Seventh Annual Research Meeting of the Noguchi Memorial Institute for Medical Research: Non-Communicable Diseases

Kwadwo A. Kusi[1], Justice Kumi[2], Constance Agbemelo-Tsomafo[3], Dziedzom K. de Souza[4], Michael Ofori[1] and Dorothy Yeboah-Manu[5]

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[1]Department of Immunology, Noguchi Memorial Institute for Medical Research, College of Health Sciences, University of Ghana.
[2]Department of Clinical Pathology, Noguchi Memorial Institute for Medical Research, College of Health Sciences, University of Ghana.
[3]Department of Animal Experimentation, Noguchi Memorial Institute for Medical Research, College of Health Sciences, University of Ghana.
[4]Department of Parasitology, Noguchi Memorial Institute for Medical Research, College of Health Sciences, University of Ghana.
[5]Department of Bacteriology, Noguchi Memorial Institute for Medical Research, College of Health Sciences, University of Ghana.

Corresponding author: Kwadwo Asamoah Kusi **E-mail:** akusi@noguchi.ug.edu.gh
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SUMMARY

Non-communicable diseases (NCDs) result from lifestyle and genetic factors and are not infectious. They include cardiovascular diseases, diabetes, obesity, cancers, mental illnesses, and chronic respiratory, liver, and kidney diseases. NCDs account for 74% of global deaths, predominantly in low- and middle-income countries, with a significant rise in sub-Saharan Africa, including Ghana. The interplay between infectious diseases and NCDs, which can alter disease outcomes, requires urgent attention. At the seventh Annual Research Meeting (ARM) of the Noguchi Memorial Institute for Medical Research (NMIMR), presentations highlighted the impact of infectious diseases on NCDs, underscoring the need for integrated approaches to manage NCDs and infectious diseases. The presentations also emphasised early detection, treatment, and the need for novel therapeutic strategies.

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INTRODUCTION

Non-communicable diseases (NCDs) are defined as diseases that are typically caused by lifestyle and/or unhealthy behaviours and cannot be spread through infection or interaction with affected persons. These include cardiovascular diseases such as heart disease and stroke, diabetes, obesity, various cancers, mental illness, chronic non-infectious liver and kidney diseases, as well as chronic respiratory diseases. Globally, NCDs are responsible for about 74% of all deaths, with 77% of these deaths occurring in low- and middle-income countries.[1] The prevalence and burden of NCDs have especially risen in sub-Saharan African countries, including Ghana.[2,3] The aetiology of many of these NCDs has not been fully elucidated but is believed to result from a combination of genetic, physiological, environmental and behavioural factors.[1,4]

Aside from these, there is increasing evidence of a significant role of infectious diseases in the progression and outcome of NCDs.[5,6] This interplay between NCDs and infectious diseases in co-morbid persons, therefore, needs urgent attention since infectious diseases, which also abound on the African continent, could modulate NCDs significantly and create NCD phenotypes that will be unique to the continent and very different from NCD phenotypes in areas of the world where infectious diseases are limited in frequency and types.

Conversely, NCDs can influence the outcome of infectious diseases in co-morbid persons [7–9], most likely through alterations of shared biochemical pathways. During the seventh Annual Research Meeting (ARM) of the Noguchi Memorial Institute for Medical Research (NMIMR) in 2022, several scientists working in this area delivered presentations on the impact of infectious diseases and some human genetic predispositions on the risk of non-communicable disease development.

Prof. Dwomoa Adu, an honorary consultant nephrologist with the Korle Bu Teaching Hospital and a special invited guest to the ARM meeting, presented some aspects of ongoing work within the H3Africa project, which he co-leads. His presentation, titled "Trypanosomiasis, Apolipoprotein L1 variants, and kidney failure", was premised on the fact that persons of African descent have an increased risk of developing chronic kidney disease (CKD) as compared with Europeans, and this was in part attributable to their having certain unique variants of the gene for Apolipoprotein L1 (APOL1). The frequency of certain variants of the APOL1 gene, currently associated with CKD, rose to very high levels in Africans some 10,000 years ago because they protected fatal African sleeping sickness (Trypanosomiasis). These gene variants can still be found in Africans and people of African descent and have been associated with an increased risk of HIV-associated nephropathy, hypertension-attributed end-stage kidney disease, focal segmental glomerulosclerosis, HIV-associated nephropathy, and other non-diabetic renal diseases. Studies aiming to establish the link between trypanosomiasis, kidney failure, and the Apolipoprotein L1 gene showed that amongst the study populations (8475 subjects), 28% carried high-risk APOL1 variants for kidney disease and were at 29% higher odds of CKD than those that are low-risk carriers. Early identification of CKD and adequate treatment should reduce the risk of disease progression. The study also established a 14% CKD prevalence rate in Ghana. As is the case in other parts of sub-Saharan Africa, almost all patients with end-stage renal disease are untreated and die from the disease. The study findings, therefore, highlight the need for greater advocacy, early identification and management, and the development of novel small-molecule inhibitors of APOL1 that may reduce the risk of CKD progression.

Ms. Monica Baaba Jones with the School of Public Health, University of Ghana, presented data from her ongoing work titled "Co-prevalence of tuberculosis and diabetes in Greater Accra Region: epidemiology, tuberculosis clinical presentation and treatment outcomes". Evidence suggests that diabetes mellitus (DM) may worsen tuberculosis (TB) disease in co-morbid persons. Out of 204 study participants, 22% were classified under the TB/DM group, and this represented a relatively high prevalence of diabetes among TB patients compared to what has been reported in most African countries. Further, being older than 59 years old and having a BMI of at least 25kg/m2 or a family history of diabetes were independently associated with being in the TB/DM group. Over 60% of diabetes cases detected in people enrolled in the study were new, but as TB treatment progressed, the patient's blood glucose levels normalised, suggesting transient hyperglycemia. Similar observations of transient hyperglycemia in TB patients have been reported elsewhere.[10,11] TB/DM severity and treatment outcomes did not differ significantly between TB patients without diabetes. However, lesions that are markers of tuberculosis were fewer in the TB/DM group compared to the TB group with no diabetes, which has implications for clinical diagnosis based on a chest X-ray. These findings echo the need to systematically screen TB patients for diabetes, particularly the most at-risk subgroups of TB patients.

Mr. Nathaniel Amasah Kotei from the Department of Biochemistry, Cell and Molecular Biology, University of Ghana, presented his work titled "Network pharmacology of chlorogenic acid with special reference to anticancer property". Cancer is a complex disease with a high prevalence and mortality rate, resulting from changes in several metabolic pathways. While standard drugs are made to have a single target, some natural products have multiple binding targets and can be developed as drugs to target multiple conditions. The exceptional and potent anti-cancer activity of chlorogenic acid (CGA) for cancer treatment has been demonstrated using cell lines and preclinical and clinical assessment approaches. In this in-silico study, the investigators used network pharmacology to identify potential multi-binding targets of CGA using data acquired from various databases and the Cytoscape software. The networks provided details of the interaction of CGA with protein targets, their pathways, and their connection to diseases, particularly cancer. In vitro studies identified seven genes involved in 20 cancer-related pathways that CGA targets. Also, 22 different types of cancer, including breast, prostate, pancreatic lung, gastric, liver and colorectal cancer, were associated with the target genes found. Chlorogenic acid demonstrated a cytotoxic effect and had the potential to induce apoptosis in DU145 prostate cancer cells.

CONCLUSION

NCDs are primarily lifestyle-related and include cardiovascular diseases, diabetes, obesity, cancers, mental illnesses, and chronic respiratory, liver, and kidney diseases. The interplay between NCDs and infectious diseases prevalent in Africa needs urgent attention due to its potential to create unique disease phenotypes. Infectious

diseases can exacerbate NCDs, and vice versa, through shared biochemical pathways. The seventh ARM of the NMIMR underscored the complex nature of NCDs and the critical need for integrated approaches in research, early detection, and treatment. Addressing these challenges requires continued advocacy, innovative financial mechanisms, and the development of new therapeutic strategies to mitigate the growing burden of NCDs in Africa.

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