# Syllabus (02/05/2022 – 04/23/2022)

**Course Title:** Research Methods in Healthcare: Data-driven Research for U.S. Residency

**Course Number:** ED 201-1

**Course Location:** All lectures will take place via Zoom.

**Course Date & Time:** Session 1: Saturdays (Feb 5th – April 23rd); 7:30 AM – 11:00 AM EST
Session 2: Sundays (Feb 6th – April 24th); 7:30 AM – 11:00 AM EST
(These times are tentative and will be changed based on students' availability)

**Course Instructor:** Dr. Aayush Visaria, MD, MPH
aayush.visaria@rutgers.edu

**Office Hours:** All questions can be addressed to Dr. Visaria and he will respond within 24 hours. Course questions not pertaining to the content should also be addressed to aayush.visaria@rutgers.edu .

**Course Advisers:** Several Rutgers faculty and practicing physicians will be reviewing and providing feedback for students' independent research projects throughout the course period. We will try our best to link students with faculty in their interested specialty fields.

**Required Course Text:** None. All texts will be supplied at the first class.
**Required Materials:** Students must have their own laptop/desktop, WiFi, and be able to download SAS and/or R programming languages on it during the first class. SAS is available to students for free through SAS OnDemand for Academics: https://www.sas.com/en_us/software/on-demand-for-academics.html#8802f278-270c-44c8-b9c6-815ead010daf. R is also a free open-source statistical programming language: https://www.r-project.org/.

**Additional/Supplemental Readings/Resources:**

(1) Smith, J. and Cody, R. (2006). Applied Statistics and the *SAS*® Programming Language, 5th Ed. Prentice Hall, NJ
(2) Kleinbaum, D., Kupper, L., Muller, K., and Nizam A. (2008). Applied Regression Analysis and Other Multivariable Methods, 5th Ed. Duxbury Publisher

**Course Description:** This course introduces students to a wide field of data-driven research using large survey healthcare datasets. Students will learn the basics of comprehensive literature reviews, cross-sectional survey datasets, study design, statistical analysis, and statistical programming. Subsequently, they will develop their own research hypothesis, write a literature review, obtain experience writing statistical programming code, and conduct robust statistical analyses to test their hypothesis. All research projects will culminate in at least 1 guaranteed abstract publication and poster presentation at a U.S. conference. We also recommend pursuing a full manuscript and potential peer-reviewed publication, although this may require independent work outside the 12-week course. All students will also be first authors on a Letter to the Editor PubMed publication.

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Students will also be trained by North American Disease Intervention (NADI), a non-profit organization focused on raising awareness about diabetes and hypertension, to provide preventive counseling and participate in virtual community service efforts in the U.S. This training will not only help those pursuing residency but also those who have a passion for community medicine and public health. All participants who pass the NADI clinical assessment can sign up for virtual NADI screening events*. Please visit www.NADIaid.org for more details and to see many pictures of the some of the screening events we have had in the past.

Students who have shown great interest in research and NADI community service will be invited to join NADI's research advisory board at the conclusion of the course.

*Students who wish to volunteer in the screening events must be 18 or older; The COVID-19 pandemic has led to many NADI event cancellations so we cannot guarantee you will be able to participate in events in the 12-week course period. However, you can choose to continue participating in NADI events as a volunteer even after this course ends. This experience does not count as U.S. clinical experience and should be inputted as community service/volunteer efforts in your ERAS application.

**Why should you take this course?** Residency programs are increasingly looking for applicants who have research experiences as it shows them that the applicants can practice evidence-based medicine and further the field. With USMLE Step 1 becoming pass/fail, research publications will be of even more importance. Most importantly, data-driven research is a highly coveted skillset among physicians. Although wet lab research and high-cost clinical trials cannot be done without grant support and a university setting, secondary data analysis is an area that is accessible to all. Research no longer is only for those who are doing their PhDs or those who are the top of their class. This course aims to teach students an easy approach to doing high-level hypothesis-driven research. It is interdisciplinary, teaching students computer programming, statistics, and clinical reasoning, all while conducting research that can potentially impact future healthcare. Data research is an important part of any health professional's life, so it is important to have the toolset and mindset to conduct one's own research and analyze others' research.

By the end of the course, you will be able to:

Integrate relevant scientific background to design experimental and observational studies in biomedical, clinical and public health research;

Use statistical computer packages (SAS and R) to organize, analyze and report collected data;

Communicate the results of statistical studies both in writing and orally to investigators and lay community members.

Learn to provide preventive education at health screening events.

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Produce at least 1 PubMed publication and 1 abstract publication/poster presentation. Most students will do much more than this during our 12 weeks.

Learn to provide preventive education at health screening events.

**Course Schedule:** This table provides a general plan for the course; some deviations may be necessary. The schedule for Session 2 is the exact same, with only the dates changed to Sundays.

| Date (Month/Day) | Class Activities | Homework |
|---|---|---|
| Week 1 (2/05) | Introduction to the course. Hand out materials and access SAS software. Lecture on survey datasets. | Choose and become acquainted with a dataset. Review statistical principles. Start reading literature about your topic(s) of interest. Choose a recently published article for your letter to the editor assignment. |
| Week 2 (2/12) | Scientific Method and Literature Review strategy. Review of basic statistics (frequencies, t-test, chi-square) and how to do them in SAS.<br>Go over letter to the editor articles and structure of letter. | Narrow down research topic of interest to one specific topic. Determine independent and dependent variables. Read and dissect 10 related research papers. Write letter to the editor draft. |
| Week 3 (2/19) | Complete literature review process. Begin developing hypothesis and consolidating outcome and exposure variables of interest. Use SAS to narrow confounding factors and create new variables. | Finish writing literature review. Use SAS to complete Table 1 as discussed.<br>Submit letter to the editor for publication. |
| Week 4 (2/26) | Developing study population. Inclusion and Exclusion criteria. Common medications, high-risk and susceptible populations. Lecture on regression analyses using SAS. | Write Study Population section of methods section of research paper. |
| Week 5 (3/05) | Normality and assumptions for statistical tests. Lecture about clinical research. | For any assumptions not met, correct if possible. Continue reading clinical papers related to your topic. |
| Week 6 (3/12) | Introduction to PROC SURVEY_ and more advanced biostatistics in SAS | Complete homework problems and determine which tests / models are to be implemented for your own project. |
| Week 7 (3/19) | Model selection and p-value interpretation. | Complete SAS code for model selection. |
| Week 8 (3/26) | Odds Ratios, Relative Risk, Prevalence Rate Ratios | Complete SAS code for calculation of PRRs/ORs and their confidence intervals. |

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| | | |
|---|---|---|
| Week 9 (4/02) | Stratified analyses and continuous-to-categorical analyses | Prepare for oral presentation (2 minutes each) as discussed. Review physician feedback. |
| Week 10 (4/09) | Final code modifications and abstract draft. Presentations. Feedback from instructor. | Review feedback given on statistical analysis and abstract. Prepare for abstract submission. |
| Week 11 (4/16) | Introduction to R and Python. NADI preventive counseling training. | Continue working on abstract submission and research paper. |
| Week 12 (4/23) | NADI Vital Signs and Preventive Education Assessment. | Continue working on abstract submission and research paper. |

**Ed2Ed Tutoring Honor Code:** All students are expected to observe the generally accepted principles of scholarly work, to submit their own rather than another's work, and to refrain from falsifying data or results.

Examples of 2021 Research Publications from Past Students (bolded):

1. Visaria A, **Nagaraj B, Shah M, Kethidi N, Modak A, Shahani J, Chilakapati R**, Raghuwanshi M. Low Amount and Intensity of Leisure-time Physical Activity in Asian Indian Adults. American Journal of Health Promotion. 2021 Dec 15:08901171211059807.

2. Visaria A, **Lo D**. Association between body mass index and hypertension subtypes in Indian and United States adults. Indian heart journal. 2020 Sep 1;72(5):459-61.

3. **Everett M**, Setoguchi S, Visaria A. Considerations when assessing the effect of nightshifts on hypertension prevalence. Journal of hypertension. 2021 Dec 1;39(12):2534.

4. **Parikh T, Saji A**, Visaria A. Observations and hypotheses for potential generational differences in cardiometabolic risk factors in US South Asians. Indian heart journal. 2021 Nov;73(6):763.

5. **Ali A, Hameed F, Nagaraj B**, Visaria A. Interpretation of ethnicity-specific data: increased risk versus increased utilisation. British Journal of General Practice. 2021 Nov 1;71(712):495-.

6. Visaria A, **Hameed F, Raval B, Islam S**. Gender Differences In Blood Pressure Control Is Mediated By Age In United States Adults. Hypertension. 2021 Sep;78(suppl_1):A54-.

7. Visaria A, **Islam S, Polamarasetti P, James J, Raju P, Sharma A, Khangura KK**, Thawani R, Dodani S. Hypertension, diabetes, and corresponding annual clinical testing utilization: Comparison between Asian Indians and other races/ethnicities. Preventive Medicine. 2021 Dec 1;153:106761.

8. **Islam S**, Visaria A, **Raju P, James J, Polamarasetti P**. The complex interaction between vitamin D, folate, and heavy metals: potential for attenuation of blood pressure effects. Journal of Hypertension. 2021 Jul 1;39(7):1469-70.

9. **Polamarasetti P, James J, Islam S, Raju P**, Visaria A. Additional Considerations for Hypertension Awareness and Control in Rural India: A Letter to the Editor. Available at SSRN 3846638. 2021.

10. Visaria A, **Shahani J, Maniar P, Dave B**. PREDICTORS OF THE WHITE COAT EFFECT AMONG US ADULTS: A CROSS-SECTIONAL ANALYSIS OF THE 2011-2018 NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEYS. Journal of the American College of Cardiology. 2021 May 11;77(18_Supplement_1):1495-.

11. Visaria A, **Sharma A, Islam S, James J, Polamarasetti P, Raju P**. INCREASED PREVALENCE OF MICROALBUMINURIA IN HYPERTENSIVE ASIAN AMERICAN ADULTS. Journal of the American College of Cardiology. 2021 May 11;77(18_Supplement_1):1654-.

12. Visaria A, **Raju P, Islam S, James J, Polamarasetti P**. Understanding the impact of blood pressure guidelines and variability on hypertension diagnoses. Journal of Hypertension. 2021 May 1;39(5):1044-5.

# Syllabus (02/05/2022 – 04/23/2022)

Example of Completed Research Poster. Student recently submitted the research article to JAMA.

## *Differences in Hypertension Prevalence Between Rural and Urban Populations in India*

**Aayush Visaria[1,3], MPH, Aditya Chauhan[1], Pamela Ohman-Strickland[2], PhD**

North American Disease Intervention (NADI); Rutgers School of Public Health, Department of Biostatistics; Rutgers New Jersey Medical School

### BACKGROUND

- Worldwide, an estimated 1.4 billion adults have hypertension. Nearly 1 in 3 have hypertension and another 1 in 3 are pre-hypertensive. There is an increasing disparity in hypertension prevalence between high-income countries (e.g. United States) and low-income countries (e.g. India).
- Despite its large global burden, hypertension is a preventable and manageable condition.

**Blood Pressure Components**

Two components comprise blood pressure: a systolic blood pressure (SBP) and diastolic blood pressure (DBP).

Blood pressure is largely determined by aortic compliance (ability to distend upon increase in blood volume) and ventricular stroke volume.

- **Systolic pressure** is the peak aortic pressure when ventricles contract.
- **Diastolic pressure** is from the elastic recoil of arteries during ventricular relaxation.
- **Pulse Pressure** is systolic pressure – diastolic pressure. It is a measure of aortic compliance (see *Figure 1 and 2*)
- **Mean Arterial Pressure** is determined by cardiac output (CO) and systemic vascular resistance (SVR)
  - **MAP = (CO × SVR) + CVP**

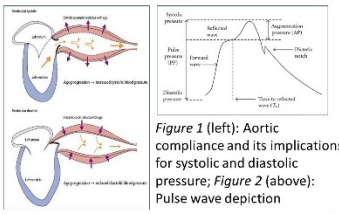


*Figure 1* (left): Aortic compliance and its implications for systolic and diastolic pressure; *Figure 2* (above): Pulse wave depiction

**RESEARCH QUESTIONS**

1. What is the prevalence of hypertension and various risk factors by state, gender, and rural/urban environment?
2. Is there a significant difference in proportion of hypertension between rural and urban Indians?
3. Among hypertensives, what proportion of them have Isolated Systolic Hypertension (ISH), Isolated Diastolic Hypertension (IDH), and Systo-Diastolic Hypertension (SDH)?
4. Is there a pattern of hypertension types by age that can be explained by lifestyle?

### METHODS

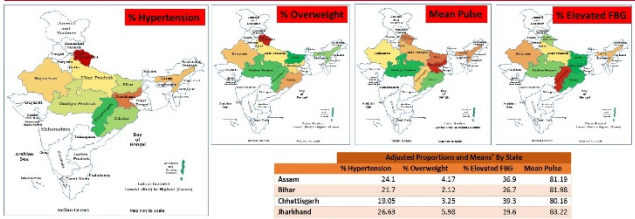
**Study Methodology**

- The 3rd **Annual Health Survey** is a representative survey that was administered by the Government of India to over 18 million individuals in 2014. It follows a uni-stage simple random sample across 9 high-focus states (Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, and Uttarakhand).
- In 2014, a **Clinical, Anthropometric, and Biochemical (CAB) Survey** was initiated with the goal to better understand the distribution of elementary health measures including blood pressure, fasting blood glucose, pulse rate, weight, height, among others.
- Prevalence rates are compared to prevalence rates from the **National Health and Nutrition Examination Survey (NHANES) 2013-2014**, a CDC-based U.S. nationally representative survey.

**Statistical Analysis**

- A total of 894,668 adult, non-pregnant subjects from nine states were included in the study. Prevalence rates were determined using multivariate conditional logistic regression models for categorical variables (e.g. hypertension – yes/no) or multivariate linear regression models for continuous variables (e.g. mean pulse rate). Statistical significance was set at 0.05.

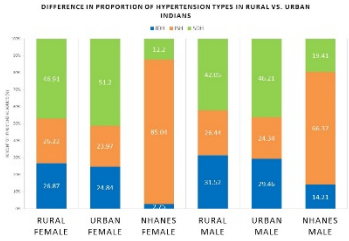
### RESULTS




Hypertension is most prevalent in Uttarakhand, where the mean SBP is 130 and least prevalent in Chattisgarh where the mean SBP is 123. Risk factors are not significantly correlated at a state-level. For example, Chattisgarh has the highest proportion of adults with elevated fasting blood glucose. Out of all the states, Odisha has the lowest overall prevalence of hypertension and risk factors, while Uttarakhand and Jharkhand have the most.

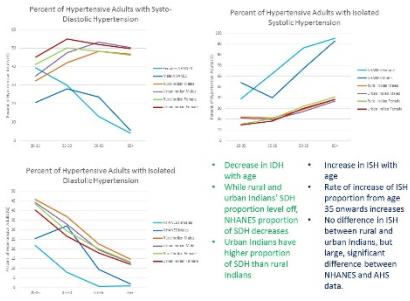
| Adjusted Proportions and Means* By State | | | | |
|---|---|---|---|---|
| | % Hypertension | % Overweight | % Elevated FBG | Mean Pulse |
| Assam | 24.1 | 4.17 | 36.9 | 81.19 |
| Bihar | 21.7 | 2.12 | 26.7 | 81.98 |
| Chhattisgarh | 19.05 | 5.25 | 39.3 | 80.16 |
| Jharkhand | 26.63 | 5.98 | 19.6 | 83.22 |
| Madhya Pradesh | 21.8 | 3.14 | 31.2 | 78.22 |
| Odisha | 20.97 | 7.44 | 27.4 | 78.73 |
| Rajasthan | 23.35 | 6.67 | 37.2 | 79.67 |
| Uttar Pradesh | 22.5 | 5.57 | 36.1 | 80.5 |
| Uttarakhand | 30.68 | 11.08 | 32.8 | 81.36 |
| P-value** | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

*- All proportions and means listed are adjusted for sex, age, and percent rural population using multivariate linear effects model.
**- P-value was calculated using ANOVA and represents the overall difference between states.
Hypertension was defined as either SBP >= 140 and/or DBP >= 90. Overweight was defined as BMI > 27 kg/m^2. Elevated Fasting Blood Glucose (FBG) was defined as plasma glucose > 100 mg/dl.

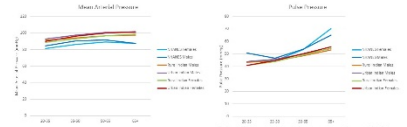



- At a country level, a higher proportion of hypertensive Indian adults have IDH and SDH than American counterparts (p<0.001).
- A greater proportion of rural Indians have ISH and IDH than urban Indians (p<0.001).
- Females have higher proportion of SDH than males (p<0.001).

### RESULTS




- Decrease in IDH with age
- While rural and urban Indians' SDH proportion level off, NHANES proportion of SDH decreases
- Urban Indians have higher proportion of SDH than rural Indians
- Increase in ISH with age
- Rate of increase of ISH proportion from age 35 onwards increases
- No difference in ISH between rural and urban Indians, but large, significant difference between NHANES and AHS data.




Mean Arterial Pressure is significantly greater in urban Indians than both rural Indians and NHANES population (p<0.001)

Rate of increase in pulse pressure is greater in NHANES population than rural or urban Indian populations. No significant difference between rural and urban populations (p=0.5067)

### DISCUSSION

- **There is a clear changing distribution of hypertension types with increasing age.** Even after adjusting for risk factors such as obesity, diabetes, anemia, and tachycardia, the elevated rate of increase in ISH after age 35 across all groups is still significant, suggesting a possible physiological, general mechanism of aging.
- Obese Indian individuals (BMI > 27) have a greater proportion of SDH than normal BMI adults. Underweight adults have a significantly lower proportion of SDH.
- **Rural Indians have lower mean blood pressure, pulse rate, BMI, and fasting blood glucose than their urban counterparts, likely due to different lifestyles.** However, mean arterial pressure for all Indians is still significantly higher than the American population, suggesting necessary intervention or at least surveillance.
- The difference in distribution of hypertension types between rural, urban, and NHANES groups suggests that environmental factors may play a role in getting a particular type of hypertension.
- Limitations include cross-sectional nature of data and lack of environmental, behavioral, and clinical measures to assess effect of diet and metabolite levels on distribution of hypertension types.

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