Global Obesity and Cardiometabolic disease

Lessons from the RODAM study

Charles Agyemang, PhD

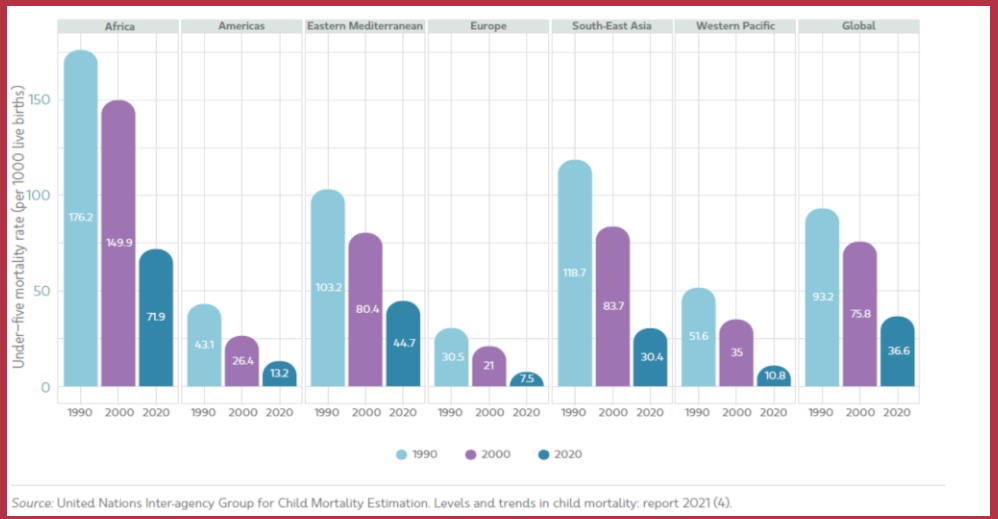
Professor of Global Migration, Ethnicity & Health, Amsterdam University Medical Centres, The Nethelands
Adjunct Professor, Depart of Medicine, John Hopkins University
Vice President, European Public Health Association, Migrant Health Section

25th September 2024

Global health systems have made significant gains

Source: Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division (11).

Maternal mortality ratios (probability per 100 000 live births), by WHO region and global, 2000 and 2017



Source: United Nations Inter-agency Group for Child Mortality Estimation. Levels and trends in child mortality: report 2021 (4).

Under-five mortality rate (probability of dying by age five per 100 000 live births), by WHO region and global, 1990, 2000 and 2020

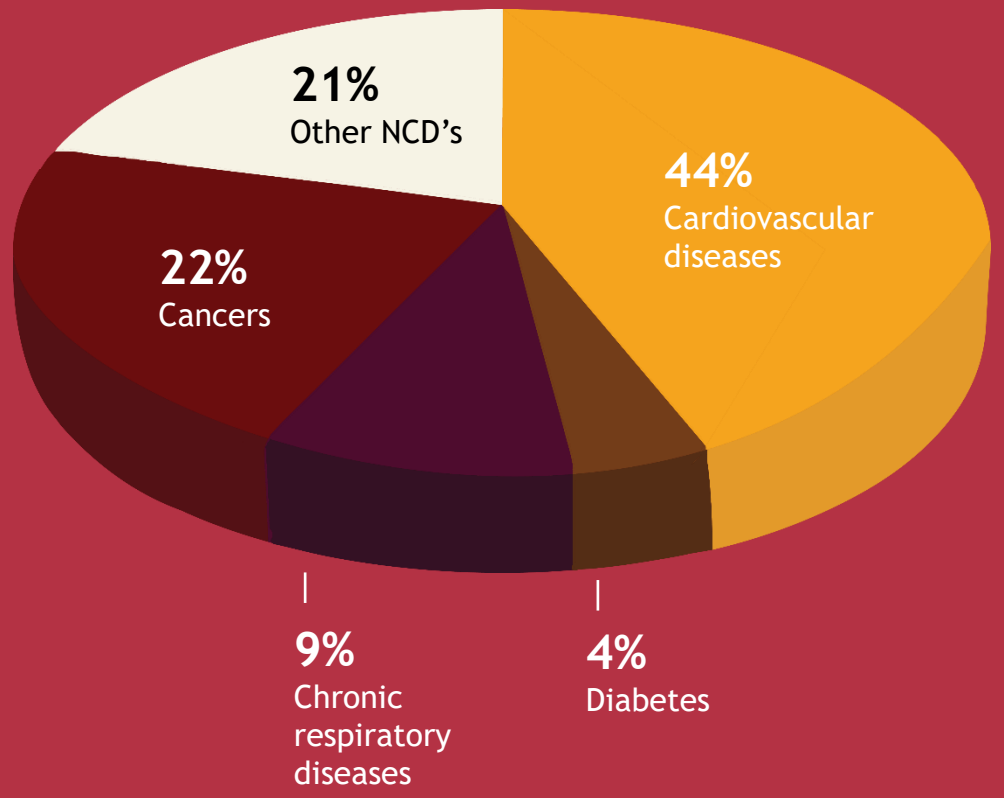
Major challenges remain

- Communicable diseases are still widespread
- Epidemic of non-communicable diseases (NCDs)
- NCDs kill 41million people/yr (74% of all global deaths)
- 77% of all NCD deaths occur in LMICs

Source: WHO Global health estimates, 2023.

Cardiometabolic diseases account for most NCD morbidity and deaths

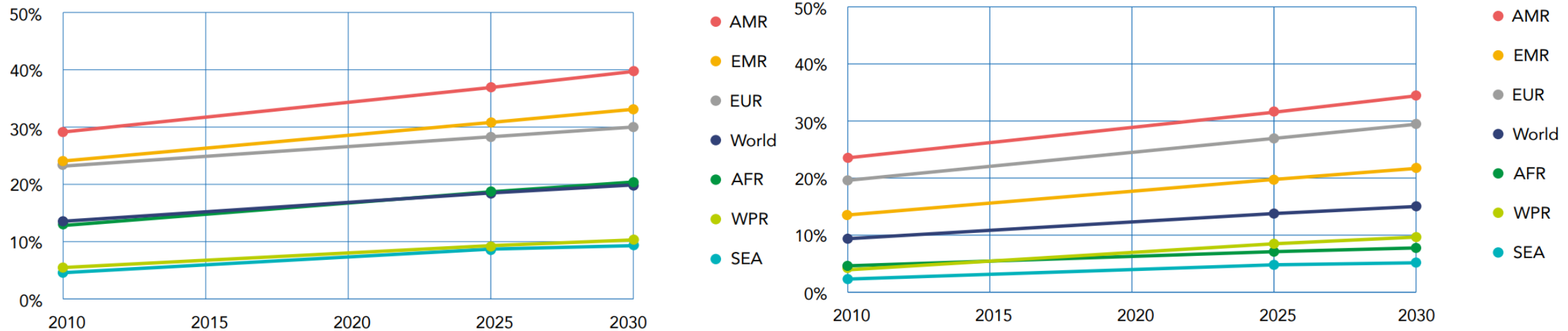
Cardiovascular disease & diabetes alone account for 19.9 million deaths of the 41 million NCDs deaths



Global cardiometabolic disease burden reflects on the obesity epidemic

- 2.5 billion adults were overweight (incl. over 890 million obese) in 2022
- Corresponds to 43% of adults (43% of men and 44% of women)
- Prevalence varied by region, from 31% in South-East Asia & Africa to 67% in American Region.

Prevalence of obesity (BMI ≥30kg/m2) among women & men by regions in 2010-2030

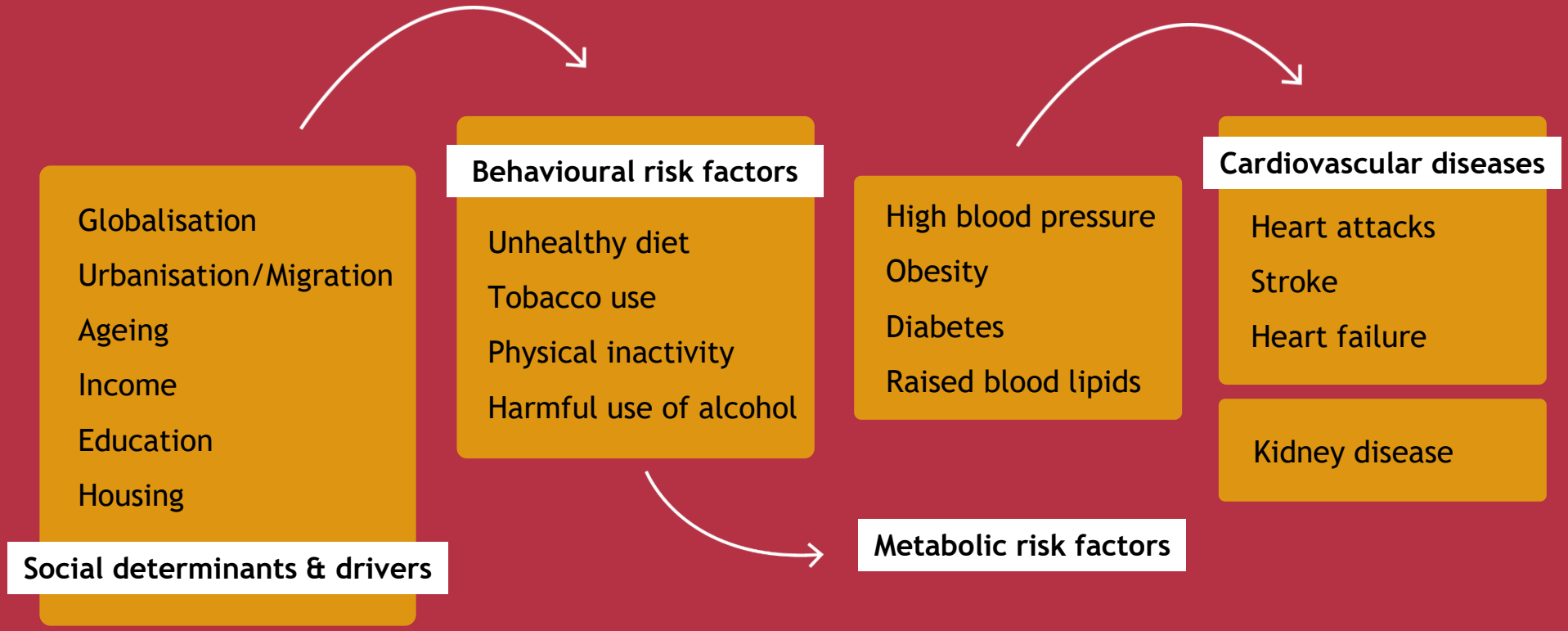


Source: NCD Risk Factor Collaboration (2017) and World Obesity Federation projections

Cardiometabolic diseases Multimorbidity

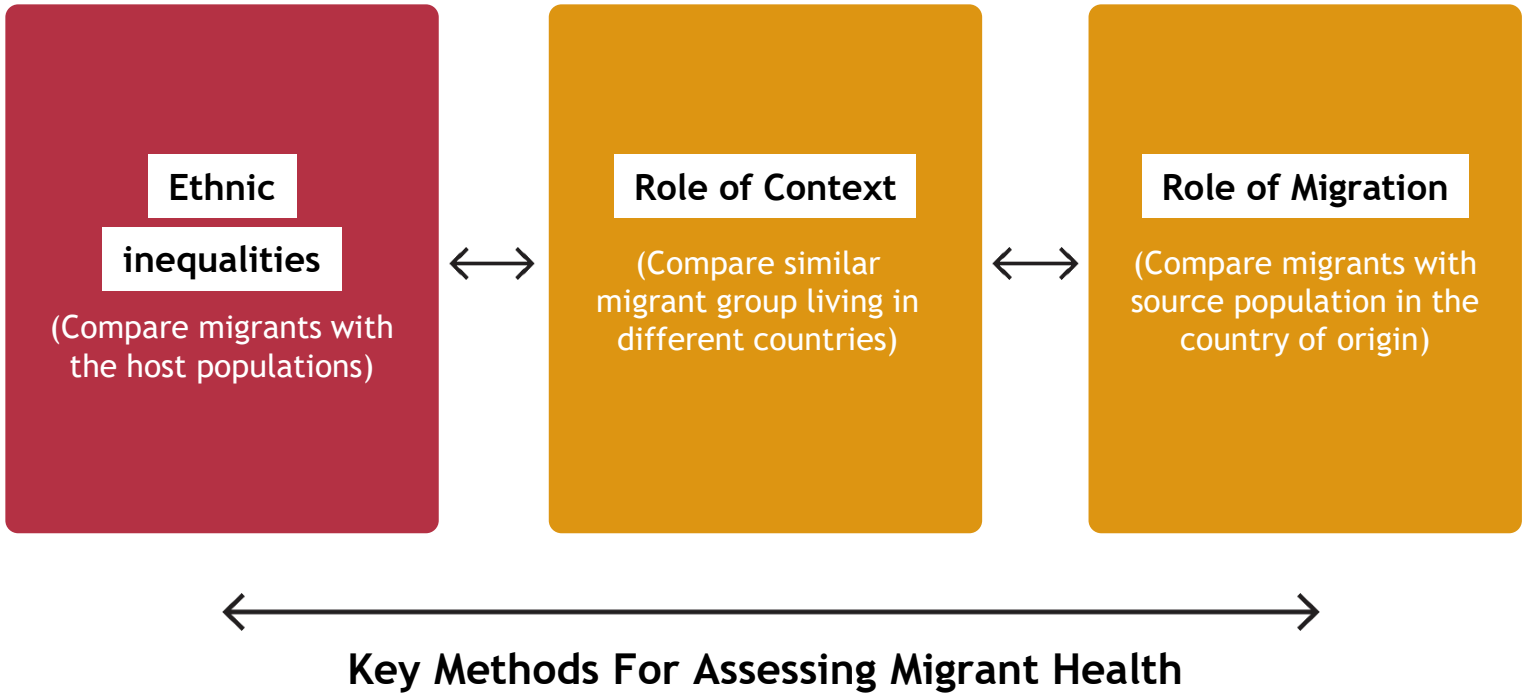
- People living with cardiometabolic diseases often have multiple rather than a single condition
- Chronic care models are mostly based on single disease frameworks
- This results in missed opportunities for early diagnosis & management of multimorbidities

Main risk factors for cardiomatabolic diseases



Some specific populations such as migrants and urban populations have been particularly been affected by obesity & cardiometabolic diseases

Three main methods of assessing migrant health

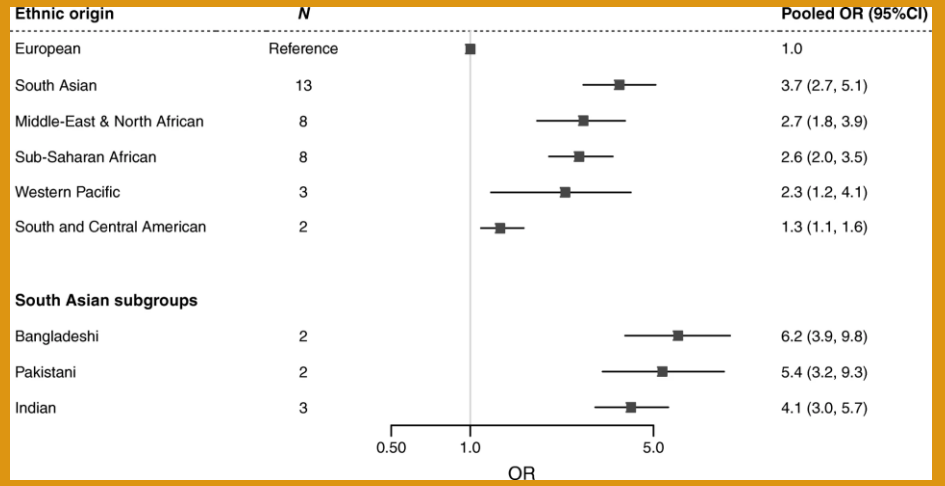


Agyemang C. Public Health 2019 Jul;172:108-115.

Diabetes burden in Migrants

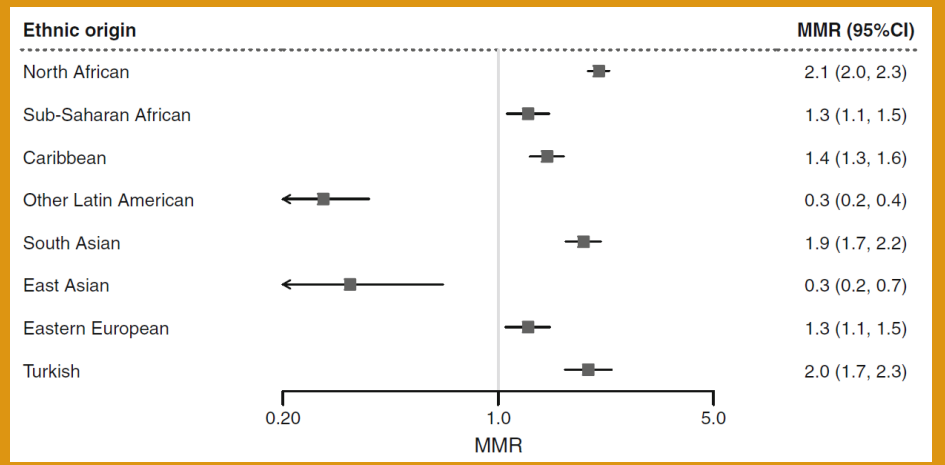
- Diabetes morbidity & mortality rates higher in most migrant groups
- Migrants develop diabetes at an earlier age than host populations
- Major risk factors for diabetes e.g., obesity and insulin resistance are also higher in migrants

Type 2 diabetes among migrant & ethnic groups in Europe



Meeks et al. Intern Emerg Med. 2016;11:327-40.

MRRs in diabetes-related mortality among migrant groups compared with Europeans in six European countries



Agyemang et al Diabetologia 2021;64(12):2665-2675.

Studies on Role of Migration have many advantages

- Reveal real lifestyle changes upon migration
- Pinpoint key predisposing factors
- Non-migrant peers in home countries
  - Provides indication of future threat of diseases
- Effective model for collaboration between host/migration countries

Earlier studies provided insights into the importance of the potential role of migration in cardiometabolic diseases

- Possible CHD rates were lower in Japanese men living in Japan than Japanese men living in Hawaii & California (Marmot et al. 1975)
- Punjabi people living in West London had a higher rate of coronary risk factors than their siblings in the Punjab, India (Bhatnager et al. 1995)

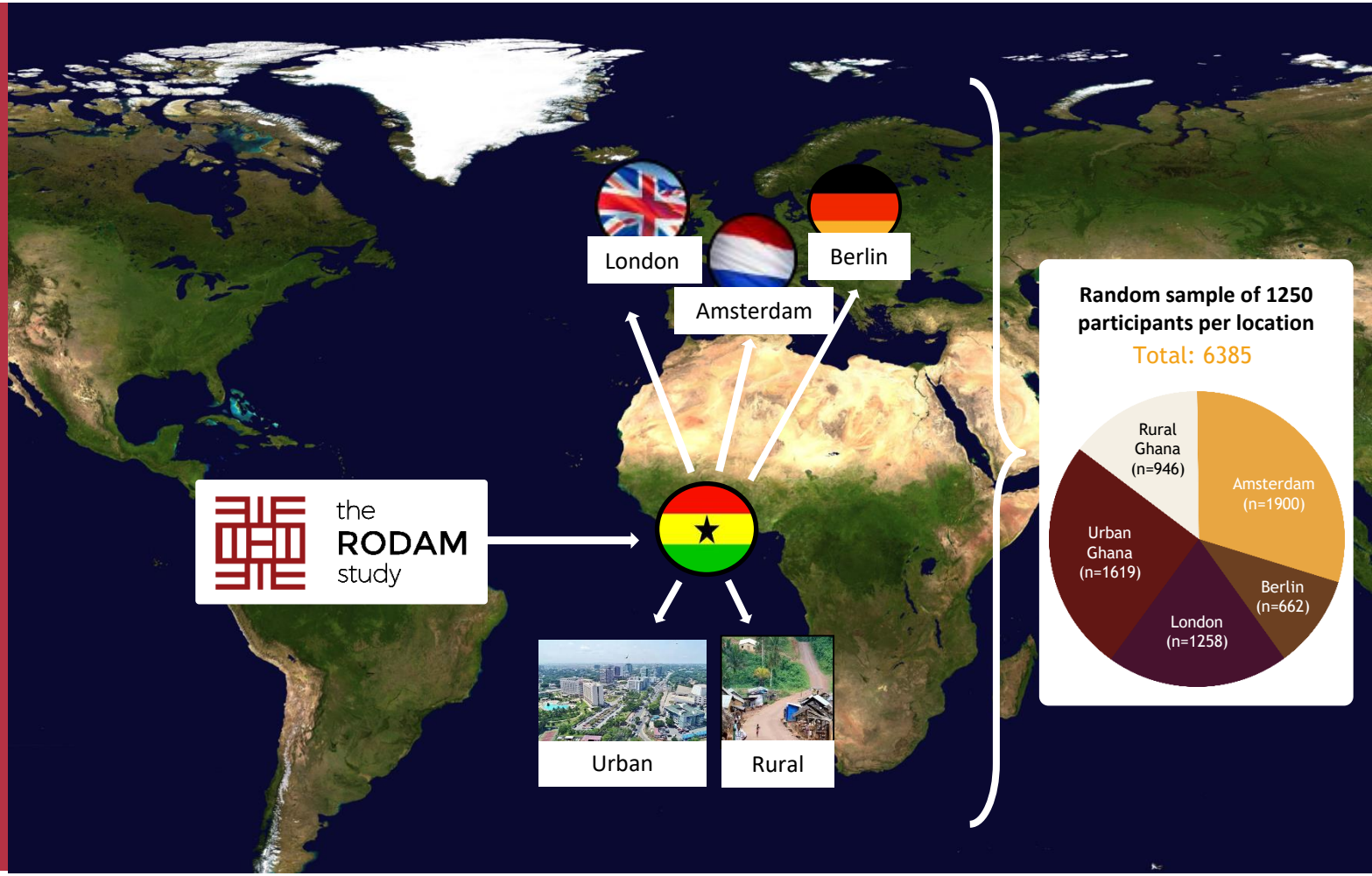
Some Lessons Learnt from Role of Urbanisation & Migration

Research on Obesity & Diabetes among African Migrants (RODAM study)
For more info on the RODAM study please see:

http://www.rod-am.eu/home

Agyemang et al Ann N Y Acad Sci. 2017 Mar;1391(1):54-70.l

Development of a unique migrant and non-migrant cohort



Agyemang et al Ann N Y Acad Sci. 2017 Mar;1391(1):54-70.l

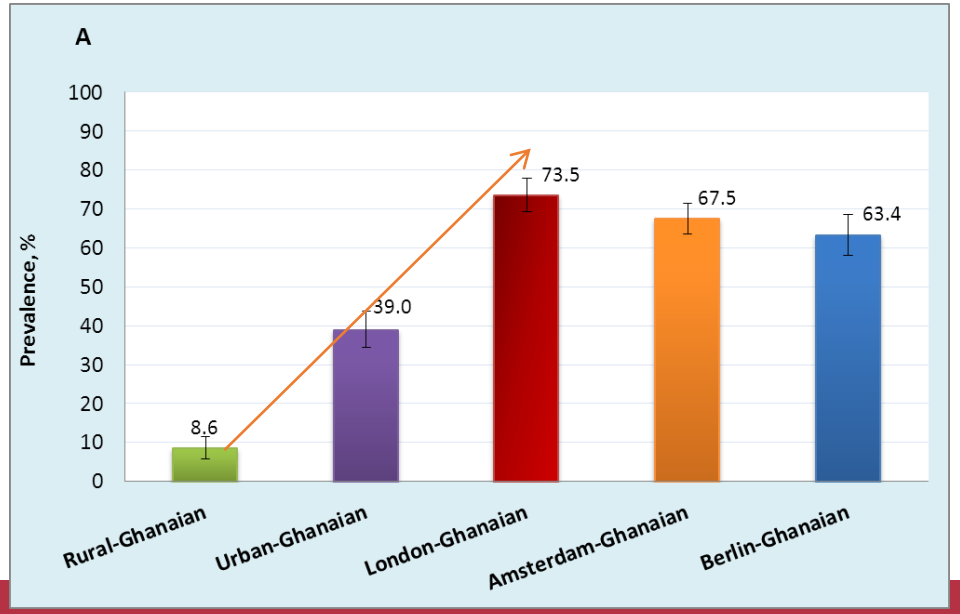
Teams in various sites & shipment of samples to one European location

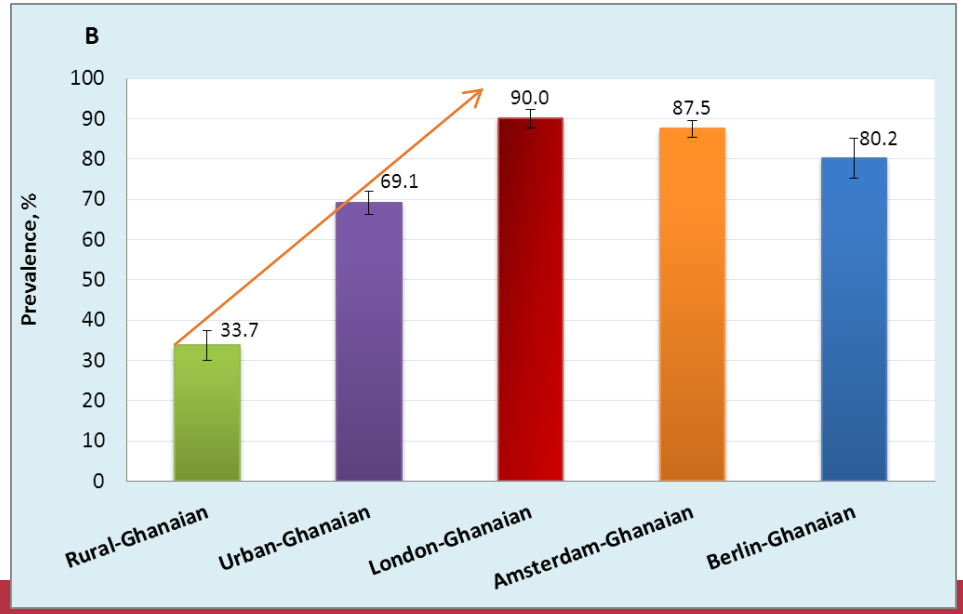
Agyemang et al Ann N Y Acad Sci. 2017 Mar;1391(1):54-70.l

Lessons Learnt

Lesson 1

Migration influences cardiometabolic disease risk & management in African migrants

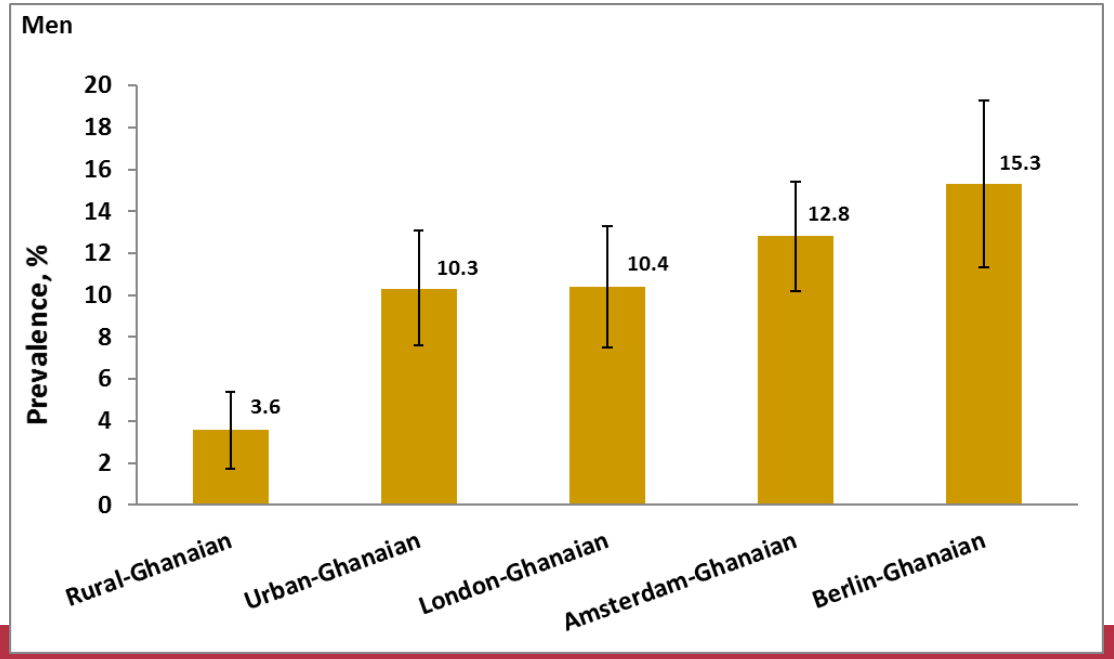


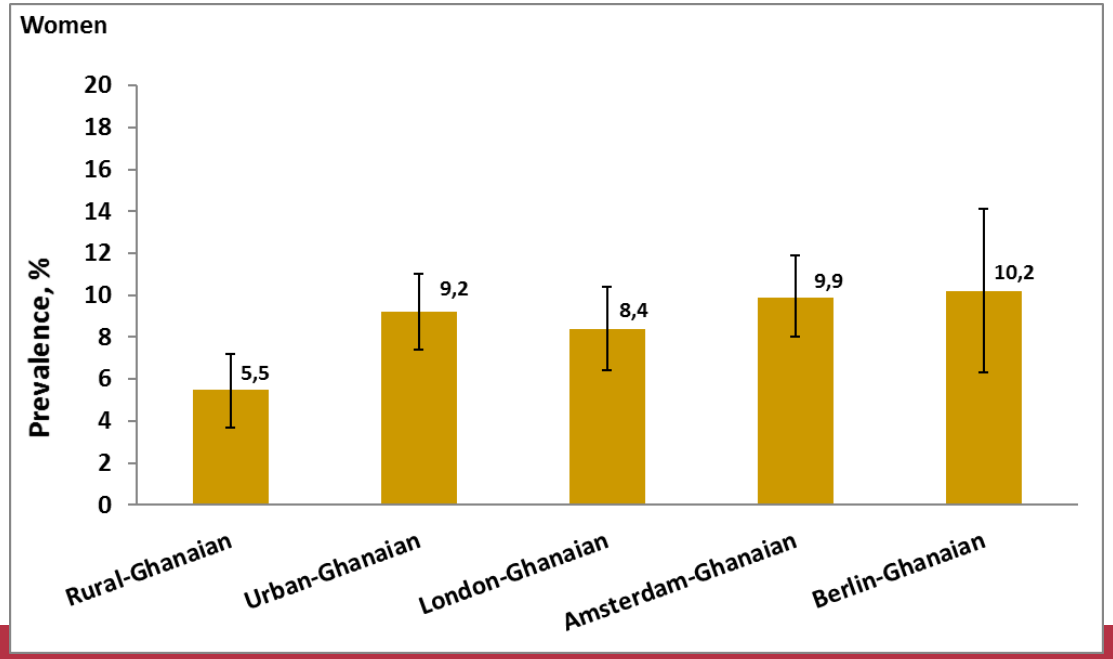


Age-standardised prevalence of overweight (BMI >=25 kg) by locality

RODAM study

Agyemang C et al. BMC Med. 2016 Oct 21;14(1):166.

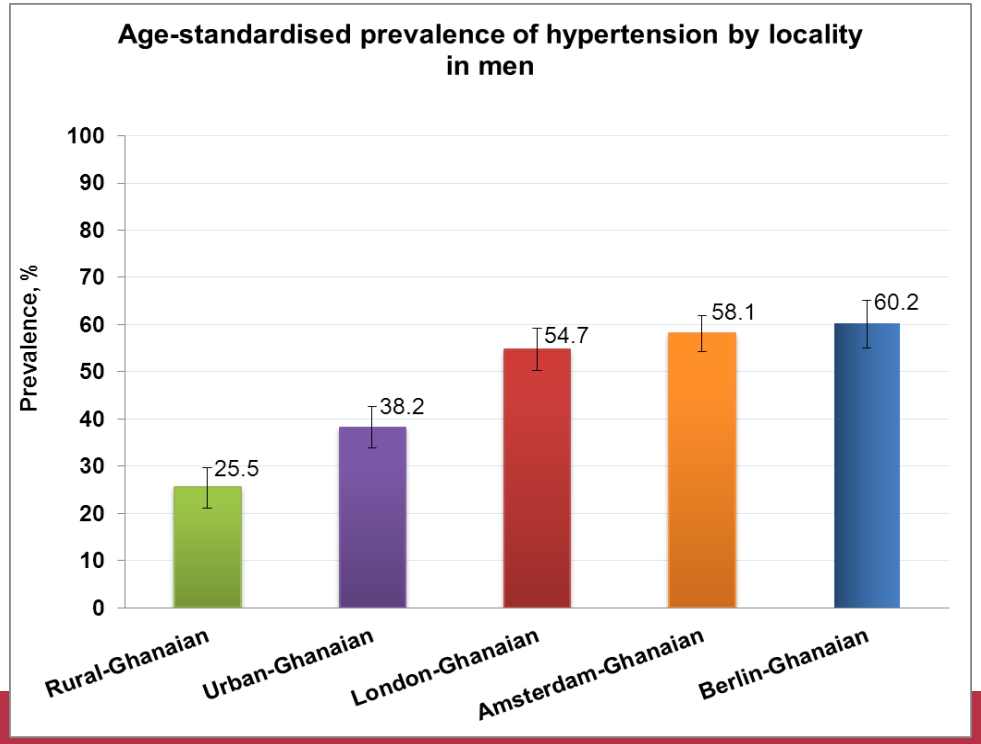


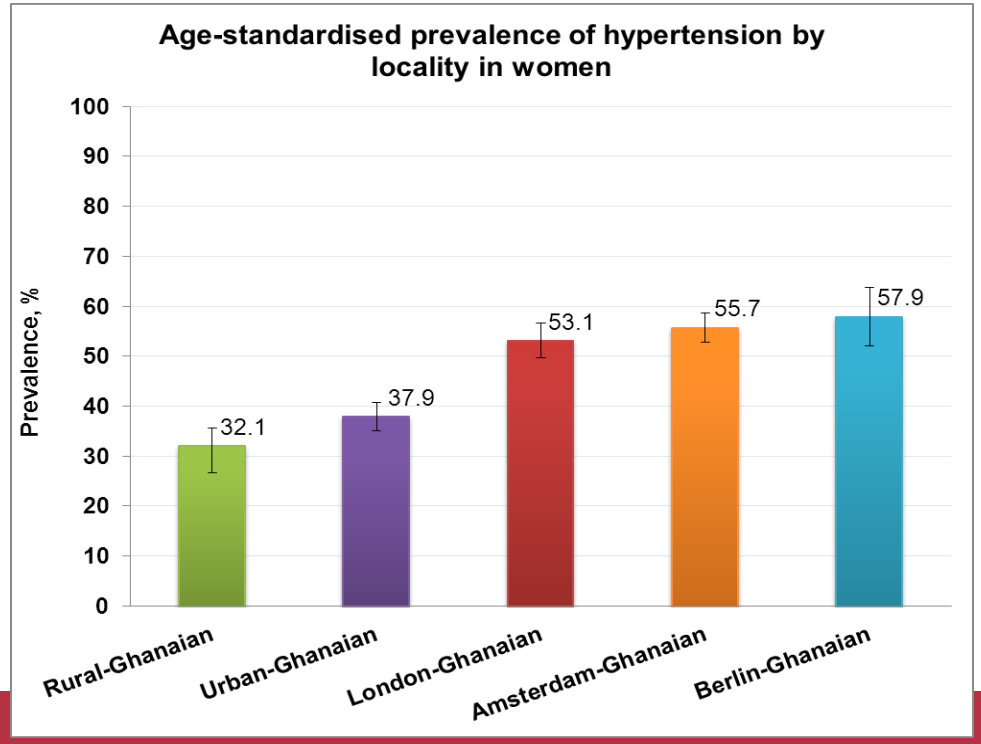


Age-standardised prevalence of diabetes (WHO criteria) by locality

RODAM study

Agyemang C et al. BMC Med. 2016 Oct 21;14(1):166.





Age-standardized hypertension prevalence by locality

RODAM study

Agyemang et al. J Hypertens 2018 Jan;36(1):169-177

Lessons Learnt

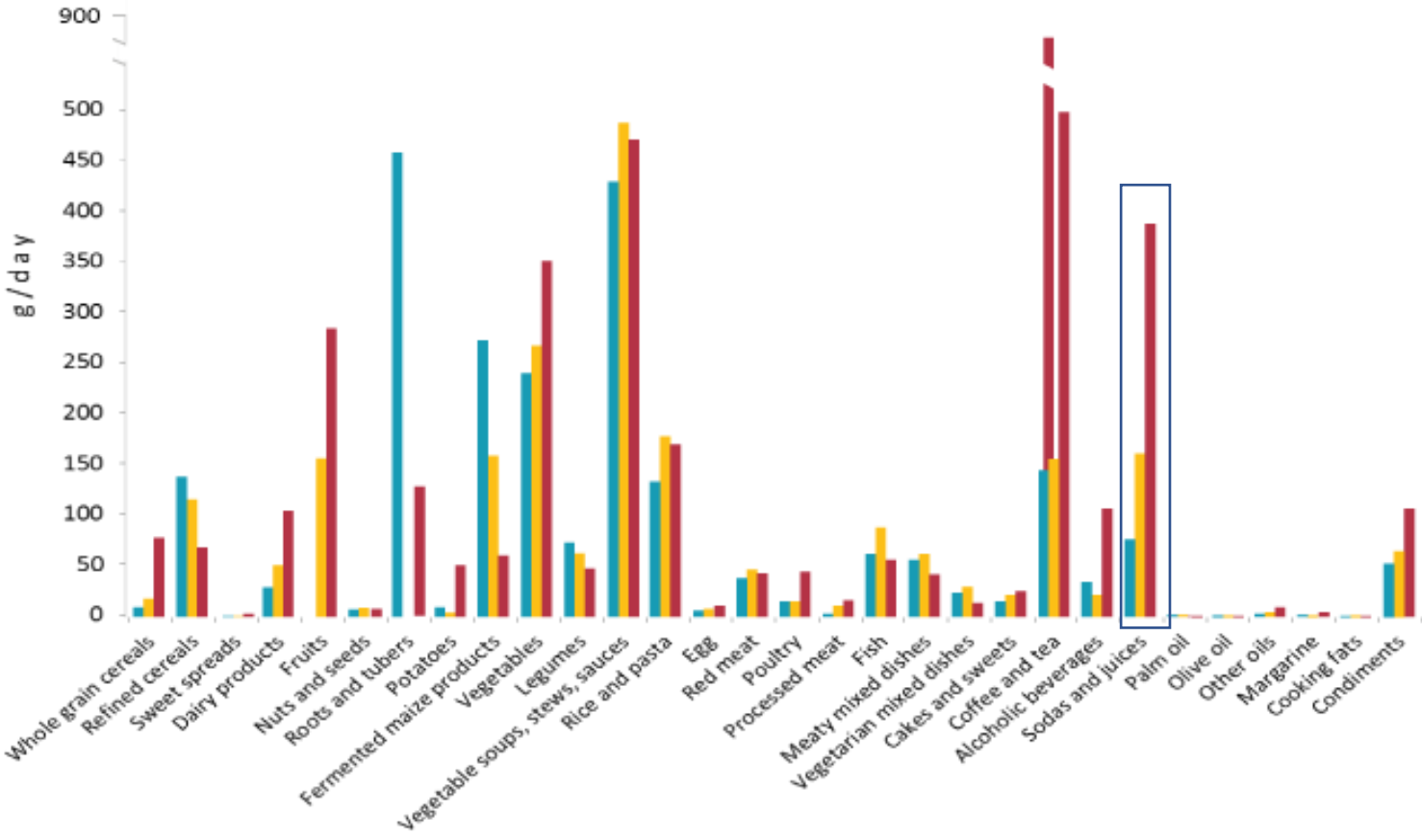
Lesson 2

Dietary behaviour contributes importantly to the different prevalences of cardiometabolic diseases between African migrants & Non-migrant Africans

Mean intakes (g/day) of 30 food groups by site

RODAM study

- Rural Ghana (n=1103)
- Urban Ghana (n=1429)
- Europe (n=2012)



Galbete et al. Food Nutr Res. 2017 Jul 6;61(1):1341809.

The New York Times | HEALTH

Obesity Was Rising as Ghana Embraced Fast Food. Then Came KFC.

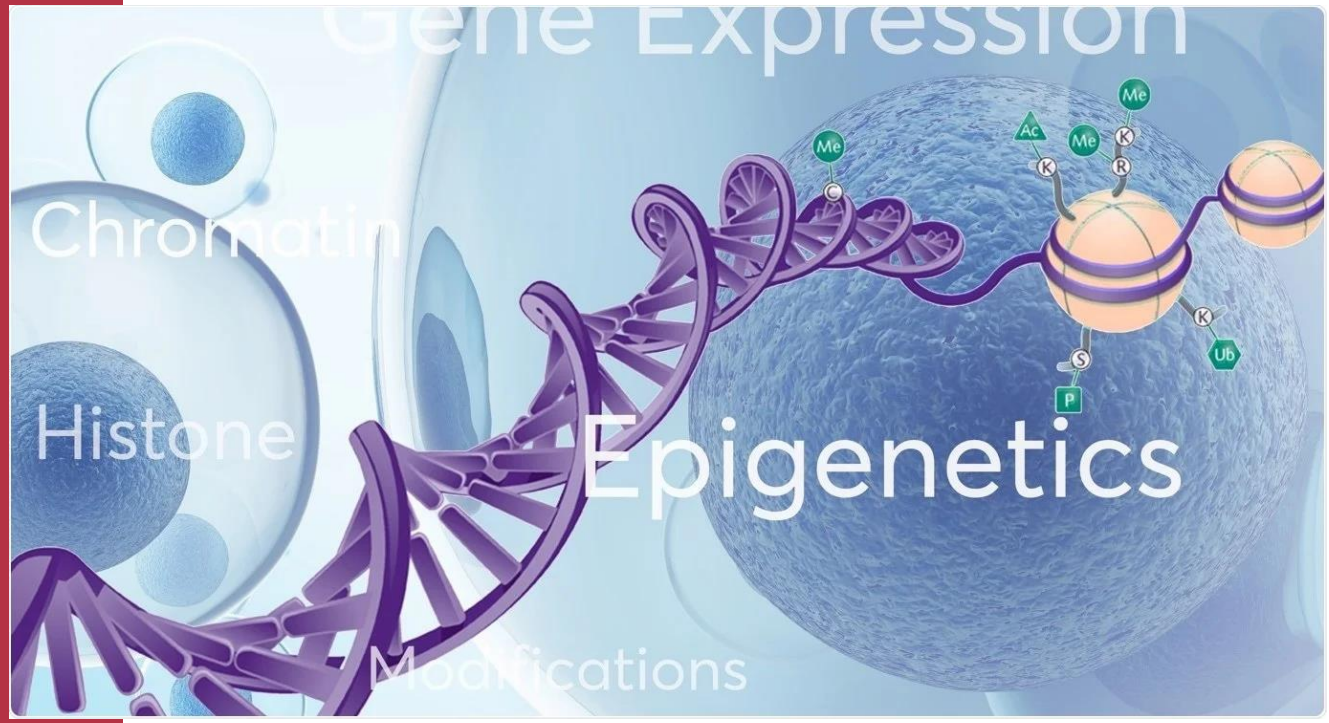
The growing popularity of fried chicken and pizza in parts of Africa underscores how fast food is changing habits and expanding waistlines.

Lessons Learnt

Lessons Learnt

Lesson 3

Epigenetic makers differ between migrants and non-migrants & contribute importantly to the high prevalence of cardio-metabolic disease.



Articles

Epigenetic-age acceleration in the emerging burden of cardiometabolic diseases among migrant and non-migrant African populations: a population-based cross-sectional RODAM substudy

Felix P Chilunga, Peter Henneman, Hannah R Elliott, H Toinét Cronjé, Gagandeep K Walia, Karlijn A C Meeks, Ana Requena-Mendez, Andrea Venema, Silver Bahendeka, Ina Danquah, Adebowale Adeyemo, Kerstin Klipstein-Grobusch, Marlien Pieters, Marcels M A M Mannens, Charles Agyemang

Summary

Background African populations are going through health transitions due to rapid urbanisation and international

Lancet Healthy Longev 2021;

Meeks et al. Clinical Epigenetics (2017) 9:103
DOI 10.1186/s13148-017-0403-x

Clinical Epigenetics

RESEARCH Open Access

An epigenome-wide association study in whole blood of measures of adiposity among Ghanaians: the RODAM study

Karlijn A.C. Meeks[1*], Peter Henneman[2], Andrea Venema[2], Tom Burr[3], Cecilia Galbete[4], Ina Danquah[4,5], Matthias B. Schulze[4], Frank P. Mockenhaupt[6], Ellis Owusu-Dabo[7], Charles N. Rotimi[8], Juliet Addo[9], Liam Smeeth[9], Silver Bahendeka[10], Joachim Spranger[11,12,13], Marcel M.A.M. Mannens[2], Mohammad H. Zafarmand[1], Charles Agyemang[1] and Adebowale Adeyemo[8*]

npj | Genomic Medicine

www.nature.com/npjgenmed

ARTICLE OPEN

Genome-wide DNA methylation analysis on C-reactive protein among Ghanaians suggests molecular links to the emerging risk of cardiovascular diseases

Felix P. Chilunga[1,2], Peter Henneman[2], Andrea Venema[2], Karlijn A. C. Meeks[1,3], Ana Requena-Mèndez[4,5], Erik Beune[1], Frank P. Mockenhaupt[6], Liam Smeeth[7], Silver Bahendeka[8], Ina Danquah[9], Kerstin Klipstein-Grobusch[10,11], Adebowale Adeyemo[3], Marcel M.A.M Mannens[2] and Charles Agyemang[1]

Epigenome-wide association study of plasma lipids in West Africans: the RODAM study

Eva L. van der Linden,[a,b,*] Karlijn A. C. Meeks,[a,c] Felix Chilunga,[a] Charles Hayfron-Benjamin,[d,e] Silver Bahendeka,[f] Kerstin Klipstein-Grobusch,[g,h] Andrea Venema,[i] Bert-Jan van den Born,[a,b] Charles Agyemang,[a] Peter Henneman,[i,j] and Adebowale Adeyemo[d,j]

Research Article

Epigenomics

DNA methylation as the link between migration and the major noncommunicable diseases: the RODAM study

Felix P Chilunga*[,1], Peter Henneman[2], Andrea Venema[2], Karlijn AC Meeks[3], Juan R Gonzalez[4], Carlos Ruiz-Arenas[4], Ana Requena-Méndez[4,5], Erik Beune[1], Joachim Spranger[6], Liam Smeeth[7], Silver Bahendeka[8], Ellis Owusu-Dabo[9], Kerstin Klipstein-Grobusch[10,11], Adebowale Adeyemo[3], Marcel MAM Mannens[2] & Charles Agyemang[1]

van der Linden et al. Clinical Epigenetics (2022) 14:159
https://doi.org/10.1186/s13148-022-01378-5

Clinical Epigenetics

RESEARCH Open Access

An explorative epigenome-wide association study of plasma renin and aldosterone concentration in a Ghanaian population: the RODAM study

Eva L. van der Linden[1,2*], Adrienne Halley[1], Karlijn A. C. Meeks[1,3], Felix Chilunga[1], Charles Hayfron-Benjamin[4,5], Andrea Venema[6], Ingrid M. Garrelds[7], A. H. Jan Danser[7], Bert-Jan van den Born[1,2], Peter Henneman[6†] and Charles Agyemang[1†]

SCIENTIFIC REPORTS
natureresearch

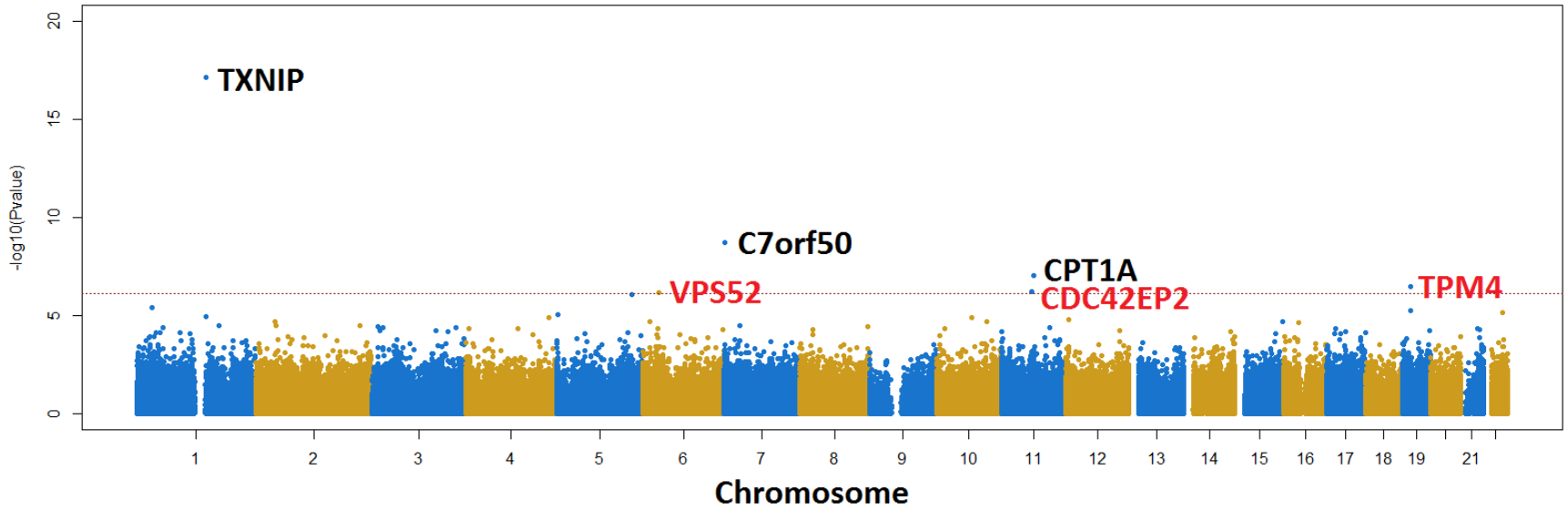
OPEN

Epigenome-wide association study for perceived discrimination among sub-Saharan African migrants in Europe - the RODAM study

Loes C. van der Laan[1,8], Karlijn A. C. Meeks[1,2,8], Felix P. Chilunga[2], Charles Agyemang[1], Andrea Venema[3], Marcel M. A. M. Mannens[3], Mohammad H. Zafarmand[4], Kerstin Klipstein-Grobusch[5,6], Liam Smeeth[7], Adebowale Adeyemo[2] & Peter Henneman[3*]

WCE WORLD CONGRESS OF EPIDEMIOLOGY 2024

SEVENTH FRAMEWORK PROGRAMME



Six Differentially methylated positions explained 25% of variance in Type 2 diabetes

Potential role of epigenetics

Manhattan plot of cosmopolitan (black) and SSA-specific (red) loci associated with T2D in Ghanaians

Meeks et al. Int J Epidemiol. 2018 Aug 10. doi: 10.1093/ije/dyy171

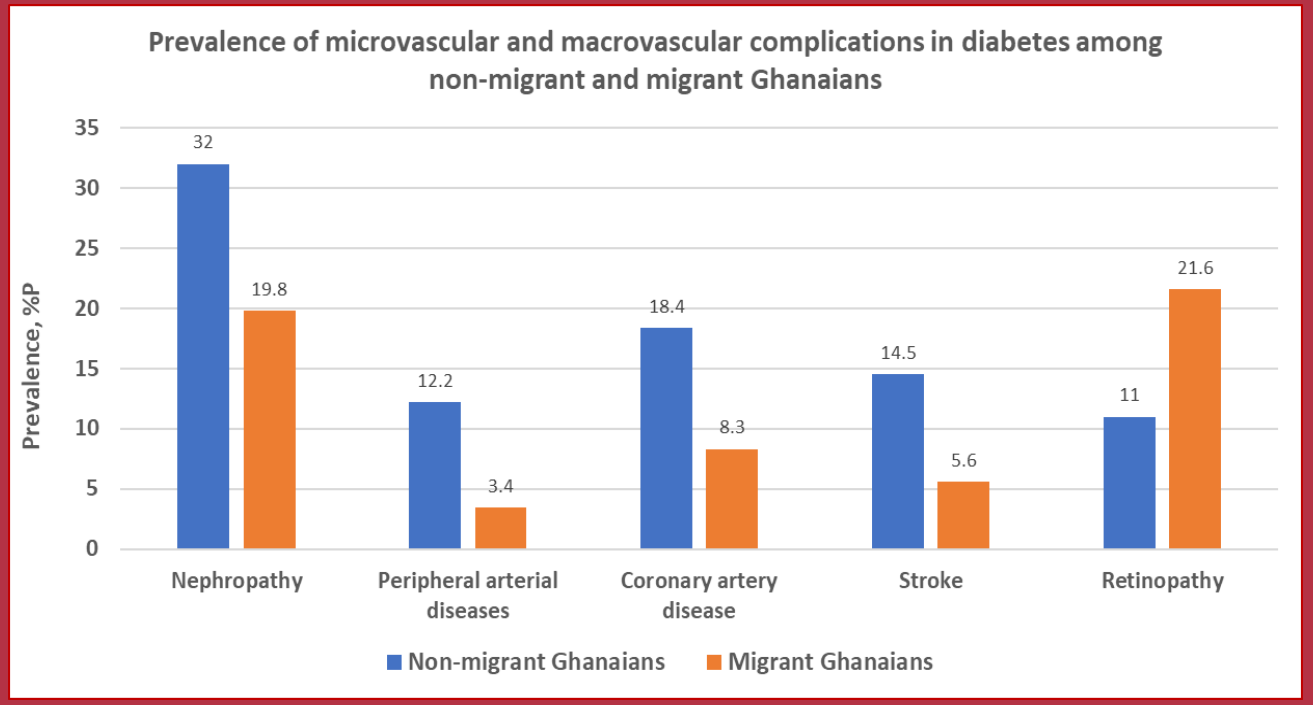
Lessons Learnt

Lesson 4

Migration influences microvascular and macrovascular complications

- Lower rates of cardiometabolic diseases in non-migrants did not translate to lower rates of complications.

Prevalence of microvascular and macrovascular complications in diabetes among non-migrant and migrant Ghanaians



Hayfron-Benjamin CF et al. J Diabetes Complications. 2019;33(8):572-578.

Lessons Learnt

Lesson 5

Opportunities for effective capacity building & interventions in both migrants and non-migrant

- Effective model for capacity building & collaboration between host/migration countries
- Provide opportunity for effective intervention as the results are taken seriously by migrants

Completed PhDs on RODAM study

Dr. Karlijn Meeks
Amsterdam University Medical Centres, University of Amsterdam, Amsterdam, The Netherlands. *PhD Focus: Epidemiology and epigenetics of type 2 diabetes among African migrants in Europe.* Thesis available

Dr. David Adjei
Amsterdam University Medical Centres, University of Amsterdam, Amsterdam, The Netherlands. *Phd focus: Epidemiology of chronic kidney disease among Ghanaians in sub-Saharan Africa and their compatriots in Europe.* Thesis available

Dr. Daniel Boateng
Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht University, The Netherlands. *PhD focus: Cardiovascular disease risk among sub-Saharan African migrant and home populations.* Thesis available

Dr. Eva van der Linden
PhD Focus:
Epidemiology and epigenetics of cardiovascular risk in African migrants. Thesis available

Dr. Gertrude Nsorma Nyaaba
Amsterdam University Medical Centres, University of Amsterdam, Amsterdam, The Netherlands. *PhD focus: Exploring the factors for the poor control of hypertension among people of sub-Saharan African descent.* Thesis available

Dr. Raphael Baffour Awuah
Regional Institute for Population Studies, University of Ghana, Legon, Ghana. *PhD focus: Psychosocial factors and non-communicable diseases among Ghanaians in Ghana and Ghanaian migrants in selected European countries.*

Dr. Ernest Afrifa-Anane
Regional Institute for Population Studies, University of Ghana, Legon, Ghana. *PhD focus: Physical activity and cardiovascular disease risk among rural and urban Ghanaians and Ghanaian migrants in selected European countries.*

Dr. Felix Chilunga
Amsterdam University Medical Centres, University of Amsterdam, Amsterdam, The Netherlands. *PhD focus: Epidemiology and epigenetics of Cardiovascular risk factors.* Thesis available

Dr. Rachel Brathwaite
London School of Hygiene & Tropical Medicine. *PhD focus: Differences in smoking by location of residence, ethnic group and country of origin: The Ghanaian perspective in sub-Saharan Africa and Europe.* Thesis available

Dr. Charles Hayfron-Benjamin
Amsterdam University Medical Centres, University of Amsterdam, Amsterdam, The Netherlands. *PhD focus: Micro- and macrovascular complications of diabetes.* Thesis available

Ongoing PhDs on Pros-RODAM

James Osei-Yeboah
PhD Focus:
Validation and development of Cardiovascular risk prediction models for African populations

Yaw Kusi-Mensah
PhD Focus:
Influence of adipokines on microvascular and macrovascular complications

Muhau Mungamba
PhD focus:
Epigenetics of Chronic Kidney Disease

Emmanuel Bannerman-Benjamin
PhD focus
Micio-Macro-vascular complications

Lambert Appiah
PhD focus
CVD risk prediction

Strong Collaboration between Amsterdam UMC & University of Ghana

Specific objectives are:

1. To promote education and training between the two institutions;
2. To promote scientific research between the two institutions.

AMC-University of Ghana Summer School in Accra | July 2019

YOUR HEALTH IS YOUR WEALTH

Your Health Is Your Wealth program in Amsterdam Southeast

WCE WORLD CONGRESS OF EPIDEMIOLOGY 2024

SEVENTH FRAMEWORK PROGRAMME

RODAM study conference in Ghana

- To describe the nature and extent of unhealthy foods and non-alcoholic beverage promotion on television, in stores, and in and around schools;
- To determine the nutritional quality of foods and non-alcoholic beverages provided or sold in child-serving institutions (mainly primary and secondary schools).
- To assess community stakeholders' readiness to accept, and capacity to implement obesity/NCD prevention interventions.

MEALS4NCDs
Providing Measurement, Evaluation, Accountability & Leadership Support (MEALS) for NCDs Prevention

IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international

Canada

https://www.meals4ncds.org/en/project-overview/

WCE
WORLD CONGRESS OF EPIDEMIOLOGY 2024

GENERATION H

- To reduce unhealthy diets and physical inactivity and their underlying social determinants among adolescents in Ghana & Kenya by designing, deploying, and evaluating the strategies for implementation of evidenced and theory-based interventions mapped on to the WHO Best Buys

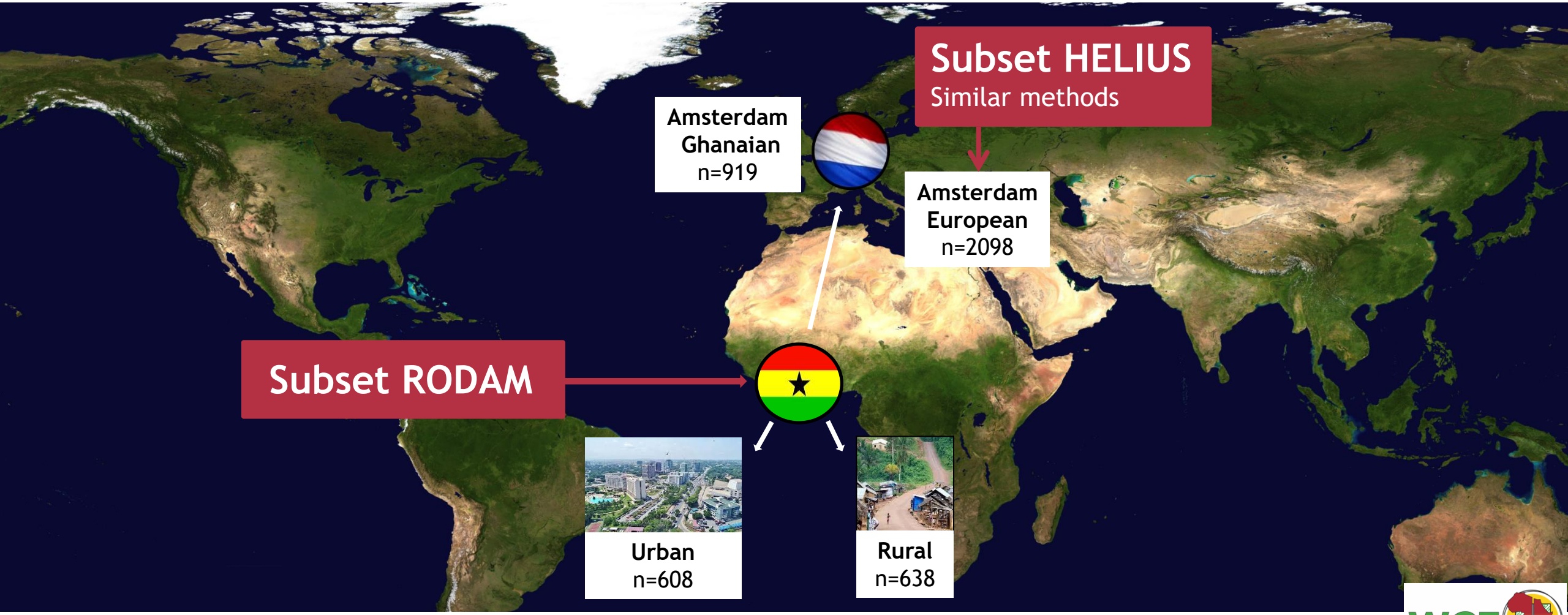
Amsterdam UMC University Medical Centers · Loughborough University · APHRC African Population and Health Research Center · IRD · sciensano · UNIVERSITY OF GHANA · VU Vrije Universiteit Amsterdam

https://www.generationh.org/

WCE WORLD CONGRESS OF EPIDEMIOLOGY 2024

Pros-RODAM

Unique migrant and non-migrant prospective study



Recommended Solutions but long way to go

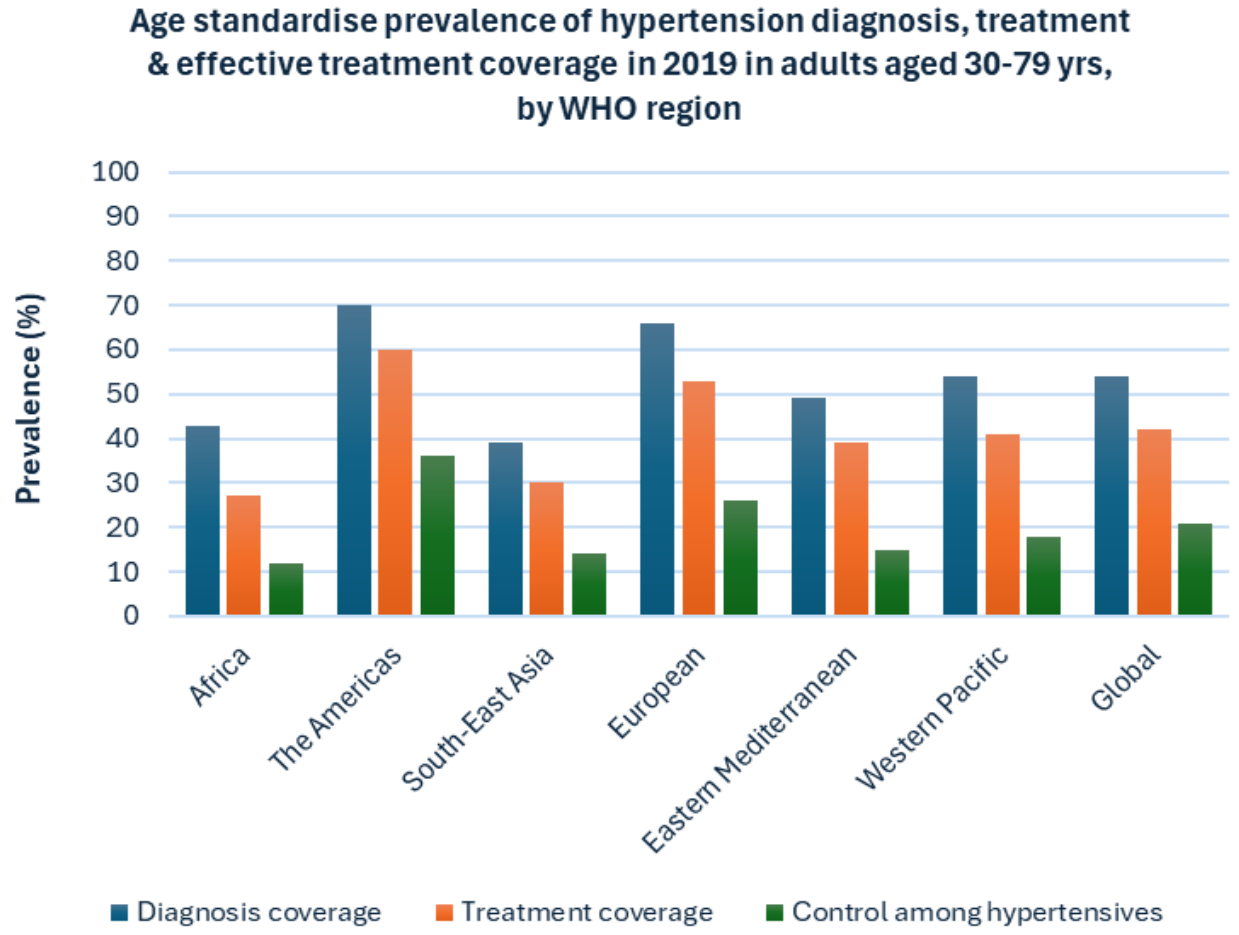
World Health Organization

✓***Best Buys*** *are interventions where a WHO Choice analysis found an average cost-effectiveness ratio of ≤I$100 per DALY averted in LMICs*

Tackling NCDs

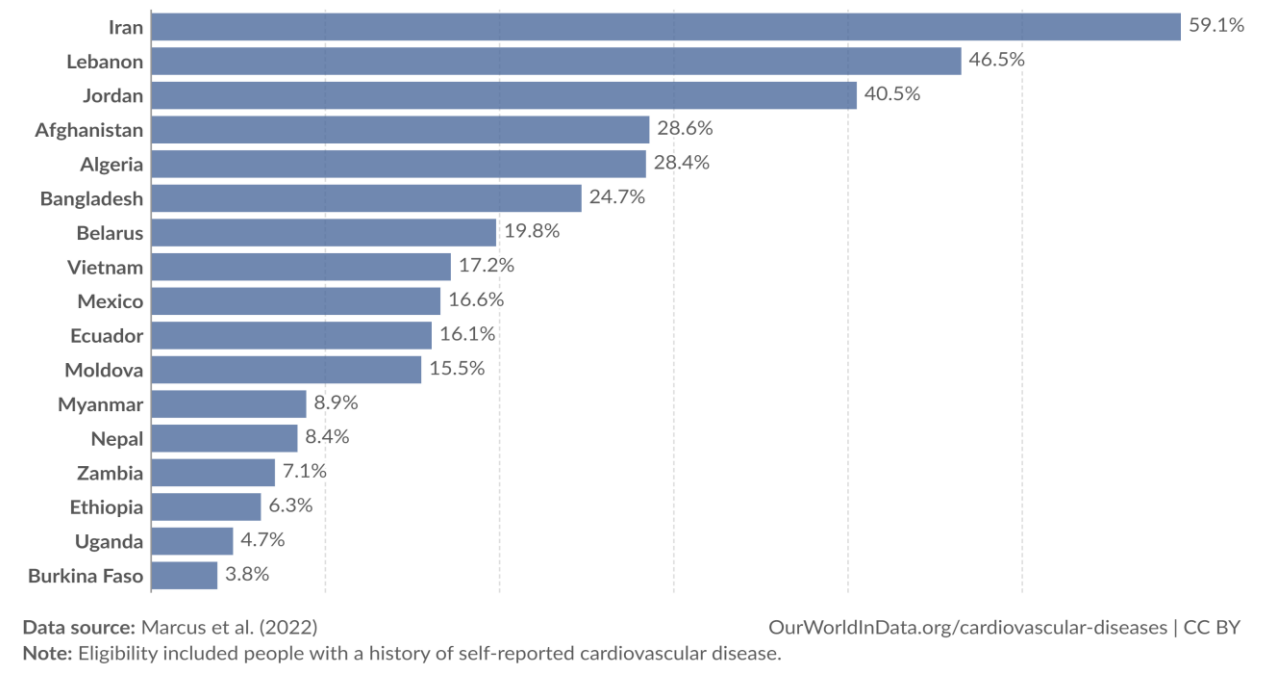
Best buys and other recommended interventions for the prevention and control of noncommunicable diseases

Despite numerous strategies, progress is very slow

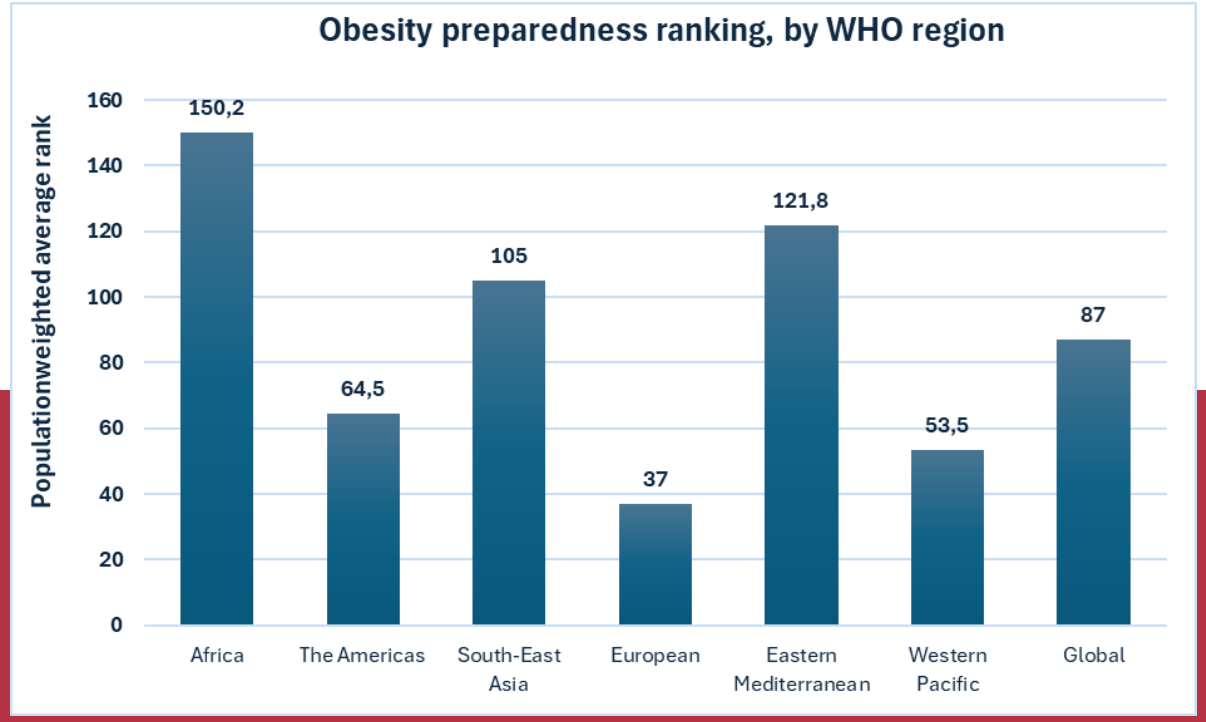


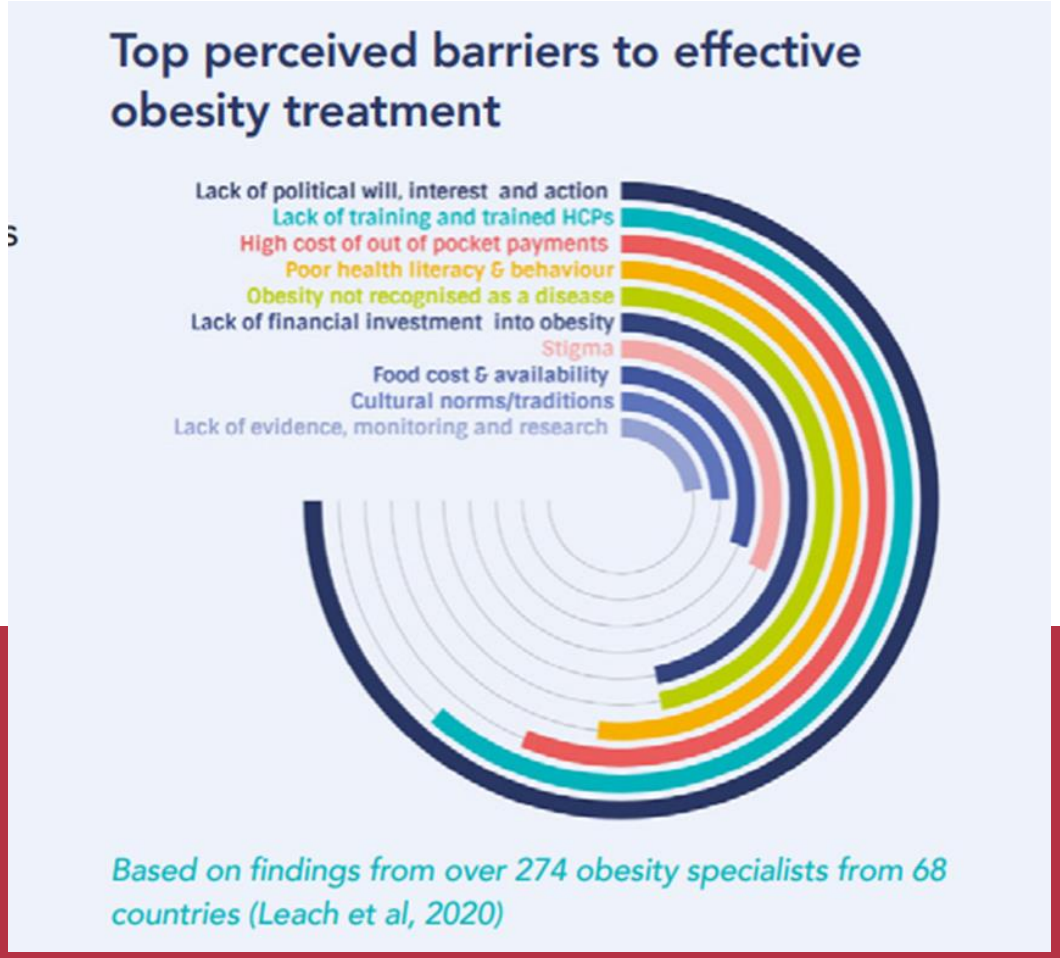
Source: World Health Organization 2023: Global Health Observatory (GHO).

Statin use by people with cardiovascular diseases to prevent complications, 2019 in LMICs



Obesity preparedness: lower score indicates better preparedness





Source: World Obesity Federation, 2022


Set of 9 voluntary global NCD targets for 2025
Premature mortality from NCDs 25% reduction
Harmful use of alcohol 10% reduction
Essential NCD medicines and technologies 80% coverage
Physical inactivity 10% reduction
Drug therapy and counseling 50% coverage
Salt/ sodium intake 30% reduction
Diabetes/ obesity 0% increase
Tobacco use 30% reduction
Raised blood pressure 25% reduction
World Health Organization
Mortality and Morbidity
Risk Factors for NCDs
National Systems Response

Achieving NCDs targets remains a major challenge and tough nut to crack

RESEARCH ARTICLE Open Access

Tracing Africa's progress towards implementing the Non-Communicable Diseases Global action plan 2013–2020: a synthesis of WHO country profile reports

Gertrude Nsorma Nyaaba[1*], Karien Stronks[2], Ama de-Graft Aikins[3], Andre Pascal Kengne[4] and Charles Agyemang[5]

Abstract

Background: Half of the estimated annual 28 million non-communicable diseases (NCDs) deaths in low- and middle-income countries (LMICs) are attributed to weak health systems. Current health policy responses to NCDs are fragmented and vertical particularly in the African region. The World Health Organization (WHO) led NCDs Global action plan 2013–2020 has been recommended for reducing the NCD burden but it is unclear whether Africa is on track in its implementation. This paper synthesizes Africa's progress towards WHO policy recommendations for reducing the NCD burden.

Methods: Data from the WHO 2011, 2014 and 2015 NCD reports were used for this analysis. We synthesized results by targets descriptions in the three reports and included indicators for which we could trace progress in at least two of the three reports.

Results: More than half of the African countries did not achieve the set targets for 2015 and slow progress had been made towards the 2016 targets as of December 2013. Some gains were made in implementing national public awareness programmes on diet and/or physical activity, however limited progress was made on guidelines for management of NCD and drug therapy and counselling. While all regions in Africa show waning trends in fully achieving the NCD indicators in general, the Southern African region appears to have made the least progress while the Northern African region appears to be the most progressive.

Conclusion: Our findings suggest that Africa is off track in achieving the NCDs indicators by the set deadlines. To make sustained public health gains, more effort and commitment is urgently needed from governments, partners and societies to implement these recommendations in a broader strategy. While donors need to suit NCD advocacy with funding, African institutions such as The African Union (AU) and other sub-regional bodies such as West African Health Organization (WAHO) and various country offices could potentially play stronger roles in advocating for more NCD policy efforts in Africa.

What needs to be done given the slow progress in prevention & management

- Inter/national commitment to tackle the problem head-on
- Ensure that commitments are translated into action & track the indicators
    - Enough talking – time to walk the talk
- Adapt and evaluate strategies for implementing the WHO Best Buys taking context into account (Avoid Copy & Paste Syndrome)
- Effective integrated chronic care models for cardiometabolic multimorbidity
- Strengthening partnership seeking synergies & coordination among partners

Conclusion statements

Obesity & Cardiometabolic diseases are a major global burden

Prevention strategies and management of the problem remain suboptimal especially in LMICs

We need (inter)national commitment to address the problem

We need to adapt, evaluate, implement and scale-up the recommended interventions to suit local context

Thanks