

# HAOYU ZHANG, Ph.D.

Division of Cancer Epidemiology and Genetics, National Cancer Institute  
9609 Medical Center Drive Rockville, MD 20850, USA

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## EDUCATION

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**Johns Hopkins University, Department of Biostatistics** Baltimore, MD  
Ph.D. in Biostatistics, *Advisors:* Nilanjan Chatterjee and Ni Zhao Sep 2014 - May 2019  
Thesis title: *Testing for Genetic Association and Building Risk Prediction Models for Cancers Incorporating Tumor Characteristics*

**Zhejiang University, Department of Mathematics** Hangzhou, China  
Bachelor of Science in Statistics Sep 2010 - Jun 2014

## PROFESSIONAL EXPERIENCE

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**National Cancer Institute, Division of Cancer Epidemiology and Genetics** Rockville, MD  
Earl Stadtman tenure-track investigator Aug 2022 - now

**Harvard University, Department of Biostatistics** Boston, MA  
Postdoctoral fellow, *Advisor:* Xihong Lin Aug 2019 - July 2022

**National Cancer Institute, Division of Cancer Epidemiology and Genetics** Rockville, MD  
Pre-doctoral fellow, *Advisor:* Montserrat García-Closas July 2017 - May 2019

**Johns Hopkins University, Department of Biostatistics** Baltimore, MD  
Research assistant, *Advisor:* Nilanjan Chatterjee Oct 2015 - May 2019

**Johns Hopkins University, Department of Biostatistics** Baltimore, MD  
Research assistant, *Advisor:* Thomas A. Louis June 2015 - Sep 2015

**Yale University, Department of Biostatistics** New Haven, CT  
Research assistant, *Advisors:* Hongyu Zhao and Can Yang Jul 2013 - Sep 2013

**The University of Queensland, Queensland Brain Institute** Brisbane, Australia  
Research assistant, *Advisors:* Naomi Wray and Guobo Chen Jul 2012 - Sep 2012

## GRANTS AND FELLOWSHIPS

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1. **K99 CA256513 NIH/NCI Pathway to Independence Award**, Methods for Mendelian randomization and mediation analysis using integrative genetic and genomic data for breast cancer, Role: Principal Investigator, Amount: \$192,702, Jan 2021- Dec 2022
2. **Pre-doctoral fellowship**, National Cancer Institute, Rockville, MD, USA, July 2017- May 2019

## HONORS AND AWARDS

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### Harvard University

1. American Society of Human Genetics Annual Conference (ASHG) Reviewers' Choice poster award, virtual meeting, Oct 2021

### Johns Hopkins University

1. American Statistical Association Section on Statistics in Genomics and Genetics **Distinguished Student Paper Award**, Denver, CO, USA, Aug 2019
2. Delta Omega Scholarship, Baltimore, MD, USA, May 2019
3. Delta Omega Public Health Honor Society, Alpha Chapter, Baltimore, MD, USA, April 2019
4. Louis I. and Thomas D. Dublin Award, Baltimore, MD, USA, March 2019
5. DCEG Fellows Award for Research Excellence (DFARE), National Cancer Institute, Rockville, MD, USA, Nov 2018 (**only graduate student winner in 2018**)
6. Joseph Zeger Travel award to ENAR, Baltimore, MD, USA, March 2018
7. Symposium on Advances in Genomics, Epidemiology, and Statistics (SAGES) Poster Award, University of Pennsylvania, Philadelphia, PA, USA, June 2017

### Zhejiang University

1. Meritorious Winner in the American Mathematical Contest in Modeling, virtual competition, 2013
2. First Class Scholarship for Outstanding Merit, Hangzhou, China, 2011
3. **National Scholarship**, Ministry of Education, Hangzhou, China, 2011 (**Top 2 %**)
4. Excellent Student Honor, Hangzhou, China, 2011
5. Scholarship for Distinguished Social Work, Hangzhou, China, 2011

## PUBLICATIONS

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\* represents joint first author

1. Hao, Y., Xiao, J., Liang, Y., Wu, X., **Zhang, H.**, ..., Jiang, X. (2022). Reassessing the causal role of obesity in breast cancer susceptibility: a comprehensive multivariable Mendelian randomization investigating the distribution and timing of exposure. *International Journal of Epidemiology*.
2. Shi, A., Gaynor, S. M., Dey, R., **Zhang, H.**, Quick, C., Lin, X. (2022). COVID-19 Spread Mapper: A multi-resolution, unified framework and open-source tool. *Bioinformatics*.

3. Ahearn, T.U.\* , **Zhang, H.\*** , ..., Garcia-Closas, M. Chatterjee, N., (2022). Common variants in breast cancer risk loci predispose to distinct tumor subtypes. *Breast Cancer Research*, 24(1), 1-13.
4. **Zhang, H.**, Zhao, N., Ahearn, T.U., Wheeler, W., Garcia-Closas, M., Chatterjee, N. (2021). A mixed-model approach for powerful testing of genetic associations with cancer risk incorporating tumor characteristics. *Biostatistics*, 22(4), 772-788.
5. Mhatre, S., Richmond, R. C., Chatterjee, N., Rajaraman, P., Wang, Z., **Zhang, H.**, ... , Dikshit, R. P. (2021). The role of gallstones in gallbladder cancer in India: a Mendelian randomization study. *Cancer Epidemiology and Prevention Biomarkers*, 30(2), 396-403.
6. Zhang, Y. D., Hurson, A. N., **Zhang, H.**, ..., Chanock, S. J., Chatterjee, N., Garcia-Closas, M. (2020). Assessment of polygenic architecture and risk prediction based on common variants across fourteen cancers. *Nature communications*, 11(1), 1-13.
7. **Zhang, H.\***, Ahearn, T. U.\* , ..., Easton, D., Chatterjee, N., Garcia-Closas, M. (2020). Genome-wide association study identifies 32 novel breast cancer susceptibility loci from overall and subtype-specific analyses. *Nature Genetics*, 52(6), 572-581.
8. Koutros, S., Kogevinas, M., Friesen, M. C., ..., **Zhang, H.**, ..., Tardon, A. (2020). Diesel exhaust and bladder cancer risk by pathologic stage and grade subtypes. *Environment International*, 135, 105346.
9. Zhao, N., **Zhang, H.**, Clark, J., Maity, A., Wu, M. (2018). Composite kernel machine regression based on likelihood ratio test for joint testing of genetic and gene–environment interaction effect. *Biometrics*, 75(2), 625-637.
10. Hu, Q., Ding, Z., **Zhang, H.**, He, Y. (2018). The superior glenohumeral joint capsule alone does not prevent superior translation of the humeral head: an in vitro biomechanical study. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, 34(11), 2962-2970.
11. Derkach, A., **Zhang, H.**, Chatterjee, N. (2017). Power Analysis for Genetic Association Test (PAGEANT) provides insights to challenges for rare variant association studies. *Bioinformatics*, 34(9), 1506-1513.
12. Mhatre, S., Wang, Z., Nagrani, R., ..., **Zhang, H.**, ..., Dikshit, R., Chatterjee, N., Rajaraman, P. (2017). Common genetic variation and risk of gallbladder cancer in India: a case-control genome-wide association study. *The Lancet Oncology*, 18(4), 535-544.

## PREPRINTS

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\* represents joint first author

1. **Zhang, H.**, Zhan, J., Jin, J.,..., Chatterjee, N., (2022). Novel Methods for Multi-ancestry Polygenic Prediction and their Evaluations in 3.7 Million Individuals of Diverse Ancestry. *Biorxiv*.
2. Zhu, J., **Zhang, H.**, Niu, Z., Song, J., Jiang, X., (2020). Do mental health disorders influence the risk of female cancer? Results from a genetic study. (*Submitted*)
3. Jiang, Z., **Zhang H.**, Ahearn T.U. , Garcia-Closas, M., Chatterjee N., Zhan, X., Zhao, N., (2021), The sequence kernel association test for multi-categorical outcomes with the application to a breast

cancergenome-wide association study. (*Submitted*)

## PRESENTATIONS

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### Invited Talks

1. Methods for risk prediction using integrative multi-ancestry genetic and genomic datasets
  - New Advances in Statistics and Data Science (NASDS), Honolulu, Hawaii, USA, May 2022
  - PRIMED Consortium Method Working Group seminar, virtual meeting, Apr 2022
  - Program in Quantitative Genomics (PQG) seminar series, Harvard T.H. Chan School of Public Health, Mar 2022
  - Department of Human Genetics, Emory University, Feb 2022
  - Rutgers Cancer Institute of New Jersey, Rutgers University, Jan 2022
  - Department of Biostatistics, University of Michigan, Jan 2022
  - Division of Cancer Epidemiology & Genetics, National Cancer Institute, Jan 2022
  - Institute for Genomic Health, Icahn School of Medicine at Mount Sinai, Jan 2022
  - Department of Biostatistics, Boston University, Jan 2022
  - Biostatistics & Computational Biology Branch, National Institute of Environmental Health Sciences, Jan 2022
  - Department of Biostatistics, New York University, Jan 2022
  - Department of Mathematical Sciences, New Jersey Institute of Technology, Dec 2021
2. Developing transethnic polygenic risk scores through empirical Bayes and super learning algorithm
  - International Chinese Statistical Association (ICSA) Applied Statistics Symposium, virtual meeting, Sep 2021
  - Program in Genetic Epidemiology and Statistical Genetics (PGSG) seminar series, virtual meeting, May 2021
3. Quantifying the transmission dynamics of COVID-19 using U.S. states and county level data
  - Joint Statistical Meetings (JSM), virtual meeting, Aug 2021
  - ICSA Applied Statistics Symposium, virtual meeting, Dec 2020
4. Methods for developing ancestry specific polygenic risk scores, *Breast Cancer Association Consortium (BCAC) 25th annual meeting*, virtual meeting, Sep 2020
5. A mixed-model approach for powerful testing of genetic associations with cancer risk incorporating tumor characteristics
  - Department of Data Science, Southwestern University of Finance and Economics, Chengdu, China, Jan 2020
  - School of Life Sciences and Biotechnology, Shanghai Jiao Tong University, Shanghai, China, Dec 2019
6. Subtypes specific GWAS and risk prediction modeling on breast cancer subtypes, *BCAC 23rd annual meeting*, Springdale, UT, USA, Apr 2019
7. Standard approach and methods accounting for subtype heterogeneity identified 32 novel breast

cancer loci, *BCAC 22nd annual meeting*, Edinburgh, UK, Jun 2018

8. Genome-wide association study identifies 19 novel breast cancer loci from analyses accounting for subtype heterogeneity, *ASHG Platform Talk*, Orlando, FL, USA, Oct 2017
9. "Testing for genetic associations in case-control studies incorporating multivariate disease characteristics", *National Cancer Institute, Division of Cancer Epidemiology & Genetics, Integrative Tumor Epidemiology Branch*, Rockville, MD, USA, Sep 2017

### Contributed Talks

1. Robust Mendelian randomization (MR) analysis with weak instruments, *JSM*, virtual meeting, Aug 2020
2. A mixed-model approach for powerful testing of genetic associations with cancer risk incorporating tumor characteristics, *JSM*, Denver, CO, USA, Aug 2019
3. Developing polygenic risk prediction models for cancer subtypes incorporating multivariate disease characteristics, *JSM*, Vancouver, BC, Canada, July 2018
4. The mixture approach to estimating a weighted population-averaged Value, *Eastern North American Regional meeting of the International Biometric Society (ENAR)*, Atlanta, GA, USA, Mar 2018
5. The mixture approach to estimating a population-averaged Value, *ENAR*, Washington, D.C., USA, Mar 2017
6. Testing for genetic associations in case-control studies incorporating multivariate disease characteristics, *JSM*, Baltimore, MD, USA, Aug 2017

### Posters

1. Developing transethnic polygenic risk scores through empirical Bayes and super learning algorithm, *ASHG*, virtual meeting, Oct 2021
2. A mixed-model approach for powerful testing of genetic associations with cancer risk incorporating tumor characteristics, *ASHG*, San Diego, CA, USA, Oct 2018
3. Genome-wide association study identifies 19 novel breast cancer loci from analyses accounting for subtype heterogeneity
  - o Johns Hopkins Biostatistics Retreat, Philadelphia, PT, USA, April 2018
  - o 14TH Annual NIH Graduate Student Research Symposium, Bethesda, MD, USA, Feb 2018
  - o Delta Omega Poster Competition, Baltimore, MD, USA, Feb 2018
  - o The Maryland Genetics, Epidemiology, and Medicine Training Program (MD-GEM), Baltimore, MD, USA, Feb 2018
4. Methods for analyzing genome-wide association Studies, *Johns Hopkins University, Department of Biostatistics, 100 years celebration*, Baltimore, MD, USA, Jul 2017
5. Testing for genetic association in case-control studies incorporating multivariate disease characteristics, *SAGES*, Philadelphia, PT, USA, Jun 2017

6. Testing for genetic association in case-control studies incorporating multivariate disease characteristics, MD-GEM, Baltimore, MD, USA, Feb 2017

## MENTORING

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### Ph.D. student

1. Tony Chen, Ph.D. student, Department of Biostatistics, Harvard University, April 2021 - Present (co-advise with Xihong Lin)
  - o Developing PRS methods to improve risk predictions for complex traits

### Postdoc fellow

1. Fu Sheng, Postdoc fellow, Biostatistics Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute, July 2022 - Present (co-advise with Kai Yu)
  - o Developing methods to test for genetic associations accounting for subtypes heterogeneity

### Alumni

1. Wenxuan Lu, Undergraduate, Applied Mathematics and Statistics Computer Science, Johns Hopkins University, July 2022 - Aug 2022 (co-advise with Nilanjan Chatterjee)
  - o Developing pipeline for cutting edge multi-ancestry PRS methods
  - o Simulate multivariate non-normal distributing using quasi-copula model

## TEACHING

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### Lab Instructor

Responsibilities: teaching 3 to 4 hours labs per week, beta-test, proctor and grade exams

1. Statistical Methods in Public Health II-III (Biostat 622-623), Master Level Class, taught by Marie Diener-West and Karen Bandeen-Roche, Baltimore, MD, USA, Oct 2018 - Mar 2019
2. Statistical Methods in Public Health II-III (Biostat 622-623), Master Level Class, taught by Marie Diener-West and Karen Bandeen-Roche, Baltimore, MD, USA, Oct 2017 - Mar 2018

### Teaching Assistant

Responsibilities: hold office hour, grade homework and exams, and hold some classes

1. Statistical Methods in Public Health I-IV (Biostat 621-624), Master Level Class, taught by Marie Diener-West, Karen Bandeen-Roche, John McGready and James Tonascia, Baltimore, MD, USA, Sep 2016 - May 2017
2. Statistical Theory I-IV (Biostat 731-734), PhD Level Class, taught by Elizabeth L. Ogburn, Constantine Frangakis and Michael Rosenblum, Baltimore, MD, USA, Sep 2015 - May 2016
3. Survey Methodology, Undergraduate Level Class, taught by Peng Zhang, Hangzhou, China, Feb 2014

- Jun 2014

## SOFTWARE AND PROGRAMMING SKILLS

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### R shiny app

1. **PAGEANT**: Power Analysis for GEnetic AssociatioN Tests  
Software link: <https://andrewhaoyu.shinyapps.io/PAGEANT/>  
Github link: <https://github.com/andrewhaoyu/PAGEANT>

### R package

1. **CKLRT**: Composite Kernel Machine Regression Based on Likelihood Ratio Test  
CRAN link: <https://cran.r-project.org/web/packages/CKLRT/index.html>  
Github link: <https://github.com/andrewhaoyu/CKLRT>
2. **TOP**: Two-stage polytomous logistic regression  
Github link: <https://github.com/andrewhaoyu/TOP>
3. **CT-SLEB**: A multi-ancestry polygenic risk score approach  
Github link: <https://github.com/andrewhaoyu/CTSLEB>

### Programming skills

R, C , Python, Shell Script, RcppEigen, Stan, Photoshop, MATLAB, PLINK, QCTOOL, GTOOL, STATA, SPSS, E-View, Origin

## EDITORIAL ACTIVITIES

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### Journal Referee

Nature Communication, Plos Computational Biology, Plos One, Frontiers in Genetics, Plos Genetics, Annals of Human Genetics, Cancer Research, The American Journal of Human Genetics

### Conference Referee

American Society of Human Genetics Annual Conference (ASHG)

## SERVICES

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1. Statistical genetics group website maintainer (<http://jhustatgen.org>), Johns Hopkins University, Department of Biostatistics, Baltimore, MD, USA, August 2018 - May 2019
2. Session chair, Statistical Advances in the Design and Analysis of Sequence-Based Genetic Association Studies, JSM, Baltimore, MD, USA, August 2018
3. **Student representative**, Johns Hopkins University, Department of Biostatistics, Baltimore, MD, USA, August 2017 - August 2018
  - o Hold the student lunches with topics including passing qualify exam and finding summer internship
  - o Organizes sessions to help students writing cover letter for summer internship
  - o Attend faculty monthly meetings

4. TA training day planning committee, Johns Hopkins University, Department of Biostatistics, Baltimore, MD, USA, August 2018
5. **Johns Hopkins Biostatistics Mixer Organizer**, JSM, Vancouver, BC, Canada, August 2018
6. **Johns Hopkins Biostatistics Mixer Organizer**, ENAR, Atlanta, GA, USA, August 2018
7. TA training day planning committee, Johns Hopkins University, Department of Biostatistics, Baltimore, MD, USA, August 2017
8. TA training day planning committee, Johns Hopkins University, Department of Biostatistics, Baltimore, MD, USA, August 2016
9. **Volunteer service**, Sharadadevi Gramudyog Utpadak Mandali Ltd (SGS), **Baroda, India**, June 2011 - August 2011
  - Collaborated with volunteers from 12 countries to create a detailed survey to examine multiple aspects of village life
  - Interviewed locals in 16 villages to gather data about education, hygiene, income and saving, etc.
  - Analyzed collected data and presented recommendations about serving the needs of nearby communities