El Rol de la Estadística en el Fortalecimiento de la Salud Pública Integral

Cynthia M. Pérez, PhD, MS

Catedrática, Departamento de Bioestadística y Epidemiología, Escuela Graduada de Salud Pública

Recinto de Ciencias Médicas, Universidad de Puerto Rico

Objetivos

- Resaltar la importancia de la estadística como base para la toma de decisiones en salud pública.
- Examinar los principales retos y oportunidades de la disciplina en el contexto actual.
- Proponer estrategias para fortalecer una salud pública integral y basada en evidencia.

Salud Pública

- Estudio de la salud y la enfermedad en las poblaciones.
  - Proteger y mejorar la salud colectiva
  - Promover estilos de vida saludables
  - Desarrollar programas de promoción, prevención y control de enfermedades

Funciones Esenciales de Salud Pública

https://www.paho.org/es/temas/funciones-esenciales-salud-publica

La Estadística en la Salud Pública

La estadística aporta el marco teórico que permite:

- Formular preguntas a partir de datos y reconocer la aleatoriedad inherente.
- Cuantificar la incertidumbre y distinguir entre señal y ruido.
- Desarrollar métodos reproducibles y verificables, que aseguran que los hallazgos puedan ser replicados por otros investigadores.
- En síntesis, la estadística no solo interpreta datos, sino que transforma la información en conocimiento confiable.

La Estadística como Herramienta Fundamental de la Epidemiología

- Investiga la etiología de las enfermedades
- Evalúa el diseño, implementación y efectividad de estrategias de control y prevención de enfermedades
- Orienta los procesos de toma de decisiones y la formulación de políticas en salud pública basadas en evidencia
- Apoya la implementación y evaluación de programas de salud poblacional

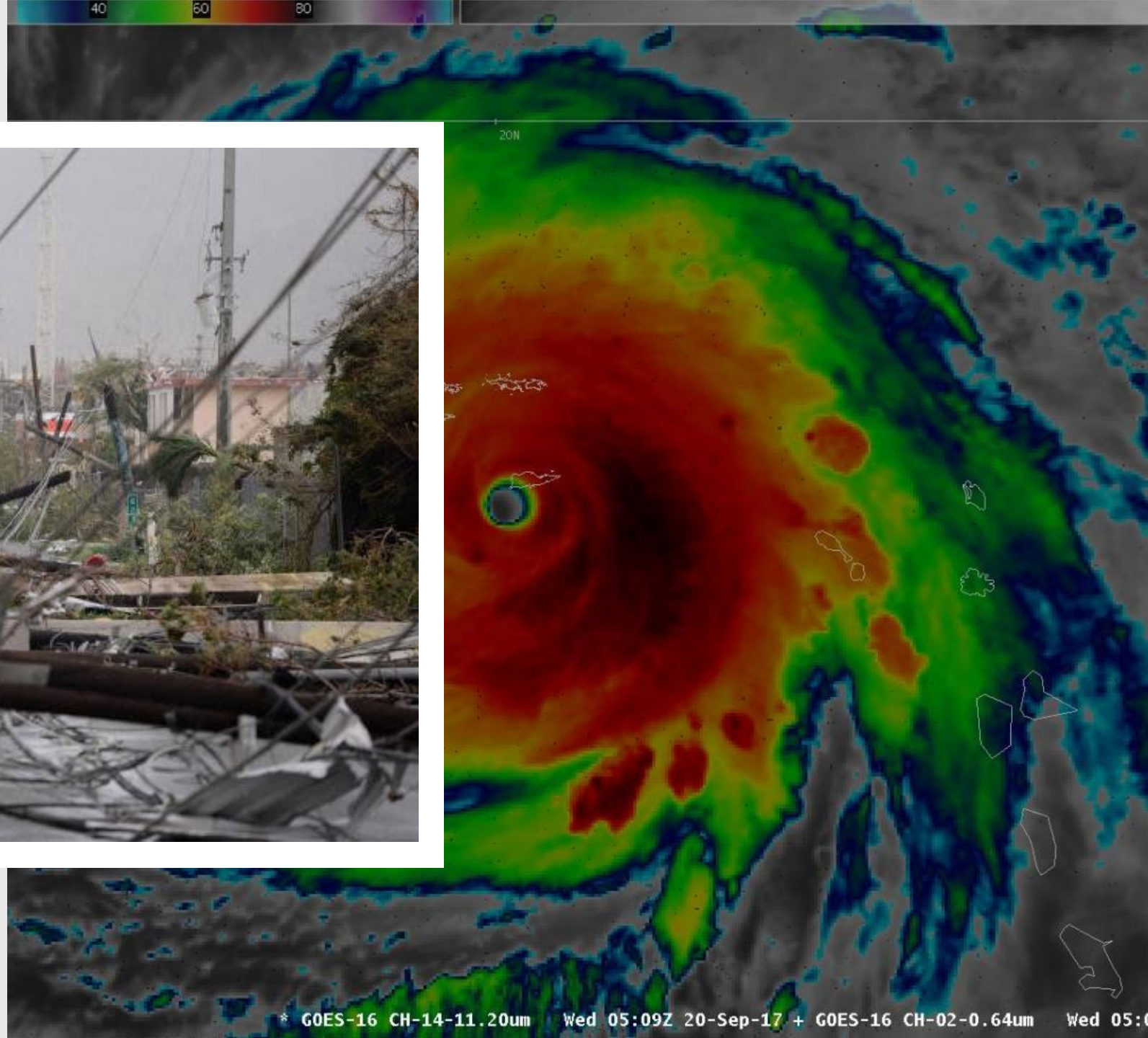
"La estadística es mucho más que números: es la base para tomar decisiones informadas, diseñar políticas efectivas y promover un desarrollo sostenible."

Fuente: Comisión de Estadística de las Naciones Unidas
https://unstats.un.org/unsd/wsd/2025/index.html

Ejemplos Aplicados en Salud Pública

- Huracán María, COVID-19 y Cáncer
- Polvo del Sahara
- Enfermedades Cardiovasculares

Huracán María



JAMA Network Open

Research Letter | Public Health

Cervical Cancer Screening Among Medicaid Patients During Natural Disasters and the COVID-19 Pandemic in Puerto Rico, 2016 to 2020

Ana Patricia Ortiz, PhD, MPH; Axel Gierbolini-Bermúdez, MA; Jeslie M. Ramos-Cartagena, MS; Vivian Colón-López, PhD, MPH; Kalyani Sonawane, PhD; Ashish A. Deshmukh, PhD, MPH; Karen J. Ortiz-Ortiz, DrPH

International Journal of Environmental Research and Public Health

MDPI

Article

Breast and Colorectal Cancer Screening Utilization after Hurricane María and the COVID-19 Pandemic in Puerto Rico

Vivian Colón-López [1,*], Héctor M. Contreras-Mora [1,*], Cynthia M. Pérez [2], Hérmilis Berríos-Ortiz [1], Carola T. Sánchez-Díaz [3], Orville M. Disdier [4], Nilda Ríos-Morales [4] and Erick L. Suárez-Pérez [2]

Disruptions in Oncology Care Confronted by Patients with Gynecologic Cancer Following Hurricanes Irma and Maria in Puerto Rico

Cancer Control
Volume 29: 1–9
© The Author(s) 2022
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/10732748221114691
journals.sagepub.com/home/ccx
SAGE

William A. Calo, PhD[1,2], Mirza Rivera, MS[3], Pablo A. Mendez-Lazaro, PhD[4], Sandra I. Garcia-Camacho, MPH[5], Yanina M. Bernhardt Utz, MPH[5], Edna Acosta-Perez, PhD[3,6], and Ana P. Ortiz, PhD[5,7]

Received: 28 October 2024 | Revised: 5 February 2025 | Accepted: 10 February 2025

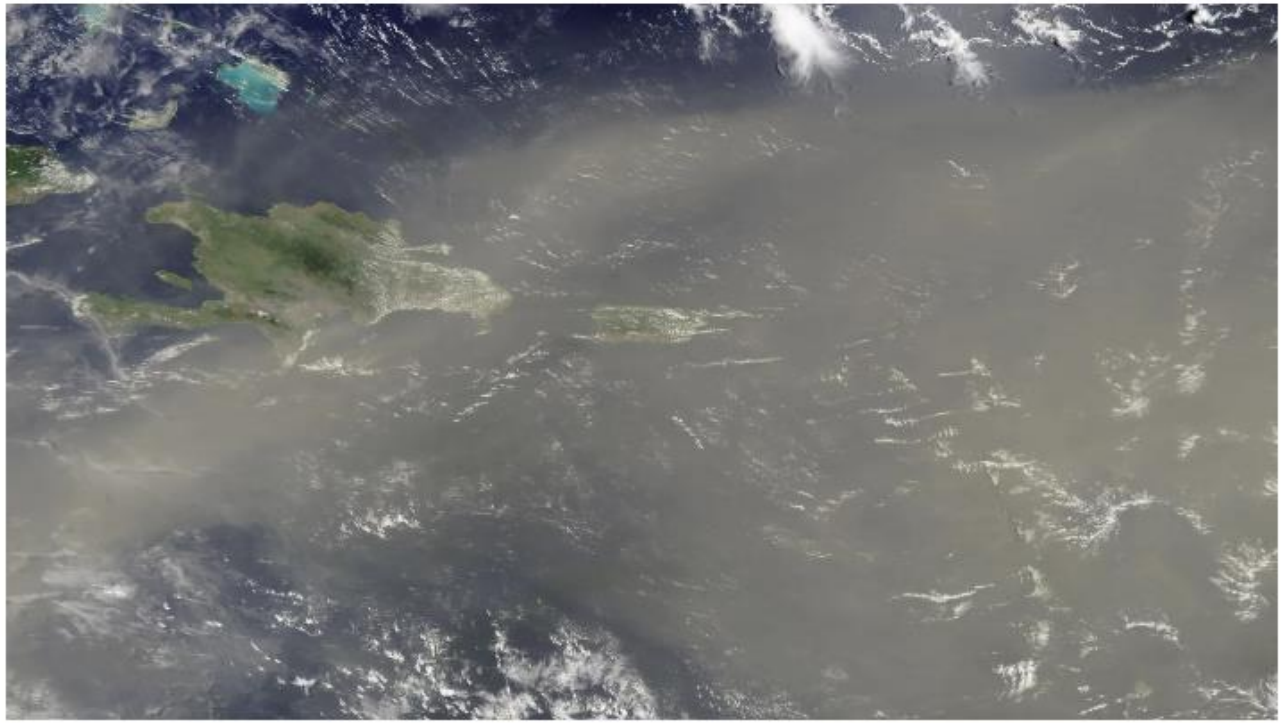
DOI: 10.1002/cncr.35793

ORIGINAL ARTICLE

Evaluating the impact of hurricanes and the COVID-19 pandemic on colorectal cancer incidence in Puerto Rico: An interrupted time-series analysis

Tonatiuh Suárez-Ramos MS[1] | Samantha Verganza MPH[2] |
Yisel Pagán-Santana DrPH[1] | Maira A. Castañeda-Avila PhD[3] |
Carlos R. Torres-Cintrón MPH[1] | Eduardo J. Santiago-Rodríguez PhD[4] |
Karen J. Ortiz-Ortiz DrPH[1,4,5]

NASA Helps Puerto Rico Prepare for Saharan Dust Impacts



Investigador Principal: Dr. Pablo Méndez-Lázaro, UPR-RCM

Saharan Dust Forecasts Minimize Health Risks in the Caribbean

Last summer, wind carried nearly 24 tons of dust from the Sahara Desert in Africa across the Atlantic Ocean, to North and South America, hitting islands in the Caribbean Sea especially hard.

It was one of the largest Saharan dust storms on record, and it came in the middle of the global pandemic. An early warning system for African dust was developed with NASA funding and put in place just days before the event. Through this tool, for the first time, citizens across Puerto Rico received advance notice that the dust storm was coming.

"We were monitoring a couple of different NASA models and satellite images," said Pablo Méndez-Lázaro, an associate professor at the University of Puerto Rico Medical Sciences Campus in San Juan, who led development of the warning system. "As soon as we saw the dust storm, we started communicating the news," he said. "We got in contact with corresponding government agencies and collaborating medical doctors."

Effect of Saharan Dust Events on Healthcare Services of COVID-19 Patients in Three Metropolitan Hospitals of Puerto Rico using NASA Earth Observation Data and Executive Orders: An Ecological Study

Show affiliations

Perez-Matias, Edgar ; Ortiz-Martinez, Ana P. ; Pimenta-Oliveira, Aluisio ; Perez-Cardona, Cynthia M. ; De Angel Sola, David E. ; Morales-Medina, Maite ; Mendez-Lazaro, Pablo

Saharan dust exposure is an emerging public health issue given the growing evidence suggesting its association with excess all-cause and cause-specific mortality and morbidity. A link between COVID-19 severity and environmental factors including air pollution and climate, was supported by emerging

Physicians' and Patients' Knowledge, Perceptions, and Awareness of Saharan Dust Events and Diesel Particulate Matter Impact on Public Health: A Qualitative Approach

Show affiliations

Perez-Matias, E. ; Bird-Rivera, G. J. ; Falcon-Lopez, J. M. ; Santos-León, E. ; Cruz-Barreto, V. M. ; Morales-Medina, M. ; Rivera Rodríguez, S. ; Forestier-Babilonia, J. M. ; Elias-Arroyo, C. V. ; Perez-Cardona, C. M. ; Ortiz-Martinez, A. P. ; Pimenta-Oliveira, A. ; Mendez-Lazaro, P.

An estimated seven million people worldwide die annually due to air pollution. Thus, the impact on climate, human health, and on the ecosystem are public health priorities for society. Epidemiological studies show significant correlations between atmospheric particulate matter and emergency rooms visits, hospitalizations, and deaths due to exacerbation of respiratory and cardiovascular diseases; however, studies assessing the health effects exclusive due to African dust and Diesel Particulate Matter are limited in Puerto Rico (P.R.) and the Caribbean. The objective of this study is to assess physicians' and patients' knowledge, awareness, and perceptions regarding the public health impact of Saharan dust in P.R. Methods: Key informant interviews, focus groups and phone interviews were performed between August 2019 thru June 2020 at private and public hospitals and outpatients' clinics in P.R.

Who Is Affected by Saharan Dust in the Caribbean? A Spatial Analysis and Citizen's Perspective from Puerto Rico during the Godzilla Dust Event in June 2020

MAITÉ MORALES-MEDINA,[a] ANA P. ORTÍZ-MARTÍNEZ,[b] CYNTHIA M. PÉREZ-CARDONA,[b] DIGNA RUEDA-ROA,[c] DANIEL OTIS,[c] EDGAR PÉREZ-MATÍAS,[a] FRANK MULLER-KARGER,[c] OLGA MAYOL-BRACERO,[d] AND PABLO MÉNDEZ-LÁZARO[a]

[a] *Department of Environmental Health, Medical Science Campus, University of Puerto Rico, San Juan, Puerto Rico*
[b] *Department of Biostatistics and Epidemiology, Medical Science Campus, University of Puerto Rico, San Juan, Puerto Rico*
[c] *College of Marine Science, University of South Florida, Saint Petersburg, Florida*
[d] *Department of Environmental Science, Rio Piedras Campus, University of Puerto Rico, San Juan, Puerto Rico*

(Manuscript received 15 January 2023, in final form 1 December 2023, accepted 10 January 2024)

ABSTRACT: An extreme Saharan dust storm (named Godzilla) arrived at the Caribbean region in June 2020, deteriorating the air quality to hazardous levels and unhealthy conditions for sensitive groups of people. Our main objective was to characterize populations at risk for Saharan dust by analyzing distribution and levels of dust events in Puerto Rico, and by conducting an online survey to assess community perceptions on Saharan dust health effects. Three daily satellite aerosols products from 2013 to 2020 were retrieved from the Visible Infrared Imaging Radiometer Suite over Puerto Rico to better understand the patterns, frequency, and seasonality of aerosols. The atmospheric results indicated that extreme values (>99th) of big size aerosols (e.g., Sahara dust) were observed over Puerto Rico on 22 June 2020. A total of 1504 qualified people participated in the survey during the summer of 2020, and it was analyzed with descriptive statistics, frequency analysis, and chi-square tests. 51% of the survey participants were on the age group of 25–44 years old, and 65% of the participants had at least one preexisting health condition (respiratory diseases 27%; cardiovascular diseases 28%). Nearly 90% of the participants indicated that Saharan dust affected the health status of both the respondents and their family members. Irritation of eyes (22%), nose (24%), and throat (23%), as well as breathing difficulties (10%), were the most common symptoms reported. Understanding patients' health profiles associated with Saharan dust is essential before developing public health strategies to minimize exacerbation of health conditions in Puerto Rico.

Understanding the Community Perception of "Godzilla" Mega African Dust Event over Puerto Rico in June 2020: Strategy to improve Air Quality Early Warning Systems

Show affiliations

Mendez-Lazaro, P. ; Perez-Cardona, C. M. ; Ortiz-Martinez, A. P. ; Perez-Matias, E. ; Mayol-Bracero, O. L. ; Otis, D. B. ; Rueda-Roa, D. T. ; Muller-Karger, F. E.

On June, 2020, the Caribbean region suffered a historic African (Saharan) dust plume. The dust plume was big enough (in extent and magnitude) to cover areas in the Caribbean Basin, the Gulf of Mexico and the United States. Using satellite observations from MODIS, VIIRS and CALIOP (aerosol optical depth - AOD), our research team got in contact with public health practitioners, stakeholders, decision makers, weather forecasters, health clinics and physicians to alert about deterioration in air quality and the "unhealthy conditions" approaching the Island of Puerto Rico. We did webinars and press releases to communicate about the Hazardous Conditions in order to protect vulnerable populations. To assess

OXFORD

JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

American Journal of Epidemiology, 2025, **194**, 587–597

https://doi.org/10.1093/aje/kwae163

Advance access publication date June 26, 2024

Study Design

The Puerto Rico Young Adults' Stress, Contextual, Behavioral, and Cardiometabolic Risk (PR-OUTLOOK) Study: design and methods

Cynthia M. Pérez[*,†,1], Catarina I. Kiefe[2], Sharina D. Person[2], Katherine L. Tucker[3], Polaris Torres[1], Estefanía Sandoval[1], Claudia Boneu[1], Zuleika Ramírez[1], Josiemer Mattei[4], José Rodríguez-Orengo[5,6], Israel Almodóvar-Rivera[7], Milagros C. Rosal[†,2]

Most young adults in Puerto Rico may have less-than-ideal heart health

By Kat Long, American Heart Association News

(Hola Images via Getty Images)

ORIGINAL RESEARCH

Cardiovascular Health Among Young Men and Women in Puerto Rico as Assessed by the Life's Essential 8 Metrics

Cynthia M. Pérez, PhD*; Andrea López-Cepero, PhD; Israel Almodóvar-Rivera, PhD; Catarina I. Kiefe, PhD, MD; Katherine L. Tucker, PhD; Sharina D. Person, PhD; Josiemer Mattei, PhD; José Rodríguez-Orengo, PhD; Milagros C. Rosal, PhD*

BACKGROUND: Cardiovascular health (CVH) in young adulthood is associated with CVD in later life, yet CVH in young adults in the United States falls below ideal levels, with noticeable sex differences. Research on CVH in young adults in Puerto Rico is scarce. This study examined CVH and sex differences in CVH in a large cohort of young adults in Puerto Rico.

METHODS AND RESULTS: Data from 2162 Puerto Rican young adults aged 18 to 29 residing in PR were obtained from the PR-OUTLOOK (Puerto Rico Young Adults' Stress, Contextual, Behavioral, and Cardiometabolic Risk) study (2020–2023). Participants were recruited through various media and community outreach. CVH scores, graded on a 0 (worst) to 100 (best) scale, were derived from survey responses, physical exams, and laboratory assays. Linear regression with the margins post-estimation command was used to determine adjusted means (95% CIs) for CVH scores by sex, controlling for age, marital status, education, childhood material deprivation, subjective social status, health insurance, and depressive symptoms. CVH was less than ideal (score<80) in 72.6% of the cohort (70.5% of women, 75.9% of men, $P<0.05$). Men had a significantly lower adjusted mean overall CVH score than women (70.7 versus 73.0) and lower adjusted mean scores for nicotine exposure (78.3 versus 86.7), non-high-density lipoprotein cholesterol (80.6 versus 86.4), and blood pressure (79.5 versus 92.2). Women had a significantly lower adjusted mean physical activity score compared with men (50.4 versus 59.5).

CONCLUSIONS: Less-than-ideal CVH is notable among young adults, with men having worse CVH than women. These identified sex differences warrant further investigation and the design of interventions to enhance and preserve CVH.

American Journal of Preventive Cardiology 20 (2024) 100875

Contents lists available at ScienceDirect

American Journal of Preventive Cardiology

journal homepage: www.journals.elsevier.com/american-journal-of-preventive-cardiology

Original Research

Psychological and socio-economic correlates of cardiovascular health among young adults in Puerto Rico

Milagros C. Rosal, Israel Almodóvar-Rivera, Sharina D. Person, Andrea López-Cepero, Catarina I. Kiefe, Katherine L. Tucker, Maria Uribe-Jerez, José Rodríguez-Orengo, Cynthia M. Pérez

* Department of Population and Quantitative Health Sciences, University of Massachusetts Chan Medical School, Office of Health Equity, 55 Lake Avenue N, S2-106, Worcester, MA, USA
* Department of Mathematical Sciences, College of Arts and Sciences, Mayaguez Campus, University of Puerto Rico, Mayaguez, PR, USA
* Department of Epidemiology, Emory University, Atlanta, GA, USA
* Department of Biomedical and Nutritional Sciences, Zuckerberg College of Health Sciences, University of Massachusetts Lowell, Lowell, MA, USA
* Fundación de Investigación (FIU) Clinical Research, San Juan, PR, USA
* Department of Biochemistry, School of Medicine, University of Puerto Rico, San Juan, PR, USA
* Department of Biostatistics and Epidemiology, Graduate School of Public Health, Medical Sciences Campus, University of Puerto Rico, San Juan, PR, USA

HIGHLIGHTS

- Rates of cardiovascular disease (CVD) and stroke have not decreased or have even increased among young adults compared with older adults.
- Cardiovascular health (CVH) in young adulthood predicts CVD outcomes in later years.
- Socioeconomically disadvantaged and minoritized groups experience worse CVH, especially at younger ages.

International Journal of Environmental Research and Public Health

MDPI

Article

The Association between Food Insecurity and Insomnia Symptoms among Young Adults in Puerto Rico and the Mediating Role of Psychological Distress Symptoms

Natalia Vázquez-Colón [1], Andrea López-Cepero [2], Claudia Amaya [1], Katherine L. Tucker [3], Catarina I. Kiefe [4], Sharina D. Person [4], Milagros C. Rosal [4] and Cynthia M. Pérez [1,*]

1 Department of Biostatistics and Epidemiology, Graduate School of Public Health, University of Puerto Rico, Medical Sciences Campus, San Juan, PR 00936, USA; natalia.vazquez6@upr.edu (N.V.C.); claudia.amaya@upr.edu (C.A.)
2 Rollins School of Public Health, Emory University, Atlanta, GA 30322, USA; andrea.a.lopez-cepero@emory.edu (A.L.C.)
3 Department of Biomedical and Nutritional Sciences, Zuckerberg College of Health Sciences, and Center for Population Health, University of Massachusetts Lowell, Lowell, MA 01854, USA; katherine_tucker@uml.edu (K.L.T.)
4 Department of Population and Quantitative Health Sciences, University of Massachusetts Chan Medical School, Worcester, MA 01655, USA; catarina.kiefe@umassmed.edu (C.I.K.); sharina.person@umassmed.edu (S.D.P.); milagros.rosal@umassmed.edu (M.C.R.)
* Correspondence: cynthia.perez1@upr.edu

Abstract: Residents of Puerto Rico face a high burden of food insecurity (FI), which has been associated with insomnia symptoms (IS). However, this association remains understudied in Puerto Rican young adults, a vulnerable group experiencing an elevated prevalence of FI and poor sleep. We evaluated the association between FI and IS and the mediating role of psychological distress symptoms among young adults in Puerto Rico. Data are derived from the PR-OUTLOOK cohort

Risk Factors and Prevention, Obesity

Overweight and obesity and cardiometabolic risk profile of young adults: the PR-OUTLOOK Study

M.C. Rosal[1], C. Kiefe[1], K. Tucker[2], S. Person[1], C. Perez[3]

[1]University of Massachusetts Chan Medical School, Population and Quantitative Health Sciences, Worcester, United States of America
[2]Univ of Massachusetts - Lowell, Biomedical and Nutritional Sciences, Lowell, United States of America
[3]University of Puerto Rico, Graduate School of Public Health, Biostatistics and Epidemiology, San Juan, United States of America

Funding Acknowledgements: Type of funding sources: Public grant(s) – National budget only. Main funding source(s): National Institutes of Health/National Heart, Lung and Blood Institute.

Background/purpose: Excess weight is associated with cardiovascular disease morbidity and mortality in middle-aged and older adults, directly and through its impact on other cardiometabolic risk factors (CMRFs). However, less is known about the association between excess weight and CMRFs among young Latino adults. We examined cross-sectional associations between overweight/obesity and CMRFs in a cohort of young adults in Puerto Rico.

Methods: PR-OUTLOOK participants (age 18-29 y) with complete data on variables of interest were included in the analyses (n= 2,659, 62.5% female). Body mass index (BMI) was calculated from measured height and weight, with overweight/obesity defined as BMI >25 kg/m2. CMRFs included: blood pressure ≥130/≥ 80 mm Hg; fasting blood glucose≥100 mg/dL or HbA1c≥5.7%; low-density lipoprotein (LDL) cholesterol >100 mg/dL; triglycerides ≥150 mg/dL; and high-density lipoprotein (HDL) cholesterol <40 mg/dL (male) and <50 mg/dL (female). Associations between overweight/obesity and CMRFs were assessed using binary logistic regression, and the association with the number of CMRFs was evaluated using multinomial regression. Models were adjusted for demographics (age, sex, marital status, subjective social status, maternal education, and health insurance), smoking, physical activity, and diet quality (assessed via questionnaires). We tested interactions by sex.

Results: 52.2% of participants had overweight/obesity. Adjusted analyses showed that overweight/obesity was associated with hypertension (OR=2.83; 95%CI:2.24-3.57); low HDL (OR=3.04; 95%CI:2.57-3.60); and elevated glucose (OR=1.97; 95%CI:1.60-2.42) and triglycerides (OR=4.62; 95%CI:3.31-6.44). Overweight/obesity also was associated with elevated LDL, with stronger associations in women (OR=2.01; 95% CI:1.64-2.47) than men (OR=1.29; 95%CI:1.00-1.68) (p-interaction=0.018). Finally, overweight/obesity was associated with the number of CMRFs, with stronger associations noted among women compared to men (ORs for 1, 2 and >3 CMRFs for women vs men were: 2.22 (95% CI:1.72-2.87) vs. 1.53 (95%CI:1.10- 2.15); 4.24 (95%CI:3.18-5.67) vs. 2.04 (95%CI:1.41-2.97); and 8.88 (95%CI:5.89-13.37) vs. 8.68 (95% CI:5.25-14.35), respectively (p-interaction=0.026)).

Conclusion: Half of our cohort of young adults had overweight/obesity, which was associated with CMRFs, especially among women. Future studies should examine whether reversing overweight/obesity during young adulthood improves the cardiometabolic risk profile of this population. Findings should be considered for prioritizing preventive efforts to reduce CMRFs among young adults in Puerto Rico.

Transformando la Salud Pública en la era de *Big Data* e InteligenciaArtificial

International Journal of
Environmental Research and Public Health

MDPI

Commentary

Artificial Intelligence and Big Data in Public Health

Kurt Benke [1,2,*] and **Geza Benke** [3]

1 School of Engineering, University of Melbourne, Parkville, Victoria 3010, Australia
2 AgriBio, Centre for AgriBiosciences, State Government of Victoria, Bundoora, Victoria 3083, Australia
3 School of Public Health and Preventive Medicine, Monash University, 553 St Kilda Rd, Melbourne 3004, Australia; geza.benke@monash.edu
* Correspondence: kbenke@unimelb.edu.au

Received: 30 August 2018; Accepted: 5 December 2018; Published: 10 December 2018

check for updates

Abstract: Artificial intelligence and automation are topics dominating global discussions on the future of professional employment, societal change, and economic performance. In this paper, we describe fundamental concepts underlying AI and Big Data and their significance to public health. We highlight issues involved and describe the potential impacts and challenges to medical professionals and diagnosticians. The possible benefits of advanced data analytics and machine learning are described in the context of recently reported research. Problems are identified and discussed with respect to ethical issues and the future roles of professionals and specialists in the age of artificial intelligence.

Artificial intelligence in public health: promises, challenges, and an agenda for policy makers and public health institutions

CrossMark

oa OPEN ACCESS

Dimitra Panteli, Keyrellous Adib, Stefan Buttigieg, Francisco Goiana-da-Silva, Katharina Ladewig, Natasha Azzopardi-Muscat, Josep Figueras, David Novillo-Ortiz, Martin McKee

Artificial intelligence (AI) can rapidly analyse large and complex datasets, extract tailored recommendations, support decision making, and improve the efficiency of many tasks that involve the processing of data, text, or images. As such, AI has the potential to revolutionise public health practice and research, but accompanying challenges need to be addressed. AI can be used to support public health surveillance, epidemiological research, communication, the allocation of resources, and other forms of decision making. It can also improve productivity in daily public health work. Core challenges to its widespread adoption span equity, accountability, data privacy, the need for robust digital infrastructures, and workforce skills. Policy makers must acknowledge that robust regulatory frameworks covering the lifecycle of relevant technologies are needed, alongside sustained investment in infrastructure and workforce development. Public health institutions can play a key part in advancing the meaningful use of AI in public health by ensuring their staff are up to date regarding existing regulatory provisions and ethical principles for the development and use of AI technologies, thinking about how to prioritise equity in AI design and implementation, investing in systems that can securely process the large volumes of data needed for AI applications and in data governance and cybersecurity, promoting the ethical use of AI through clear guidelines that align with human rights and the public good, and considering AI's environmental impact.

Lancet Public Health 2025; 10: e428–32

Published Online February 28, 2025 https://doi.org/10.1016/S2468-2667(25)00036-2

European Observatory on Health Systems and Policies, Brussels, Belgium (D Panteli DrPH, J Figueras PhD, Prof M McKee DSc); **WHO Regional Office for Europe, UN City, Copenhagen, Denmark** (K Adib MPH, N Azzopardi-Muscat PhD, D Novillo-Ortiz PhD); **Ministry**

REVISTA ESPAÑOLA DE SALUD PÚBLICA

Volumen 99 e202503017 Recepción: 5/12/2024 Aceptación: 27/2/2025 Publicación: 26/3/2025

PENSAMIENTO CRÍTICO 12 páginas

VERSIÓN EN LÍNEA

La inteligencia artificial en Salud Pública: oportunidades, retos éticos y perspectivas futuras

Artificial intelligence in Public Health: opportunities, ethical challenges and future perspectives

AUTOR

(1,2) Sergio Castaño Castaño [ORCID: 0000-0003-4571-769X]

FILIACIONES

(1) Departamento de Psicología; Universidad de Oviedo. OVIEDO ESPAÑA

(2) Instituto de Investigación Sanitaria del Principado de Asturias (ISPA). OVIEDO ESPAÑA.

CONTRIBUCIÓN DE AUTORÍA

El autor único de este artículo se encargó de la conceptualización, redacción y revisión final del manuscrito.

FINANCIACIÓN

Este artículo no ha recibido financiación de ninguna fuente pública, privada o comercial.

CORRESPONDENCIA

Sergio Castaño Castaño castanosergio@uniovi.es

Departamento de Psicología; Universidad de Oviedo. Plaza Feijoo, s/n. CP 33003. Oviedo. España.

CITA SUGERIDA

Castaño Castaño S. La inteligencia artificial en Salud Pública: oportunidades, retos éticos y perspectivas futuras. Rev Esp Salud Pública. 2025; 99: 26 de marzo e202503017.

El autor declara que no existe ningún conflicto de intereses

RESUMEN

La inteligencia artificial (IA) está transformando la Salud Pública al proporcionar herramientas innovadoras para enfrentar desafíos globales complejos. Su capacidad para analizar grandes volúmenes de datos en tiempo real permite mejorar la vigilancia epidemiológica, optimizar la gestión de recursos sanitarios y personalizar intervenciones preventivas. Estas aplicaciones han demostrado ser valiosas en situaciones como pandemias, donde los algoritmos de IA han contribuido a la predicción de brotes, la asignación eficiente de recursos y el diseño de estrategias dirigidas.

Sin embargo, la adopción de la IA también plantea importantes desafíos éticos y regulatorios. Cuestiones como la privacidad de los datos, la transparencia de los algoritmos y los sesgos en los modelos destacan la necesidad de marcos normativos robustos que garanticen su uso ético y equitativo. Además, la falta de capacitación de los profesionales de la Salud Pública y la alfabetización digital de las comunidades limitan el impacto potencial de estas tecnologías.

Este artículo analiza las aplicaciones prácticas, los desafíos éticos y las estrategias necesarias para una adopción responsable de la IA en la Salud Pública. Se enfatiza la importancia de la capacitación, la colaboración interdisciplinaria y la investigación continua para garantizar que la IA se convierta en una herramienta transformadora que contribuya al bienestar global. Si se implementa de manera ética y sostenible, la IA puede desempeñar un papel crucial en la promoción de la equidad y la calidad en los sistemas de Salud Pública.

Statistics in Biosciences
https://doi.org/10.1007/s12561-024-09454-5

COMMENTARY

Statistics Evolution and Revolution to Meet Data Science Challenges

Hulin Wu[1]

Received: 6 November 2023 / Revised: 22 July 2024 / Accepted: 26 August 2024
This is a U.S. Government work and not under copyright protection in the US; foreign copyright protection may apply 2024

Abstract
The advent of the Big Data era has necessitated a transformational shift in statistical research, responding to the novel demands of data science. Despite extensive discourse within statistical communities on confronting these emerging challenges, we offer our unique perspectives, underscoring the extended responsibilities of statisticians in pre-analysis and post-analysis tasks. Moreover, we propose a new definition and classification of Big Data based on data sources: Type I Big Data, which is the result of aggregating a large number of small datasets via data sharing and curation, and Type II Big Data, which is the Real-World Data (RWD) amassed from business operations and practices. Each category necessitates distinct data preprocessing and preparation (DPP) methods, and the objectives of analysis as well as the interpretation of results can significantly diverge between these two types of Big Data. We further suggest that the statistical communities should consider adopting and rapidly incorporating new paradigms and cultures by learning from other disciplines. Particularly, beyond Breiman's (Stat Sci 16(3):199–231, 2021) two modeling cultures, statisticians may need to pay more attention to a newly emerging third culture: the integration of algorithmic modeling with multi-scale dynamic modeling based on fundamental physics laws or mechanisms that generate the data. We draw from our experience in numerous related research projects to elucidate these novel concepts and perspectives.

REPORT 2019

STATISTICS AT A CROSSROADS: WHO IS FOR THE CHALLENGE?

RAPPORTEURS: Xuming He, David Madigan, Bin Yu, Jon Wellner
PREPARED FOR: The National Science Foundation

Advances in Data Analysis and Classification (2022) 16:823–846
https://doi.org/10.1007/s11634-021-00455-6

REGULAR ARTICLE

Is there a role for statistics in artificial intelligence?

Sarah Friedrich, et al. *[full author details at the end of the article]*

Received: 13 September 2020 / Revised: 6 July 2021 / Accepted: 7 July 2021 / Published online: 6 August 2021
© The Author(s) 2021

Abstract
The research on and application of artificial intelligence (AI) has triggered a comprehensive scientific, economic, social and political discussion. Here we argue that statistics, as an interdisciplinary scientific field, plays a substantial role both for the theoretical and practical understanding of AI and for its future development. Statistics might even be considered a core element of AI. With its specialist knowledge of data evaluation, starting with the precise formulation of the research question and passing through a study design stage on to analysis and interpretation of the results, statistics is a natural partner for other disciplines in teaching, research and practice. This paper aims at highlighting the relevance of statistical methodology in the context of AI development. In particular, we discuss contributions of statistics to the field of artificial intelligence concerning methodological development, planning and design of studies, assessment of data quality and data collection, differentiation of causality and associations and assessment of uncertainty in results. Moreover, the paper also discusses the equally necessary and meaningful extensions of curricula in schools and universities to integrate statistical aspects into AI teaching.

Harvard Data Science Review • Issue 7.2, Spring 2025

Challenges and Opportunities for Statistics in the Era of Data Science

Claudia Kirch[1] Soumendra Lahiri[2] Harald Binder[3] Werner Brannath[4] Ivor Cribben[5] Holger Dette[6] Philipp Doebler[7] Oliver Feng[8] Axel Gandy[9] Sonja Greven[10] Barbara Hammer[11] Stefan Harmeling[7] Thomas Hotz[12] Göran Kauermann[13] Jascha Krause[14] Georg Krempl[15] Alicia Nieto-Reyes[16] Ostap Okhrin[17] Hernando Ombao[18] Florian Pein[19] Michal Pešta[20] Dimitris Politis[21] Li-Xuan Qin[22] Tom Rainforth[23] Holger Rauhut[13] Henry Reeve[24] David Salinas[25] Johannes Schmidt-Hieber[26] Clayton Scott[27] Johan Segers[28] Myra Spiliopoulou[1] Adalbert Wilhelm[29] Ines Wilms[30] Yi Yu[31] Johannes Lederer[32]

ASA
AMERICAN STATISTICAL ASSOCIATION
Promoting the Practice and Profession of Statistics®

ASA Statement on *The Role of Statistics in Data Science and Artificial Intelligence*
August 4, 2023

Data science and artificial intelligence (AI) have, in recent years, captured the attention of a world audience for their spectacular contributions in a wide range of scholarly research and commercial endeavors. Whether it be the development of self-driving cars, machines to recognize speech and generate human-like text, or technology that can accurately detect cancer, the success of data science and AI is all around us and will continue to affect scientific innovation and how we live our lives. The ability to address challenging questions with complex data combined with thoughtful methods is largely the fruit of the innovative and entrepreneurial spirit that characterizes these burgeoning areas. Nonetheless, the interdisciplinary nature of data science and AI means a substantial collaborative effort is needed, and that statisticians—who themselves are data scientists—should be extensively involved in data science and AI initiatives to realize their full potential for productivity, innovation, and problem-solving.

IA y *Big Data*: Transformando la Salud Pública

Transformación del enfoque en salud

- Análisis de grandes volúmenes de datos de diversas fuentes para una visión integral de la salud y los estilos de vida
- Procesamiento de datos en tiempo real para apoyar la toma de decisiones
- Integración interdisciplinaria
- De lo descriptivo a lo predictivo y prescriptivo

IA y *Big Data*: Transformando la Salud Pública

Oportunidades y aplicaciones

- Fortalece la vigilancia epidemiológica al analizar grandes volúmenes de datos en tiempo real, permitiendo predecir brotes y activar alertas tempranas.
- Optimiza la gestión de recursos de salud (camas, medicamentos, personal).
- Personaliza intervenciones preventivas y terapéuticas según factores de riesgo individuales y comunitarios.

IA y *Big Data*: Transformando la Salud Pública

Oportunidades y aplicaciones

- Facilita la detección temprana de enfermedades con precisión comparable a la de especialistas.
- Identifica determinantes sociales de la salud para reducir desigualdades.
- Apoya la planificación y respuesta ante emergencias de salud, mejorando la eficiencia en la toma de decisiones.

All of Us Puerto Rico

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL REPORT

The "All of Us" Research Program

The All of Us Research Program Investigators

SUMMARY

Knowledge gained from observational cohort studies has dramatically advanced the prevention and treatment of diseases. Many of these cohorts, however, are small, lack diversity, or do not provide comprehensive phenotype data. The All of Us Research Program plans to enroll a diverse group of at least 1 million persons in the United States in order to accelerate biomedical research and improve health. The program aims to make the research results accessible to participants, and it is developing new approaches to generate, access, and make data broadly available to approved researchers. All of Us opened for enrollment in May 2018 and currently enrolls participants 18 years of age or older from a network of more than 340 recruitment sites. Elements of the program protocol include health questionnaires, electronic health records (EHRs), physical measurements, the use of digital health technology, and the collection and analysis of biospecimens. As of July 2019, more than 175,000 participants had contributed biospecimens. More than 80% of these participants are from groups that have been historically underrepresented in biomedical research. EHR data on more than 112,000 participants from 34 sites have been collected. The All of Us data repository should permit researchers to take into account individual differences in lifestyle, socioeconomic factors, environment, and biologic characteristics in order to advance precision diagnosis, prevention, and treatment.

LONGITUDINAL COHORT STUDIES HAVE improved human health by characterizing natural histories of diseases, identifying their risk factors, and revealing new biomarkers. Advances in genomics and biosensors have set the stage for refined taxonomies of disease, which may help to guide prognosis, improve existing treatments, and aid in the development of new therapies. Most important, advances in genomic analyses have helped to identify the underlying causes of disease in individual patients. However, many efforts have been hampered by an inadequate sample size and a lack of diversity among participants,[1] restrictive policies regarding data access, or failure to capture genotype and phenotype data comprehensively.[2] Collectively, these challenges have slowed the pace of medical discovery, decreased the generalizability of research findings, hindered reproducibility, and led to incorrect interpretations.[3,4] Population-based research, which requires large sample sizes and highly granular phenotypic data, benefits from access to populations of patients from various ancestries. The All of Us Research Program seeks to provide these data. Here, we describe the goals of the program and the extent to which they have been met.

In his State of the Union address in January 2015, President Barack Obama first announced the program (then called the Precision Medicine Initiative cohort program[5]), and the All of Us network of grant awardees received initial funding from the National Institutes of Health (NIH) in July 2016. A central goal of the program is to enroll at least 1 million persons who agree to share their electronic health record (EHR) data, donate biospecimens for genomic and other laboratory assessments, respond to surveys, and have standardized physical measurements taken. Participants will also have the opportunity to contribute data from sensors and mobile health devices and be contacted for future research opportunities. The All of Us cohort will thereby provide data for prospective, retrospective, and cross-sectional analyses. The program launched in May 2018; a year later, the program met more than one fifth of its recruitment goal of 1 million persons.

About the Research Hub

The *All of Us* Research Hub matches a broad research community with a large cohort of research participants from across the United States. Its goal is to advance precision medicine research and fuel new insights into human health. The Research Hub houses one of the largest, most comprehensive, and most broadly accessible datasets ever assembled. It also provides an interactive Data Browser where anyone can learn about the type and quantity of data that *All of Us* collects. Users can explore aggregate data including genomic variants, survey responses, physical measurements, electronic health record information, and wearables data.

Registered users can use the Researcher Workbench to dive deeper into the data; conduct rapid, hypothesis-driven research; and build new methods for the future, using a variety of tools. The data may help facilitate new studies that could help lead to new insights, treatments, and strategies for disease prevention that are tailored to individuals. Learn more about *All of Us* at AllofUs.nih.gov.

869,000+
Participants

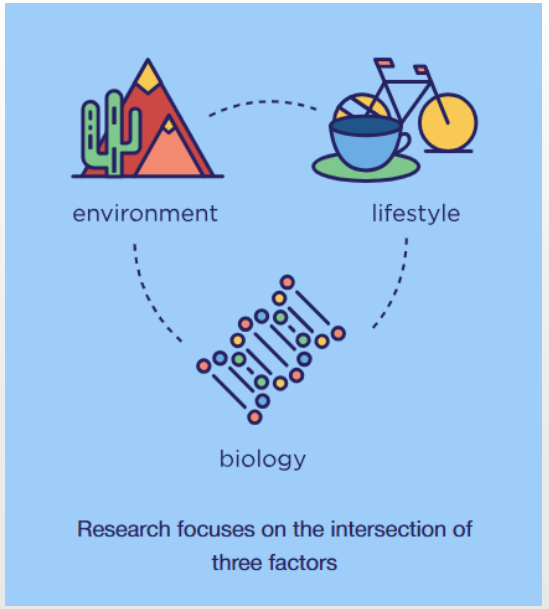
597,000+
Participants who have completed initial steps of the program

473,000+
Electronic Health Records

611,000+
Biosamples

The Dataset

All of Us' one-of-a-kind dataset is stored on the Researcher Workbench, a secure, cloud-based platform. Registered researchers can access data from surveys, genomic analyses, electronic health records, physical measurements, and wearables to study the full range of factors that influence health and disease.



https://www.researchallofus.org/data-tools/data-snapshots/

Desafíos en la Calidad e Integración de datos

- Datos inconsistentes o incompletos pueden producir conclusiones erróneas.
- Las fuentes usan formatos y codificaciones distintas, lo que dificulta su integración.
- La gestión de grandes volúmenes requiere infraestructura tecnológica avanzada.
- La privacidad y la gobernanza de datos son esenciales para evitar vulneraciones.

Retos Éticos en el Uso de Datos

- Protección de la privacidad y consentimiento informado.
- Sesgos por falta de representación de ciertos grupos.
- Dilemas sobre el uso y la propiedad de los datos.
- Responsabilidad ética.

Rigor y Reproducibilidad

- Reproducibilidad y transparencia como pilares de la ciencia de datos.
- Principios estadísticos para validación, inferencia y generalización de modelos.
- Estándares éticos, apertura de datos y revisión responsable.
- Del dato al conocimiento responsable: minimizar sesgos, proteger la privacidad y asegurar representatividad.

Evolución del Rol del Estadístico en la Era Digital

- Renovar su cultura y visión para mantener la relevancia.
- Su valor central radica en el rigor inferencial, la gestión de la incertidumbre y la validación de modelos.
- El desafío actual es integrar la solidez teórica con la eficiencia computacional.
- Se requiere una nueva generación de estadísticos capaces de unir el desarrollo de técnicas analíticas, la computación y la aplicación práctica.

Evolución del Rol del Estadístico en la Era Digital

- Integra rigor estadístico, ciencia de datos e inteligencia artificial.
- Domina programación, análisis de datos masivos y comunicación efectiva.
- Actúa con ética, pensamiento crítico y responsabilidad social.
- Colabora en equipos interdisciplinarios para resolver problemas reales y tomar decisiones basadas en evidencia.

Tendencias en la Formación Académica en Estadística y Ciencia de Datos (EE. UU.)

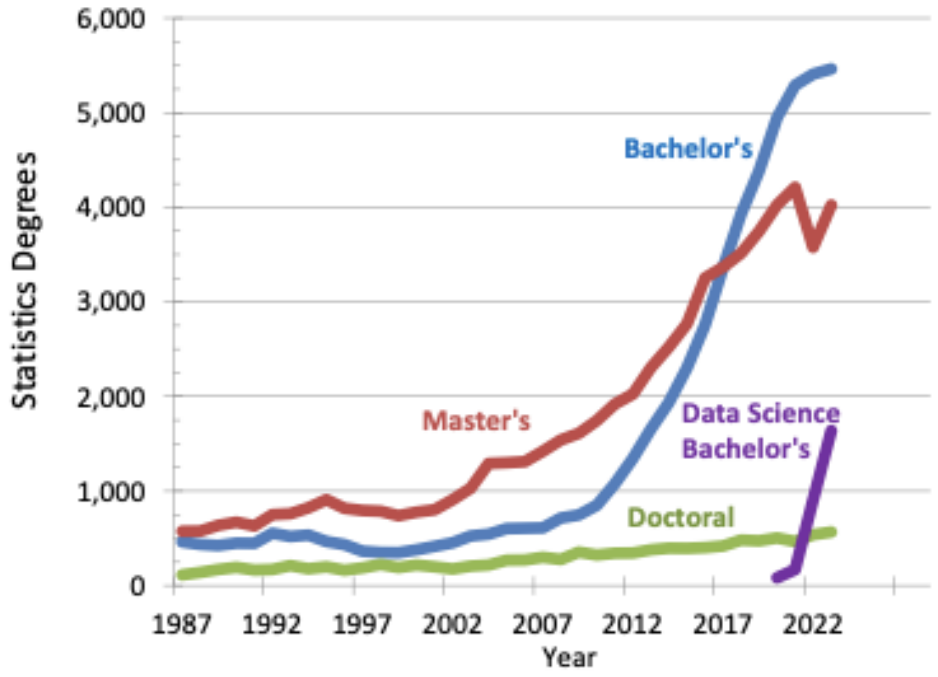


Figure 2: Statistics degrees by degree level and data science bachelor's degrees awarded in the United States

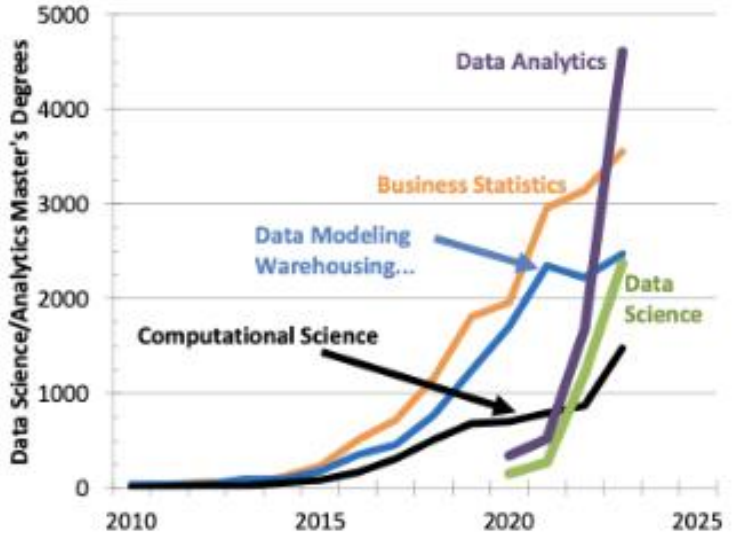


Figure 3: Master's degrees awarded from 2010–2023 for three Classification of Instructional Programs codes commonly used by new data science/analytics programs. The graph also shows the number of master's degrees awarded for 2020–2023 using the new codes for "data analytics" and "data science."

https://magazine.amstat.org/blog/2024/11/05/data-science-analytics-degrees-see-explosive-growth/

Table 6: Degrees Earned by NCES Race/Ethnicity Group and Degree Level, Averaged Over 2011–2023, as a Percentage of Degrees Earned by US Citizens or Residents

	AIAN	ASIA	BKAA	HISP	NHPI	WHIT	2MOR	UNKN
BA Stats	0.1%	27.3%	2.7%	7.8%	0.1%	54.7%	4.0%	3.1%
MS Biostats	0.1%	24.9%	4.4%	6.7%	0.1%	54.5%	3.0%	6.3%
MS Stats	0.1%	23.4%	4.2%	7.1%	0.1%	56.4%	2.6%	6.1%
PhD Biostats	0.0%	23.9%	4.8%	4.5%	0.5%	56.6%	1.6%	8.1%
PhD Stats	0.1%	18.1%	3.6%	4.0%	0.1%	61.6%	2.6%	8.9%

Source: National Center for Education Statistics Integrated Postsecondary Educational Data System

Tendencias en Grados Académicos en Estadística por Grupo Racial/Étnico (EE. UU.)

Fortalecimiento de la Salud Pública Integral

Claves para una Salud Pública Moderna y Equitativa

- Capacitación continua de profesionales con pensamiento crítico, dominio técnico y habilidades de comunicación.
- Acceso equitativo, participación ciudadana y uso responsable de la tecnología.
- Integración y gestión ética de datos con garantías de calidad, privacidad y transparencia.

Claves para una Salud Pública Moderna y Equitativa

- Marcos éticos y legales sólidos que orienten la innovación y la toma de decisiones.
- Investigación aplicada y evaluación continua del impacto, la equidad y la calidad.
- Colaboración interdisciplinaria para generar soluciones innovadoras con propósito social.

Conclusión

- Hoy, el *Big Data*, la inteligencia artificial y los modelos predictivos son aliados poderosos, capaces de transformar la salud pública.
- El desarrollo pleno de estos campos requiere colaboración interdisciplinaria, y que los estadísticos son **actores esenciales** dentro de este ecosistema.
- El futuro sostenible de la salud pública no dependerá solo de la tecnología, sino de profesionales preparados, éticos, críticos y comprometidos, capaces de usar los datos para construir sociedades más justas y saludables.

“¿Qué hay del futuro?

El futuro del análisis de datos puede implicar grandes avances, la superación de verdaderas dificultades y la prestación de un gran servicio a todas las áreas de la ciencia y la tecnología.

¿Será así?

Eso depende de nosotros, de nuestra disposición a recorrer el camino pedregoso de los problemas reales en lugar del camino fácil de los supuestos irreales, los criterios arbitrarios y los resultados abstractos sin conexión con la realidad.

¿Quién acepta el desafío?”

— John W. Tukey, PhD
The Future of Data Analysis, 1962

Tukey, John W. "The Future of Data Analysis." Annals of Mathematical Statistics, 33 (1962), pp. 1-67.

Gracias por su atención!