

FINAL REPORT – WAEL ALMAHMEED & IAS RESEARCH TRAINING FELLOWSHIP 2025

Fellow: Dr. Geoffrey Kimotho

Host Institution: Department of Disease Control, University of Nairobi

Supervisor: Prof. Hariri Mathew

Fellowship Period: 1st November 2025 – April 2026

1. Introduction

Cardio-cerebro-metabolic diseases are rapidly becoming a leading public health challenge in Sub-Saharan Africa, with **atherosclerosis** at the center of this growing burden. Traditionally perceived as diseases of high-income countries, conditions such as coronary artery disease and stroke are now increasingly prevalent in low- and middle-income settings due to **rapid urbanization, dietary transitions, sedentary lifestyles, and environmental stressors**. Despite this shift, there remains a critical gap in **region-specific data**, particularly regarding early detection and prevention of atherosclerosis.

Atherosclerosis is a progressive condition characterized by the accumulation of lipids and inflammatory cells within arterial walls, often beginning silently long before clinical symptoms appear. In African populations, the early biological signals of this process remain poorly understood, largely due to limited access to **biomarker-based research and advanced diagnostic tools**. As a result, most cardiovascular diseases are detected at late stages, reducing opportunities for effective prevention.

The **7th Wael Almahmeed and IAS Research Training Fellowship** provided a timely and strategic opportunity to address this gap. Through this fellowship, I aimed to strengthen my expertise in **cardiovascular epidemiology, biomarker analysis, and systems-based research approaches**, with a specific focus on urban populations in Kenya.

The fellowship was hosted at the **Department of Disease Control, University of Nairobi**, under the mentorship of **Prof. Hariri Mathew**, whose expertise in public health and epidemiology provided invaluable guidance. The program integrated **laboratory-based training, field data collection, statistical analysis, and scientific dissemination**, creating a comprehensive learning and research experience.

This report presents a detailed account of the fellowship activities, findings, and contributions to the understanding of **early atherosclerotic risk in urban African settings**.

2. Objectives of the Fellowship

The overarching aim of the fellowship was to enhance my **technical, analytical, and research capacity in atherosclerosis and cardio-cerebro-metabolic diseases**, with a strong emphasis on translational and context-specific applications.

The fellowship was guided by the following **specific objectives**:

First, to **develop advanced technical skills in cardiovascular biomarker analysis**, particularly in measuring inflammatory and lipid markers associated with early atherogenesis. This included hands-on training in laboratory techniques such as enzyme-linked immunosorbent assays (ELISA) and lipid profiling methods.

Second, to **investigate the prevalence and distribution of key biomarkers**, including **C-reactive protein (CRP), interleukin-6 (IL-6), apolipoprotein B (ApoB), and oxidized low-density lipoprotein (oxLDL)**, among urban populations exposed to varying socio-environmental conditions.

Third, to **apply systems epidemiology approaches** in understanding the complex interactions between biological, behavioral, and environmental determinants of cardiovascular risk. This involved integrating multiple data sources and using advanced analytical models to explore causal pathways.

Fourth, to **contribute to scientific knowledge and dissemination**, through the preparation of peer-reviewed publications, conference presentations, and collaborative research outputs.

Finally, to **strengthen institutional and international collaboration**, particularly with networks affiliated with the International Atherosclerosis Society, thereby promoting knowledge exchange and capacity building in cardiovascular research.

3. Activities Undertaken

The fellowship involved a comprehensive set of activities designed to integrate **theoretical knowledge with practical research experience**.

The first phase of the fellowship focused on **laboratory training and capacity development**. During this period, I gained hands-on experience in key laboratory techniques essential for cardiovascular biomarker analysis. This included training in **ELISA assays for inflammatory markers such as CRP and IL-6**, as well as enzymatic assays for lipid profiling, including **LDL-C, HDL-C, total cholesterol, and ApoB**. I also developed competencies in **sample handling, laboratory quality control, data recording, and assay validation**, ensuring the reliability and reproducibility of results.

The second phase involved **field-based data collection** in selected urban communities in Nairobi. A total of **200 participants aged 25 to 55 years** were recruited using community-based sampling approaches. Ethical approvals were obtained, and informed consent was secured from all participants prior to data collection.

Data collection included both **biological and socio-environmental components**. Venous blood samples were collected following standardized protocols and transported to the laboratory for analysis. In parallel, participants completed structured questionnaires capturing information on **dietary patterns, physical activity, smoking behavior, alcohol consumption, and psychosocial stress**.

To complement individual-level data, **environmental exposure data** were integrated using geospatial tools and secondary datasets. These included measures of **air pollution (PM2.5 levels), population density, access to healthcare services, and urban infrastructure**. This approach enabled a more comprehensive understanding of the contextual drivers of cardiovascular risk.

Throughout the fellowship, I actively participated in **weekly seminars, interdisciplinary research meetings, and capacity-building workshops** within the Department of Disease Control. These platforms provided opportunities to present preliminary findings, receive feedback, and engage in critical discussions with peers and senior researchers.

Mentorship played a central role in the fellowship experience. Under the guidance of **Prof. Hariri Mathew**, I received continuous support in research design, data analysis, and scientific writing. Additionally, I contributed to mentoring junior researchers and graduate students, fostering a collaborative and supportive research environment.

4. Key Results and Findings

The analysis of data collected during the fellowship yielded several **important insights into early atherosclerotic risk in urban African populations**.

One of the most significant findings was the **elevated levels of inflammatory biomarkers**, particularly **C-reactive protein (CRP) and interleukin-6 (IL-6)**, among participants residing in high-density urban environments. These findings suggest a strong link between **urban stressors and systemic inflammation**, which is a key driver of atherogenesis.

In terms of lipid profiles, the study revealed a **high prevalence of dyslipidemia**, characterized by elevated **low-density lipoprotein cholesterol (LDL-C)** and reduced **high-density lipoprotein cholesterol (HDL-C)**. Additionally, increased levels of **apolipoprotein B (ApoB)** and **oxidized LDL (oxLDL)** were observed, particularly among individuals with unhealthy dietary habits and low physical activity levels.

Further analysis demonstrated **significant associations between biomarker levels and socio-environmental factors**. For example, participants exposed to higher levels of air pollution and psychosocial stress exhibited increased inflammatory markers, while those with limited access to healthy food options showed adverse lipid profiles.

Using advanced statistical techniques, including **multivariate regression and systems modeling**, a **preliminary cardiovascular risk model** was developed. This model integrates biological, behavioral, and environmental variables, providing a more holistic approach to risk assessment.

These findings highlight the importance of **context-specific research** in understanding cardiovascular disease and underscore the need for **early detection strategies tailored to African populations**.

5. Outputs and Deliverables

The fellowship resulted in several **key outputs and deliverables**, contributing to both scientific knowledge and practical applications.

A major output is the development of a **full research manuscript**, which has been prepared and is currently under review for submission to a peer-reviewed journal specializing in cardiovascular epidemiology. The manuscript presents the study findings, methodological approach, and implications for early detection of atherosclerosis.

In addition, a **conference abstract** based on the research findings has been submitted to an international cardiovascular research conference. This provides an opportunity to share insights with the global scientific community and receive feedback from experts in the field.

Another important deliverable is the creation of a **prototype cardiovascular risk assessment tool**, which integrates biomarker data with environmental and behavioral factors. This tool has potential applications in **community-based screening and preventive health programs**, particularly in resource-limited settings.

The fellowship also contributed to **strengthening research collaborations**, both within the University of Nairobi and with regional and international partners. These collaborations are essential for advancing cardiovascular research and building sustainable research capacity in Africa.

Overall, the outputs of this fellowship align with the mission of the International Atherosclerosis Society to promote **scientific understanding and global collaboration in atherosclerosis research**.

6. Skills and Capacity Development

The IAS Research Training Fellowship significantly strengthened my **technical, analytical, and professional competencies**, positioning me to contribute more effectively to cardiovascular research in Africa and globally.

One of the most important areas of growth was in **advanced laboratory skills**, particularly in the measurement and interpretation of cardiovascular biomarkers. Through hands-on training, I gained proficiency in **enzyme-linked immunosorbent assays (ELISA)** for inflammatory markers such as **C-reactive protein (CRP) and interleukin-6 (IL-6)**, as well as **enzymatic lipid profiling techniques** for markers including **LDL-C, HDL-C, and apolipoprotein B (ApoB)**. These skills are essential for identifying early signs of atherosclerosis and understanding disease progression at the molecular level.

In addition to laboratory techniques, the fellowship enhanced my capacity in **data analysis and systems epidemiology**. I developed advanced skills in **statistical modeling, multivariate regression, and pathway analysis**, enabling me to explore complex interactions between biological, behavioral, and environmental variables. The application of **systems-based approaches** allowed for a more comprehensive understanding of cardiovascular risk beyond traditional single-factor analyses.

The fellowship also improved my **scientific writing and communication skills**. I gained experience in preparing manuscripts for peer-reviewed journals, structuring research findings, and presenting data in a clear and compelling manner. Participation in seminars and conferences further strengthened my ability to communicate complex scientific concepts to diverse audiences.

Another key area of development was **interdisciplinary collaboration**. Working within the Department of Disease Control exposed me to a diverse network of researchers, including epidemiologists, clinicians, environmental scientists, and data analysts. This collaborative environment enhanced my ability to integrate perspectives from multiple disciplines, which is critical for addressing complex health challenges such as atherosclerosis.

Finally, the fellowship contributed to my growth in **research leadership and mentorship**. I had the opportunity to support junior researchers and students, guiding them in data collection, analysis, and interpretation. This experience strengthened my leadership skills and reinforced my commitment to capacity building within the African research community.

7. Impact and Future Directions

The fellowship has had a **transformative impact on my research trajectory**, both in terms of technical expertise and strategic direction. It has strengthened my ability to conduct **high-quality, context-specific research** on atherosclerosis and related diseases, and has positioned me as an emerging leader in cardiovascular epidemiology in Africa.

One of the most significant impacts of this fellowship is the generation of **new evidence on early atherosclerotic risk in urban African populations**. The identification of **biomarker patterns linked to environmental and lifestyle factors** provides valuable insights that can inform prevention strategies and health policy. This work contributes to closing the gap in **Africa-specific cardiovascular data**, which has historically been limited.

The development of a **prototype cardiovascular risk assessment model** represents another important outcome. By integrating biological, behavioral, and environmental data, this model offers a more accurate and context-relevant approach to risk prediction. With further validation, this tool has the potential to be applied in **community health programs and clinical settings**, supporting early detection and intervention.

Looking ahead, I plan to expand this research into a **longitudinal cohort study**, tracking changes in biomarker levels and cardiovascular risk over time. This will provide deeper insights into disease progression and the long-term impact of urbanization on cardiovascular health.

I also intend to strengthen collaboration with **national and international research institutions**, including networks affiliated with the International Atherosclerosis Society. These partnerships will facilitate knowledge exchange, joint research initiatives, and capacity building.

In addition, I aim to engage with **policymakers and public health practitioners** to translate research findings into actionable strategies. This includes advocating for the integration of **biomarker-based screening** into national health systems and promoting interventions that address environmental and lifestyle risk factors.

Overall, the fellowship has laid a strong foundation for my continued contribution to **cardiovascular health research, policy, and practice in Africa**.

8. Conclusion

The **7th Wael Almahmeed and IAS Research Training Fellowship** has been an invaluable experience that has significantly advanced my expertise in **atherosclerosis and cardio-cerebro-metabolic research**.

Through a combination of **laboratory training, field-based research, data analysis, and scientific dissemination**, I have developed critical skills and generated meaningful insights into the early stages of cardiovascular disease in African populations. The fellowship has enabled me to bridge gaps between **clinical research, epidemiology, and environmental health**, adopting a systems-based approach to understanding disease risk.

The findings from this research highlight the importance of **early detection and prevention**, particularly in rapidly urbanizing settings where exposure to risk factors is increasing. By identifying key **inflammatory and lipid biomarkers** and their association with socio-

environmental conditions, this work contributes to the development of **targeted and context-specific interventions**.

Beyond technical skills, the fellowship has strengthened my **professional network, research leadership capacity, and commitment to advancing health equity**. It has reinforced the importance of collaboration, innovation, and evidence-based practice in addressing complex global health challenges.

I am confident that the knowledge and experience gained through this fellowship will have a lasting impact on my career and will contribute to the broader goal of **reducing the burden of cardiovascular diseases in Africa and beyond**.

9. Acknowledgement

I would like to express my sincere gratitude to the **International Atherosclerosis Society (IAS)** and **Dr. Wael Almahmeed** for their generous support and commitment to advancing cardiovascular research in the Middle East and Africa.

I am deeply thankful to my supervisor, **Prof. Hariri Mathew**, for his mentorship, guidance, and continuous support throughout the fellowship. His expertise and dedication were instrumental in shaping the direction and success of this research.

I also acknowledge the **Department of Disease Control at the University of Nairobi** for providing a conducive research environment, access to laboratory facilities, and opportunities for interdisciplinary collaboration.

Special appreciation goes to the **study participants**, whose willingness to contribute made this research possible. I am also grateful to my colleagues and research assistants for their invaluable support in data collection, analysis, and project implementation.

Finally, I extend my appreciation to the broader **IAS community and collaborating institutions**, whose commitment to scientific excellence and knowledge sharing continues to inspire my work.

10. Certification by Supervisor

I hereby certify that **Dr. Geoffrey Kimotho** has successfully completed the **IAS Research Training Fellowship (2025)** and that this report accurately reflects the work undertaken and results achieved during the fellowship period.

Name: Prof. Hariri Mathew
Title: Dean, School of Public Health
Institution: University of Nairobi

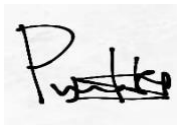
Signature:



Date: __3/4/2026__

Submitted by:
Dr. Geoffrey Kimotho

Signature:



Date: __6/4/2026__