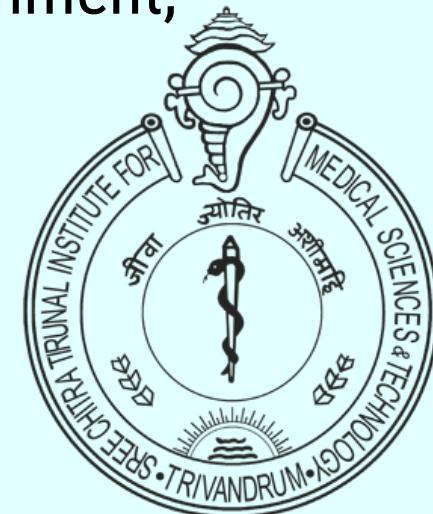


NCDs & Ayurveda: Generating Evidence for Public Health using the Data Science Approach

STP 608 | Institute of Management in Government,
Thiruvananthapuram
19th April, 2022



Dr Arun Mitra
Research Scholar, AMCHSS,
Sree Chitra Tirunal Institute for Medical Sciences & Technology, Trivadrum

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1. Epidemiological Transition
2. Newer Evidence on NCDs
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4. How to Generate Evidence: Data Science Approach
5. The Way Forward



About SCTIMST, Trivandrum

Institution of National Importance with the status of a University in 1980 under the Department of Science and Technology, Govt. of India by an Act of Parliament (Act 52 of 1980).

The institute has the status of a university and offers excellent research and training facilities.

It has three wings:
One of the unique
institutions in the
country.



Super Speciality Hospital



Bio-Medical Technology
Wing



Achutha Menon Centre

- MPH program
- PhD program
- Post Doctoral Fellowships



AMCHSS, SCTIMST, Trivandrum

Regional Center for Health Technology Assessment (One of Six in India)

Established under the Department of Health Research (DHR), MoHFW, Govt of India.

Advanced Center for Clinical Trials

Established under the Indian Council for Medical Research (ICMR)

Research Collaborations

National Bodies, NGOs, International Universities, Health Agencies

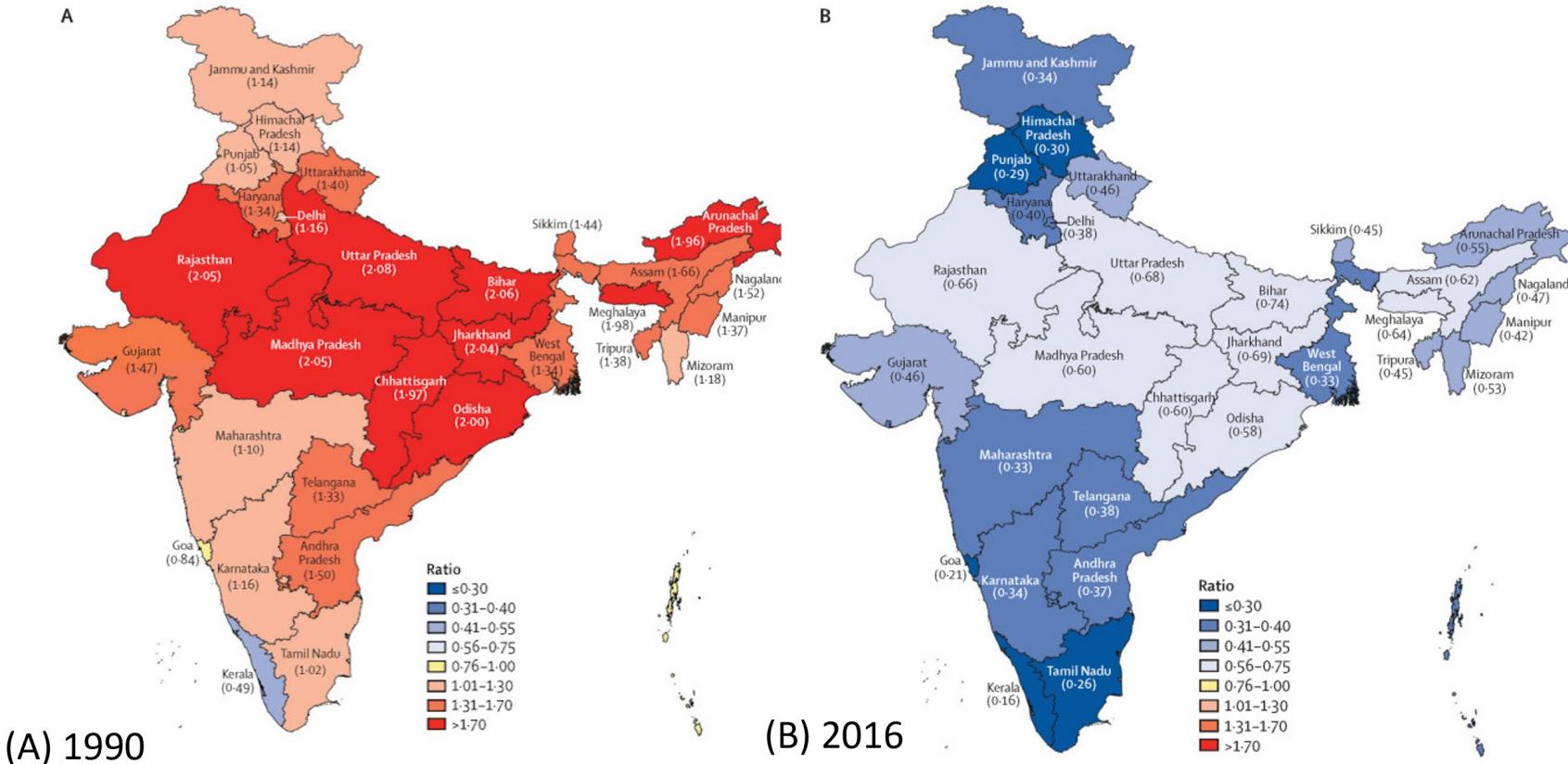
Activities on NCDs at AMCHSS



- NCD Risk factor Survey; 2016-20; funded by Govt. of Kerala
- NCD Risk Factor Survey under the Integrated Disease Surveillance Project (ICMR funded).
- Secondary prevention of stroke survivors in Kollam. 2021-2022; (GOK funded)
- Prevalence of NCD risk factors in the Kani Tribe in Trivandrum; funded by KSCSTE
- Understanding disease clustering (multi-morbidity) in the tribal population of Kerala and Tamil Nadu.
- Scaling up interventions to improve the control of hypertension and diabetes in partnership with the governments of Kerala and Tamil Nadu: Leveraging India's National NCD program. Funded by National Health and Medical Research Council, Australia
- Kerala Diabetes Prevention Project Extension study. Funded by National Health and Medical Research Council, Australia

1. Epidemiological Transition

Ongoing Epidemiological Transition



(A) 1990

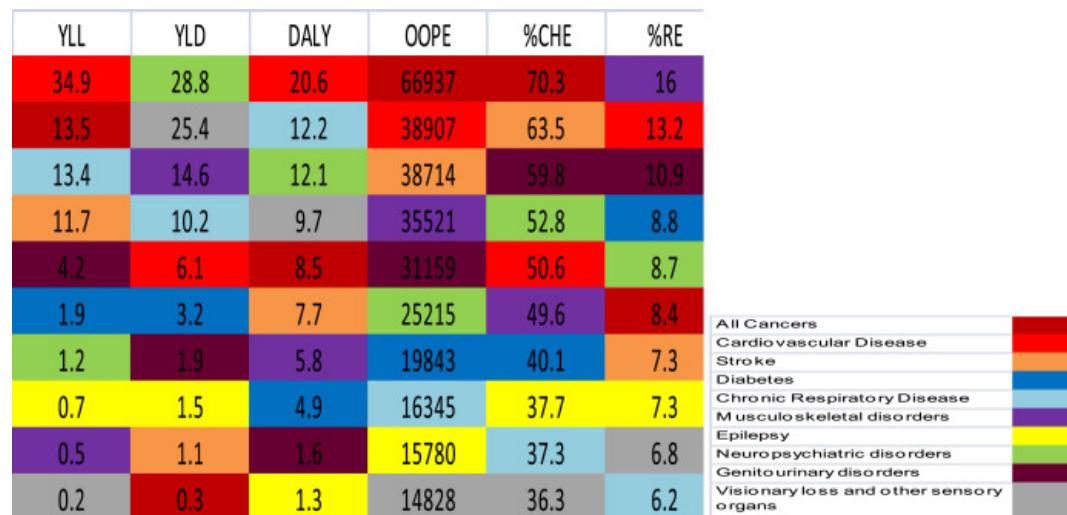
(B) 2016

Dandona L, Dandona R, Kumar GA, et al. (2017) Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. *The Lancet* 390(10111). Elsevier: 2437–2460. DOI: 10.1016/S0140-6736(17)32804-0

Burden of NCDs in India

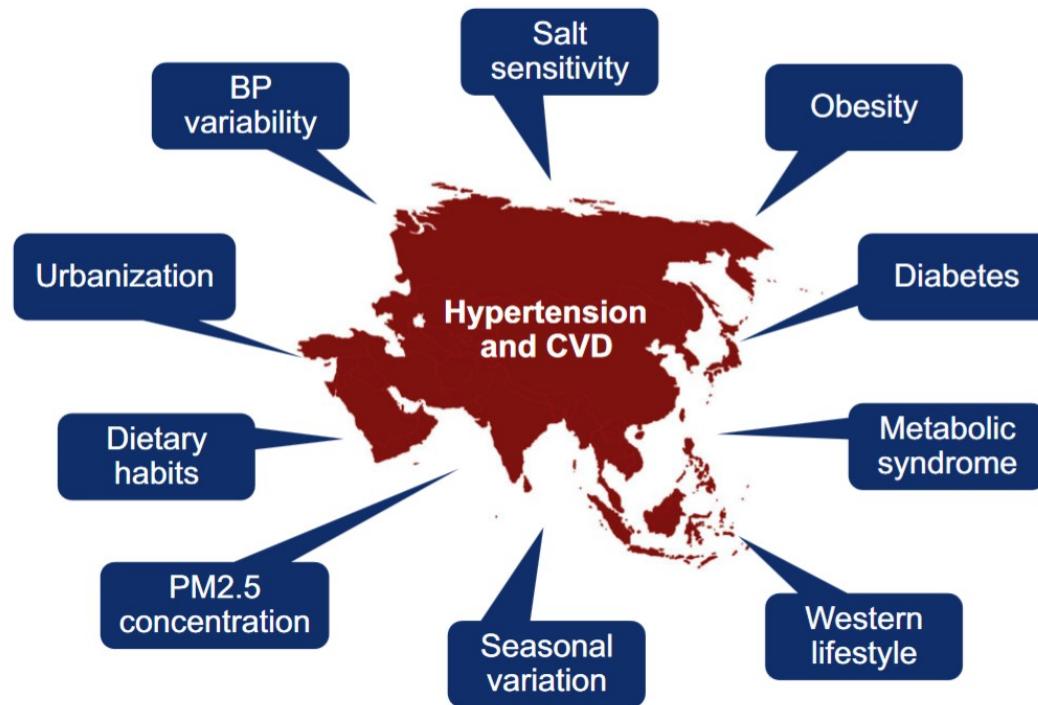


- Approximately 4.7 million deaths.
- Comprised 49% of all-cause mortality.
- 16,939 DALYs per 1,00,000.
- 50–70% of patients treatment in private facilities.
- States with a higher disease burden like Kerala, utilize private health facilities more than
- Private health facilities pushed more households to CHE (66.3%) as compared to public health facilities (17.1%).

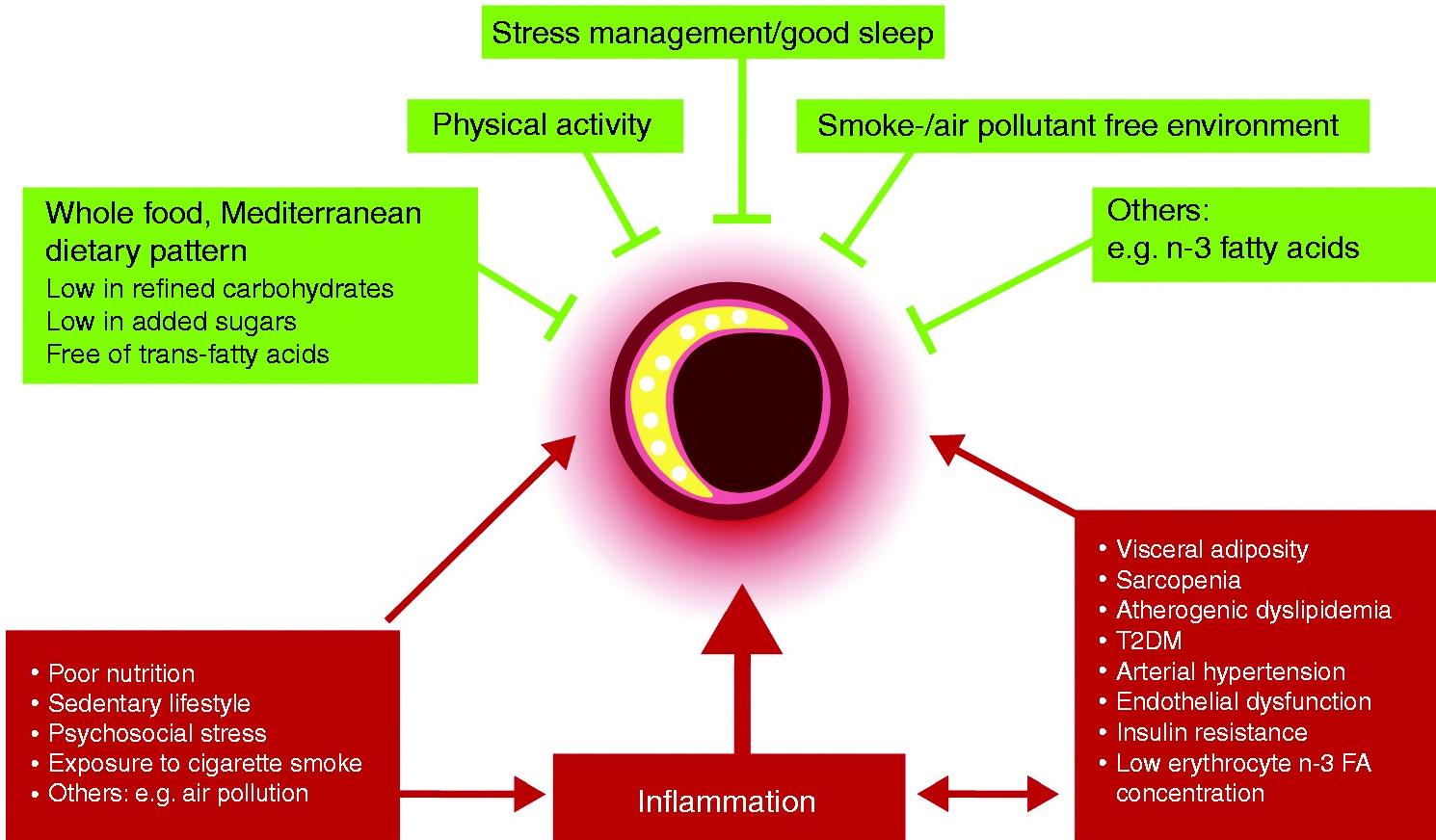


Menon GR, Yadav J, John D. Burden of non-communicable diseases and its associated economic costs in India. Social Sciences & Humanities Open. 2022 Jan 1;5(1):100256.

Factors contributing to hypertension and cardiovascular disease



Lifestyle Risk Factors of Atherosclerosis



Lechner, et. al., Lifestyle factors and high-risk atherosclerosis: Pathways and mechanisms beyond traditional risk factors, European Journal of Preventive Cardiology, Volume 27, Issue 4, 1 March 2020, Pages 394–406, <https://doi.org/10.1177/2047487319869400>

Beyond Traditional Risk Factors

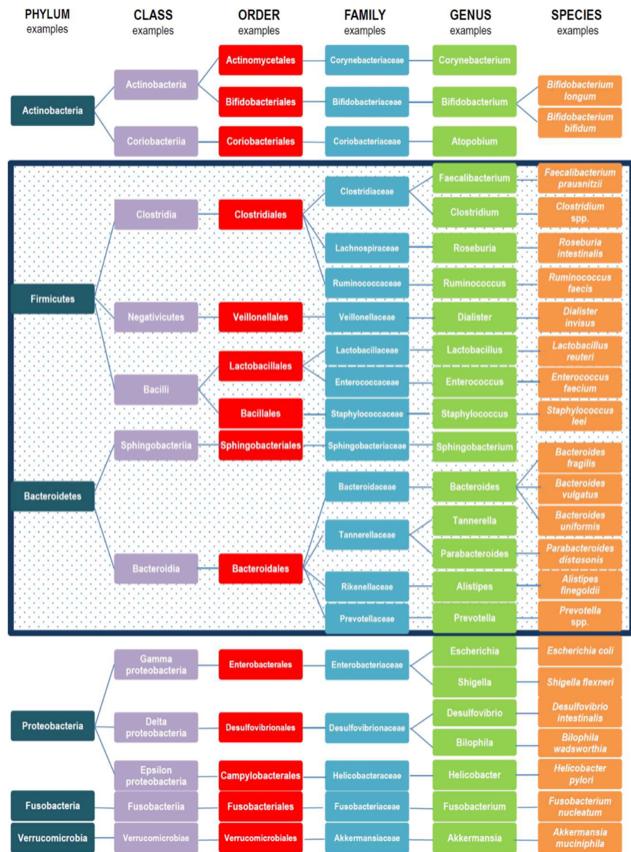
Chronic inflammation

Dysbiosis (gut microbiota), leaky gut

Lack of metabolic flexibility

Senescence & autophagy

Species Diversity



Profile of microbiota in Eubiosis

Rinninella E, Raoul P, Cintoni M, et al. (2019) What is the Healthy Gut Microbiota Composition? A Changing Ecosystem across Age, Environment, Diet, and Diseases. *Microorganisms* 7(1): 14. DOI: 10.3390/microorganisms7010014.

2. Newer Evidence on NCDs



Editorial

Nutrition, Microbiota and Noncommunicable Diseases

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² Instituto de Investigación Biosanitaria IBS.GRANADA, Complejo Hospitalario Universitario de Granada, 18,014 Granada, Spain

³ Children's Hospital of Eastern Ontario Research Institute, Ottawa, ON K1H 8L1, Canada

Received: 21 June 2020; Accepted: 29 June 2020; Published: 2 July 2020



The advent of new sequencing technologies has inspired the foundation of novel research to ascertain the connections between the microbial communities that reside in our gut and some physiological and pathological conditions. The microbiota, defined as the full collection of microbes (bacteria, fungi, and viruses, among others) that naturally exist within a particular biological niche, is estimated to contain 500–1000 species [1–4].

Dysbiosis

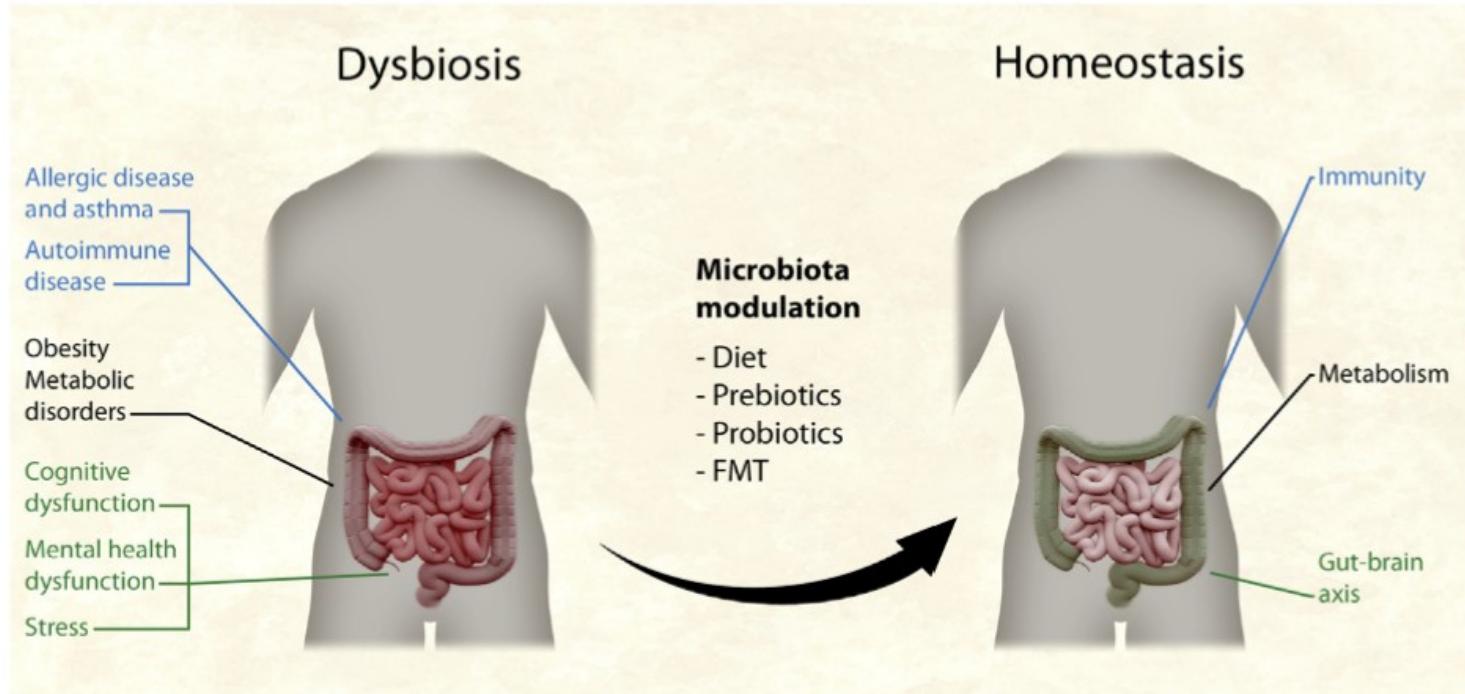


FIG 1. Dysbiosis, an “imbalance in the structure and/or function of the microbiota that leads to disruption of host-microorganism homeostasis,”⁶ has been implicated in a broad range of inflammatory disease states. There is also suggestive evidence that changes in gut microbiota have implications for cognitive and mental health dysfunction and stress responses. These diverse multisystem influences have sparked interest in strategies to favorably modulate the gut microbiota to attain homeostasis.

West CE, Renz H, Jenmalm MC, Kozyrskyj AL, Allen KJ, Vuillermin P, Prescott SL, MacKay C, Salminen S, Wong G, Sinn J. The gut microbiota and inflammatory noncommunicable diseases: associations and potentials for gut microbiota therapies. *Journal of Allergy and Clinical Immunology*. 2015 Jan 1;135(1):3-13.

Antibiotics use and Dysbiosis

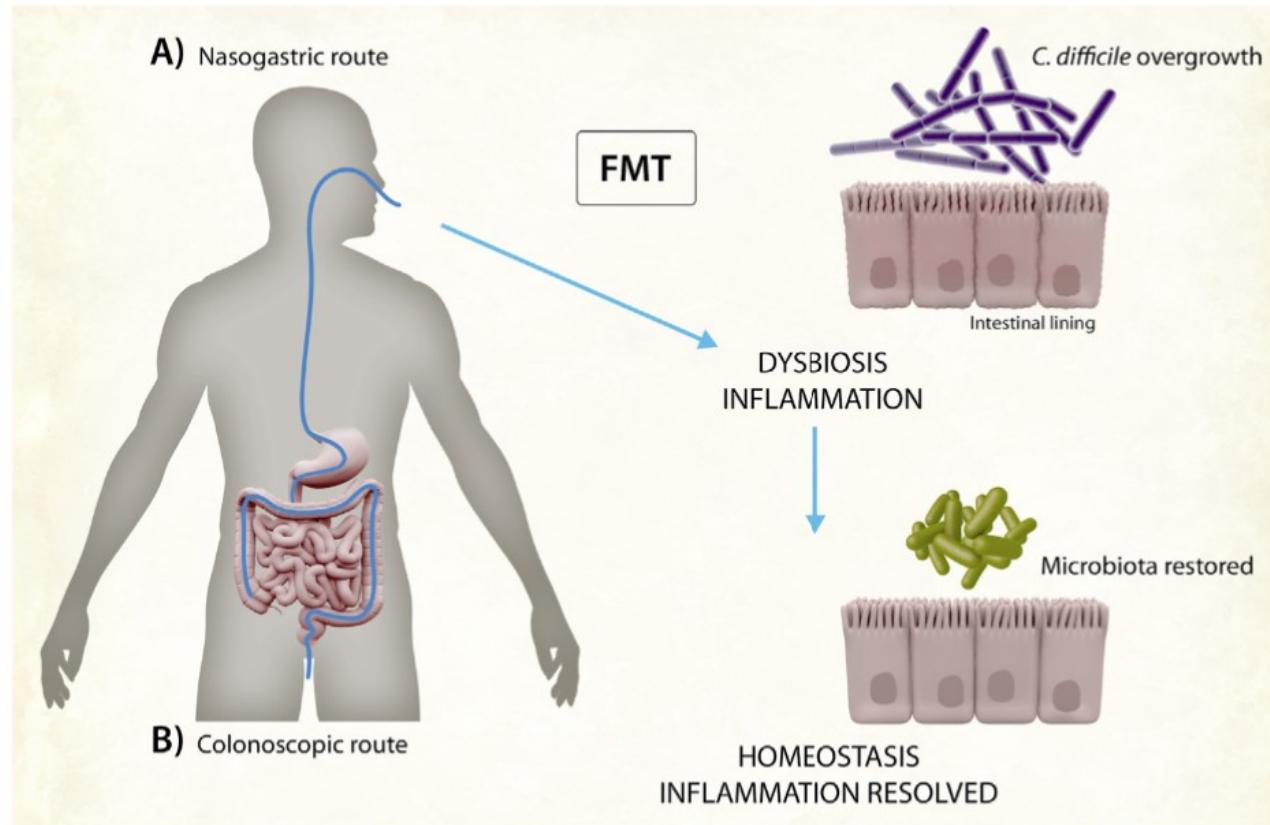


FIG 2. Overuse or repeated courses of broad-spectrum antibiotics disrupt the normal ecology, allowing colonization of *C difficile* and leading to dysbiosis. FMT with feces from a healthy donor administered through the nasogastric (A) or colonoscopic (B) routes restores microbial ecology and resolves

West CE, Renz H, Hedenmalm MC, Kozyrskyj AL, Allen KJ, Vuillermin P, Prescott SL, MacKay C, Salminen S, Wong G, Sinn J. The gut microbiota and inflammatory noncommunicable diseases: associations and potentials for gut microbiota therapies. Journal of Allergy and Clinical Immunology. 2015 Jan 1;135(1):3-13.

Newer Hypotheses on NCDs

Review

A gut dysbiotic microbiota-based hypothesis of human-to-human transmission of non-communicable diseases



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^a Department of Occupational and Environmental Health, Central South University, Changsha, 410078, China

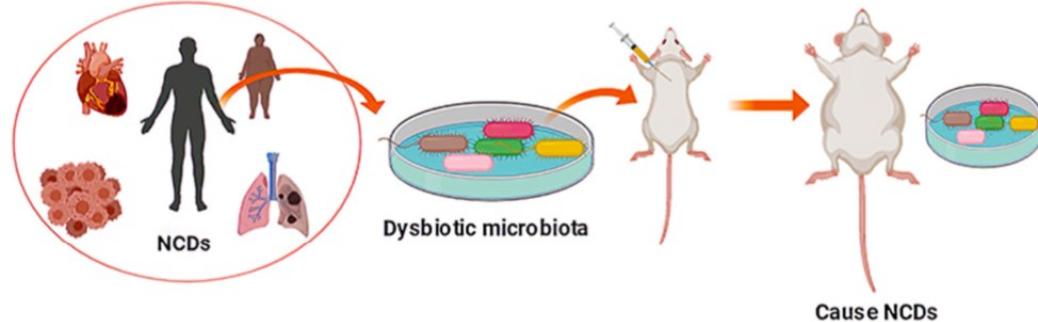
^b Department of Radiation Biology, Beijing Key Laboratory for Radiobiology, Beijing Institute of Radiation Medicine, AMMS, Beijing 100850, PR China

^c Institute for Chemical Carcinogenesis, State Key Laboratory of Respiratory, Guangzhou Medical University, Guangzhou 511436, PR China

HIGHLIGHTS

- Based on the microbiota-associated postulates, non-communicable diseases may transfer human-to-human by dysbiotic microbiota
- Our hypothesis would represent a paradigm shift in efforts to prevent and control these diseases, and stimulate additional studies on the associations among environmental factors, gut microbiota, and NCDs.

GRAPHICAL ABSTRACT



Latest Evidence



Hypertension Research (2022) 45:555–572
<https://doi.org/10.1038/s41440-022-00874-8>

EDITORIAL

Special Issue: Current evidence and perspectives for hypertension management in Asia



Latest hypertension research to inform clinical practice in Asia

Kazuomi Kario¹ · Masaki Mogi² · Satoshi Hoshide¹

Received: 1 February 2022 / Accepted: 2 February 2022 / Published online: 5 April 2022
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Abstract

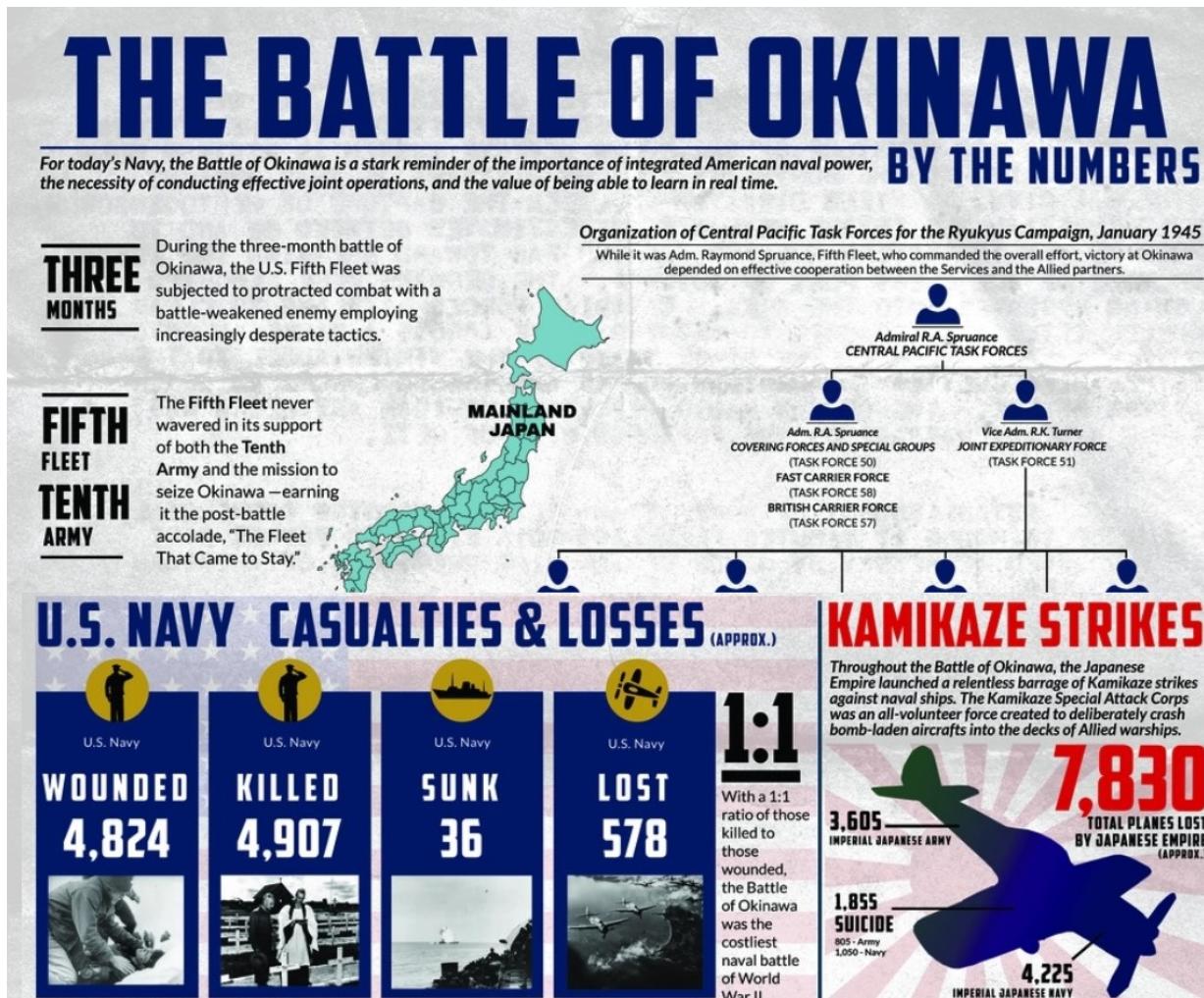
Despite the challenges associated with the coronavirus pandemic, the last 2 years have been active periods for hypertension research and initiatives in Asia. There are new hypertension guidelines from the World Health Organization that can be interpreted and applied locally. This is also the case for data from the latest Blood Pressure Lowering Treatment Trialists' Collaboration meta-analysis, which showed that greater reductions in systolic blood pressure (BP) are associated with lower risks of cardiovascular events. The randomized controlled Strategy of Blood Pressure Intervention in the Elderly Hypertensive study and the Salt Substitute and Stroke Study provide local data to inform practice. Other initiatives to help reduce high salt intake in Asia are also underway. Both drug-resistant and nocturnal hypertension are appropriate areas of focus in Asia, and there are an increasing number of pharmacological and non-pharmacological treatment options for these conditions. Digital therapeutics to promote uptake and implementation of lifestyle interventions are showing promise, and other digital-based strategies such as telemedicine, wearable BP monitors to detect beat-by-beat BP and artificial intelligence will no doubt become integral parts of future strategies to reduce the burden of hypertension and hypertension-related disease. A number of initiatives from the Hypertension Cardiovascular Outcome Prevention and Evidence in Asia Network and Japanese Society of hypertension are underway, and there is good reason for optimism regarding the ongoing and future management of hypertension in Asia based on these and the active research activities in the region.

Keywords Hypertension · Antihypertensives · Cardiovascular risk · Digital therapeutics · Artificial intelligence · Blood pressure monitoring

Kario K, Mogi M, Hoshide S. Latest hypertension research to inform clinical practice in Asia. *Hypertension Research*. 2022 Apr;45(4):555-72.

3. Bridging the Evidence Gap: Need for Research

The Battle of Okinawa



Okinawa Island had the bloodiest ground battle of the Pacific War from April 1 to June 22, 1945. During this 82-day-long battle, about 95,000 Imperial Japanese Army troops and 20,195 Americans were killed.

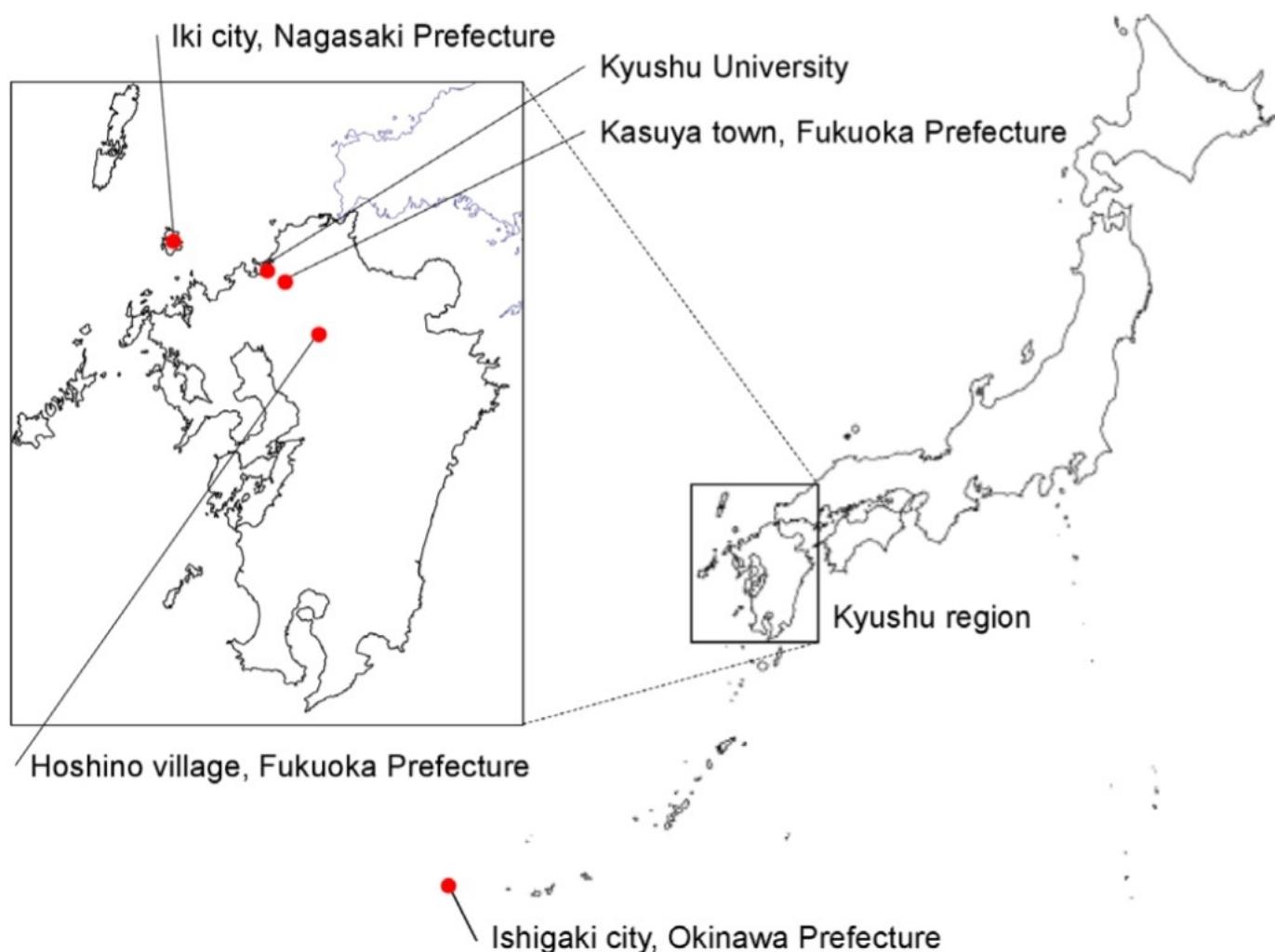


Figure 1 Location of the four study regions of the Kyushu and Okinawa Population Study.

Ikezaki H, et.al; Kyushu and Okinawa Population Study (KOPS): a large prospective cohort study in Japan. BMJ open. 2021 Dec 1;11(12):e053763.

Steady rise in number of Centenarians

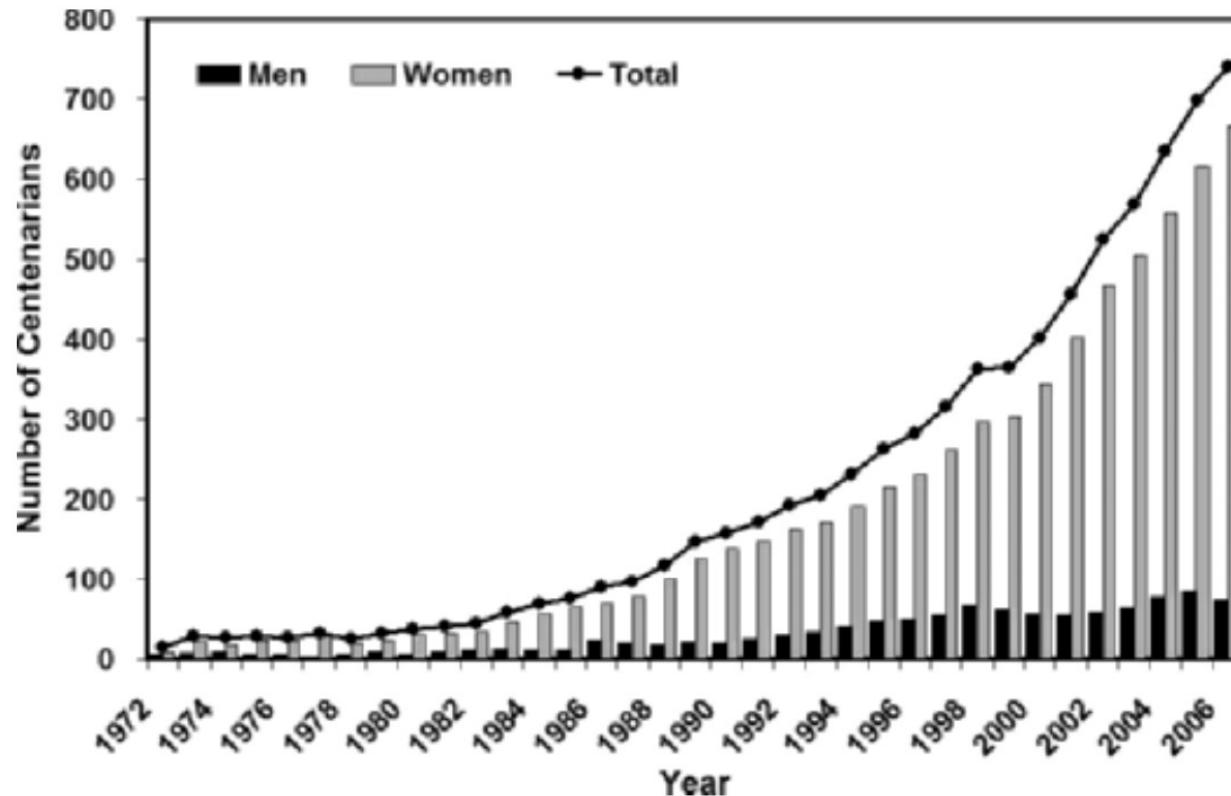
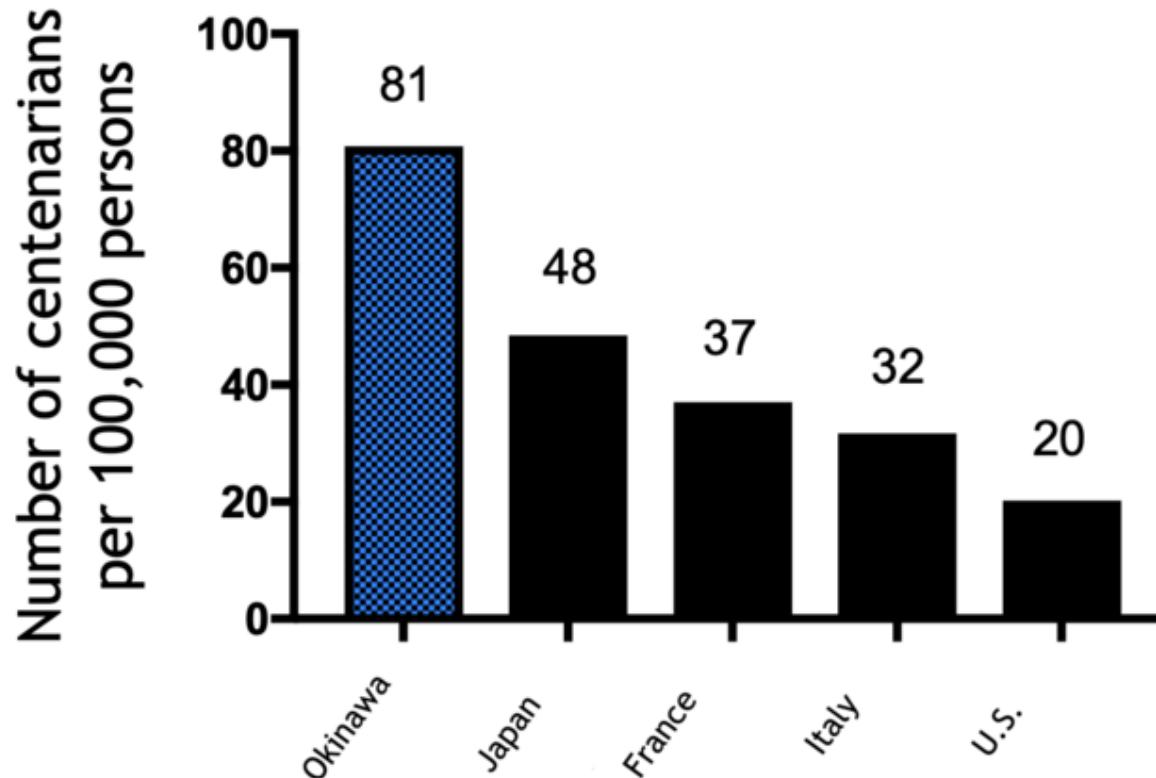


Figure 2. Number of centenarians in Okinawa from 1972–2006.

Willcox DC, Willcox BJ, Hsueh WC, Suzuki M. Genetic determinants of exceptional human longevity: insights from the Okinawa Centenarian Study. Age. 2006 Dec;28(4):313-32.

Prevalence of Centenarians

2015 Centenarian Prevalence (per 100,000 persons)



Willcox DC, Willcox BJ, Hsueh WC, Suzuki M. Genetic determinants of exceptional human longevity: insights from the Okinawa Centenarian Study. Age. 2006 Dec;28(4):313-32.

Whipple's Index highest in the World

Table 5. Whipple's Index for Centenarians*

Region	Okinawa [†]	Sweden [‡]	Difference (%)
Men	0.903	0.880	2.5
Women	0.957	0.908	5.1
Both sexes	0.945	0.901	4.6

Notes: A relative deviation of <5% or 5%–9.99% indicates very accurate or relatively accurate data quality by United Nations standards (16).

*Whipple's index for centenarians = (sum of numbers of deaths at ages 95, 100, 105)/total number of deaths between ages 93 and 107 years.

[†]The index for Okinawa is based on year 2000 data from Japan Ministry of Health, Labour and Welfare (10).

[‡]The index for Sweden is based on data supplied by Wang and colleagues (16).

Books on the Okinawa Program



The New York Times Bestseller

How the world's LONGEST-LIVED people achieve EVERLASTING HEALTH—and how you can too

The OKINAWA PROGRAM

LEARN THE SECRETS TO
HEALTHY LONGEVITY:

- 16 Ways to Eliminate Excess Calories
- 10 Healing Foods and Herbs
- 4 Keys to Becoming and Staying Optimistic
- Tips for Achieving a Healthy Protein Balance
- . . . and much more

BASED ON THE 25-YEAR OKINAWA CENTENARIAN STUDY

BRADLEY J. WILLCOX, M.D., D. CRAIG WILLCOX, Ph.D., and MAKOTO SUZUKI, M.D.

FOREWORD BY ANDREW WEIL, M.D.

"The Okinawa Diet Plan is a significant contribution to the science of healthy weight loss and longevity. This book can help you reduce the risk of many weight-related diseases by achieving and maintaining the healthiest weight for you."

—ANDREW WEIL, M.D., author of *8 Weeks to Optimum Health*

**GET LEANER,
LIVE LONGER, and
NEVER FEEL HUNGRY**

THE OKINAWA DIET PLAN

the only diet with
100 years
of living proof

- Discover how the world's longest-lived and healthiest people eat to stay slim
- Use the caloric density index to achieve lifelong healthy weight
- Choose the right proteins, the right fats, and the right carbs
- With more than 150 delicious, easy-to-prepare recipes

Bradley J. Willcox, M.D., D. Craig Willcox, Ph.D., and Makoto Suzuki, M.D.,
Authors of the *New York Times* bestseller *The Okinawa Program*

First autopsy study of an Okinawan centenarian: absence of many age-related diseases

Adam M Bernstein¹, Bradley J Willcox, Hitoshi Tamaki, Nobuyoshi Kunishima, Makoto Suzuki,
D Craig Willcox, Ji-Suk Kristen Yoo, Thomas T Perls

Affiliations + expand

PMID: 15602075 DOI: [10.1093/gerona/59.11.1195](https://doi.org/10.1093/gerona/59.11.1195)

Abstract

Consistent with the compression-of-morbidity hypothesis, several studies have reported that a significant proportion of centenarians delay or escape age-related diseases. Of those who live with such diseases for a long time, many appear to do so with better functional status than do younger persons who do not achieve extreme old age. The authors describe the first autopsy in an Okinawan-Japanese centenarian who escaped many age-related illnesses and delayed frailty toward the end of her very long life. Her late-life morbidity pattern is contrasted with that of white centenarians.

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Abstract

Okinawa in the news for a different reason

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Education

Want to live to be 100?

The islanders of Okinawa live longer than anyone else on the planet. And they stay fit, active and happy long into old age. Now a new book reveals their secrets. Emily Wilson reports

The cover line is guaranteed to strike fear into the heart of anyone with a God-given allergy to self-help, change-your-life health regimes. "How the world's longest-lived people achieve everlasting health, and you can too," it says. And there's more: "Features four-week turnaround plan." Now there's a lot you can do in four weeks, but I'm willing to bet, er, everything, that achieving everlasting health isn't one of them. So far, so alternative, new-age, step-plan-tastic.

Emily Wilson
Thu 7 Jun 2001 16.24 BST

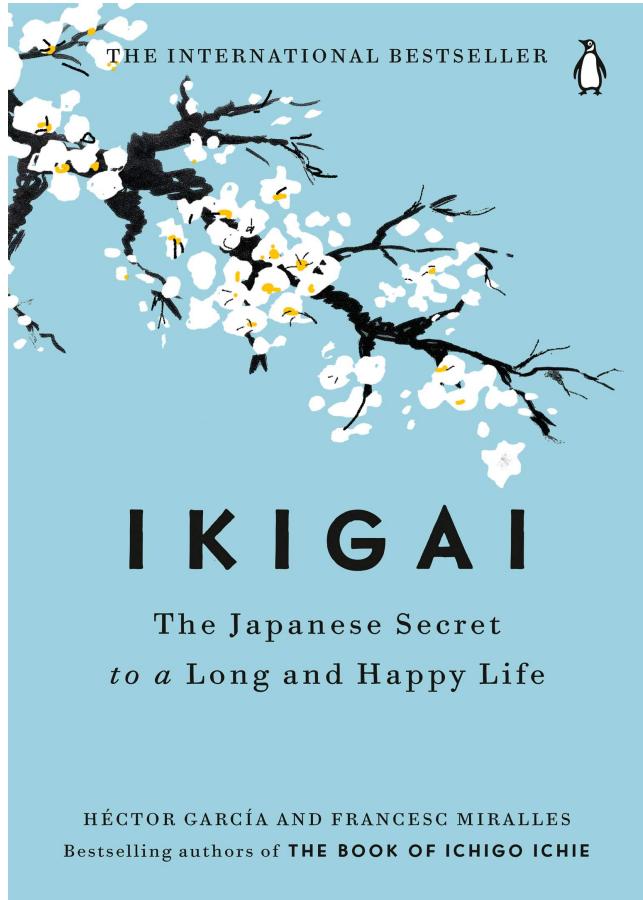
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Secret #1: Ikigai



The Japanese Secret
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HÉCTOR GARCÍA AND FRANCESC MIRALLES
Bestselling authors of **THE BOOK OF ICHIGO ICHIE**



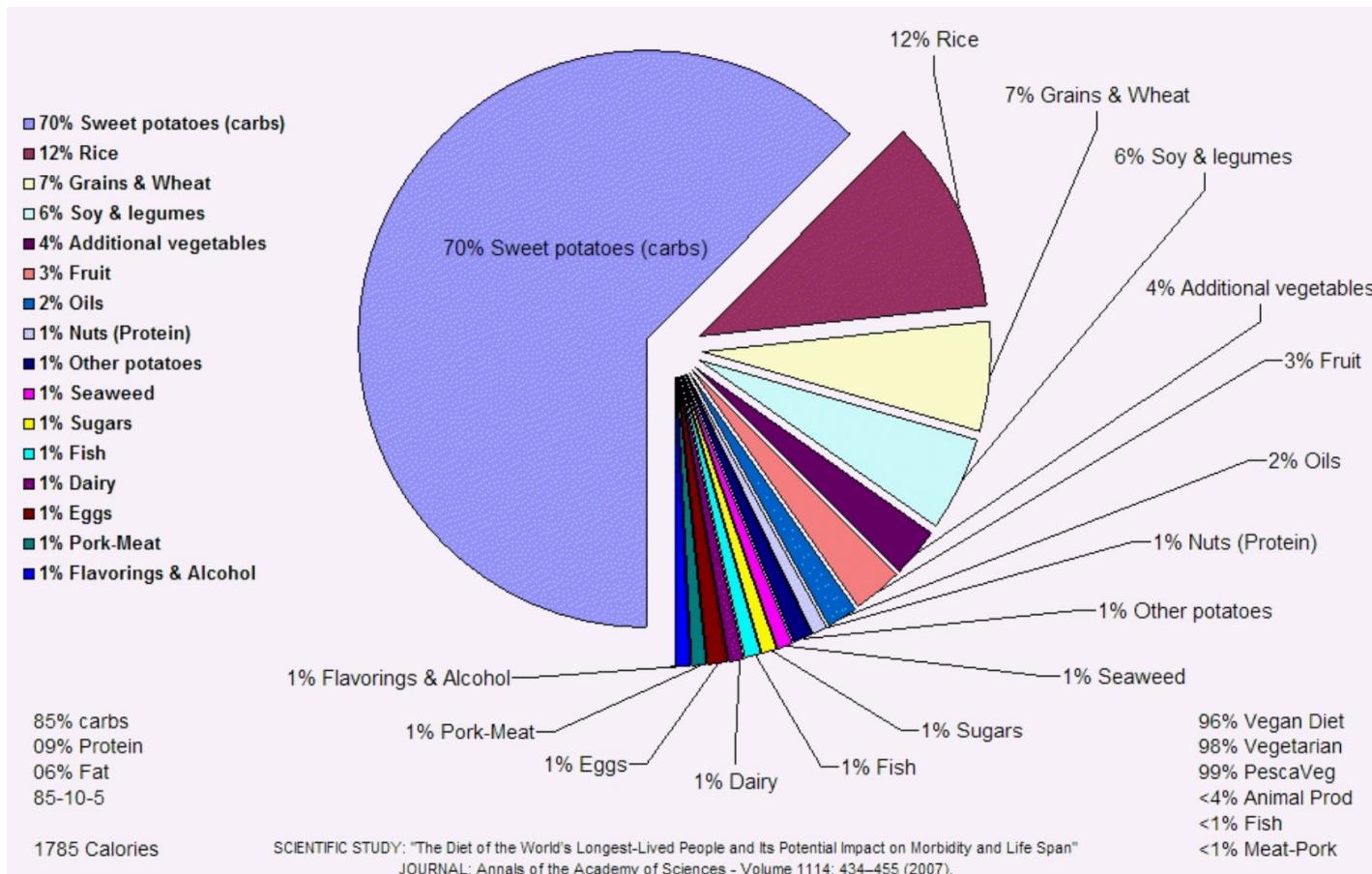
Secret #2: Hara Hachi Bu



Practice hara hachi bu.

Take a cue from the Okinawans and practice hara hachi bu. It's easy -- just stop eating when you're about 80% full. Notice how it makes you feel. I'll bet you'll enjoy being pleasantly satisfied but not STUFFED.

Caloric restriction: Key to Okinawa Diet



Validation Studies



Journal of Gerontology: BIOLOGICAL SCIENCES
2008, Vol. 63A, No. 4, 338–349

Copyright 2008 by The Gerontological Society of America

They Really Are That Old: A Validation Study of Centenarian Prevalence in Okinawa

D. Craig Willcox,^{1,2,4} Bradley J. Willcox,^{2,3,4} Qimei He,²
Nien-chiang Wang,⁵ and Makoto Suzuki^{4,6}

¹Okinawa International University, Japan.

²Pacific Health Research Institute, Honolulu, Hawaii.

³Departments of Geriatric Medicine and Medicine, John A. Burns School of Medicine, University of Hawaii, Honolulu.

⁴Okinawa Research Center for Longevity Science, Japan.

⁵National Taiwan University, Taiwan.

⁶Faculty of Medicine, University of the Ryukyus, Okinawa, Japan.

Long-lived individuals, such as centenarians, may harbor genetic or environmental advantages important for healthy aging. Populations with high prevalence of such individuals offer fertile ground for such research. However, precise phenotypes are required, particularly accurate age. Okinawa has among the world's highest reported prevalence of centenarians but, despite extensive study, no systematic validation of centenarian prevalence has been published. Therefore, we performed comprehensive age validation of a subset (8%) of the total centenarian population and assessed the reliability of the age registration system. Self-reported age was validated with several common methods and found to correlate well with documented age. Demographic methods, including assessment of age heaping, maximum age at death, centenarian proportions, and male to female ratios of centenarians indicate that the age registration system is reliable. We conclude that the high reported centenarian prevalence in Okinawa is valid and warrants further study for its genetic and environmental correlates.

Key Words: Longevity—Centenarian—Age Validation—Okinawa.

Willcox BC, Willcox BJ, He Q, Wang NC, Suzuki M. Validation study of centenarian prevalence in Okinawa and the health of centenarians. *J Gerontol Biol Sci*. 2008;63A(4):338-349. life span. Annals of the New York Academy of Sciences. 2007 Oct;1114(1):434-55.

Large Scale, Prospective Cohort Study

Open access

Cohort profile

BMJ Open Kyushu and Okinawa Population Study (KOPS): a large prospective cohort study in Japan

Hiroaki Ikezaki  ^{1,2}, Norihiro Furusyo, ^{1,3} Ryoko Nakashima, ¹ Makiko Umemoto, ¹ Ken Yamamoto, ¹ Yuji Matsumoto, ^{1,4} Azusa Ohta, ^{1,4} Sho Yamasaki, ^{1,4} Satoshi Hiramine, ¹ Koji Takayama, ¹ Eiichi Ogawa, ^{1,4} Kazuhiro Toyoda, ¹ Masayuki Murata, ¹ Nobuyuki Shimono, ¹ Jun Hayashi^{1,5}

To cite: Ikezaki H, Furusyo N, Nakashima R, et al. Kyushu and Okinawa Population Study (KOPS): a large prospective cohort study in Japan. *BMJ Open* 2021;11:e053763. doi:10.1136/bmjopen-2021-053763

ABSTRACT

Purpose The Kyushu and Okinawa Population Study (KOPS) was established to investigate gene–environmental interactions in non-communicable diseases in Japan. Besides collecting blood samples and anthropometric measurements, we also obtained medical histories, psychological status and lifestyle habits, including physical activities and dietary patterns.

Participants KOPS is a community-based prospective cohort

Ikezaki H, Furusyo N, Nakashima R, Umemoto M, Yamamoto K, Matsumoto Y, Ohta A, Yamasaki S, Hiramine S, Takayama K, Ogawa E. Kyushu and Okinawa Population Study (KOPS): a large prospective cohort study in Japan. *BMJ open*. 2021 Dec 1;11(12):e053763.

Strengths and limitations of this study

- The Kyushu and Okinawa Population Study is a large-scale, population-based prospective cohort and aims to investigate the gene–environmental interactions on non-communicable diseases in Japan.
- We collected the extensive data on medical histories, lifestyle habits, psychological factors and genomic

Food Pyramid of the Okinawa Diet

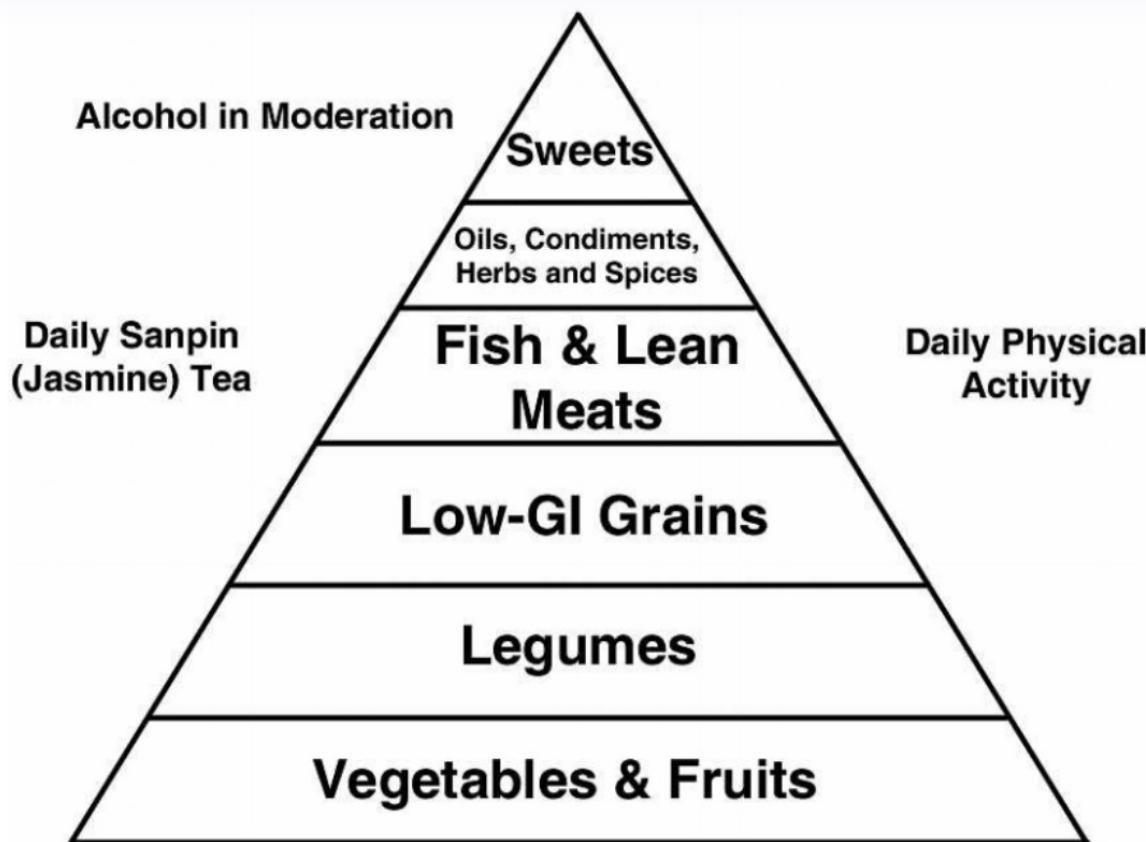


Fig. 2. Traditional Okinawan diet food pyramid.

Ikezaki H, Furusyo N, Nakashima R, Umemoto M, Yamamoto K, Matsumoto Y, Ohta A, Yamasaki S, Hiramine S, Takayama K, Ogawa E. Kyushu and Okinawa Population Study (KOPS): a large prospective cohort study in Japan. BMJ open. 2021 Dec 1;11(12):e053763.

Aims to investigate the gene–environmental interactions on NCDs in Japan

Collected the extensive data on medical histories, lifestyle habits, psychological factors and genomic information.

Table 1 Details of the self-administered questionnaire for KOPS

Measurement	Measurement lists
Basic information	
Demographics	Sex, age at baseline, height, weight and weight at the age of 20 years
Lifestyle characteristics	
Alcohol consumption	Alcohol drinking status, age at the start of habitual drinking, type and amount of alcohol and drinking frequency
Smoking	Smoking status, age at the start of habitual smoking and number of cigarettes smoked per day
Sleeping	Hours of sleep and subjective assessment of sleep
Physical activities	Frequency and hours of physical activities in leisure time (light, moderate and hard), commuting, work and household chores
Dietary information	Food Frequency Questionnaire
Clinical characteristics	
Medical history	Personal and family disease history and information on drugs
Psychological stress	Self-reported stress and stress management
Female reproductive history	Menstruation status, age at the start of menstruation, and information on pregnancy and childbirth

Table 5 Biological tests in KOPS

Biological samples	Specific biological tests
Whole blood	White blood cell, red blood cell, haemoglobin, haematocrit, platelet count, fasting blood glucose, glycated haemoglobin
Serum	Serum creatinine, uric acid, aspartate aminotransferase, alanine aminotransferase, gamma-glutamyl transferase, glycated albumin, fasting serum insulin, total cholesterol, high-density lipoprotein cholesterol, triglycerides, low-density lipoprotein cholesterol, high-sensitivity C reactive protein
Urine	Urine protein, glucose, occult blood

KOPS, Kyushu and Okinawa Population Study.

Secret #3: Moai

Mo•ai (/mo,eye/) *Japan*

noun

1. A group of lifelong friends
2. A social support group that forms in order to provide varying support from social, financial, health, or spiritual interests

Experience Less Stress

Be Happier

Live Longer



Ayurveda for the Management of Non Communicable Diseases

"One who carefully observes the rules regarding diet and behavioural practices, consumes healthy and wholesome food, observes beneficial practices, carries himself thoughtfully in daily activities, does not succumb to passion and greed, who cherishes a selfless noble generous nature, has equal respect for every living being in all conditions, speaks and relies on the truth, maintains a forgiving attitude and reposes faith in knowledgeable, experienced and elderly persons is successful in maintaining healthy living and a healthy body and in leading a disease-free, peaceful, healthy and happy life"

-- Vaghata from Ashtanga Hridaya

The efficiencies of such practices in providing long lasting effect on such NCDs need to be compared, documented and published in standard journals, rather

Various Ayurvedic modalities for NCD Management

- Dincharya
- Changes to Aahar & Vihar
- Rituanusar Shodhanakarma
- Triyaupasthambha
- Rasayana
- Aacharrasayana
- Sadvrita
- Vajikarana

4. How to Generate Evidence: Data Science Approach

Need for Innovation in Research

- Needs to evolve.
- Cluster Randomized Trials vs Randomized Clinical Trials
- Larger study populations and numerous variables
- Need to establish Salience and Individualized care
- Using EHR

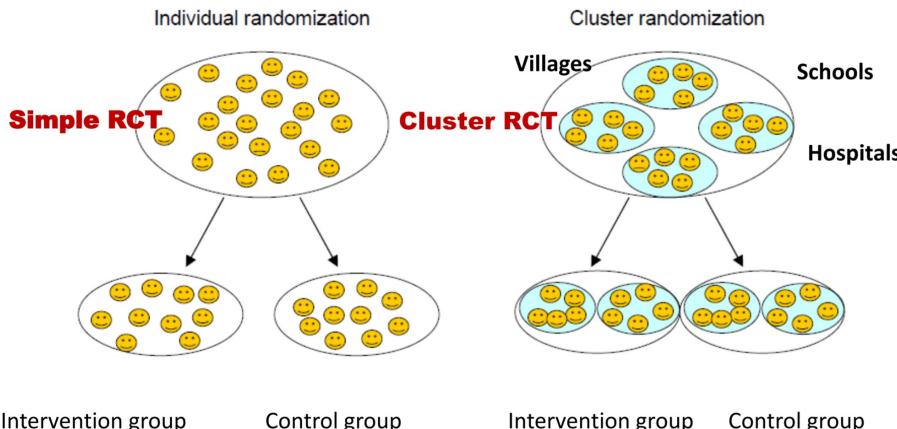


TABLE 1 | Epistemological comparison of modern biomedicine and Ayurveda.

Aspects	Modern biomedicine	Ayurveda
1 Approach and disease classification system	Largely focuses on structural/material aspects	Mainly focuses on functional aspects
2 Location	Organ specific or localized	Systemic
3 Causality	Single Causality	Multiple causality
4 Reasoning method	Linear	Non-linear, circular reasoning
5 Causative reason	Largely organism centered/external	Primarily immunity centered
6 Nature of knowledge	Objectivity centered	Subjectivity centered
7 Nature of assessment	Predominantly quantitative	Predominantly qualitative
8 Context of validation	Outside individual's context, laboratory	Within the context
9 Diagnostic approach	Universalization of standards	Individualization
10 Domains	Physical and mental; disease centered	Physical, mental, and spiritual; illness centered
11 Treatment focus	Curative focus, importance given to drugs, surgery	Preventive and promotive focus, importance given to drugs, food, and lifestyle
12 Treatment strategy	Targeted medicine	Compound formulations (<i>yoga</i>) and line of treatment concept
13 Line of treatment	Treating a specific manifestation at given time	Stage-wise management of the illness
14 Outcome	Effect is important	Effect should not lead to after effect, quality of life
15 Knowledge/practice focus	Standard protocols and institution driven	Physician driven

Framework for Research

AGE	0-10 10-20 20-30 30-40 40-50 50-60 60-70 70-80 80-90 90-100
DISEASE	Cardiovascular Ears and Eyes Gynaecological Respiratory Skeleton Urinary Digestive Endocrine Nervous Sexual Skin
SEX	Male Female
REGION	North Chandigarh Delhi Haryana Himachal Pradesh Punjab Jammu & Kashmir Uttarakhand Uttar Pradesh West Gujarat Goa Maharashtra Rajasthan Central Chattisgarh Madhya Pradesh East Bihar Jharkhand Odisha West Bengal South Andhra Pradesh Karnataka Kerala Tamil Nadu Telangana
CHRONICITY	0 to 3 months 4 to 12 months 1 to 5 years 5 to 10 years
VIKRITI	Vata Pitta Kapha Tridosha Vata Kapha Vata Pitta Pitta Kapha
EFFECTIVENESS of TREATMENT (EoT)	No relief Condition aggravated Little improvement Significant relief Condition relieved
MEDICINE	Single ingredient Multiple ingredients
DISEASE PREVALENCE	Non Co-morbid Co-morbid

Leveraging EHR for Generating Evidence



Centralized Hospital Management System

Centralised Electronic Medical Records

Centralized Public Health Management System

Comprehensive Healthcare Web Portal

Administrative Modules

Government Commitment: Health ID

The screenshot shows a web browser window for the Ayushman Bharat Digital Mission website at <https://healthid.ndhm.gov.in>. The page features the National Health Authority logo and navigation links for Home, Login, Generate ID, Facility, Contact, and FAQ. A prominent 'Health ID' icon is displayed. Below the header, the text 'Ayushman Bharat Digital Mission' and 'Creating India's Digital Health Ecosystem' is visible, along with the tagline 'Health ID - Key to your digital healthcare journey'. To the right, there is a graphic illustrating a digital health ecosystem, featuring a computer monitor displaying a patient profile, various medical icons (heart, ECG, plus signs), and a person sitting at a desk.

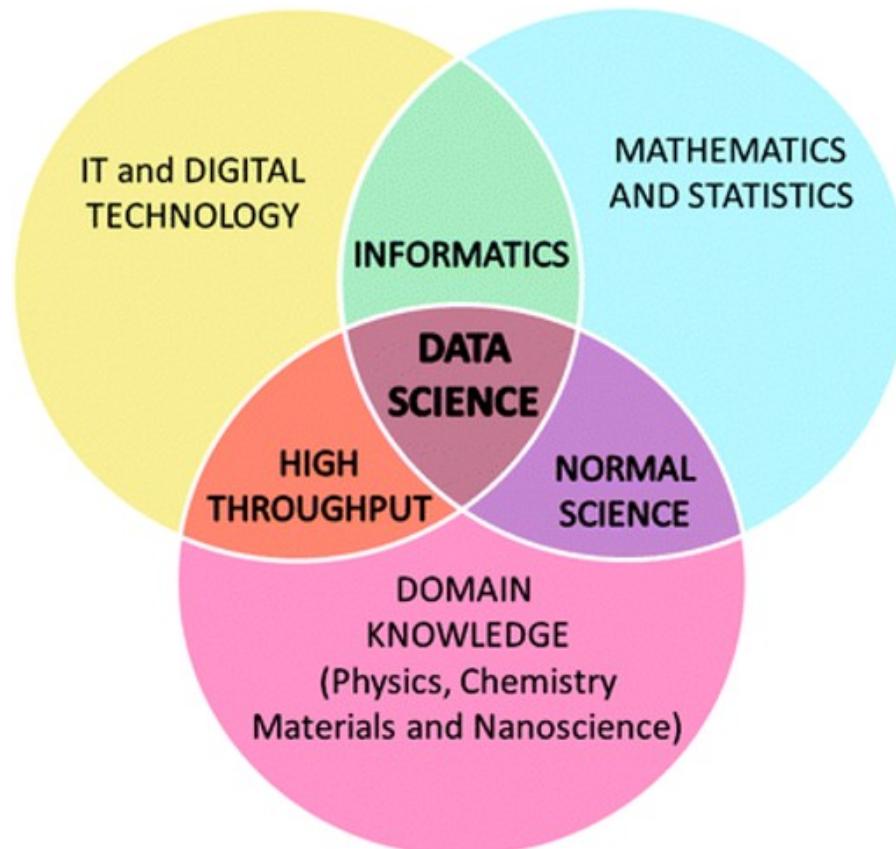
Ayushman Bharat Digital Mission

Creating India's Digital Health Ecosystem

Health ID - Key to your digital healthcare journey

Need for meticulous documentation

- Ayurvedic research need to be more rigorous
- Huge data with high throughput rates need to be harnessed
- Difficulties in comprehension and analysis
- Traditional ways have limits
- Data science is the way forward



Sun B, Fernandez M and Barnard AS (2016) Statistics, damned statistics and nanoscience – using data science to meet the challenge of nanomaterial complexity. *Nanoscale Horizons* 1(2). The Royal Society of Chemistry: 89–95. DOI: 10.1039/C5NH00126A.

Big Data and Ayurveda

What is Big Data?

- Volume
- Velocity
- Variety
- “Some” vs. “All”
- “Clean” vs. “Messy”
- “Causation” vs. “Correlation”
- Concerns of statistical significance



Data Science approach for generating evidence



Big Data Research in Ayurveda

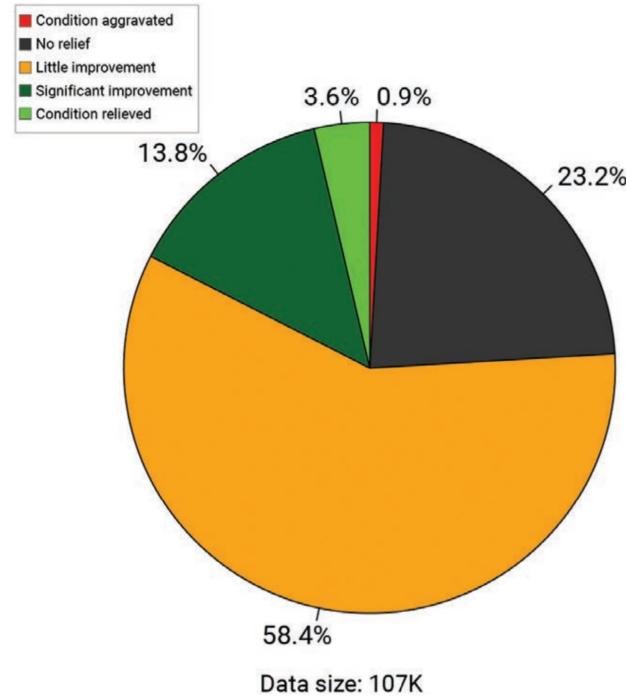
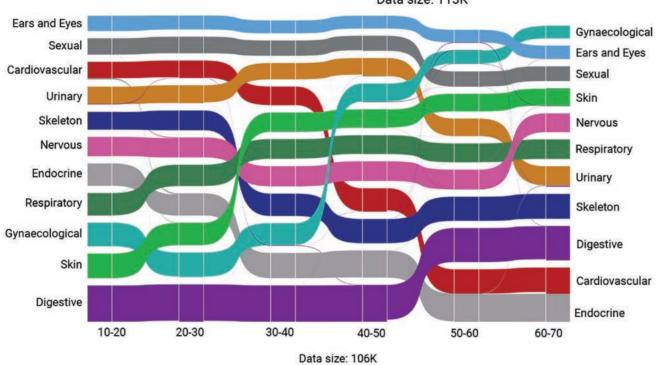
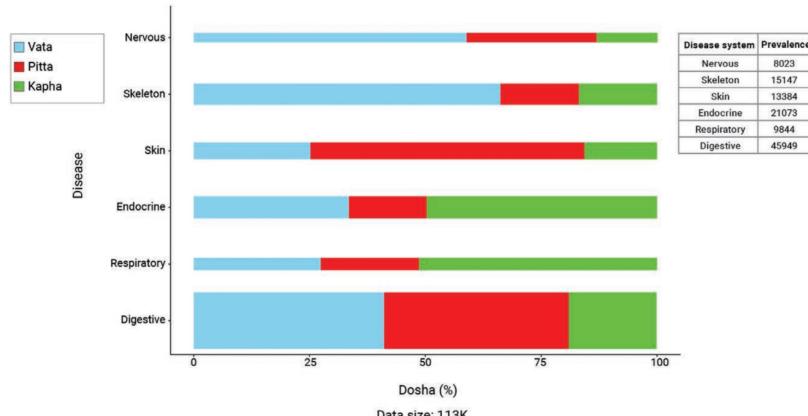
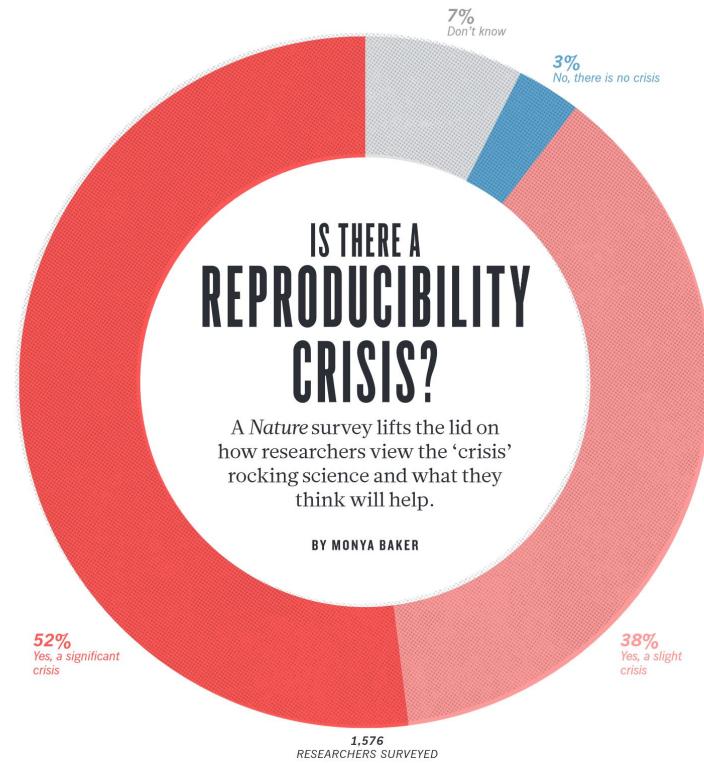


Fig 12. Distribution of follow-up relief—Overall. Pie chart represents the population with their percentage of outcome relief marked in terms of little improvement, significant improvement, condition relieved and no relief. In total, 0.9% has aggravated or have side effect, more than 75% have got relief.

Reproducible Research

Research is considered to be reproducible when the exact results can be reproduced if given access to the original data, software, or code.

- The same results should be obtained under the same conditions
- It should be possible to recreate the same conditions



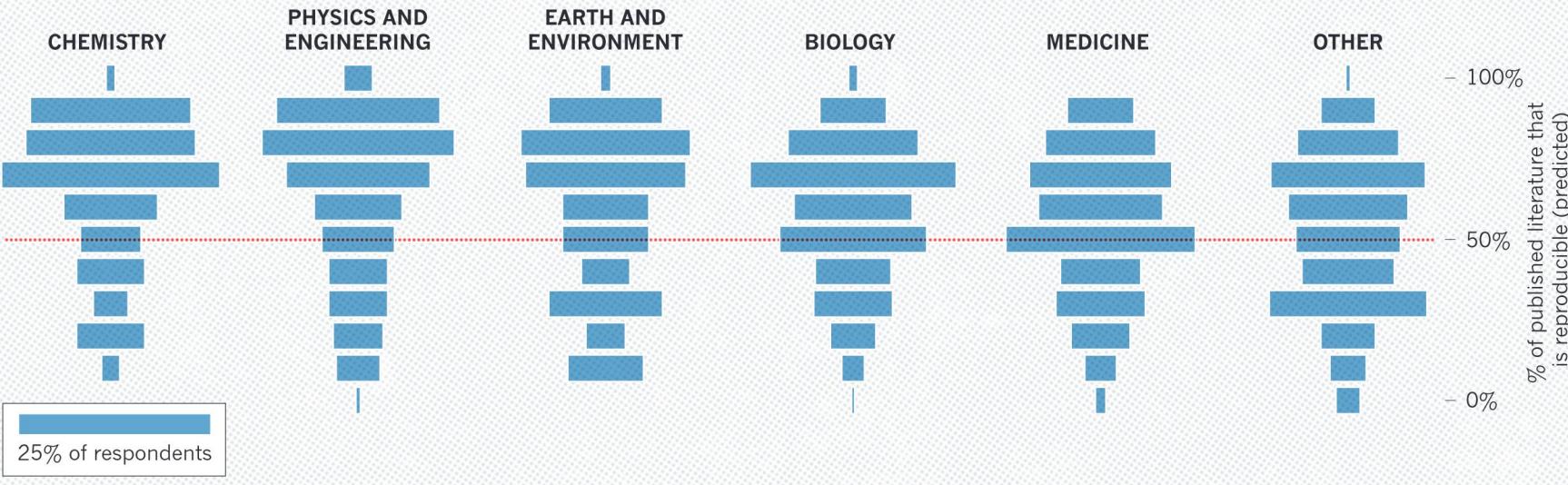
Reproducibility Crisis

A ‘CRISIS’ IN NUMBERS

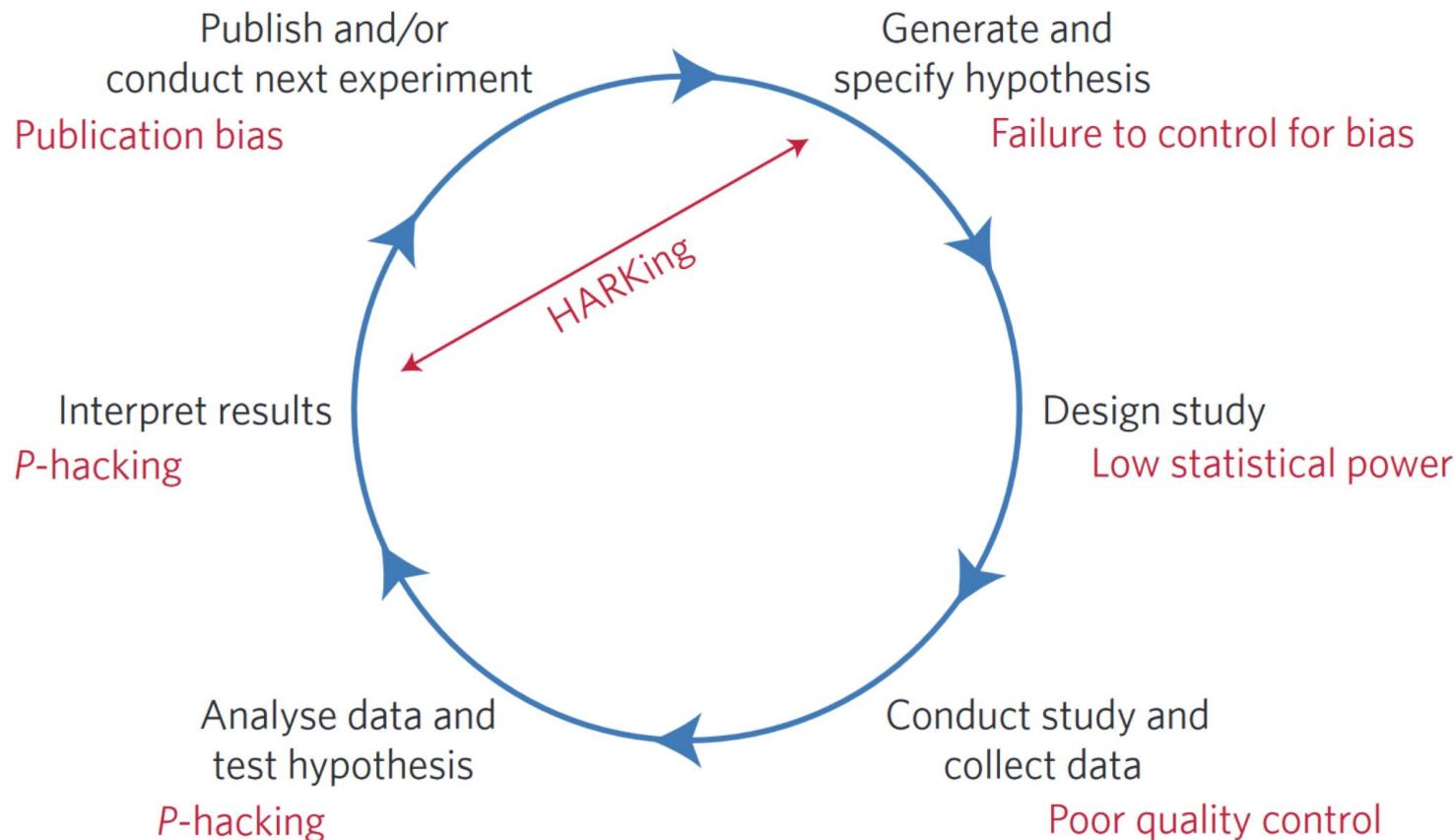
Nature surveyed 1,576 scientists online to get their thoughts on reproducibility in their field and in science in general. See go.nature.com/2vjr4y for more charts and access to the full data.

HOW MUCH PUBLISHED WORK IN YOUR FIELD IS REPRODUCIBLE?

Physicists and chemists were most confident in the literature.



Threats to Reproducibility

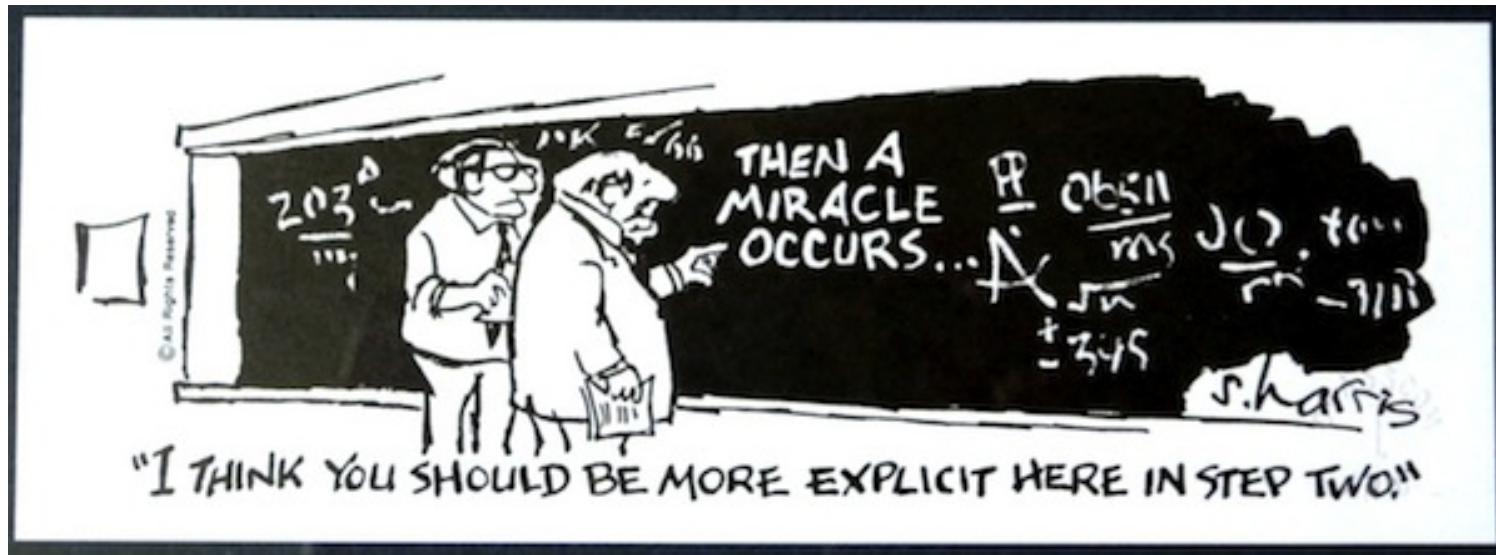


Munafò, M.R., Nosek, B.A., Bishop, D.V.M., Button, K.S., Chambers, C.D., Percie du Sert, N., Simonsohn, U., Wagenmakers, E.-J., Ware, J.J., Ioannidis, J.P.A., 2017. A manifesto for reproducible science. *Nature Human Behaviour* 1, 0021. <https://doi.org/10.1038/s41562-016-0021>

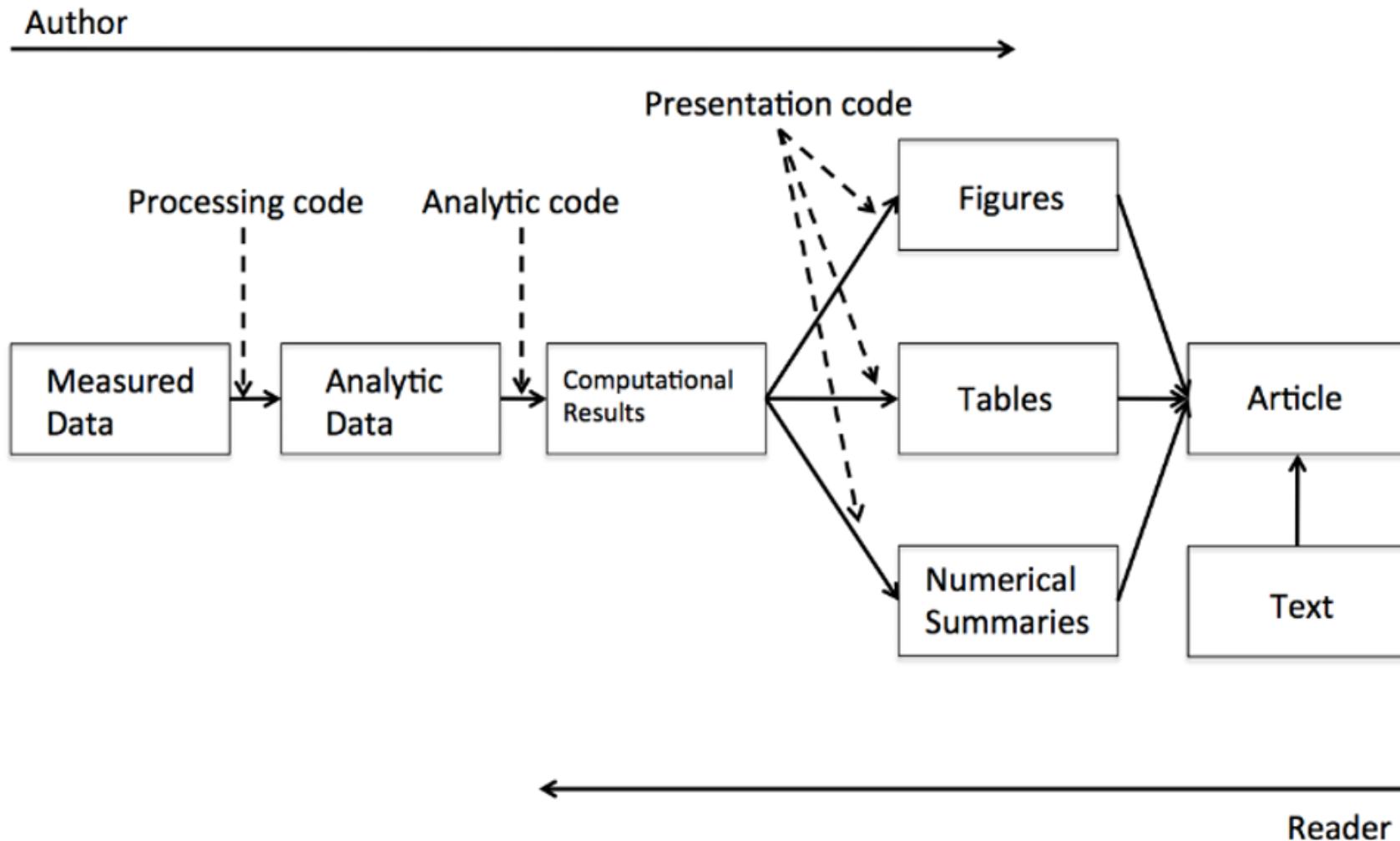
What are the good practices of reproducible research?

How to make your work reproducible?

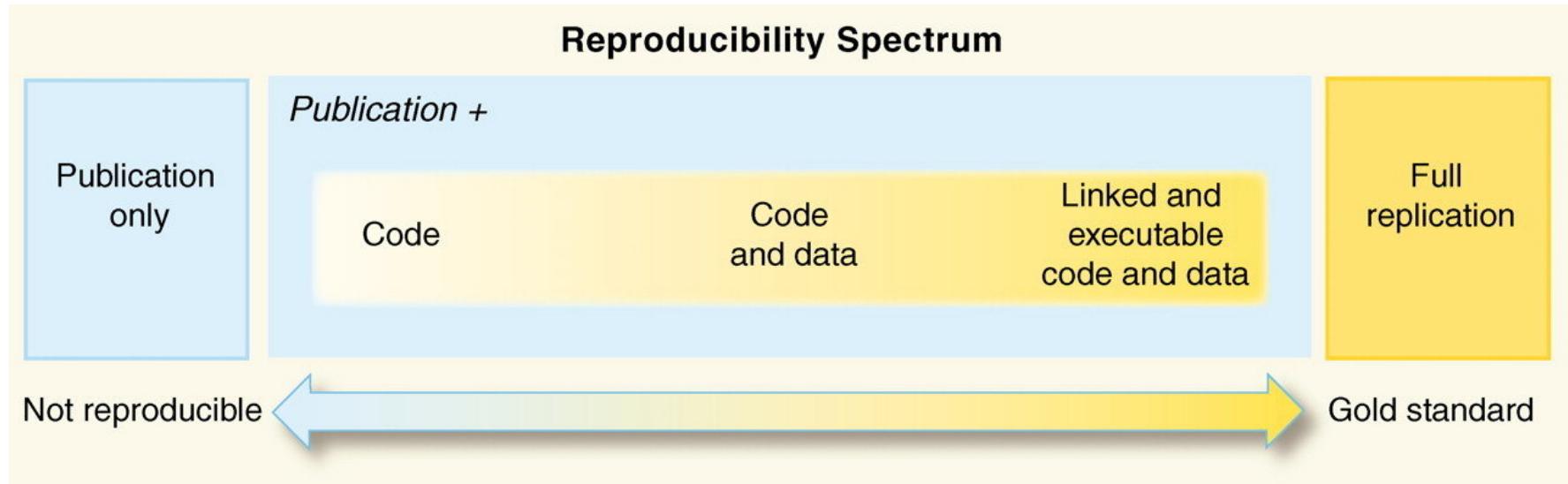
Reproducible workflows give you credibility!



Research Pipeline

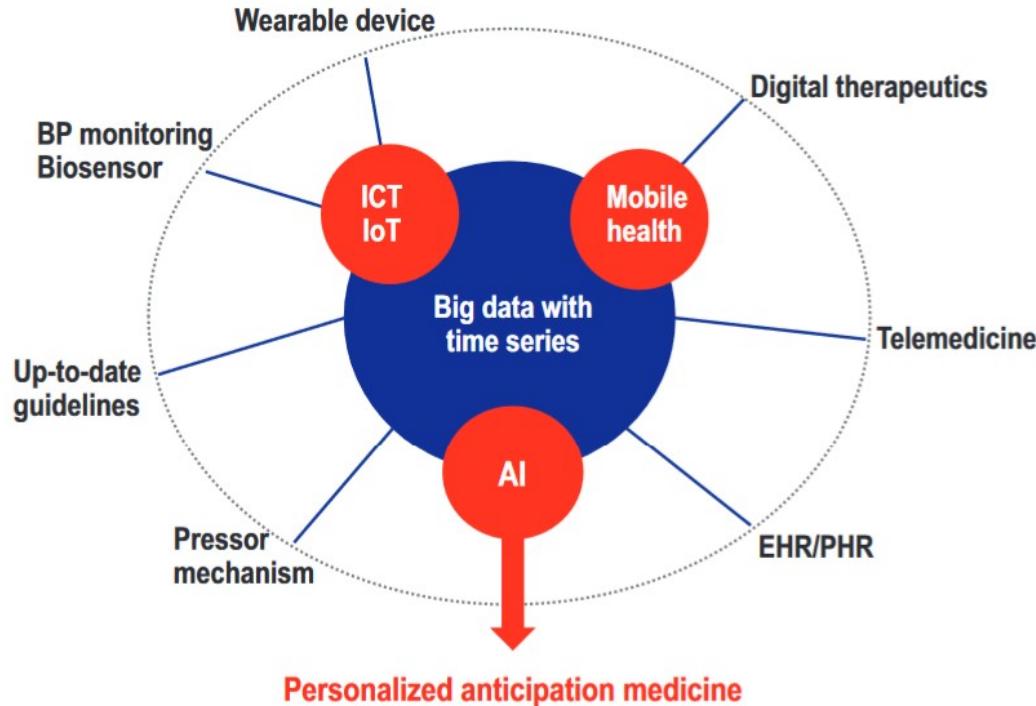


Reproducibility spectrum for published research



5. The Way Forward

Digital Management of HTN

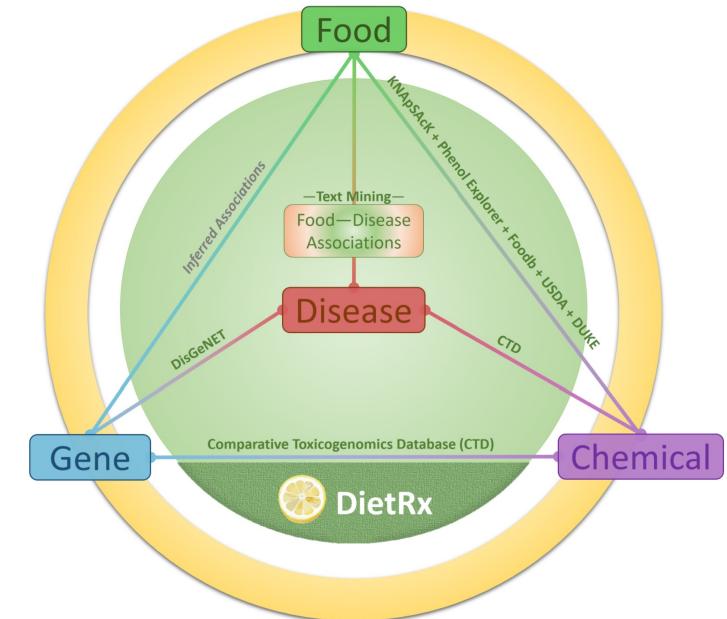
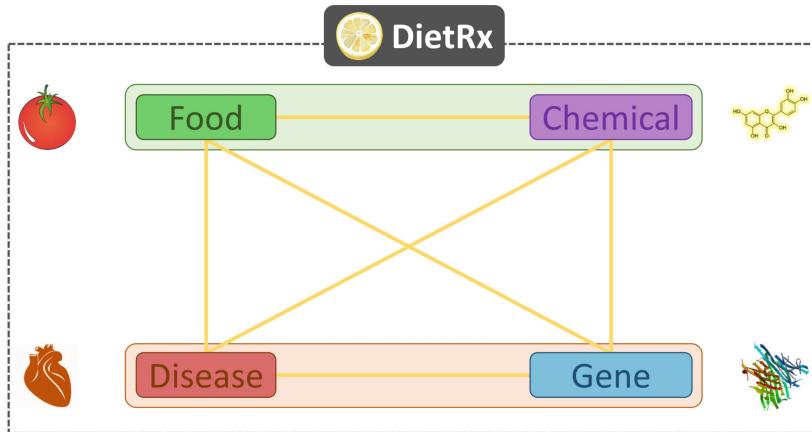


DietRx: Innovation by IIIT-Delhi

<https://cosylab.iiitd.edu.in/dietrx/>

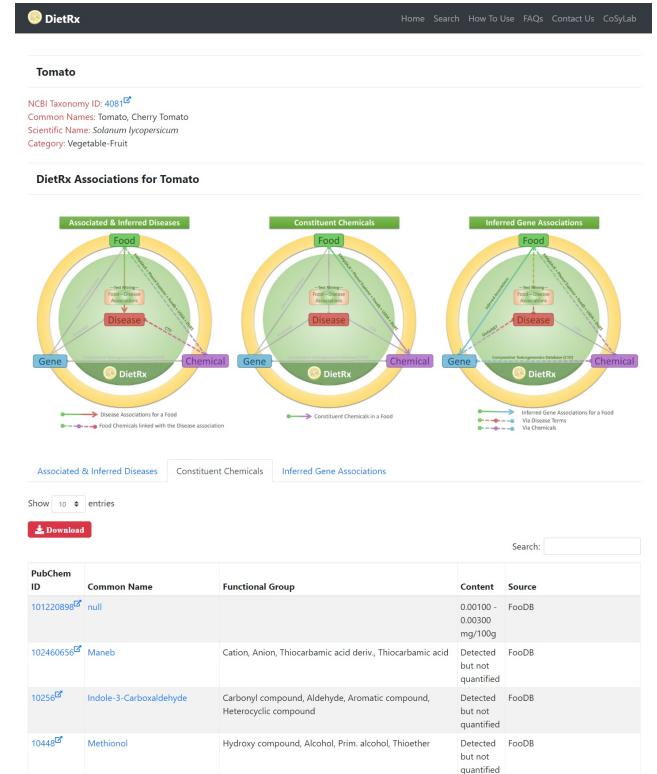
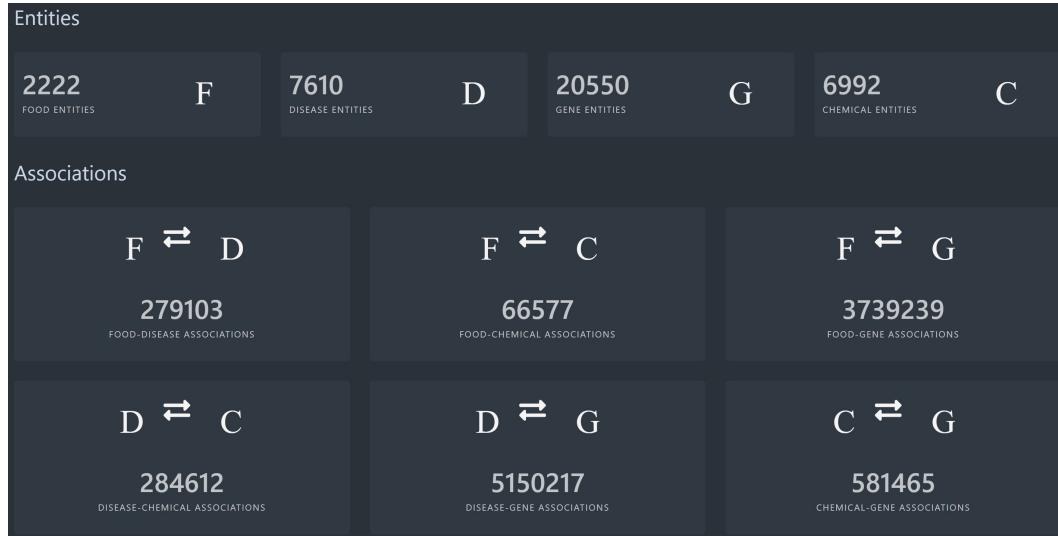


$$f(\text{Food} \otimes \text{Person}) = \text{DietRx}$$



Rudraksh Tuwanit, Neelansh Garg†, Rakhi NK and Ganesh Bagler*, DietRx: An integrative resource to explore interrelationships among foods, diseases, genes and chemicals (2018),
<http://cosylab.iiitd.edu.in/dietrx/>

DietRx: Innovation by IIIT-Delhi



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<http://cosylab.iiitd.edu.in/dietrx/>

Health Data Science at AMCHSS

Data Analysis Workshops: ~100 Health Professionals

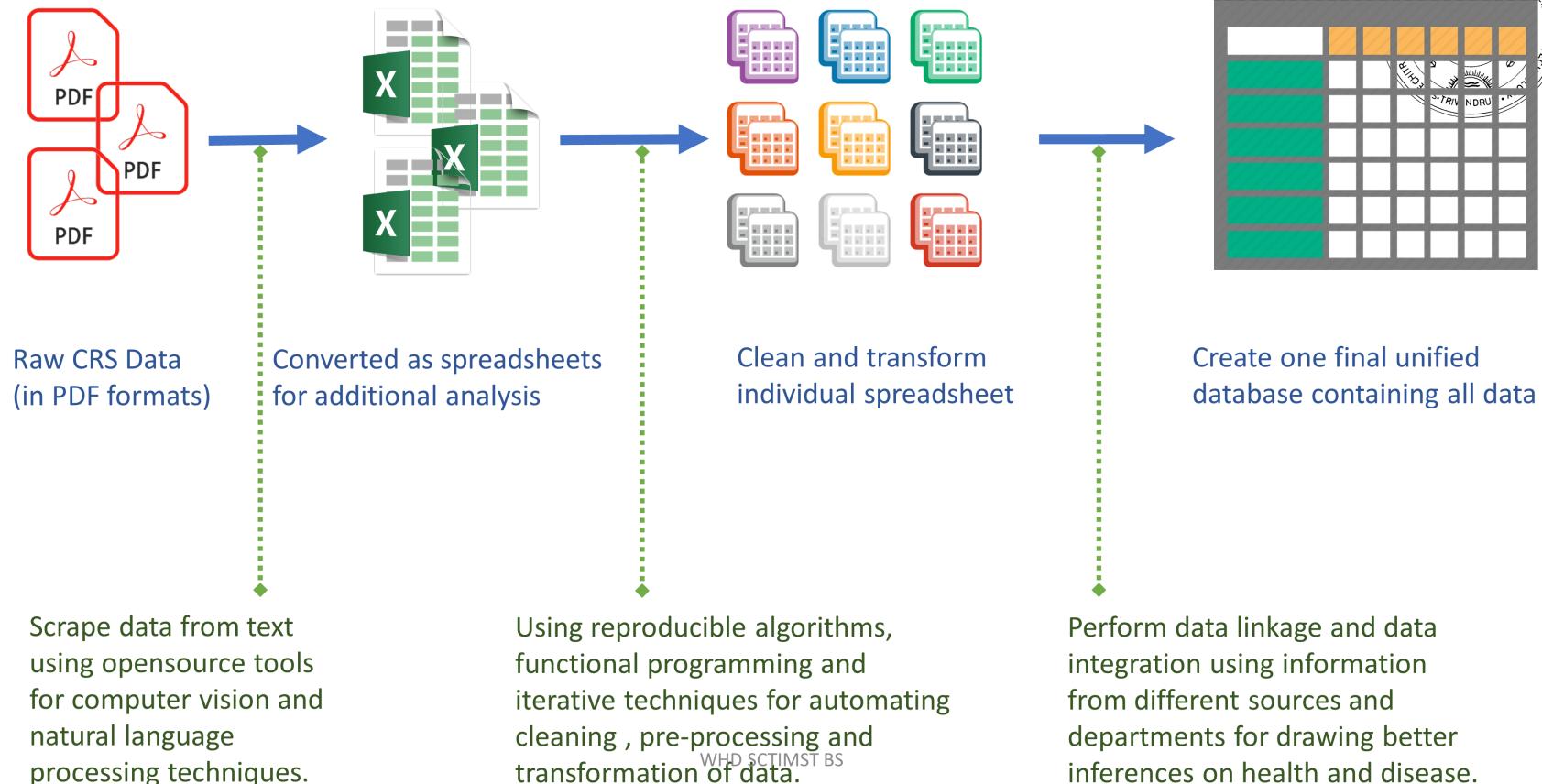
- National Centre for Disease Control, New Delhi
- Centre for Disease Control, US Embassy
- National Institute of Epidemiology, Chennai
- Armed Forces Medical College, Pune
- All India Institute of Medical Sciences, New Delhi, Bhopal, Raipur, Jhodpur

Developing Course Modules in Health Data Science: University of Norway, University of South Korea

Mapping Stroke Centers in India: University of Chicago

Analysing COVID-19 Testing Data: ICMR, DHR, MoHFW

The data science approach



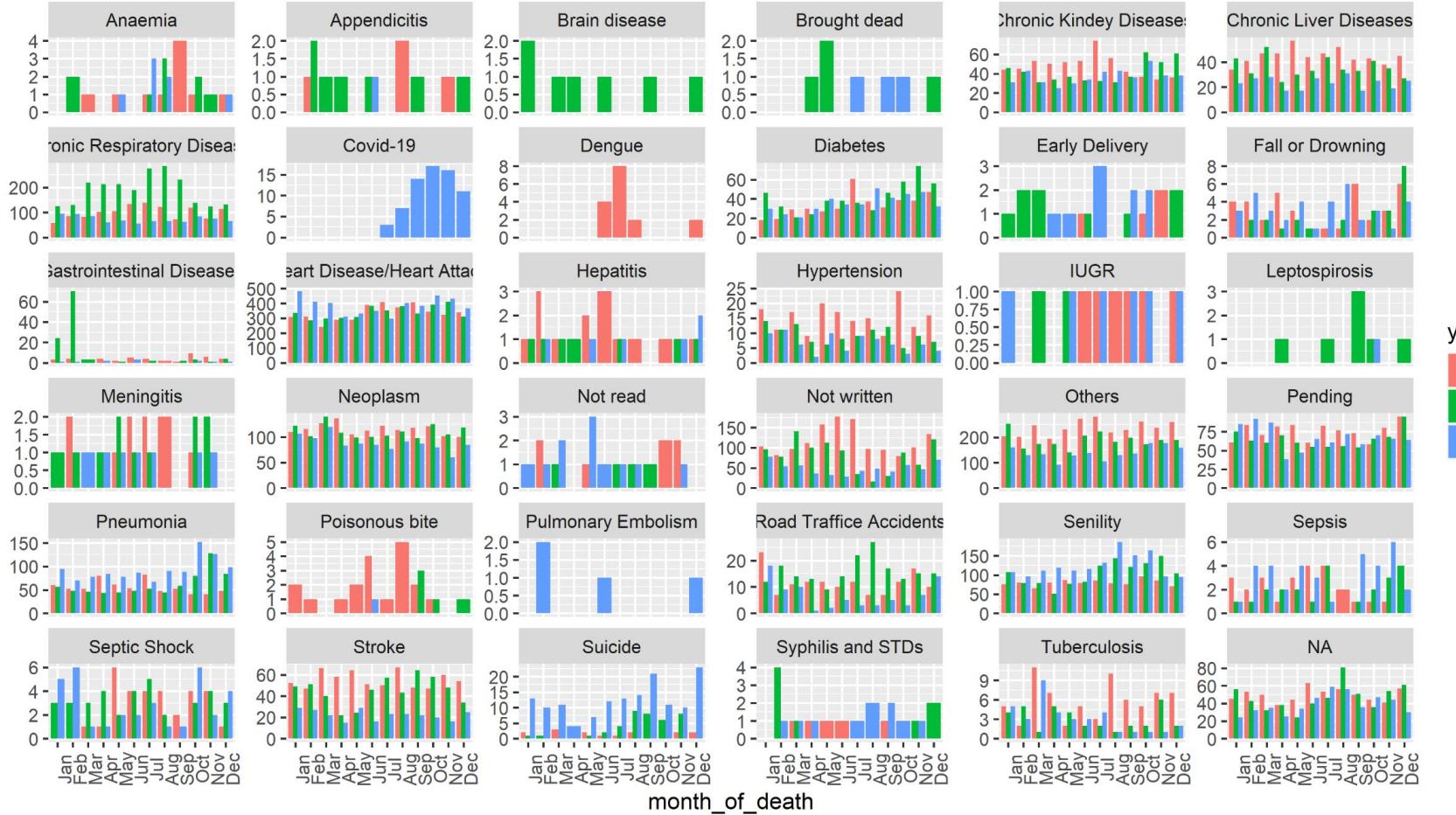


Some Quick Summaries

Cause of Death	Age Distribution of the Deceased						
	N	Mean	Std.Dev	Histogram	Median	IQR	Boxplot
NCDs	12868	61.18	16.16		63.0	53 - 72	
Heart Disease/Heart Attack	11449	65.50	14.53		66.0	57 - 75	
Miscellaneous	11040	52.19	24.67		58.0	38 - 70	
Infections	3067	65.82	15.70		68.0	58 - 76	
Senility	897	81.20	9.36		82.0	76 - 88	
Road Traffic Accidents	308	45.01	17.72		46.5	30 - 59	
MCH issues	36	35.28	30.34		35.0	4 - 62	
Suicide	18	46.22	16.03		47.0	38 - 56	

Cause of Death	Number of Deaths		
	2017	2018	2020
Heart Disease/Heart Attack	3712	3693	4033
Others	2829	2233	1651
Pneumonia	668	727	1101
Neoplasm	1236	1179	843
Chronic Respiratory Diseases	1038	2087	712
Diabetes	371	473	416
Chronic Kidney Diseases	551	467	398
Senility	237	389	269
Chronic Liver Diseases	517	403	242
Stroke	640	515	212

Cause of Death by month and year



AMCHSS COVID-19 Dashboard



AMCHSS COVID-19 Dashboard

Home

Epidemic Curves

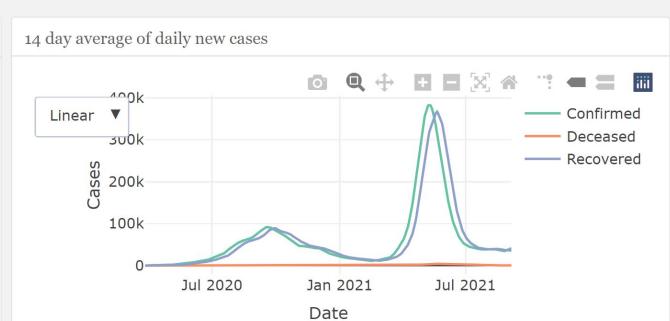
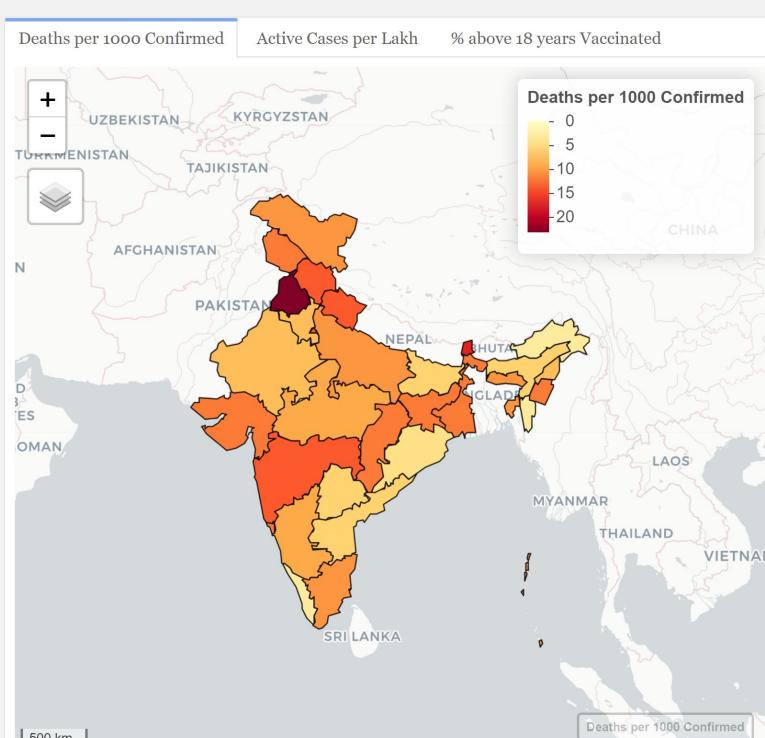
Epidemiological Parameters

Vaccinations

Testing

Projections

About



Background

It has now been over one year since the first case in Kerala and India has seen over 33 million cases as of 05 September 2021. India's approach to containing the first wave of the epidemic was spearheaded by the implementation of a strict nation-wide lockdown along with closure of schools and prohibition of mass gatherings. Rapid response from the public health department in contact tracing and testing has enabled the flattening of the curve and given the healthsystem the much needed time and opportunity to prepare and plan the mitigation strategies. However, with the second wave of COVID-19 infections in India commencing, the earlier strategy of lockdowns may not be viable this time around.

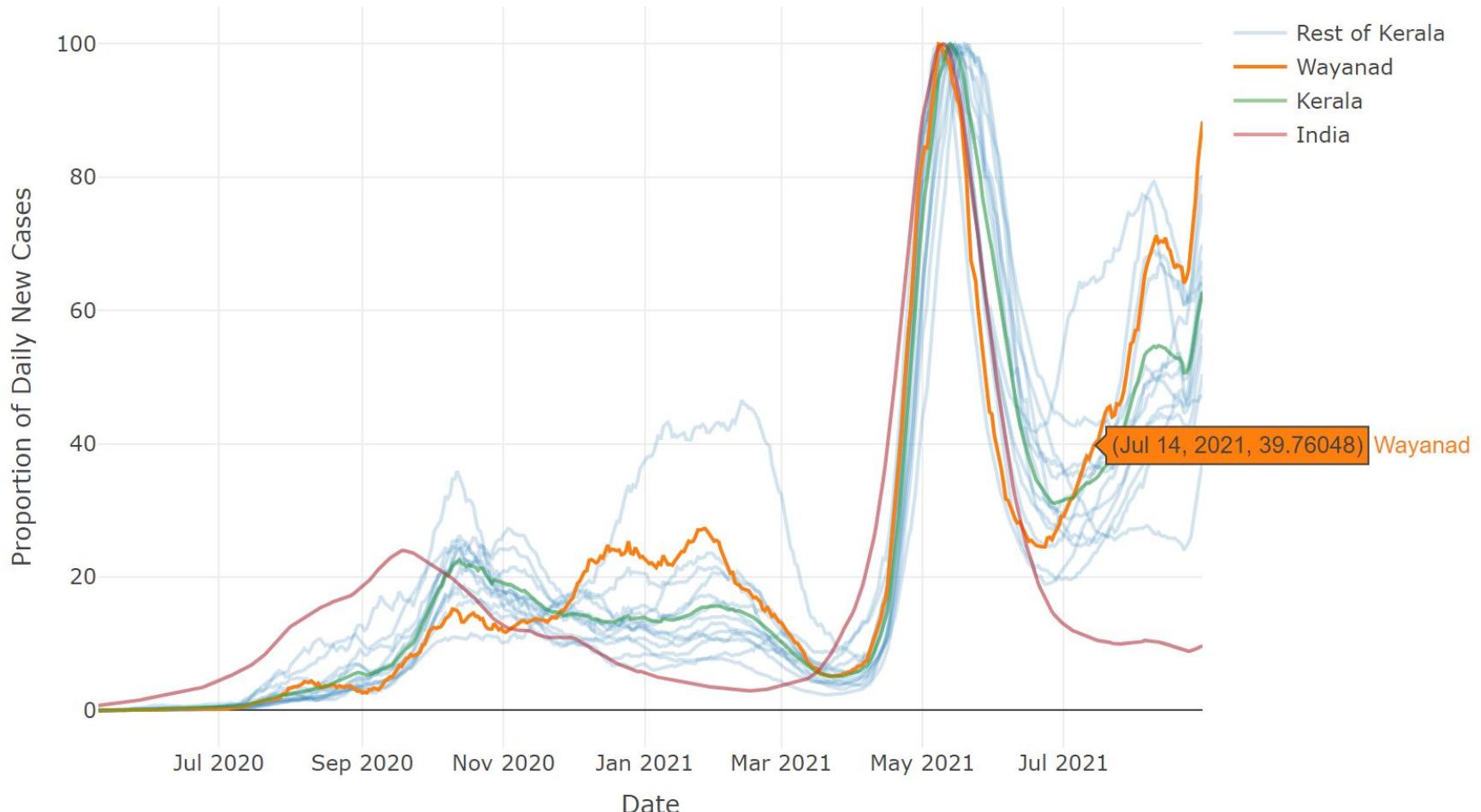
The dashboard would be updated on a weekly basis

Last updated on **2021-09-05**

Near Real-time Evidence



Weekly Average of Daily New Cases (as a % of their maximum value) in Wayanad



Incorporates data from other sources



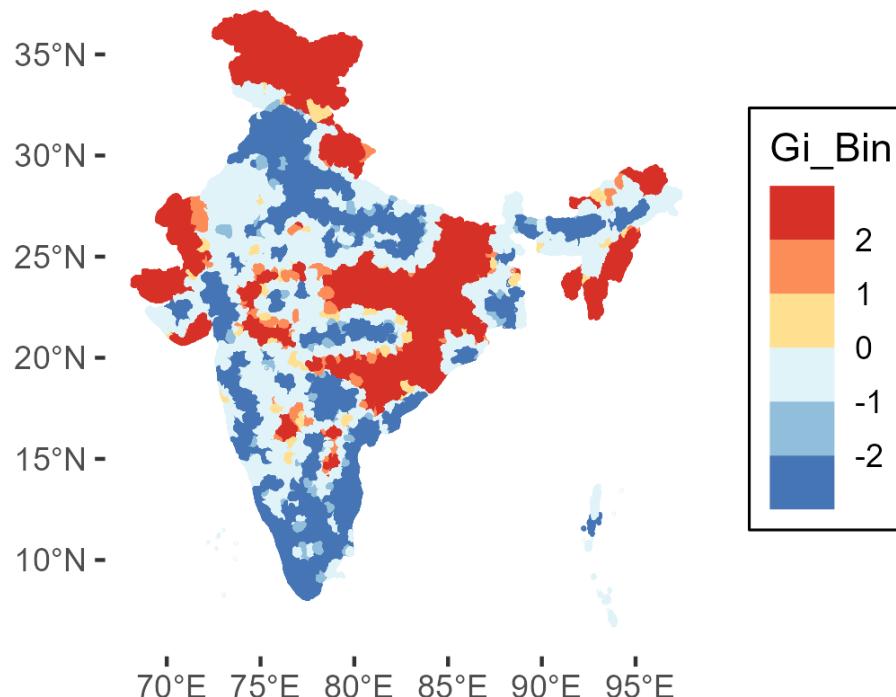
Semi-automated interactive reporting





Spatial Analysis

Hotspots for Access to Stroke Centers across India



Using Medical Images to predict Diabetic Retinopathy

Deep Learning | Convolutional Neural Networks

Deployable Public Health Tools



Public Health Implications

- Encourage Data-use policy
- Improve data processing, validation, and efficiency of the system
- Integrate Data from different sources
- Timely and actionable evidence for public health interventions
- Spatial and temporal analysis are possible
- Semi-automated Report Generation



- Mapped 35,461 households covering 1,31,095 people spread over 48.5 sq km through participatory GIS

Thank You



arunmitra@sctimst.ac.in

<https://amchss.github.io/RIntro2022/>

<https://www.sctimst.ac.in/>