

**BIOMEDICAL & VETERINARY SCIENCES
GRADUATE PROGRAM**



ANNOUNCES

The Doctor of Philosophy Seminar and Examination of

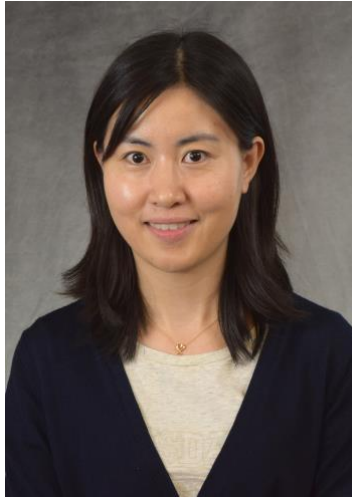
Youjing Zheng

**“The Direct Impact of Gut Microbiome Derived
Metabolite Trimethylamine-N-Oxide on Cardiac
Function”**

Friday, December 9th, 2022

1:00PM

VMCVM Classroom 220



Bio

I was born and raised in China had an interest in clinic and biomedical research from an early age. I got my MD at Fudan University, Shanghai, China and finished my residency on Radiology at Pecking Union Medical College Hospital, Beijing, China. I then work as a radiologist in China-Japan Friendship Hospital in Beijing for three years.

With the interests in biomedical research and cardiology diseases, as well as the different life experience, I joined Dr. Jia-qiang He's Lab at 2018 and start my research on cardiovascular diseases. Here, I have had the opportunity to use my background in cardiac radiology and combine it with the basic biomedical research, to study the impact of gut microbiome metabolite TMAO in cardiac function.

Funded by

NIH 1R15HL140528-01

IGEP-RM18-20

ONE-HEALTH

VMCVM Office of Research and Graduate Studies

Lay Language Abstract

Cardiovascular diseases (CVDs) are a group of diseases related to our heart and blood vessels, such as heart attack and stroke. It is the leading cause of death and disability around the world, more common than diabetes and cancer. According to the reports of the American Heart Association, CVDs cost America 555 billion US dollars in 2016 while by 2035, the cost will reach 1.1 trillion. The individual, population, and economic impact of CVDs are tremendous, making CVD one of the largest public health problems at present. Despite the extensive investigations into the cause of CVDs, the exact underlying reason still not fully understand. The microbiome living inside our body has raised much attention in recent years due to its close relationship with human health, including CVDs. The microbiome from the gut can affect our heart health by affecting the immune system and its metabolites after we eat daily foods.

Among thousands of metabolites, one named trimethylamine N-oxide (TMAO) is related to increased CVDs risks. After we eat choline-rich food such as red meat and eggs, the gut microbiome can use these nutrients and produce TMA as metabolite waste, the TMA then goes into the liver and is converted to TMAO via liver enzymes.

However, the impact of TMAO on cardiovascular health is not fully understood yet. Our study uses the mice model to test whether TMAO has a direct impact on heart cells and heart function. We fed the mice with water containing 0.12% TMAO for the different periods including 3w, 6w, and 13w, and then check the mice's heart function through heart ultrasound and ECG. The results showed that TMAO could significantly harm heart function after long-term exposure in mice (13w). Further histology analysis of heart tissue showed increased heart cell size, which may contribute to decreased heart function. Certain blood inflammation cytokines related to CVDs also increased. The experiments using isolated mice heart cells showed that the ROS, which could harm the heart cells and related to lots of other damage processes in human health, were increased after exposure to the TMAO. Several other factors, including cell skeleton, cell channels responsible for cell-to-cell communication, and cell calcium balance were all damaged by TMAO, which could finally induce heart damage and heart disease.

Publications

Zheng, Council-Troche, M., and He, J.Q., *In preparation*, Gut microbiota metabolite Trimethylamine- N-Oxide induces cardiac dysfunction through microtubule mediated defect of connexin43.

Zheng, Council-Troche, M., and He, J.Q., *In preparation*, Trimethylamine- N-Oxide modulate calcium signaling in intact mice cardiomyocyte.

Zheng, Y.J. and He, J.Q., Interleukin receptor associated kinase 1 signaling and its association with cardiovascular disease. *Rev. Cardiovasc. Med.* 2022, 23(3), 97.

Zheng, Y.J. and He, J.Q., Pathogenic mechanisms of Trimethylamine N-Oxide-induced atherosclerosis and cardiomyopathy. *Cur Vasc Pharmacol.* 2022;20(1):29-36

Zheng, Y.J. and He, J.Q., Common differentially expressed genes and pathways correlating both coronary artery disease and atrial fibrillation. *EXCLI J.* 2021 Jan 18; 20:126-141.

Presentations

Biomedical and Veterinary Sciences Seminar Series (BMVS) – 2022 “The direct impact of Trimethylamine-N-Oxide in cardiac function”.

BMVS Symposium—2021 “Connexin43 is involved in the gut metabolite Trimethylamine-N-Oxide mediated cardiac dysfunction”.

Biomedical and Veterinary Sciences Seminar Series (BMVS) – 2021 “The role of gut microbiota in cardiovascular diseases”.

The Animal and Poultry Science Research Symposium. Blacksburg, VA.----2019 “Gut microbial metabolite trimethylamine-N-oxide impairs cardiac function and electrocardiogram of mouse model”.

The 6th Annual Meeting of the American Physiological Society (VA/MD/DC Chapter) at George Washington University. Washington D.C.---2019 “Gut microbial metabolite trimethylamine-N-oxide impairs cardiac function and electrocardiogram of mouse model”.

Examination Graduate Committee

Major Advisor/Chair:

Jia-qiang He, PhD
Associate Professor of Stem Cell Physiology
Department of Biomedical Sciences and Pathobiology

Graduate Advising Committee Members:

Robert Gourdie, PhD, FAHA, AIMBE
Professor and Director
Center for Vascular and Heart Research

Irving Coy Allen, PhD, MBA, MS
Associate Professor of Inflammatory Disease
Department of Biomedical Sciences and Pathobiology

Xin M. Luo, PhD
Associate Professor of Immunology
Department of Biomedical Sciences and Pathobiology

Liwu Li, PhD
Professor of Biological Sciences
Department of Biological Sciences



VIRGINIA TECH™