Brief Report

Institution-level collaboration in cardiovascular research in sub-Saharan Africa

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Abstract: The contribution of sub-Saharan Africa to scientific knowledge on cardiovascular disease (CVD) prevention and care is very limited compared to other regions of the world. This underlies the challenge of understanding and addressing the high prevalence of risk factors for CVD in sub-Saharan Africa. The patterns of collaboration between institutions in the region in the area of cardiovascular research are not well documented, although there is evidence of significant collaboration in health research between Africa-based researchers and those in countries outside the region. This study focuses on mapping the linkages between institutions in this region using co-authorship of publications in cardiovascular research from 2005 to 2014. The key institutions in sub-Saharan Africa which engaged in collaboration are identified and the potential of these networks for stimulating the growth of research capacity in this field is discussed.

Keywords: Cardiovascular research; collaboration; networks; sub-Saharan Africa

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Introduction

The growing prevalence of cardiovascular diseases (CVDs) in sub-Saharan Africa is well documented (1). Many countries in the region have made commitments to develop and implement national action plans for control of non-communicable diseases (2). The objectives of the proposed action plans include supporting national capacity for high quality research for the prevention of non-communicable diseases and strengthening South-South collaborative partnerships. At present, not much is known about the patterns of collaboration in cardiovascular research in sub-Saharan Africa.

The volume of studies on research collaboration has grown significantly in the last 20 years. The availability of online bibliographic databases such as PubMed, Scopus and Web of Science has facilitated the use of publication data for analysis of research collaboration at national and international levels (3). One frequently used approach for studying research collaboration involves co-authorship networks (3,4). Co-authorship networks are a class of social networks which illustrate collaboration based on presence as co-authors in a research publication. Publication data can be used to visualize collaboration between authors (micro-level), institutions (meso-level) and countries (macro-level) (3).

In this study, co-authorship data are used to visualize the connectedness of institutions in sub-Saharan Africa working in cardiovascular research over the last decade and to identify institutions in the region that serve as collaboration hubs in this field. An understanding of these networks is useful for identifying institutions and research centres around which sub-regional capacity strengthening in cardiovascular research can be effected.

Methods

Bibliographic data were obtained from the Thompson Reuters Web of Science for the period 2005 to 2014. The Web of Science comprises multiple databases: Science Citation Index Expanded (SCI-EXPANDED), Conference Proceedings Citation Index-Science (CPCI-S), Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH) and Arts & Humanities Citation Index

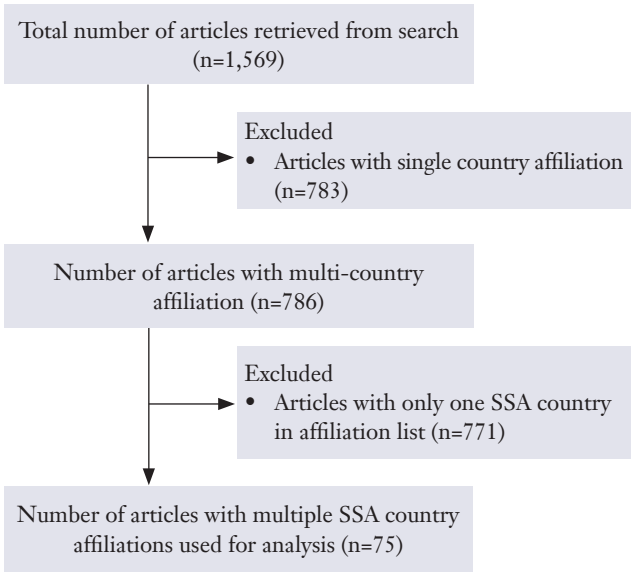


Figure 1 Steps in the derivation of the final list of publications for inclusion in the analysis. SSA, sub-Saharan Africa.

Figure 2 Visualization of country-level collaborations in cardiovascular research in sub-Saharan Africa [2005-2014].

(A&HCI). It was selected as the source of bibliographic data for this study due to the availability of individual authors' institutional affiliation and country over the period of analysis.

The procedure to extract cardiovascular research publications from the Web of Science database involved the use of an advanced search strategy that combined the cardiovascular descriptors with the names of 47 countries in sub-Saharan Africa (5). The searches were conducted within the Title, Abstract, Keyword and Address fields. The search strategy based on cardiovascular keywords was adapted from the method used by Bolaños-Pizarro *et al.* (6): (Arrhythm* OR Cardio* OR Cardia* OR Coronar* OR Echocard* OR Kardi* OR Myocard* OR ventric* OR angina) NOT (Chrysanthe*coronar* OR Intestin* angin* OR Velo cardi* faci* OR gastri* cardi* OR Cardiocond* bate* OR Hedysar* coronar*).

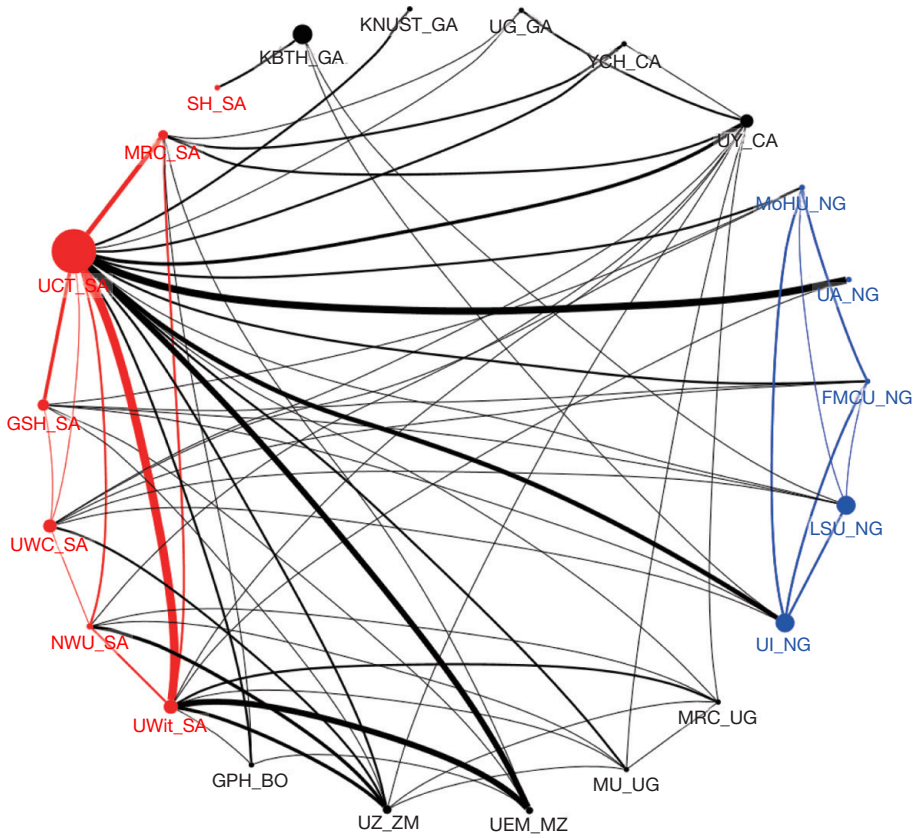
The search yielded 1,569 articles for the period under consideration. *Figure 1* shows the steps in the derivation of the final dataset used for network analysis. Preprocessing of the data was undertaken to obtain a dataset in which all publications had more than one author located in sub-Saharan Africa. Institution-level analysis was conducted by stripping each affiliation of all other details except the institution and performing cleaning operations to eliminate variations of the institution name. Duplicates of institutions within the same publication record were also eliminated. After preprocessing, a total of 75 cardiovascular research publications were obtained that had more than one country affiliation within sub-Saharan Africa.

Adjacency matrices for both the country and institution level data sets were created and the networks visualized using Node-XL, an open source network analysis software (7). The visualization of the collaboration between sub-Saharan African countries was created using the Harel-Koren algorithm and the institution-level network was created using the Circle Layout algorithm.

Results

The country-level network in cardiovascular research in sub-Saharan Africa is shown in *Figure 2*. A total of 34 countries in the region had at least one instance of co-authorship with another sub-Saharan African country. The strongest connection occurred between South Africa and Nigeria, as seen by the width of the line. There were 15 co-authored publications by the two countries over the 10-year period, the highest in the region. Cameroon had the highest number of countries with which it collaborated in the region, indicating a role as a boundary spanner linking the Francophone and Anglophone countries in the region.

Figure 3 shows the patterns of institution-level collaborations in the field in sub-Saharan Africa. The



Code	Institution	Code	Institution
UCT_SA	Univ Cape Town, South Africa	MU_UG	Makerere Univ, Uganda
UWit_SA	Univ Witwatersrand, South Africa	MRC_UG	MRC UVRI, Uganda
MRC_SA	MRC, South Africa	UY_CA	Univ Yaounde, Cameroon
GSH_SA	Groote Schuur Hosp, South Africa	CF_CA	Clin Fleurs, Cameroon
UWC_SA	Univ Western Cape, South Africa	YCH_CA	Yaounde Cent Hosp, Cameroon
SH_SA	Sunninghill Hosp, South Africa	UG_GA	Univ Ghana, Ghana
NWU_SA	North West Univ, South Africa	KBTH_GA	Korle Bu Teaching Hosp, Ghana
UI_NG	Univ Ibadan, Nigeria	KNUST_GA	Kwame Nkrumah Univ Sci & Technol, Ghana
UA_NG	Univ Abuja, Nigeria	UEM_MZ	Univ Eduardo Mondlane, Mozambique
LSU_NG	Lagos State Univ, Nigeria	GPH_BO	Gaborone Private Hosp, Botswana
MoHU_NG	Minist Hlth, Umuahia, Nigeria	UZ-ZM	Univ Zimbabwe, Zimbabwe
FMCU_NG	Fed Med Ctr, Umuahia, Nigeria	KUC_DRC	Kinshasa Univ Clin, D R Congo

Figure 3 Institution-level collaboration in cardiovascular research in sub-Saharan Africa from 2005 to 2014. The section highlighted in red shows collaboration between institutions in South Africa and that in blue shows collaboration between institutions in Nigeria. The size of the node shows the number of collaborations that institution was involved in and the thickness of the connection reflects the frequency of collaboration by a pair of institutions. The abbreviations are defined in the table.

network graph shows only the institutions that had more than one instance of collaboration with another institution in the region. The most prominent institution in this field is University of Cape Town in South Africa which had collaborations with 45 other institutions in sub-Saharan Africa. University of Cape Town also had significant collaboration in this field with University of Abuja and University of Ibadan in Nigeria. Another institution that had significant cardiovascular research collaboration in the region is the Eduardo Mondlane University in Mozambique. The Eduardo Mondlane University had co-authored publications most frequently with University of Cape Town and University of Witwatersrand in South Africa. In Cameroon, the University of Yaoundé had 26 collaborations with other institutions in sub-Saharan Africa, the most diverse of any institution outside South Africa.

A comparison of the extent of collaboration in cardiovascular research based on the principal language of communication in the country revealed higher average degree centrality (8.8 *vs.* 5.3) and average betweenness centrality (36.7 *vs.* 3.2) values in Anglophone countries compared to Francophone countries. This reflects a higher level of international collaboration and stronger links between sub-groups of institutions in this field in Anglophone countries than in Francophone countries. Of the 120 institutions identified in the final dataset, 60 institutions were located in Anglophone countries and 56 in Francophone countries.

Discussion

This study analyses the patterns of collaboration between institutions in cardiovascular research using co-authorship in scientific journals as an indicator. As the calls for greater focus on CVD prevention and care in the sub-Saharan Africa increase, there is urgent need to address the slow growth of research capacity in this field (8). The results of this study show that the patterns of country-level collaboration in the field were similar to those previously reported for international scientific collaboration in the region (9,10). South Africa and Nigeria were the most productive countries in terms of scientific output in sub-Saharan Africa, and also led in terms of research collaboration. The larger economies of both countries and the number of institutions involved in scientific research may partly explain this pattern (11).

To address the question regarding where within the countries in sub-Saharan Africa cardiovascular research was conducted and which institutions in the region were collaborating, this study analyzed and visualized institution-level networks. The results show that the Hatter Institute for Cardiovascular Research in Africa in University of Cape Town and the Chris Baragwanath Hospital affiliated with University of Witwatersrand in South Africa are the leading hubs for cardiovascular research collaboration in sub-Saharan Africa. These institutions have the resources and expertise required to support high quality research on CVD. Through a number of multi-country studies funded both internally and externally, other countries in sub-Saharan Africa have benefitted from the partnerships with these universities. The funding provided for field studies in multiple countries offers opportunities for supporting graduate trainees at these remote institutions. An example of significant collaboration in this field involves the Eduardo Mondlane University in Mozambique which collaborated frequently with University of Cape Town and University of Witwatersrand in South Africa despite the difference in the languages used in the two countries. Nigeria presents an interesting case with respect to collaboration in cardiovascular research. A total of 15 institutions in Nigeria had at least one instance of collaboration with another sub-Saharan African institution compared with 16 institutions in South Africa. However, the level of collaboration between Nigerian institutions and others in sub-Saharan Africa remains much lower than that seen in South Africa.

The higher levels of collaboration by institutions in Anglophone countries compared to those in Francophone countries may be partly due to the dominance of institutions in South Africa and Nigeria. Although, institutions in Ghana (University of Ghana), Zimbabwe (University of Zimbabwe), Uganda (MRC Uganda Virus Research Institute) and Gambia (Royal Victoria Teaching Hospital) also had substantially high collaboration in the region. The two main hubs of cardiovascular research collaboration among the Francophone countries were University of Yaoundé (Cameroon) and Institut de cardiologie d'Abidjan (Cote d'Ivoire).

In conclusion, this study identifies the key institutions involved in collaboration in cardiovascular research in sub-Saharan Africa between 2005 and 2014. The importance of collaboration and research partnerships between institutions in this region needs to be emphasised given the urgency of addressing the growing prevalence of CVD. The weak economies in sub-Saharan Africa have limited resources to support research on numerous health priorities and

can benefit enormously from close partnerships between the researchers in the region with similar interests. There have been calls for the Pan-African Society of Cardiology (PASCAR) to facilitate networking and resource mobilization across the continent and provide leadership in CVD research and training (12). Cross-border support for local research on CVD prevention and care in sub-Saharan Africa is critical if the expectations as stated in national non-communicable disease action plans are to be realized.

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None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

Disclaimer: This article was prepared by the author in his personal capacity. The opinions expressed in this article are the author's own and do not reflect the views of Alberta Innovates-Health Solutions.

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