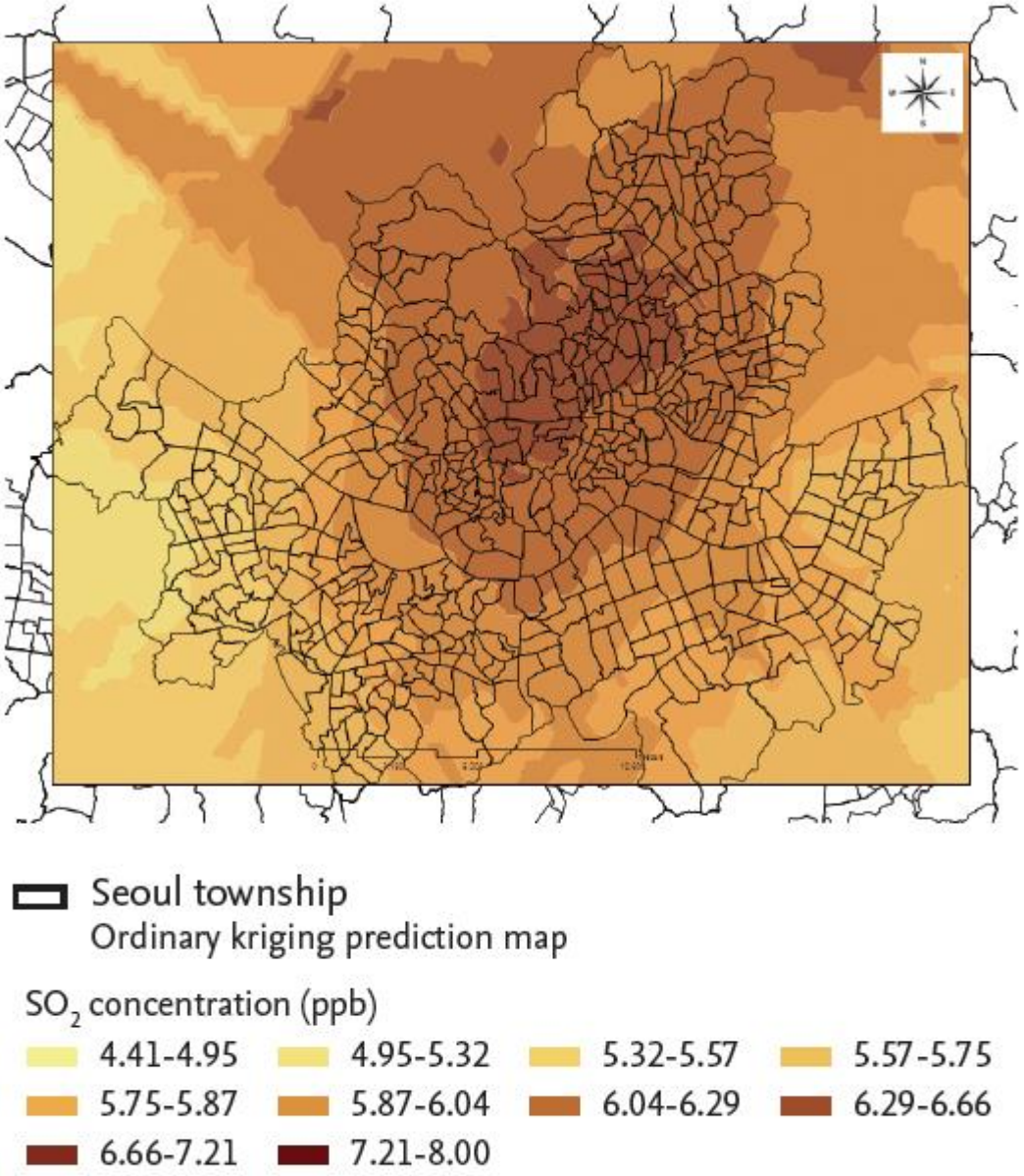


Figure 1. Estimated SO_2 levels using air-monitoring data and kriging between January 1, 1997 and December 31, 2006, in the Seoul metropolitan area.

결과

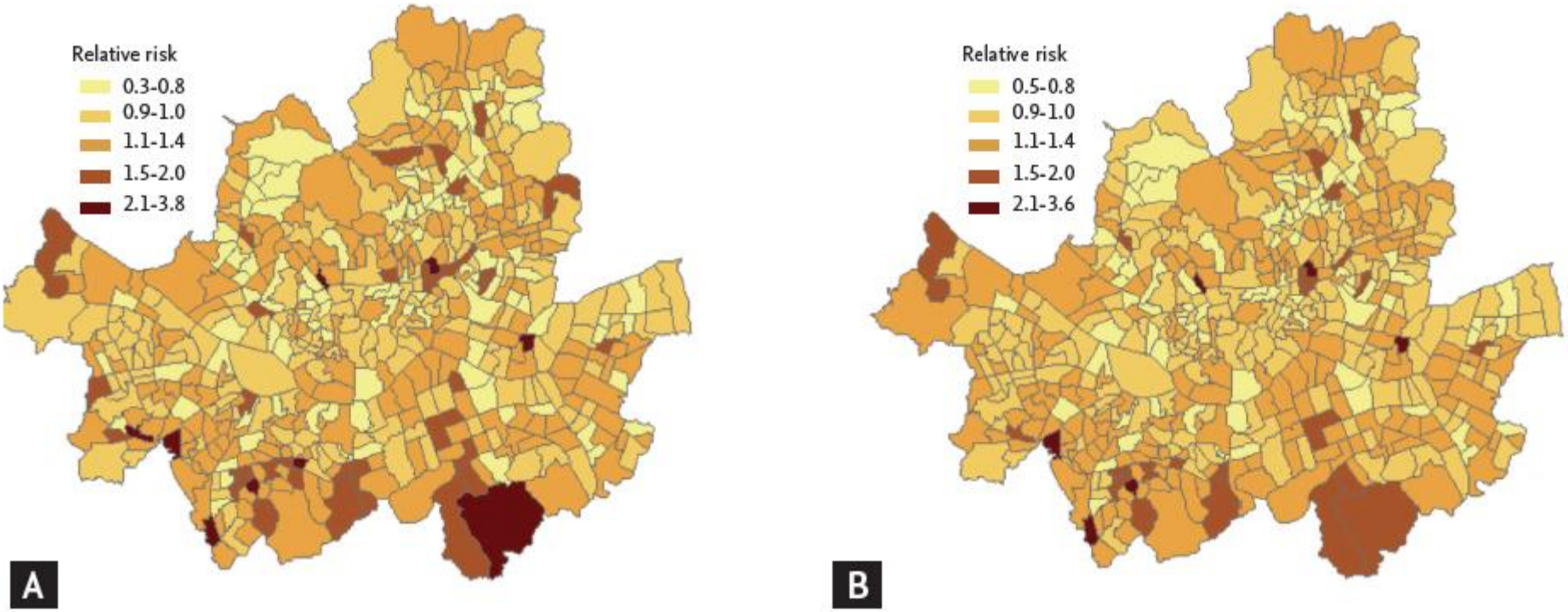


Figure 2. Unsmoothed (A) and smoothed (B) map of the standardized incidence ratios of tuberculosis in the Seoul metropolitan area between January 1, 2002 and December 31, 2006 (smoothing of risk estimates were calculated based on Bayesian inference methods).

결과

Table 4. Impact of an interquartile increase in pollutant concentration on the incidence of tuberculosis

Model	Male RR[a] (95% CrI)	Female RR[a] (95% CrI)
PM_{10}, μg/m³	0.98 (0.94–1.02)	1.01 (0.97–1.06)
O_3, ppb	0.99 (0.94–1.03)	1.01 (0.97–1.05)
CO, ppb	0.99 (0.95–1.03)	1.01 (0.98–1.04)
NO_2, ppb	1.00 (0.96–1.05)	1.01 (0.98–1.05)
SO_2, ppb	1.07 (1.03–1.12)	1.02 (0.98–1.07)

RR, relative risk; CrI, credible interval; PM_{10}, particulate matter with an aerodynamic diameter ≤ 10 μm.
[a]RRs were adjusted for the quintiles of the Carstairs index as an indicator variable.

라돈가스 노출 수준과 조혈기계 발생에 관한 지리상관성 연구

International Journal of
Environmental Research and Public Health

MDPI

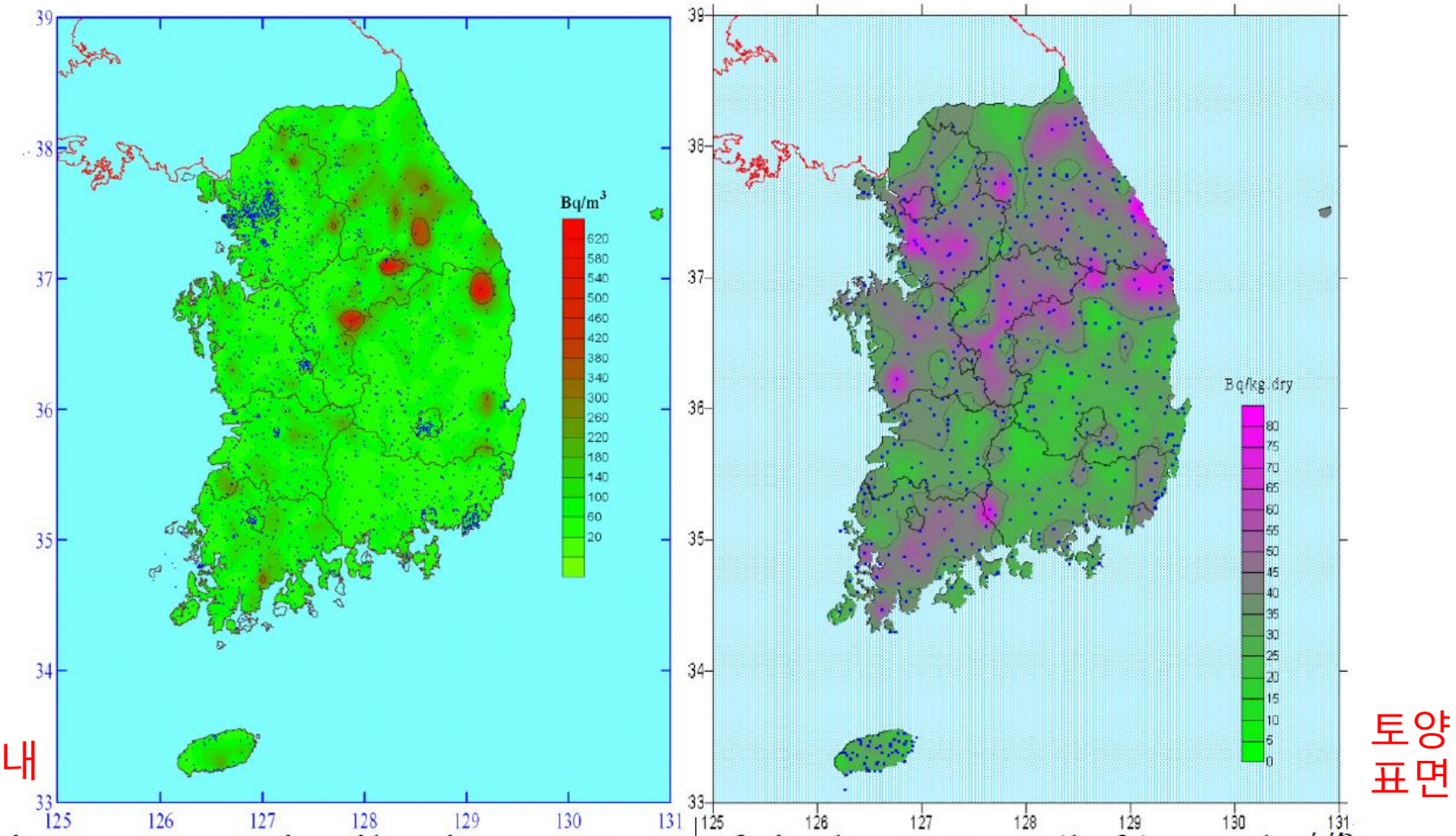
Article

Geographical Correlations between Indoor Radon Concentration and Risks of Lung Cancer, Non-Hodgkin's Lymphoma, and Leukemia during 1999–2008 in Korea

Mina Ha [1,*], Seung-sik Hwang [2], Sungchan Kang [2], No-Wook Park [3], Byung-Uck Chang [4] and Yongjae Kim [4]

우리나라의 라돈 농도 분포

(National radon survey in Korea, Radiation Protection Dosimetry 2011;146(1):6-10)

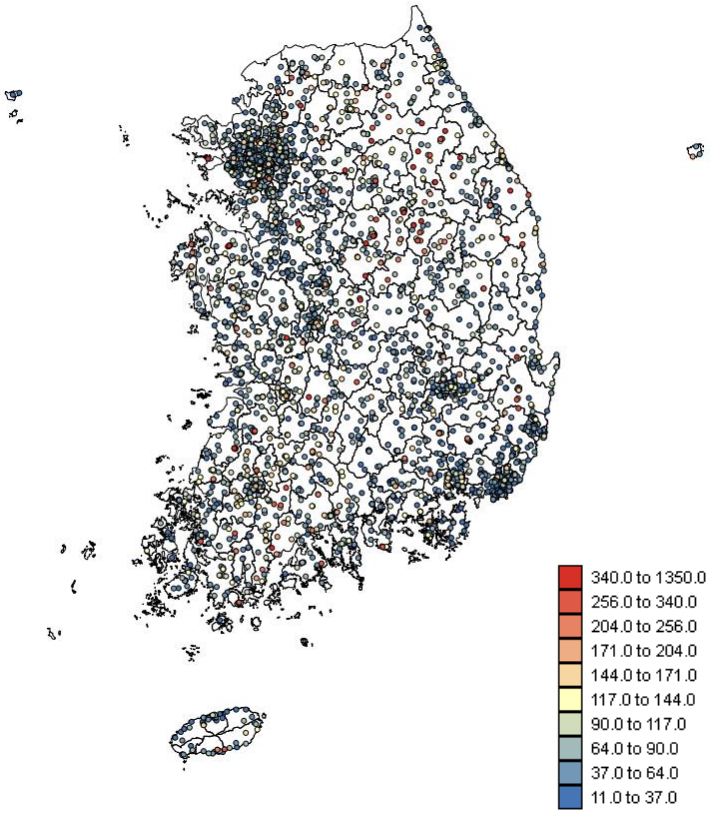


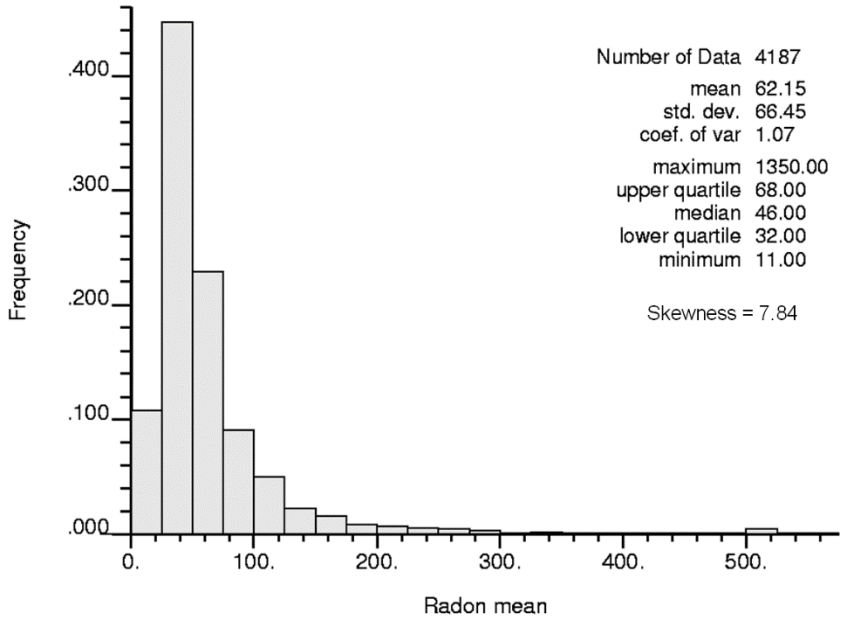
실내

토양 표면

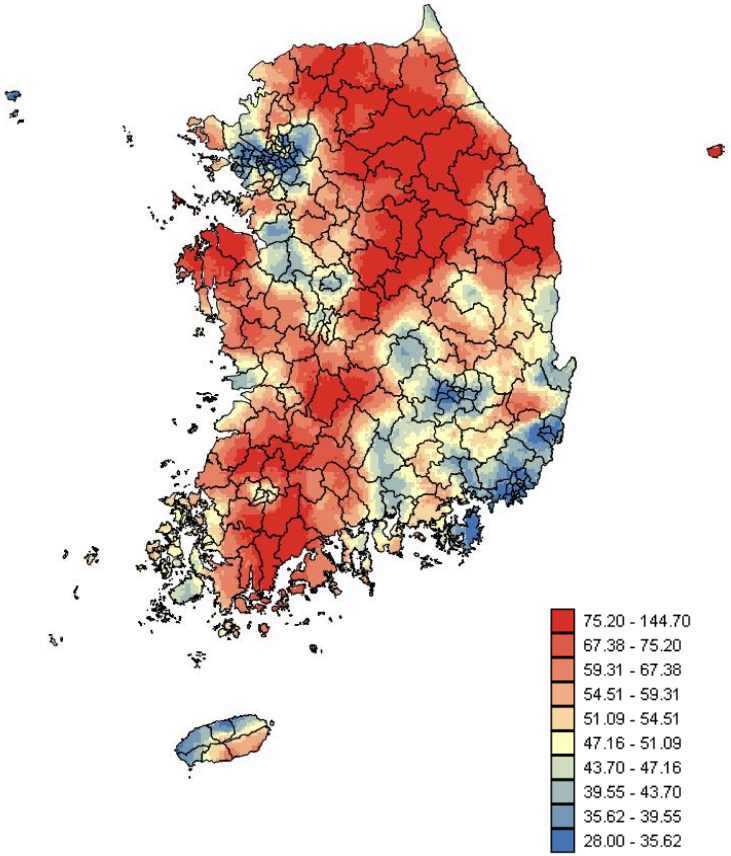
Figure 1. Distribution maps of indoor Rn (left) and ^{226}Ra concentrations in surface soil (right) in Korea.

라돈 관측 자료 크리깅 (1)

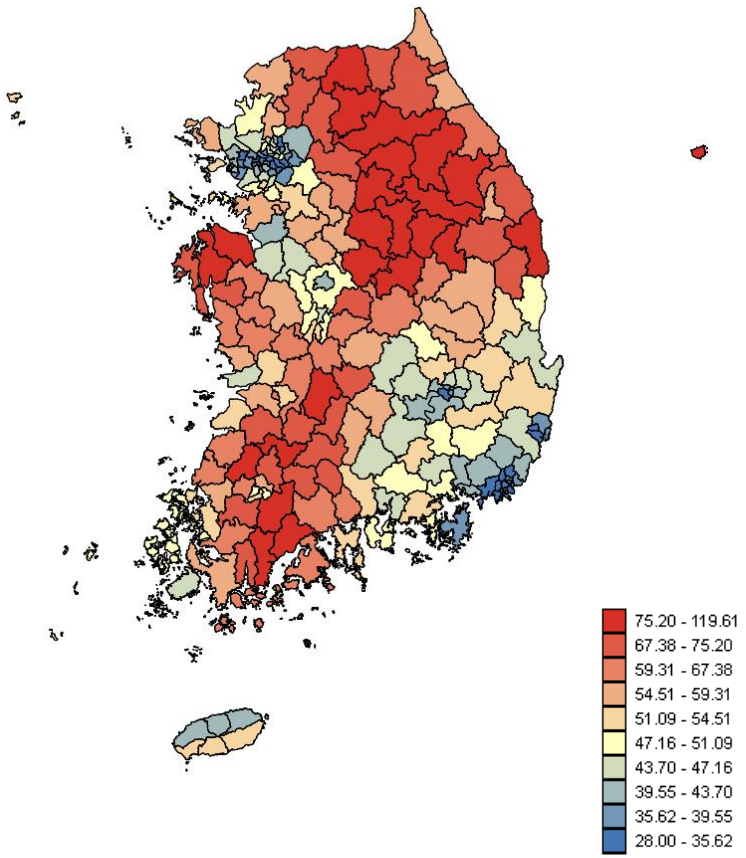

340.0 to 1350.0
256.0 to 340.0
204.0 to 256.0
171.0 to 204.0
144.0 to 171.0
117.0 to 144.0
90.0 to 117.0
64.0 to 90.0
37.0 to 64.0
11.0 to 37.0


Number of Data 4187
mean 62.15
std. dev. 66.45
coef. of var 1.07
maximum 1350.00
upper quartile 68.00
median 46.00
lower quartile 32.00
minimum 11.00
Skewness = 7.84
Frequency
.400
.300
.200
.100
.000
0.
100.
200.
300.
400.
500.
Radon mean

라돈 관측 자료 크리깅 (2)



정규 크리깅 적용 결과



행정구역별 평균 라돈 농도 분포도

Table 3. Relative risk and 95% credible intervals for lung cancer, non-Hodgkin's lymphoma, and leukemia in relation to regional indoor radon concentrations in 234 regions of Korea, 1999 to 2013.

	Per 10 Bq/m³ Increase in Radon Concentration	Crude		Adjusted [a]	
	Cancer Type	Relative Risk	95% Credible Intervals	Relative Risk	95% Credible Intervals
Male	Lung cancer	1.03	(1.02, 1.05)	1.01	(1.00, 1.02)
	NHL, all	1.01	(0.99, 1.03)	1.00	(0.98, 1.02)
	NHL in children and adolescents [b]	0.98	(0.94, 1.02)	0.97	(0.93, 1.02)
	Leukemia, all	0.98	(0.96, 1.00)	0.98	(0.96, 1.00)
	Leukemia in children and adolescents [b]	0.96	(0.89, 1.03)	1.00	(0.92, 1.08)
Female	Lung cancer	1.01	(0.99, 1.02)	1.01	(0.99, 1.02)
	NHL, all	1.03	(1.01, 1.06)	1.04	(1.02, 1.07)
	NHL in children and adolescents [b]	1.04	(0.99, 1.10)	1.07	(1.01, 1.13)
	Leukemia, all	0.98	(0.96, 1.01)	0.98	(0.95, 1.00)
	Leukemia in children and adolescents [b]	1.00	(0.91, 1.10)	0.98	(0.88, 1.08)

Relative risk and 95% credible intervals estimated using the hierarchical Bayesian model with Markov Chain Monte Carlo methods; [a]: adjusted for smoking rate and regional deprivation index; [b]: less than 20 years of age; NHL: non-Hodgkin's Lymphoma.

Spatial and Spatio-temporal Epidemiology 26 (2018) 107–112

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Spatial and Spatio-temporal Epidemiology

journal homepage: www.elsevier.com/locate/sste

Original Research

Regional variation in lung and bronchus cancer survival in the US using mortality-to-incidence ratios

Cassie L. Odahowski[a,b,c], James R. Hébert[a,b], Jan M. Eberth[a,b,c,*]

[a] Cancer Prevention and Control Program, University of South Carolina, Columbia, SC, United States
[b] Department of Epidemiology and Biostatistics, University of South Carolina, Columbia, SC, United States
[c] SC Rural Health Research Center, University of South Carolina, Columbia, SC, United States

Highlights

- Mortality-to-incidence ratios (MIRs) can be calculated easily and inexpensively.
- Many southern states had high lung and bronchus cancer MIRs.
- State MIRs were highly correlated with 1-survival rates from SEER states.
- Surveillance can be strengthened by examining geographic variation in MIRs.

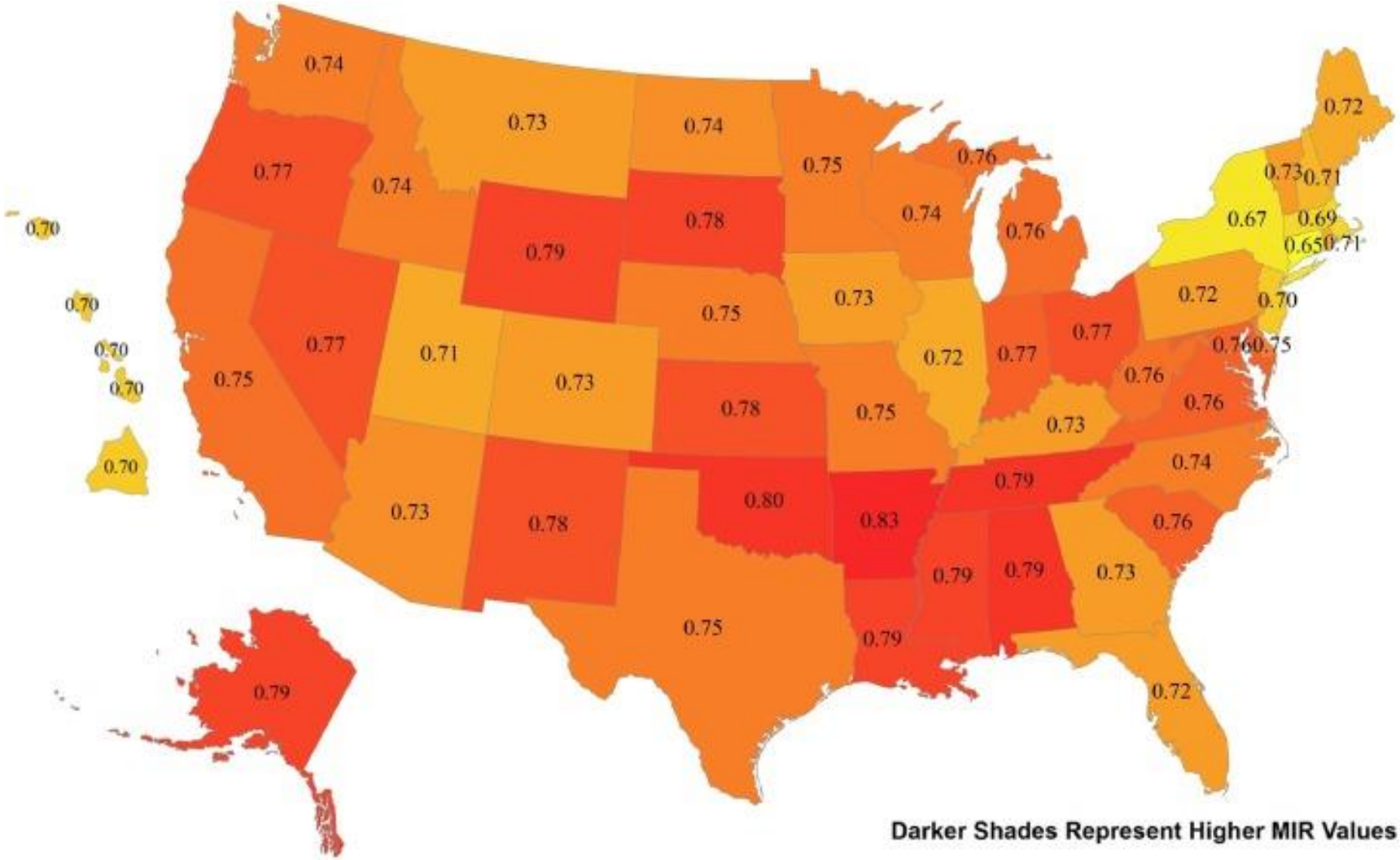

Fig. 3. Continuous scale of lung and bronchus cancer MIRs in the U.S., 2008–2012.

Environmental Research 164 (2018) 585–596

Contents lists available at ScienceDirect

Environmental Research

journal homepage: www.elsevier.com/locate/envres

Review article

Lung cancer and particulate pollution: A critical review of spatial and temporal analysis evidence

Ning Wang[a], Kerrie Mengersen[b], Michael Kimlin[c,d], Maigeng Zhou[e], Shilu Tong[a,f,g], Liwen Fang[e], Baohua Wang[e], Wenbiao Hu[a,*]

Results

(...) No paper included spatial and temporal analyses simultaneously and considered spatiotemporal uncertainty into model predictions. (...)

Conclusions

Advanced spatial and temporal epidemiological methods were seldom applied to PM-lung cancer associations. Further research is urgently needed to develop and employ robust and comprehensive spatiotemporal analysis methods for the evaluation of PM-lung cancer associations and the support of lung cancer prevention strategies.

경청해주셔서 고맙습니다.

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