Sachin Anil Ghag

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Education:

August 2021-Present
Ph.D. student in Vision Science (Major)
Relevant Coursework: Systems Approach to Biomedical Science, Vision Science, Ethical issues in scientific research, Oxyopia- Vision Science Seminar
Minor: Cell biology, Development Biology, Genetics, Bioinformatics
School of Optometry, Indiana University, Bloomington, IN, USA
Cumulative GPA: 3.57/ 4.0 (2 semesters)

June 2013-August 2015
Master of Science (M. S.) in Biophysics
Relevant Coursework: Cell & Molecular Biophysics, Biochemistry, Molecular Biology, Protein Engineering, Bio crystallography, Medical Biophysics, Nanomaterials in Biology and Medicine, Molecular Modelling and Drug Design, Bioinformatics, Biostatistics
Department of Biophysics, University of Mumbai, Mumbai, MH, India
Cumulative GPA: 3.1/ 4.0

June 2009-March 2012
Bachelor of Science (B. S.) in Biotechnology (Major)
Relevant Coursework: Cell Biology, Genetics, Microbiology, Physiology, Plant and Animal Biotechnology, Food Biotechnology, Embryology, Ecology, Bioinformatics, Biostatistics
Minor: Horticulture
Ramnarain Ruia College, Mumbai, MH, India
Cumulative GPA: 3.2/ 4.0

Research Experience:

August 2021-Present
Ph.D. Student (Full Time)
School of Optometry, Indiana University, Bloomington, IN, USA
Advisors: Dr. Raji Shyam and Dr. Joseph Bonanno
Research topic: Investigating the mechanisms and dynamics of SLC4A11
Solute Carrier proteins (SLC) transporters superfamilies mediate the translocation of substrates across biological membranes of cells and subcellular organelles. SLC4A11 mutations are reported in Congenital Hereditary Endothelial Dystrophy (CHED) and Fuchs Endothelial Corneal Dystrophy (FECD). However, the molecular mechanism of SLC4A11 is not well studied. Recent studies from the lab have shown that this transporter's location bias can play a role in disease manifestation. Therefore, I will explore how mutations in SLC4A11 play an essential role in CHED and FECD via location biases.

- To investigate the subcellular localization of SLC4A11.
- To develop gene therapy to restore mutant SLC4A11 expression.
- By using transgenic mouse models and *in vivo* and *ex vivo* imaging studies, provide proof of concept for this strategy.

January 2020-June 2021
Research Analyst (Full Time)
Department of Ophthalmology, Indiana University Purdue University Indianapolis (IUPUI), USA
Project 1- Cathepsin K (CTSK) is a lysosomal cysteine protease involved in extracellular matrix remodeling in the trabecular meshwork. **[Equal contribution to the research paper]**
Project 2- The role of canonical Notch signaling in steroid-induced glaucoma.
Principal Investigator: Dr. Padmanabhan Pattabiraman
Steroid-induced glaucoma is associated with excessive extracellular matrix (ECM) accumulation resulting in increased resistance to aqueous humor drainage via trabecular meshwork (TM) and elevated intraocular pressure (IOP). Transforming growth factor β2 (TGFβ2) is a secreted profibrotic factor known to be elevated in glaucoma and induce elevated IOP. But the mechanisms through which corticosteroid hormone dexamethasone (DEX) and TGFβ2 cause ocular hypertension are not well understood. Here, I investigate the mechanisms of DEX and TGFβ2-induced ocular hypertension, which modulate CTSK activation, Notch signaling, and ECM remodeling in the TM.

- Assessed RNA and protein expression and distribution of CTSK and canonical Notch signaling proteins in ECM remodeling using qPCR, Immuno-fluorescence staining, and western blotting in porcine and human TM.
- Prepared adenovirus using DNA cloning technique for overexpression of proteins of interest.
- Assessed knockdown effect of genes of interest on ECM remodeling using siRNA.
- Assessed effects of activators and inhibitors of CTSK and canonical Notch signaling proteins in human and porcine eye anterior segment perfusions.

August 2018-
May 2019

Research Assistant (Full Time)
Department of Physiology, Southern Illinois University Carbondale (SIUC), USA
Project- Y-chromosome-linked genes in the development of external genitalia.
Principal Investigator: Dr. Zhengui Zheng
The regulation of developmental control genes by steroid receptors is essential for forming sexually dimorphic traits. Still, the identity of the target genes that control the development of these specific traits remains largely unknown. So, I was trying to understand when, where, and how sex steroids and their receptors interact with developmental gene networks to regulate sexually dimorphic development and the mechanism of congenital penile anomalies.

- Dissected mice embryos to see the expression of selected genes in different development stages of external genitalia.
- Designed primers for selected Y- chromosome-linked genes and prepared clones using DNA cloning and synthesized RNA probe by in-vitro transcription.
- Assessed presence of mRNA expression by whole mount in-situ hybridization (ISH) in embryos.
- Plasmid clones of selected genes were verified by DNA sequencing.

November 2014-
April 2017

Senior Research Fellow (Full Time)
Department of Clinical Research, National Institute for Research in Reproductive Health (NIRRH), Mumbai, India
Project- Premature menopause in North-East: A Risk Factors Evaluation Study.
Principal Investigators: Dr. Parag Tamhankar, Dr. Lalita Savardekar
Premature menopause affects 1% of all women under the age of 40 years. In a population of women 30 years or younger, the prevalence of premature menopause is 0.1%. Here, I investigated the relationship between genetic risk factors of premature and early menopause in women from the North-East region of India and compared it with their Mumbai counterparts.

- Recruited patients/healthy volunteers and screened them according to inclusion and exclusion criteria.
- Assessed 9 hormones by ELISA to enroll 150 women project participants according to inclusion criteria and reported hormone values to participants to seek any treatment if needed.
- Assessed seven amplicons to search mutation/ single nucleotide polymorphisms (SNPs) by PCR and DNA sequencing (Sanger's method). Analyzed sequences for the quality using ABI sequencer scanner software. Samples were compared with control and analyzed using NovoSNP software. Identified sites of the polymorphisms /mutations by BLAST search tool and Ensemble genome browser. The statistical software package for the social sciences (SPSS) compared all the data.
- Trained North-East center's research fellows and prepared standardized protocol booklets for them. Also, I trained 6 research trainees in the lab for their master's thesis.

June 2014-
October 2014

Research Trainee (Full Time)
Department of Gamete Immunobiology, National Institute for Research in Reproductive Health (NIRRH), Mumbai, India
Project- Characterization of Tubulin Interactome and its Orchestration of Sperm Flagella Motility.
Principal Investigator: Dr. Priyanaka Parte
Regulation of microtubule dynamics is critical for the motility of sperm and includes the posttranslational modification of tubulin. Here, I investigated the status of a-tubulin acetylation in asthenozoospermia.

- Dissected rats to prepare caudal sperm protein lysates and prepared human sperm protein lysates from Normal and Asthenozoospermic participants.
- Checked sperm motility by computer-assisted sperm analyzer and analyzed other parameters.
- Assessed presence of acetylated α-tubulin from rat and human sperm protein lysates by immunoprecipitation, SDS- polyacrylamide gel electrophoresis, silver staining, and western blot analysis.

Academic Research:

December 2013-April 2014 (M.S. Thesis)

Evaluation of DNA Damage & Lipid Peroxidation in Chicken Embryos Treated with Zinc Oxide Nanoparticles.

- Investigated the toxicity of ZnO nanoparticles in chicken embryo liver and brain cells in vivo.
- Evaluated DNA damage by the alkaline comet assay after exposure of ZnO nanoparticles.
- Assessed lipid peroxidation by thiobarbituric acid-reacting substance assay.

July 2012-November 2013 (M.S. Literature Review)

Molecular Mechanisms of Ultraviolet Radiation-Induced DNA Damage and Repair.

- This review deals with UV-induced alterations in DNA and its maintenance by various repair mechanisms.
- Mentioned ultraviolet radiation (UVR) induced DNA lesions such as cyclobutene pyrimidine dimers (CPDs), 6-4 photoproducts (6-4PPs), as well as DNA strand breaks.
- Discussed in detail repair mechanisms such as photoreactivation, base excision repair (BER), nucleotide excision repair (NER), mismatch repair (MMR), double-strand break repair, SOS response, cell-cycle checkpoints, and programmed cell death.

June 2011-March 2012 (B.S. Thesis)

Antimicrobial activity of *Moringa oleifera* (Drumstick) seed extracts against Microorganisms.

- Prepared methanolic extract, terpenoid extract, N-oxides, quaternary alkaloids extract, and basic alkaloid extract from the powder of dried seeds.
- Analyzed the antimicrobial activity of seed extracts on *S. aureus, B. megaterium, E. coli, and K. pnemoniae* microorganisms by agar cup method.

Teaching Experience:

August 2022-Present — **Associate Instructor:** Teaching a course on lab experiences in the systems approach to Biomedical Science (V542) to a class of 90 Doctor of Optometry and graduate students for fall 2022.

January 2019-May 2019 — **Teaching Assistant:** Taught a course on lab experiences in Physiology (PHSL208) to a class of 12 undergraduate students for spring 2019.

April 2014-May 2016 — **Teacher:** Tutored Biology to 10th and 12th standard students. Provided comprehensive educational training to students who are candidates for the National examinations.

Lab Skills:

Tissue Culture	Sterile technique, Preparation of medium and buffers, Cell counting, Maintain and cryopreservation of cell lines, Immunofluorescence (IF), Immunohistochemistry (IHC), In-situ hybridization, Plant tissue culture techniques, Human & porcine eye perfusions
Animal	Breeding, Weaning, Mouse genotyping, Weigh animals, Collections of various organs and tissues in mouse, porcine, human- cornea, lens, trabecular meshwork.
Bacteriology	Maintain and purify bacteria, phage stocks, cell culture, Culture transfers, Inoculation, Prepare media, Bacterial Transformation, Plasmid amplification
Genetics/ Biochemistry/ Molecular Biology	DNA, RNA & protein extraction, Tests for quantification of DNA & proteins (Nanophotometer, Spectrophotometer), Nucleus, Mitochondria, Lysosomes extraction, qPCR or RT-PCR (Quantitative or Real-Time Polymerase Chain Reaction), traditional PCR, PCR Clean-up, PCR Sequencing Clean up, Sanger sequencing, Plasmid (or DNA) cloning, Adenoviral vector production, siRNA transfection, Agarose Gel Electrophoresis (AGE), RNA probe synthesis, Tissue fixation-Paraffin embedding-sectioning, Immuno-histochemistry, Hematoxylin & Eosin-Y staining, Comet assay, Immuno-precipitation SDS- polyacrylamide gel electrophoresis, Silver staining, Traditional western blotting, JESS capillary western blotting, Restriction Fragment Length Polymorphism (RFLP), Enzyme-Linked Immuno-Sorbent Assay (ELISA)
Microscopy	Confocal, Airyscan imaging, Light microscopy, Optical coherence tomography
Bioinformatics/ Software	Image J, Primer designing, DNA sequencing analysis, Ensembl genome browser & other NCBI Databases

Fellowship/ Assistantship/Award:

- Graduate Assistantship by School of Optometry- IU Bloomington- 2021-26.
- Association for Research in Vision and Ophthalmology (ARVO)Travel Grant- May 2021.
- Glick Eye Institute Special Recognition Award-Finalist- 2020-21
- Graduate Assistantship by Department of Physiology- SIUC- 2018-19.
- Research Fellowship by Department of Biotechnology (Government of India)- NIRRH- 2014-17.

Professional Membership:

- American society for cell biology (ASCB) (October 2020-22)
- Association for research in vision and ophthalmology (ARVO) (October 2020-21)

Trainings/ Workshops/ Seminars/ Conferences:

- Completed online certificate **Collaborative Institutional Training Initiative (CITI)** program on Basic Introduction to Biosafety, Initial Biosafety Training, Emergency and Incident Response to Biohazard Spills and Releases, Animal Biosafety, Working with Mice in Research, Reducing Pain and Distress in Laboratory Mice and Rats, Working with the IACUC, Institutional Official- Animal Care and Use, SIUC Animal Care on December 2018.
- Participated in Conference on **"8th Illinois Symposium on Reproductive Sciences (ISRS)"** held at Southern Illinois University, Carbondale, USA on 7-8th October 2018.
- Participated in workshop on **"Analytical Techniques for Characterization"** at Birla College, India, on 26th August 2012.
- Participated in workshop on **"Enzymology"** held at Haffkine Institute for Training Research and Testing, Mumbai, India, from 24-25th September 2011.
- Participated as a trainee in **"Principles and Practices of Laboratory Animal Care"** held at Haffkine Institute for Training Research and Testing, Mumbai, India, from 4-5th June 2011.
- Participated as a trainee in the **"Annual Biotechnology Training Program"** held at Haffkine Institute for Training Research and Testing, Mumbai, India, from 18-29th April 2011.

Poster Presentation:

- Participated and presented a poster in **"The Association for Research in Vision and Ophthalmology (ARVO)"** on 2nd -6th May 2021. (Poster- **Role of Notch Signaling in Steroid Induced Glaucoma.)- Received Travel award**
- Participated and presented a poster in **"The American Society for Cell Biology (ASCB)"** on 2nd -16th December 2020. (Poster- **Dexamethasone Inhibits Canonical Notch Signaling Pathway in Trabecular Meshwork.)**
- Participated in Poster Competition **"Vision Research Day"** held by the Department of Ophthalmology at IUPUI, USA, on 7th August 2020. (Poster- **Dexamethasone Inhibits Canonical Notch Signaling Pathway in Trabecular Meshwork.)**
- Participated in Poster Competition **"Ruia Research Convention"** held at Ramnarain Ruia College, Mumbai, India, on 21st January 2012. (Poster- **Antimicrobial activity of *Moringa oleifera* (Drumstick) seed extracts against Microorganisms.**)

Leadership/ Extra-curricular activities:

- **President:** Bloomington Cricket Club at Indiana University (BCCI), USA- 2022-present
- **Organizer:** Desi Jags: Indian Student Association, IUPUI, USA- 2019-21.
- **Student Representative-** Indian Student Association, SIUC, USA- 2018-19.
- **Organizer:** 8th International Annual Conference On **"Translational Clinical Pharmacology Research in Drug Development"** held at the Nehru Centre, Mumbai, India from 23rd -25th April 2015.
- **Organizer:** National Seminar On **"Advances in Bio-imaging"** held at the University of Mumbai, Mumbai, India, on National Science Day, 26th February 2014.
- **Organizer:** National Symposium On **"Frontiers of Biophysics, Biotechnology, and Bioinformatics"** and **"37th Annual Meeting of the Indian Biophysical Society"** held at the University of Mumbai, Mumbai, India, from 13th-16th January 2013.

Publications:

- Soundararajan A, Wang T, **Ghag SA**, Kang MH, Pattabiraman PP **Novel insight into the role of clusterin on intraocular pressure regulation by modifying actin polymerization and extracellular matrix remodeling in the trabecular meshwork**. Journal of Cell Physiology 2022 **DOI:** 10.1002/jcp.30769
- Soundararajan, A*****., **Ghag, SA.*;** Vuda, SS.; Wang, T.; Pattabiraman, PP. **Cathepsin K Regulates Intraocular Pressure by Modulating Extracellular Matrix Remodeling and Actin-Bundling in the Trabecular Meshwork Outflow Pathway**. Cells 2021 **DOI:** 10.3390/cells10112864. **(*equal contribution).**
- **Ghag SA**, Soundararajan A, Pattabiraman PP.**The role of canonical Notch signaling in steroid-induced glaucoma (**Under preparation**).**
- Singh C, Soundararajan A, **Ghag SA**, Wang T, Jusufbegovic D, Lind J, Pattabiraman PP. **Diabetes and Glaucoma: A Sweet Connection (**review article**;** Under preparation**).**