IMPROVING RESEARCH PRODUCTION AND USE IN CAMEROON

IMPROVING NATIONAL HEALTH RESEARCH SYSTEMS PERFORMANCE: THE CASE OF RESEARCH PRODUCTION AND USE IN CAMEROON

By CLEMENCE ONGOLO- ZOGO, B.H.Sc

A Thesis Submitted to the School of Graduate Studies in Partial Fulfilment of the Requirements for the Degree Master of Science

MASTER OF SCIENCE (2020) McMaster University

Health Research Methodology Hamilton, Ontario

Title: Improving National Health Research Systems Performance: The Case of Research Production and se in Cameroon

Author: Clémence Ongolo-Zogo, BHSc. (McMaster University)

Supervisor: Dr. Lawrence. Mbuagbaw MD MPH PHD

Number of Pages: x, 44

Lay Abstract

National health research systems answer questions about individuals' health and the health care system they use. To do this, it is important to determine what we already know, which questions have not been answered and where resources should be directed in the future. Cameroon's health research system needs to improve its research production capacity. It needs to produce answers which can be used to improve the health of Cameroonians and the decisions which are made about their health care system. As a first step towards achieving these goals, we created a database of health research from Cameroon. We used the database to create maps of what we know and don't know about health topics such as adolescents' use of contraception. We also made recommendations for future research in this field. The database will be useful for researchers, students, health professionals, funders and stakeholders involved with health research in Cameroon

Abstract

Background: Efficient national health research systems (NHRS) generate knowledge to improve health outcomes while accounting for local health system specificities. African NHRS have a limited capacity to generate such knowledge; and rely on global or external sources of evidence which require adaptation. However, systematic, timely and comprehensive identification of local evidence needed for adaptation is challenging. Thus, the objectives of this study are to develop a centralized database of health research from Cameroon and test its applicability for informing future research production and use.

Methods: We used an evidence mapping design. From October 2018 to May 2019, we searched 10 electronic databases and hand searched the archives of non-indexed African and Cameroonian journals. We screened titles, abstracts, and full texts based on these criteria: peer reviewed journal articles; published between 1999 and 2019; in English or French; investigating health-related outcomes in Cameroon. We extracted relevant study characteristics using a pre-established guide. We developed a coding scheme to label studies and ease searches on the database. Studies were coded independently by two reviewers and discrepancies resolved by consensus. We used the database to create evidence maps and identify knowledge gaps on sexual and reproductive health (SRH) priorities.

Results: We included 4384 studies. Most were open access (76.3%); published in English (79.7%); conducted in the Centre region (45%) with an observational design (71.6%). The domains with the highest frequency were medical specialties (89.0%), and diseases (80.4%). The most researched specialty, diseases and population were infectiology, infectious diseases, and children respectively. Our gap maps revealed: (1) geographic and demographic disparities in the local evidence on adolescents' contraceptive use (2) gaps in the type of local evidence needed for contextualisation and policymaking on obstetric fistula.

Conclusion: Local evidence mapping and gap analysis can contribute to improving national research production and use in decision-making.

Acknowledgements

I dedicate this work to my family and loved ones, particularly to those gone before they could see the fruits of our labour. Thanks for your prayers, support and staying up late with me while I worked on this thesis.

I would also like to thank my mentor who believed in this project and in me (even when I didn't).

Finally, none of this would have been possible without my fellow students, colleagues and Cameroon-enthusiasts. Thanks for your contributions to this project.

Table of Contents

List of Figures and Tables

List of Abbreviations and Symbols

CAMHRED: Cameroon Health Research and Evidence Database
GEM: Global Evidence Mapping
KT: Knowledge translation
NHRS: National Health Research Systems
PRISMA: Preferred Reporting Items for Systematic Reviews
RCT: Randomized controlled trials
SRH: Sexual and Reproductive Health
SUPPORT: Supporting Policy Relevant Reviews and Trials
SURE: Supporting the Use of Research Evidence
WHO: World Health Organisation
WHO AFRO: World Health Organisation African Region.

Declaration of Academic Achievement

I, Clémence Ongolo-Zogo, declare this thesis to be my own work. I am the sole author of this document. No part of this work has been published or submitted for publication or for a higher degree at another institution.

The following individuals contributed to screening and data extraction for this thesis : Dr. Frederick Morfaw; Dr. Joseline Zafack; Dr. Pascal Djiadeu; Dr. Paul Wanka; Ms Agatha Nyambi; Ms Andrea Darzi; Ms Andrea Youta; Ms Babalwa Zani; Mr. Hussein El-Khechen; Ms Jassimar Kochhar; Ms Neema Francis; Ms Rosain Stennett; Ms Sehely Rahman and Mr Tejan Baldeh.

To the best of my knowledge, the content of this document does not infringe on anyone’s copyright.

Chapter 1: Introduction

Health systems are different across the world. Therefore, each health system needs a national health research system (NHRS) which can account for its specific challenges.[1] Each NHRS consists of the "people, institutions and activities whose primary purpose is to generate and promote the utilisation of high-quality scientific knowledge to promote, restore, and/or maintain the health of populations"[2] (pg. 816). They achieve this purpose through four main functions: stewardship; financing; creating and sustaining resources; producing and using research.[2]

Research generated within NHRS serves various functions.[2,3] For example, epidemiological research elucidates the risks and burden of disease within populations.[4] Meanwhile, biomedical and clinical research are used to develop and evaluate new preventive or curative drugs, interventions and technologies.[4,5] On the other hand, health systems and policy research addresses questions related to the health system as a whole rather than specific diseases and populations.[6] It is concerned with improving how health care and services are organized, financed and delivered.[6] In an efficient NHRS, the knowledge created through the production of all these research types is used to improve health outcomes and health system performance.[2,7,8]

Low research productivity in some countries curtails the efficiency of their NHRS and health system strengthening efforts.[9,10] Crude measures of productivity include the number of publications from researchers affiliated with a given country.[11] According to these measures, sub-Saharan African countries in particular are lagging behind.[11,12] Some factors contributing to the situation include the absence of national health research strategies, insufficient financial investments and technical capacity for health research.[9,11,12] Collaboration between international and local researchers creates opportunities to address research gaps.[12] Such collaborations often involve authors from high-income countries and may offer local researchers better access to research funding and expertise.[12,13] Unfortunately, local researchers can also be excluded from such research opportunities.[12] This becomes problematic given that their access to scientific publications may already be limited. Without access to research findings, local researchers risk duplicating research efforts, and not addressing questions for which current literature is insufficient.

Research gaps also affect decisionmakers' ability to implement health system or policy reforms. In this case, the gaps might be related primarily to the type of research (study design) produced by the NHRS. Different study designs and types of evidence are needed to clarify a problem; to support decisions about the adoption of interventions or policy options and to address how these options should be implemented. While single observational studies might help clarify problems at a national level, they might not be the best evidence available to support intervention or policy choices and their implementation. Instead, randomized controlled trials, systematic reviews of effects, guidelines and cost-effectiveness evaluations are preferable.

African NHRS face challenges in producing the types of research mentioned above and often rely on external or global sources of evidence to fill this gap.[14–16] For example, global health systems guidance and other recommendations from the World Health Organisation (WHO) are used to support decisionmakers' choices during national policy development. However, this guidance is often non-specific (intended for certain regions, or income settings) and requires adaptation to a specific setting or national context to ensure proper implementation.[15,16] The information needed to tailor and adapt these recommendations can only be generated within a functional NHRS.[17] Therefore, interventions which target national capacity to produce and use research cannot be carried out in a vacuum. They need to be accompanied by initiatives targeting the other functions of the NHRS. The impact of these interventions on health system performance also need to be monitored over time. In that way progress can be assessed and comparisons with countries facing similar challenges can help develop applicable recommendations.

1.1 Evaluating national health research systems: The Case of Cameroon

The necessity to improve national health research capacity to strengthen the health systems of countries in the WHO African region; led to the Algiers Declaration and the Bamako Call to Action on research for health. [18,19] Subsequently, initiatives were established to set common objectives within the region and evaluate national efforts to achieve them. These included the regional committee's research for health ten-year strategies and the NHRS barometer respectively.[1,19] The NHRS barometer is used to evaluate research activities in African countries as a measure of health system performance.[1,9] Routine data collection from individual countries has allowed for trends in NHRS performance to be monitored across the four function domains.[1,9,17] These domains and their subfunctions are presented in Table 1.[1]

During the first evaluation conducted in 2014, the Cameroonian NHRS scored low on all domains with a total barometer score of 36%.[9] However, the latest evaluations from 2018 show a drastic improvement to 85%.[17] A number of factors have contributed to Cameroon's improved health research system performance. Back in 2008, before the establishment of a national health research strategy, the portion of national health budget allocated to health research was 0.7%.[20] Today, this portion has increased and reached the 2% recommendation established by the Commission on Health Research for Development.[17] Only two countries in the whole WHO AFRO region have achieved this goal.[17] Previous health-system analyses had attributed low budget allocations to low commitment to health research at the highest levels of leadership in Cameroon.[21] Perhaps these trends are reversing, which might indicate an opportunity to introduce more interventions targeting the NHRS

Table 1: National Health Research Systems Barometer (Function domains and sub-functions) [1]

A. **Governance or Stewardship of Research for Health**	B. **Developing and Sustaining Resources for Health**
1. National policy on research for health 2. Strategic plan on research for health 3. Law governing research 4. National research for health priority list 5. National ethics review committee 6. National health research focal point	7. University colleges of health sciences conducting research 8. National health research institutes or council 9. Health research programme at Ministry of Health 10. Number of researchers in a research for health programme 11. Non-governmental organisations conducting research for health
C. **Producing and Using Research**	D. **Financing Research for Health**
12. Research for health programme action plan 13. Existence of knowledge translation platform 14. Existence of health research management forum 15. Research for health peer reviewed publications per 100,000 population	16. Existence of a budget line in the health budget for research for health 17. Progress towards the target of allocating 2% of national health budget on research for health

In fact, the 2016 – 2027 health sector strategy policy document places an emphasis on building research capacity and ensuring the sustainability of existing research programmes and KT platforms.[22] This commitment is reflected in the number of universities in which health research is conducted and the increase in the availability of technical research staff in research units.[17,21] The creation of highly specialized research units and interdisciplinary knowledge to action platforms also contributed to better NHRS performance in the latest evaluation. Examples include the Centre for Applied Research, Endoscopic Surgery and Human Reproduction (2015)[21] and the SRH platform of the Family Health Unit at the Ministry of Public Health (2018)[23].

Finally, the improved climate for evidence-informed decision making,[24] facilitated by KT platforms like The Centre for the Development of Best Practices in Health (www.cdbph.org) helped strengthen the NHRS. The platform has served as a bridge between researchers and policy makers in Cameroon since 2008.[25] It has supported the use of evidence to inform policy decisions on scaling up access to artemisinin combination therapy (ACT); maintaining health care personnel in remote areas; optimizing the use of antenatal care services, and improving the quality of care in emergency departments.[21,26,27] Additionally, it provides training workshops on

knowledge translation, systematic reviews and randomized controlled trial methodologies.[26,28–30] The target audience for these training activities include policy makers, health professionals, researchers and civil society organisations.[26,28–30]

Despite the progress observed, some aspects of the NHRS are still wanting. For example, concerns remain about the coordination and efficiency of operational research[21]; access to the findings from studies conducted by local and international researchers; [31] and the overreliance on donors to mobilize research resources.[17]

1.2 Rationale

When national production and use of research for health is inadequate, global evidence and recommendations often help fill the gaps. For example, health systems guidance from the WHO can support national policy development and health system strengthening initiatives.[15,16] Likewise, clinical guidelines developed elsewhere can be adopted in settings where de novo development would be expensive and time consuming.[14,32] In both cases, there is evidence suggesting that contextualisation or adaptation might be needed to implement these recommendations. [14–17,32,33]

The availability of local evidence is one of the requirements for successful contextualisation or adaptation.[15] Local evidence is needed to clarify problems; assess intervention options; examine implementation considerations and monitor the effects of selected options .[15,34]This local evidence can be in the form of program evaluations, costing studies, qualitative studies on views, values and preferences, community surveys, practitioner surveys, administrative health databases, and routine program surveillance data.[15,34,35] A systematic approach to identifying and using local evidence is also important.[34] However, there are challenges to finding and synthesising such evidence, as demonstrated by a pilot attempt at country-specific research synthesis in 2015.[31] This project revealed that research output from Cameroon is often published in journals which are not indexed on common databases like Web of Science, Scopus or MEDLINE.[31,36] Furthermore, the archives of such journals are not easily searchable or accessible in some cases.[31] Finally, there is a paucity of research being conducted on some research topics or using certain research designs; such that local evidence is simply not available. All these issues can be threats to systematic and comprehensive identification and use of local evidence for contextualisation.

To address these challenges, we propose a local evidence mapping initiative. The output of this mapping initiative would be an online searchable database of peer- reviewed health research from Cameroon. The database would serve as a starting point to incorporate local evidence into the following NHRS processes: research priority setting, identifying research and funding gaps (production), and contextualising KT processes (use). This will be possible by using the content in the database to compare current research output to national health and research priorities; and to the functions of local evidence in KT processes related to policymaking.

1.3 Research Question

How can evidence mapping and synthesis methods be applied to research output from Cameroon, to support the production and use of health research as measures of national health research system performance?

The objectives of this study are:

1. To develop a centralized source of local evidence in the form of an online database of health research from Cameroon.

2. To develop a protocol for adapting evidence mapping methods for local rather than global evidence mapping and gap map analysis.

3. To test the applicability of the database and mapping protocol for future research production and knowledge translation on sexual and reproductive health.

Chapter 2: Methodology

We used an evidence mapping design for this study. Our methodology was guided by the mapping protocol established by the Global Evidence Mapping Initiative.[37] The GEM Initiative core tasks and steps were modified as needed to fit the purpose of this work. These changes and their rationale are explained throughout this chapter.

Evidence mapping involves the systematic searching and reviewing of a broad body of literature to identify knowledge and research gaps.[38–40] The results of evidence mapping can be presented in the form of visual representations (tables, graphs) and user-friendly outputs such as searchable databases.[40,41] Evidence mapping borrows from other methods of identifying and collating research evidence such as systematic reviews and scoping reviews.[37,40]All three designs require an in-depth, systematic and comprehensive search of relevant literature using electronic databases, hand-searching journals, reference lists and existing networks (conferences, registries).[37,42,43] However, unlike systematic reviews, evidence mapping does not address a narrow or focused clinical question (for instance, answering a question about a particular population, intervention, comparator and set of outcomes). Instead, it identifies the boundaries and context of a study area as a scoping review does.[37,42] Additionally, evidence mapping (like scoping reviews) does not include quality appraisal.[37]

The methods used in this study reflect all the features of evidence mapping described above. In addition, we also analyzed the trends and characteristics of publications on a specific body of literature (i.e. health research from Cameroon). Such analyses are outside the scope of either systematic or scoping review methodologies. Consequently, bibliometric methods were also incorporated in our mapping design.

In summary, we blended systematic, scoping and bibliometric analysis methods to map a broad field of research from a specific setting. We also embedded smaller mapping processes into our design to identify and characterise evidence on more than one research topic within the boundaries of the first map. (see figure 1). This study contributes to the literature on evidence mapping by introducing methods to identify and characterise local rather than global evidence on broad research areas. This study also demonstrates how to identify local evidence to answer questions about what research should be produced to support health system and policy decision-making (Chapter 5). Thus, we provide an opportunity to evaluate the impact of national research production and use (function of NHRS) on health systems.

2.1 Setting boundaries and context

The boundary of this mapping exercise was set at a national level (Cameroon). Although this is a major departure from the GEM Initiative mapping protocol, it was the most appropriate given the objectives of this thesis.

Steps 1 and 2 of the GEM core tasks and steps, suggest the use of expert consultations, online surveys and preliminary literature searches, for the development and prioritisation of researchable questions. For these steps, we used data from a deliberative dialogue on the SRH of adolescents conducted in Cameroon in April 2018.[23,44]

This deliberative dialogue was the first amongst a series of dialogues organized within the framework of a multi-country SURE-KT project. The main project objectives were assessing, enhancing and institutionalising the translation of SRH evidence into action. Participants comprised researchers and stakeholders involved in decision-making, delivery and implementation of policies and interventions targeting the SRH of adolescents. The main deliverable of the dialogue was a list of stakeholders' priorities for primary research and reviews in the SRH field. [23,44]

One primary research and one review priority were selected from the list as topic areas for which mapping, and gap analysis could be conducted. (Chapter 5)
Smaller evidence maps on these priorities were embedded in the larger process of mapping local evidence from Cameroon. The results of our mapping initiative were presented as an online searchable database called the Cameroon Health Research and Evidence Database (CAMHRED). The online platform and website which will host CAMHRED are currently in development.

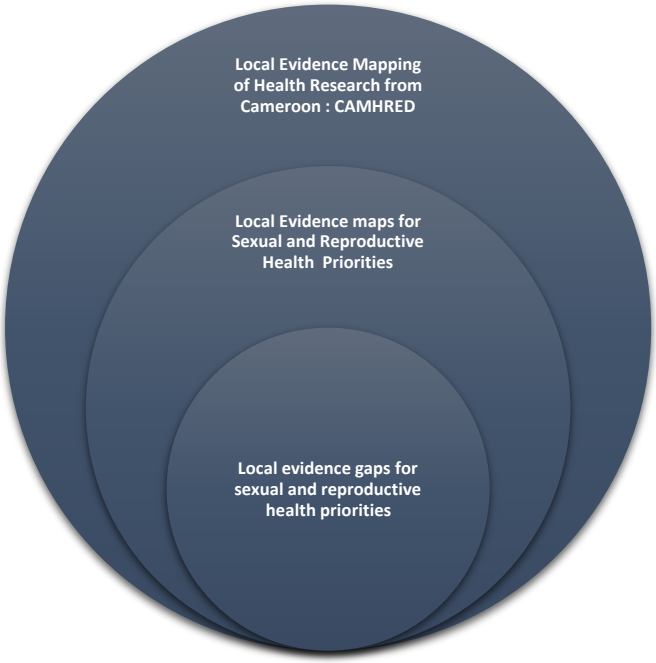

Figure 1: Framework for local evidence mapping initiative in Cameroon

2.2 Search and Selection

a. Eligibility

Types of studies

We included primary research, primary or secondary data analysis focusing on health states, health outcomes, health systems, health policy, medicine, nursing and allied health professions, social determinants of health, health economics, and human genetics. We included quantitative (experimental, observational), qualitative, mixed methods studies.

Types of participants

We included studies focusing on Cameroonian populations and systems.

b. Search Strategy

From October 2018 to May 2019, we searched 10 electronic health databases (BDSP, HAL, PERSEE, ERUDIT, EMBASE and MEDLINE via OVID, CINAHL, AMED, LILACS, PSYCINFO and hand searched the archives of non-indexed African (African Journals Online) and Cameroonian journals (Health Sciences and Disease, Revue de Medecine et Pharmacie, Clinics in Mother and Child Health, African Journal of Integrated Health) . Our search terms included *Cameroon, Cameroun* and *Kamerun*. We restricted searches to English and French articles published from 1999 onwards (20 years).

c. Selection of studies

Reviewers screened all search results and excluded ineligible studies based on title and abstracts using the Rayan software (rayyan.qcri.org). We retrieved full-text articles of remaining studies and screened these articles for inclusion.

2.3 Reporting

a. Data extraction and management

We used DistillerSR (Evidence Partners, Ottawa, Canada) to extract data on the following study characteristics:

- Language: English or French
- Publication status: reported as full text publication, manuscript abstract, conference abstract or published abstract
- Unique identifier; reported as first author last name, year
- Country of affiliation of the first author; based on the location of their host institution. For first authors with multiple affiliations, the first affiliation was selected.
- Contact information; email preferably
- Level of access; reported as open or restricted
- International collaboration defined as any author with a non-Cameroonian affiliation

- Study location; one of the ten regions of Cameroon
- Study period; reported as the month/year at the start and end of the study.
- Study design; reported as experimental (randomized controlled trials, non-randomized study of interventions), observational (case study, case series, case control, cross sectional, cohort, retrospective review), qualitative, mixed methods, and secondary analysis.
- Funding; reported as public, private, self-funded, none

b. Coding Scheme

We developed a coding scheme to label included articles and create a searchable database. The coding scheme comprised domains and subdomains guided by existing taxonomies such as the health topics used by the WHO (www.who.int/health-topics) and the Health Systems Evidence Database (healthsystemsevidence.org) at McMaster Health Forum. (See Table 1)

Each article was coded independently by two reviewers and discrepancies resolved by consensus.

2.4 Data analysis

Data extracted for all the studies in the CAMHRED were imported into a Microsoft Excel (version 16.37) file for data cleaning. Descriptive analysis was conducted using Microsoft Excel and SPSS (Statistical Package for the Social Sciences) version 25.0 [45] We described health research from Cameroon based on trends in publication characteristics; authorship structure and international collaboration; study characteristics and content. We reported all results as counts and percentages.

Table 2: CAMHRED Taxonomy

Disability
- Blindness and visual impairment,
- Cognitive or learning disabilities
- Deafness and hearing impairment
- Multiple disabilities
- Orthopedic impairment
- Speech and language impairment.

Diseases and health Conditions
- Allergies
- Burns and other injuries
- Genetic disorders
- HIV
- Infectious or parasitic diseases (excluding STIs)
- Malaria
- Mental, behavioral or neurodevelopmental disorders
- Neoplasms (cancer)
- Neurodegenerative disorders
- Non-communicable diseases (excluding neoplasms)
- Respiratory diseases
- Sexually transmitted diseases
- Tropical diseases
- Tuberculosis

Health Systems
- e-health or mobile health
- Ethics
- Health care provider training
- Health economics
- Health equity
- Health insurance
- Health policy
- Health statistics and information systems
- Health systems delivery arrangements
- Health systems financing arrangements
- Health systems governance arrangements
- Health systems implementation arrangements
- Knowledge translation
- Universal health coverage

Providers
- Allied health professionals
- Informal/ family caregivers.
- Lay/ community health worker
- Nurse
- Pharmacist
- Physician

Medical Specialties
- Anesthesiology
- Cardiology
- Dentistry
- Dermatology
- Emergency medicine
- Family medicine
- Gynaecology
- Genetics (Genomics)
- Infectiology
- Internal medicine
- Neurology
- Obstetrics
- Oncology
- Ophthalmology
- Pathology
- Pediatrics
- Psychiatry
- Radiology and diagnostic imaging
- Rehabilitation
- Surgery
- Traditional medicine
- Urology

Public Health
- Blood transfusion safety and availability
- Disease control in humanitarian Emergencies
- Disease surveillance
- Health promotion and disease prevention
- Immunization or vaccination
- Nutrition and health
- Road traffic injuries

Pharmaceutics
- Access to medicines
- Antiretroviral therapy
- Counterfeit drugs
- Drug adherence
- Drug coverage
- Drug resistance
- Drug safety
- Essential medicines

Sexual and Reproductive Health
- Abortion
- Breastfeeding
- Contraception
- Family planning
- Female genital mutilation
- Infertility
- Intimate partner and sexual violence
- Obstetric fistula.

Population
- Adolescents and youth
- Adults
- Children
- Linguistic minorities
- New-born and infants
- Older persons
- Persons living in rural communities
- Persons with disabilities
- Pregnant women
- Refugees or migrants
- Women

Social Determinants of Health
- Disability
- Early childhood development
- Education
- Food insecurity
- Gender
- Health services
- Occupation
- Place of residence (urban vs tural)
- Race/ Ethnicity/ Culture/ Language
- Social capital
- Social safety Network
- Socioeconomic Status (income)

Chapter 3: Results

3.1 Search results

Our search resulted in 20,091 records. After duplicate removal, title and abstract screening, 4412 were excluded and 5549 were assessed for eligibility based on the inclusion criteria described above. We extracted data on 4384 eligible studies and mapped their content onto the pre-established coding scheme mentioned in chapter 2.

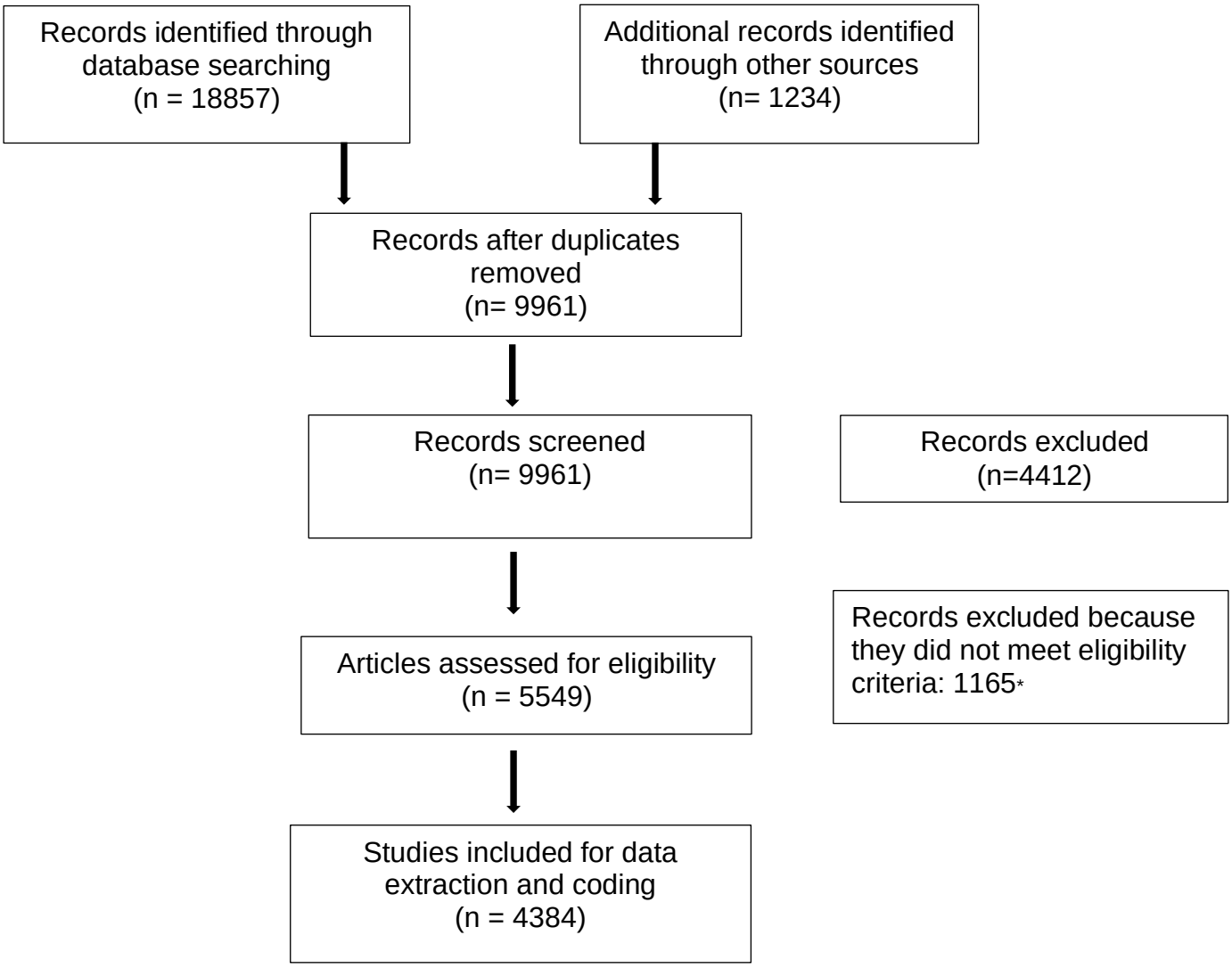

Figure 2: PRISMA diagram for systematic search and selection of CAMHRED studies.

* see Table 1.1 in Appendix 1 for exclusion reasons.

3.2 Description of studies included in CAMHRED

a. Publication characteristics

We extracted data from 3723 (84.9%) full text publications while the remaining were manuscript abstracts (n = 295), conference abstracts (n=317) and published abstracts (n= 50). Most studies were published in English (79.7%) and available as Open access articles (76.3%). Studies retrieved from handsearching non-indexed journals made up 14.4% of all eligible studies (n= 633).

The average number of publications per year increased from 86.9 (standard deviation [SD] =22.8) in the first decade [1999 – 2008] to 338.9 (SD =114.4) in the next [2009-2018]. This increase was significant (p-value < 0.001). While we only included studies during the first half of 2019, these already exceeded the annual number of publications in 2008. In addition, the mean increase in publication per year was 7.5 (SD = 12) in (1999-2008), compared to 40.3 (SD = 52) in (2009-2018).

Table 3: Publication characteristics for CAMHRED studies

Characteristic	N (%)	
Language, N (%)		
English	3494	(79.7)
French	890	(20.3)
Publication Status		
Full Text	3723	(84.9)
Conference Abstract	317	(7.2)
Manuscript Abstract	294	(6.7)
Published Abstract	50	(1.1)
Level of Access		
Open	3344	(76.3)
Restricted	1024	(23.4)
Not Clear	16	(0.4)
Journal type		
Indexed	3751	(85.6)
Non-Indexed	633	(14.4)

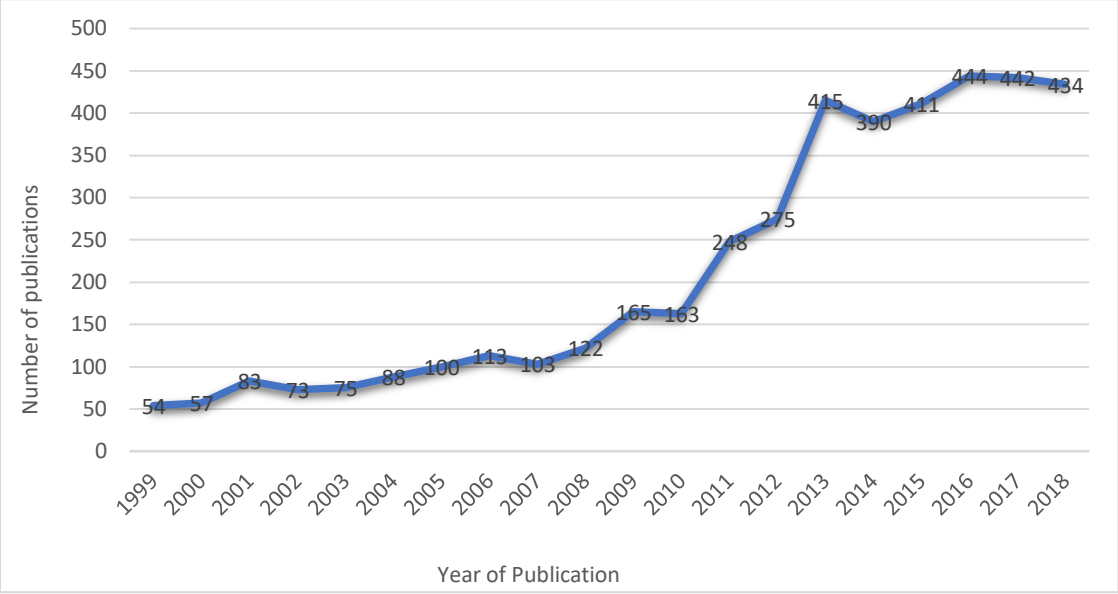

Figure 3: Trends in annual peer reviewed publications from 1999 to 2018

b. Authorship & International Collaboration

Authorship structure

Authors with Cameroonian affiliations were first authors in 2945 (67.2%) of the eligible studies. The remaining 32.8% were primarily from European (16%), North American (11.1%), African countries (4.3%) and other parts of the world (1.4%). The United States was the most common non-Cameroonian affiliation for first authors [n = 433 (9.8%)].

International Collaboration

Based on author affiliations, we identified 2128 (48.5%) studies without international collaboration. These included 1903 (43.4%) studies in which all authors had Cameroonian affiliations and 225 (5.1%) in which no author had a Cameroonian affiliation.

Of the 2180 (49.7%) studies in which there was international collaboration, 1971 (45.0%) included Cameroonian authors. Cameroonians were first authors in 973 (22.2%) studies. 209 (4.8%) studies included collaborations between authors from other countries excluding Cameroon.

We identified 522 (11.9%) studies representing collaboration between Cameroonian and North American authors (USA and Canada). More North American collaborators were first authors in these studies compared to Cameroonian authors (n = 315 versus n = 207).

Our analysis of international collaboration between Cameroonian and European authors only included the most common countries of collaboration (France, Belgium, UK, Switzerland, Italy, Germany and Sweden). 1000 (22.8%) studies represented this type of collaboration. More Cameroon-affiliated authors were first authors in these collaborations (n = 527 versus n = 473).

African collaboration was primarily with South Africa (n =208 (4.7%)) and more Cameroonian authors had first author position in these studies (n = 155 versus n = 53).

Table 4: Authorship & International Collaboration characteristics of CAMHRED studies

Characteristic	Total N (%)
First Author	
Cameroon	2945 (67.2)
Other	1439 (32.8)
Other First Authors	
Europe	705 (16.0)
North America	485 (11.1)
Africa	187 (4.3)
Rest of the world	62 (1.4)
International Collaboration (IC)	
Yes	2180 (49.7)
No	2128 (48.5)
Unclear	76 (1.7)
Geographic distribution of IC	
Europe*	1000 (22.8)
North America	522 (11.9)
Africa+	208 (4.7)
Local authors only	1903 (43.4)
No local authors	225 (5.1)

* Only includes IC with France, Belgium, United Kingdom, Switzerland, Italy, Germany and Sweden.
+ Only includes IC with South Africa

c. Study Characteristics

Missing information
We assessed the amount of information not reported in included studies using three characteristics: study location, study period and source of funding. The study location was not reported in 812 (18.6%) studies. The study period was not reported in 1885

(43.0%) studies and it was considered unclear for 1158 (26.4%) studies. Source of funding information was not available for 2465 (56.2%) studies.

Re-analysing missing information for full text publications only, showed similar trends. In 591 (15.9%) studies, the study location was not reported. The study period was not reported in 1487 (39.9%) studies while 1011 (27.2%) were considered unclear. Funding information was not available for 1853 (49.8) studies. We also analysed trends in missing information for full text publications based on publication decades (See table 5).

Table 5: Missing information in CAMHRED studies

Characteristic	All Publication Types (n =4384)	Full Texts: (n = 3723)	1999-2008 (n = 739)	2009-2019 (n = 2984)
Study Location				
Not reported	812 (18.6)	591 (15.9)	104 (14.1)	487 (16.3)
Reported	3572 (81.5)	3132 (84.1)	635 (85.9)	2497 (83.7)
Study Period				
Not reported	1885 (43.0)	1487 (39.9)	344 (46.5)	1143 (38.3)
Reported	1341 (30.6)	1234 (33.1)	175 (23.7)	1052 (35.3)
Unclear	1158 (26.4)	1011 (27.2)	222 (30.0)	789 (26.4)
Funding				
Not reported	2465 (56.2)	1853 (49.8)	345 (46.7)	1508 (50.5)
Reported	1919 (43.7)	1870 (50.2)	394 (53.3)	1476 (49.5)

Study Location
Most studies were conducted in the Centre region (n =1972 [45%]) and Littoral region (n = 747 [17.0%]). Studies conducted nationwide represented 2.1% of all studies (n = 90). Meanwhile, the two minority English-speaking regions combined accounted for 22.6% of all studies (North west and South west).

Funding
Of the 1919 (43.7%) studies reporting on funding, 1335 (30.4%) received public funding; 348 (7.9%) received funding from private sources; 331 (7.5%) received no funding; 78 (1.8%) studies were funded by industry and 42 (1%) studies were author funded.

Design
Most studies were observational in design (n= 3144, 71.7%) and primarily cross sectional (44.6%). Two hundred and eighty-three studies (6.5%) were secondary analyses. These consisted primarily of demographic and health survey data collected through the DHS program. These are nationally representative household surveys which collect data for monitoring and impact evaluation of a variety of health indicators.

Experimental studies represented 5.7% of all studies and 3.1% were randomized controlled trials. One hundred and eighty-two (4.2%) studies were qualitative and 88 (2.0%) were mixed methods studies. Four hundred and thirty-eight (10.0%) studies were included as other study designs, the most common being genetic analyses (n =200, 4.6%)

Table 6: Characteristics of CAMHRED studies

Characteristics	**N (%)**	
Study Location		
Adamawa	195	(4.4)
Centre	1972	(45.0)
East	211	(4.8)
Far North	226	(5.2)
Littoral	747	(17.0)
North	216	(4.9)
North West	480	(10.9)
South	239	(5.5)
South West	561	(12.8)
West	331	(7.5)
Nationwide	90	(2.1)
Funding		
Industry	78	(1.8)
Public	1335	(30.4)
Private	348	(7.9)
Self-funded	42	(1.0)
None	331	(7.5)
Study Designs		
Experimental	250	(5.7)
Non RCT	116	(2.6)
RCT	134	(3.1)
Observational	3144	(71.7)
Case Control	133	(3.0)
Cross-sectional	1956	(44.6)
Cohort	264	(6.0)
Case study	324	(7.4)
Case series	129	(2.9)
Retrospective Studies	342	(7.8)
Secondary Analysis	283	(6.5)
Qualitative	181	(4.1)
Mixed Methods Studies	88	(2.0)
Other	437	(10.0)
Genetic Analyses	200	(4.6)

d. Content:

The full CAMHRED coding scheme or taxonomy consists of 10 main domains divided into subdomains. Each domain represents a content category used to describe the focus of research output from Cameroon. These domains include Disability, Diseases and Health Conditions, Health Systems, Medical Specialties, Pharmaceutics, Public Health, Providers, Population, Social Determinants of Health, Sexual and Reproductive Health. The Sexual and Reproductive health domain was created specifically for the application section of this thesis and will be described subsequently.

The most coded domains in the CAMHRED were Diseases and conditions (n = 3524); Medical Specialties (n=3903); Population (n = 2267) and Public Health (n = 2253). Within these domains, the most common subdomains were; Infectious and parasitic diseases (n = 1194); Infectiology (n = 2005); Children (n = 654); Disease surveillance (n = 1661) respectively. Subdomains within the same domain were not mutually exclusive.

Table 7: Content Domains for CAMHRED studies

Domain	N (%)	
Disability	267	(6.10)
Diseases and Conditions	3524	(80.40)
Health Systems	518	(11.80)
Medical Specialties	3903	(89.00)
Pharmaceutics	610	(13.90)
Public Health	2253	(51.40)
Providers	258	(5.90)
Population	2267	(51.70)
Social Determinants of Health	930	(21.20)
Sexual and Reproductive Health	638	(14.60)

Chapter 4: Discussion

CAMHRED is the most comprehensive local evidence mapping initiative on peer reviewed health research from Cameroon. It contains 4384 studies covering 20 years and categorized according to study characteristics and content. The database reveals an increase in health research output in Cameroon over the past 20 years with a significant increase in the average annual number of publications between the first and second decade. While these findings can be attributed to better NHRS performance, they might also reflect our search strategy's reliance on publications and records available online. In other words, articles from earlier years published in journals with non-digitised archives might have been overlooked. Notable features of the database and their implications for its use are described below:

First, CAMHRED comprises a disproportionate amount of studies (62%) conducted in the Centre and Littoral regions. Although these regions have the highest estimated number of inhabitants in the country,[46] and demographic justifications to our findings are tempting; they might not be accurate. For instance, other highly populated regions such as the Far North (2nd) and North (4th),[46] only account for 10.1% of all research output. A more reasonable explanation for regional disparities in research output, might be the concentration of institutional capacity and expertise for research in urban hubs like Yaoundé (Centre) and Douala (Littoral). By providing regional information needed to map research output and identify gaps according to geographic location; CAMHRED can contribute to decreasing disparities in future research production.

Second, a high proportion of CAMHRED studies had an observational design (71.7%). In fact, cross sectional surveys or secondary analysis of nationally representative surveys (DHS) accounted for approximately 50% of all studies in the database. These designs are often used to answer questions about risk factors or the burden of disease and the current health status of a population.[4] From a research system perspective, producing only these types of studies eventually becomes problematic because they fail to answer other questions relevant for priority-setting and decision-making at a national level. These questions include what interventions or policy options are effective, cost-effective or simply what works in practice for a particular condition or specific population. Additionally, findings from observational studies have a lower ranking in the hierarchy of evidence compared to experimental studies and syntheses of evidence like systematic reviews.[47,48] Experimental studies only accounted for 5.7% of all studies in CAMHRED. Thus, in its current state, research output from Cameroon might not provide the best available evidence to support decision-making in practice and policy. As a result, future research production would also have to account for gaps in specific research designs. CAMHRED can contribute to identifying these gaps for specific research areas or topics.

Third, the content of studies in the database reflects the trends in top causes of mortality in Cameroon. From 2007 to 2017, infectious diseases have been the top three causes of deaths in the country.[49,50] Accordingly, infectious diseases were the most

researched conditions in CAMHRED. The majority of these studies were considered "disease surveillance" studies in which the prevalence of these infectious conditions was measured using routine hospital surveillance or population-based surveys. Given the high proportion of CAMHRED studies which had an observational design, this content-related finding was not surprising. Such disease-oriented studies are relevant for estimating or clarifying the magnitude of health problems within a population.[34,51] However, problem definition can also be health system related.[51] Likewise, addressing these health problems at a national level might require both disease-oriented and health system related solutions. Therefore, future research production in Cameroon might need to move (1) from disease-oriented to health-system related problem definition; and (2) from problem definition to determining which interventions are effective and how they should be implemented.

4.1 Strengths

The strengths of this study and its main deliverable (the database) can be categorized according to methodological contributions and potential applications of the database. Some of these potential applications are mentioned in the discussion above and reiterated here:

CAMHRED is a springboard and support tool for other local evidence mapping and synthesis initiatives. It has relevant applications for setting priorities, funding research, producing research (type and content), knowledge translation and policymaking. Extensions of evidence mapping (such as knowledge gap analyses, scoping studies and narrative syntheses) derived from CAMHRED will be relevant for researchers, students, funders, decision makers and anyone with an interest in health research from Cameroon. The contribution of CAMHRED-derived evidence maps and gap analyses towards efficient research production and use is presented in Chapter 5.

Literature on the methodology to guide evidence mapping is still growing with some lack of consensus. The absence of reporting guidelines such as those present for systematic reviews further compounds the issue.[38,40] To the best of our knowledge, there are no mapping protocols for local evidence specifically. We had to blend systematic, scoping and bibliometric analyses techniques to identify and characterise broad research areas from a specific setting. Thus, the CAMHRED protocol provides preliminary guidance on adapting existing global evidence mapping methods to support local evidence mapping and gap analysis.

4.2 Limitations

The limitations of this study and the database, as well as efforts to address them are outlined below:

First, contrary to other evidence maps, the boundaries for this work were at a national level. Moreover, the breadth of topics was even larger (all health research compared to orthopedic rehabilitation as a topic area for instance). This created a huge research output to review, categorize and describe. These processes were resource and time intensive, posing challenges to the sustainability of this work. From the last searches to coding completion, the process took one year. Other resource implications included software license purchases and staff time. Despite these limitations, the twenty-year period and the breadth of topics was maintained to allow for a more comprehensive database and to enable comparisons over a long period of time. Moreover, subsequent updates of the database will incorporate these time and resource considerations. Frequent updates to the database's content will be needed to ensure that CAMHRED-derived evidence maps, and gap analyses stay relevant. Using the average number of publications for the past five years (n = 424, SD:21.1), we can suggest a preliminary timeframe of three months to complete searches, eligibility screening, data extraction and coding. Commitment from at least two pairs of reviewers will be needed to complete all tasks during this timeframe.

Second, although content categories were based on existing taxonomies, input from target users outside the research team was not included during development. The decision not to include these target users were based on time constraints and an assumption that these existing taxonomies were widely known. Nonetheless, understanding of the domains and subdomains in the database is expected to influence its usefulness. Opportunities for training workshops with target users should be explored prior to incorporating the use of the database in any NHRS processes in Cameroon.

Finally, the characteristics of studies included in the database can limit its applications (other mapping and synthesis initiatives). For example, 1044 (23.4%) studies included in CAMHRED were published in restricted journals. While the database might provide information on basic study characteristics, access to full text publications is still required to create the CAMHRED-derived products (evidence maps and knowledge gaps) which are useful for researchers, policymakers and funders. The extent of missing information in included studies represents a similar threat to the database's applications.

Chapter 5: Applying local evidence mapping and gap analysis to improve research production and use for sexual and reproductive health in Cameroon

5.1 Introduction

This section provides a description of possible applications of local evidence mapping for improved research production and use in Cameroon. Our main objective was to compare stakeholder-driven primary research and review priorities in SRH to what is currently available in the literature. By mapping local evidence and creating gap maps, we expected to have a clearer picture of where resources for research production within a particular field (SRH of adolescents) might be needed. While advocating for more efficient resource allocation for research production; we also assumed that research produced based on stakeholder driven priorities had more chances to be used subsequently.

Research use can also be visualised through the lens of knowledge-to-action initiatives in which evidence briefs, evidence summaries, guidelines and global recommendations are made available to policymakers, clinicians and other stakeholders to inform their choice of policies and interventions.[26,27,35,52–54] In these cases, local evidence has been identified as a means to contextualise these processes by identifying barriers and facilitators to the adoption of these evidence-informed actions.[14–16,34,35] Hence, we also mapped the local evidence available on a stakeholder-driven review priority to determine if context relevant evidence would be available for KTA activities on this particular topic.

As a reminder, stakeholders involved in the field of SRH in Cameroon participated in a project aimed at assessing, enhancing and institutionalising the translation of evidence into action. The project was motivated by unsatisfactory SRH indicators, despite an increase in the interventions known to be effective globally.[23,55] Preliminary consultation meetings between researchers and decision makers allowed for an opportunity to clarify the rationale behind SRH intervention choices.[23] The use of evidence in stakeholder interventions and policies was also assessed through document analysis.[55] This information was used as a basis for a deliberative dialogue conducted during the first year of the project.[55] One deliverable of the dialogue was a list of stakeholder-identified primary research and synthesis priorities. [23] Ensuing dialogues focused on specific themes identified in this list but are beyond the scope of the current study.

Instead, we focus on one primary research and review priority each from the list mentioned above. We use the primary research priority to describe the role of local evidence mapping and gap analysis in the production of relevant SRH research. And we use the review priority to assess the role of local evidence in providing the contextual information needed so that evidence from SRH research can be used.
The primary research priority selected was “contraceptive prevalence among adolescents in Cameroon” while the review priority was “interventions for obstetric fistula for adolescent girls.”[23]

5.2 Methods

Stakeholder and expert consultations are useful to generate relevant research questions for evidence mapping.[37] The existing priority setting exercise described above enabled us to skip this first step. Our two relevant research questions were

(1) What is the contraceptive prevalence among adolescents in Cameroon? (primary research priority)
(2) What are effective interventions for obstetric fistula in adolescent girls? (review priority)

While creating the CAMHRED taxonomy described in the first section of this thesis, we created a SRH domain in which subdomains were reflective of the list of priorities developed by stakeholders in Cameroon.[23] The subdomains relevant for our two research questions were contraception, family planning and obstetric fistula. Therefore, we retrieved all the studies coded under these subdomains. Then, we used the population domain codes to select studies looking at adolescents and youth.

Analysis 1: Contraceptive Prevalence among Adolescents

To be included in the gap analysis, studies had to be available as full text publications and measure the prevalence of contraceptive use. Publication and study characteristics had already been extracted for the database. However, we extracted the following additional information to design our gap maps: specific population characteristics (age); setting (rural vs urban); and contraceptive use measure.

Analysis 2: Interventions for Obstetric Fistula

We used a hypothetical KT scenario in which Cameroonian policymakers working on a national strategy for obstetric fistula, requested evidence briefs and global evidence recommendations on preventive, treatment, and management interventions for patients. We assumed that systematic reviews, guidelines and global recommendations on these topics exist. Then, we mapped local evidence on obstetric fistula to assess how the available literature would contribute to contextualising this KT process. The SUPPORT (supporting policy relevant reviews and trials) project team created a list of the different ways local evidence can be used to support policy making and the type of local evidence needed to do this.[34] We analysed local evidence on obstetric fistula according to these uses and types of local evidence to identify gaps.

5.3 Results and discussion

a. Contraceptive Prevalence among Adolescents

i. Search results

We retrieved 138 studies coded as contraception (n=133) OR family planning (n = 43) from the CAMHRED. 38 of these had been coded both as contraception AND family planning. Applying the population (adolescents and youth) code resulted in 58 studies. After excluding studies not available as full text (n= 6) and those in which contraceptive prevalence was not measured (n = 8); we included 44 studies for our evidence maps and gap analysis.

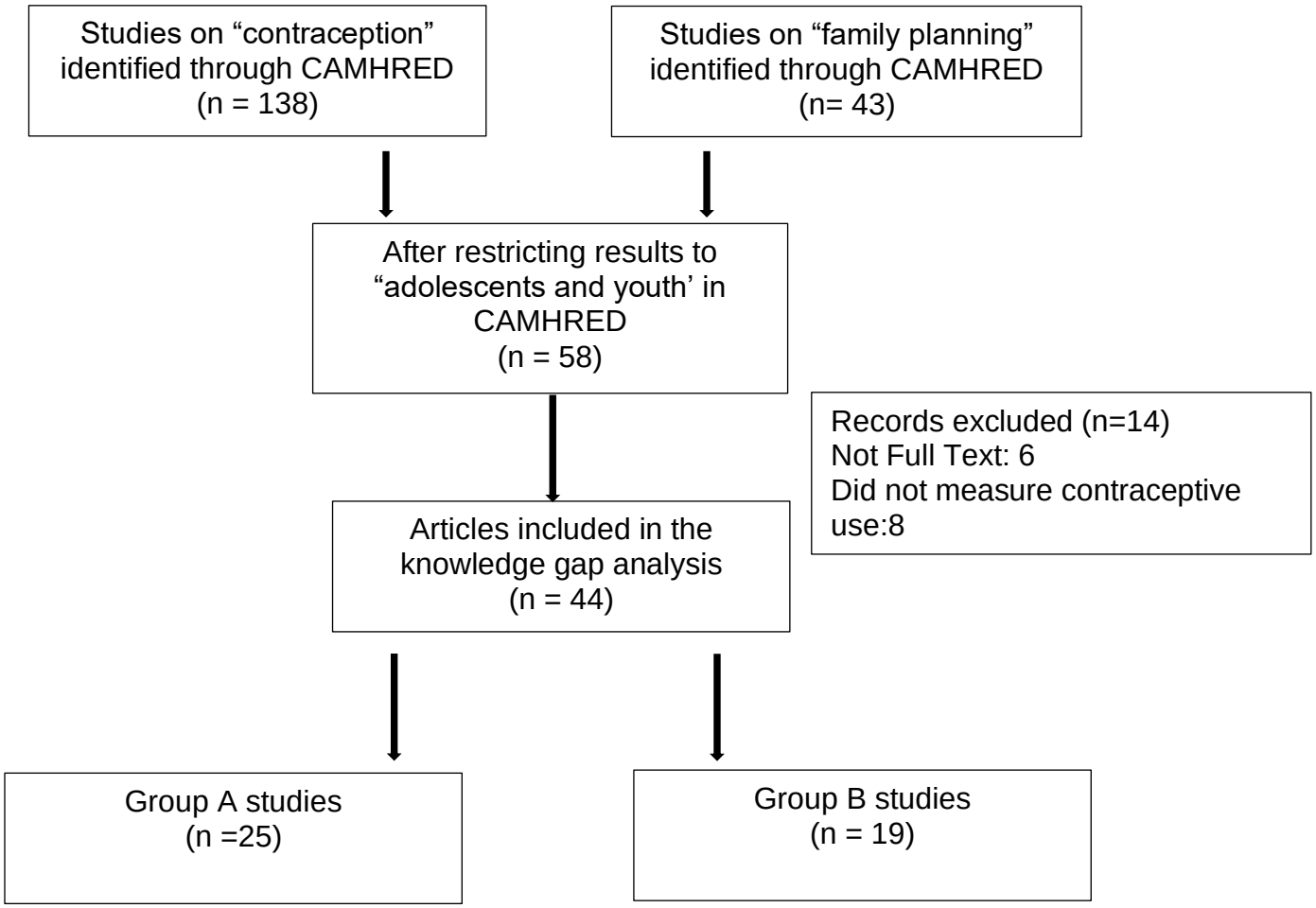

Figure 4: Flow diagram of studies included in the knowledge gap analysis on contraceptive prevalence in adolescents.

We identified two types of studies; studies which specifically set out to measure the prevalence of contraceptive use within a population (n = 25) and studies with another focus (HIV, early pregnancies, abortion and alcohol consumption) but in which contraceptive use was reported (n = 19). For both types of studies cross sectional design was the most common (n = 40). Contraceptive prevalence was measured using self-reported information on time-dependent use of contraception (current, lifetime, past

X months); sexual contact- dependent use of contraception (first, last); and frequency of use.

Table 2.1 and 2.2 in Appendix 2 summarise the characteristics of studies measuring contraceptive prevalence among adolescents and youth in Cameroon. The two types of studies mentioned above are reported separately as Group A and Group B. While these maps were mainly used to identify research gaps for this thesis; they can also serve other purposes. For instance, researchers interested in estimating the national prevalence of contraceptive use by pooling existing prevalence studies could use them as a starting point. However, value added work such as quality appraisal might be necessary for such synthesis. National prevalence estimates derived from pooling single peer-reviewed studies could also be compared to estimates from demographic and health surveys. Such comparisons can be of importance for the development of policy and strategy documents which currently rely heavily on demographic and health survey data for problem definition.[55]

ii. Research gaps

"Adolescents and youth" is a term used to capture a period of life ranging from 10 to 24 years of age. WHO categorization of adolescents and youth based on age groups is as follows: young adolescents (10-14); adolescents (10 - 19); and youth (15 – 24).[56] These distinctions are justified when you consider the potential social, environmental, occupational, educational and developmental heterogeneity of this group.[56] However, these distinctions are not necessarily reflected in how health outcomes are reported in this population

For instance, some studies included in this analysis differentiated age groups to describe their sample, but contraceptive prevalence was hardly ever reported according to these different age groups. This was particularly problematic in studies including adolescents and youth amongst a broader sample of adults (n =19). As a result, we described research gaps using the different adolescent categories. We also used study location (region) and setting (rural versus urban) to determine where the allocation of research resources could be prioritized.

Adolescent categories

Out of 44 studies included for this analysis; no study had measured contraceptive prevalence among young adolescents only (10-14). However, young adolescents were included in 41 studies without disaggregated data on their contraceptive use. Thus, this research gap might be more reflective of inadequacies in how research is reported rather than actual lack of evidence on this particular population. These findings echo decision makers' concerns about younger adolescents being overlooked in SRH policies in Cameroon due to assimilation with older adolescents and youth.[23] From an efficiency perspective, researchers might have found it more useful to investigate contraceptive use among a broader range of adolescents and youth. But adequate reporting did not follow. For SRH policies and interventions to become more adapted to all adolescent categories, problem definition among young adolescents is needed. To

help with this, researchers should report adolescent health outcomes according to different age categories irrespective of how age affects logistic regressions.

Regions

Progress on SRH indicators is slower in some regions of Cameroon (Far North, North, Adamawa and East region)[21,22,57] In fact, a national investment strategy was launched to address SRH problems in these regions in 2017.[57] The policy document describing the strategy mostly referenced DHS data and other national surveys to estimate the magnitude of SRH problems in these regions.[57] The findings of our gap analysis also places these regions as high priorities for future research. We could not identify any primary research (cross sectional) on contraceptive prevalence in the North, Adamawa and East region. The only study identified for the Far North region was a Group B study looking at HIV risk factors among university students between the ages of 17 and 50.[58] While adolescents and youth were included in this study, it is unlikely they were the main target population. And disaggregated data on their contraceptive use was not available either.

The geographic distribution of primary research on contraceptive prevalence signals disparities in how research for health is conducted in Cameroon. Despite knowledge on where the magnitude of certain health problems might be high, local evidence is not mobilised to clarify these problems. Here again, overreliance on DHS data should be reduced by allocating resources to conduct research which helps clarify these problems. These disparities are also visible at the rural versus urban level. Only four regions had studies which were conducted among adolescents and youth living in rural areas (n = 11).

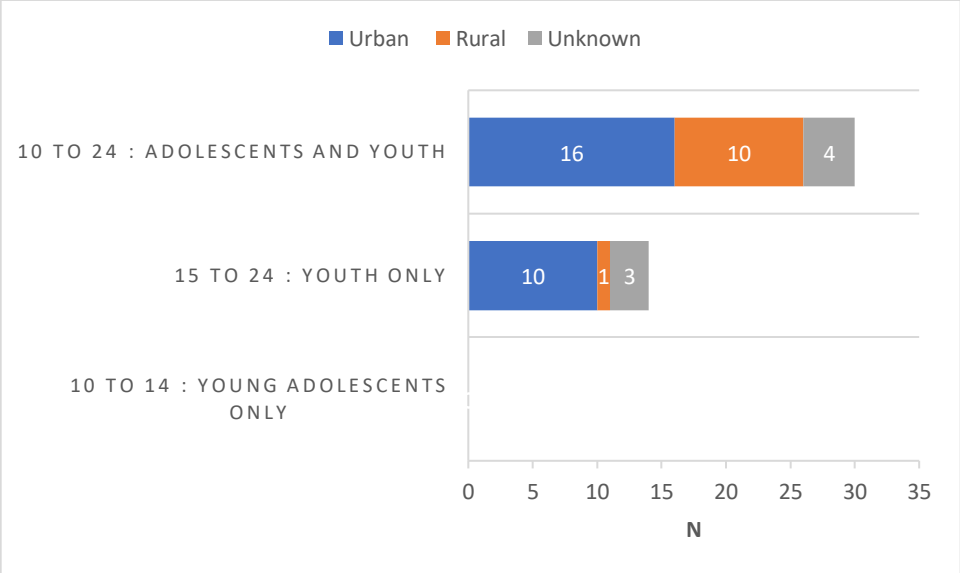

Figure 5: Research gaps based on adolescent categories and setting

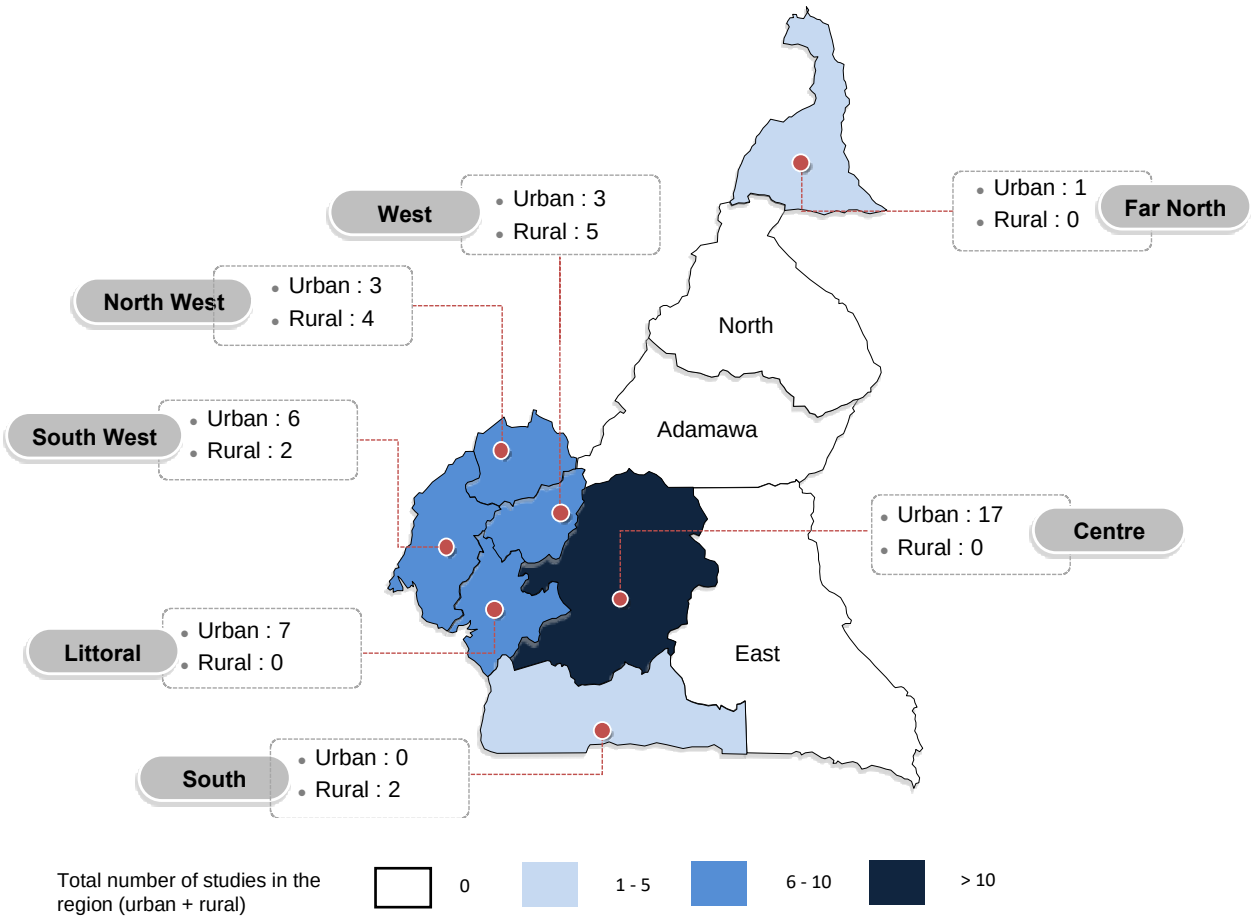

Figure 6 : Research gaps based on study location (region)

iii. Recommendations

Stakeholders' decision to prioritize primary research on contraceptive prevalence among adolescents is valid, despite the existence of 44 local studies already addressing this question. Inadequate reporting and geographic disparities in the existing local evidence limits its usefulness and justifies allocating future research resources to this question.

Table 2.3 in Appendix 2 maps sources of funding for these local studies according to first author affiliation and the type of collaboration between researchers. Health research in African countries like Cameroon is heavily dependent on international funding (from both public and private sources).[17,21] As such, funding institutions are in a position to influence the type of research produced through funding calls and grant application criteria. Decisions about what gets funded can be tailored to the knowledge gaps identified through local evidence mapping while still accounting for funding institutions' priorities and missions.

Additionally, local evidence mapping outputs can also be used to determine what research has already been funded to prevent redundancies and make more efficient use of research resources. Quality appraisal of already funded studies might need to be incorporated here as well, since the quantity of funded studies on a research question might not necessarily reflect availability of findings which are useful to the health system or the health of populations. Local researchers should also be more transparent in their reporting of sources of funding, so that funding gap analysis can be conducted accurately.

In sum, any primary research produced on contraceptive prevalence among adolescents in Cameroon should take into consideration what already exists; the gaps identified above; and how reporting can be improved to ease subsequent use.

b. Interventions for Obstetric Fistula

i. Search Results

We retrieved 12 studies on obstetric fistula and included all of these in our evidence map. The majority of studies (n = 7) had been conducted in the northern regions of Cameroon where the prevalence of obstetric fistula is high.[59–61] All the studies were observational and no study made distinctions between adolescents girls and older women. Surgical management was the most common intervention mentioned (n = 8). One study also looked at social integration interventions following surgical management in the Far North region. Table 8 summarises the characteristics of local evidence on obstetric fistula in Cameroon.

ii. Research gaps

Uses of Local Evidence

Local evidence can be used to diagnose a problem, assess policy options, explore implementation strategies and monitor the effects of policy options.[34] For the KT scenario described above, monitoring the effects of policy options was not relevant. The content of local evidence was mapped on to each of the other uses with the following results:

- Risk factors for obstetric fistula: Problem definition
- Interventions currently implemented: Assessing options
- Outcomes of interventions currently implemented: Assessing options
- Patients' knowledge, attitude and perceptions regarding interventions currently implemented: Assessing options
- Healthcare workers' knowledge, attitude and practices regarding the disease and interventions (human resource availability): exploring implementation strategies, barriers and facilitators
- Community members' knowledge, attitude and perceptions regarding the disease and interventions: exploring implementation strategies, barriers and facilitators

Notable gaps included:

- the cost of current interventions which would have been useful for assessing options;
- the supply of resources such as infrastructure and equipment which would have been useful for assessing implementation strategies, barriers and facilitators.

These gaps were expected since this type of information is more likely to be found in other sources of local evidence (health departments or programmes data),[34] not included in CAMHRED.

Table 8: Fit between local evidence on Obstetric fistula in Cameroon and uses of local evidence for policymaking

Author + Year of Publication	Study Location	Study Design	Population Description	Problem Definition	Assessing options				Implementation strategies, barriers and facilitators	
				Risk Factor	Current Interventions	Outcomes	Patient KAP	Cost	Community KAP	Health care workers KAP
Ngaroua 2018[62]	Adamawa	Cross sectional	Women and girls greater than 15 years with obstetric fistula.	✗	✓	✓	✗	✗	✗	✗
Mbu 2006[59]	Adamawa	Case series	Primiparous teenagers with obstetric fistula	✗	✓	✓	✗	✗	✗	✗
Nkwabong 2017[63]	NR	Case study	25-year-old woman with obstetric fistula following delivery 5 weeks prior	✗	✓	✓	✗	✗	✗	✗
Tebeu 2014[64]	Centre	Cohort	HIV+ and HIV- women 16 years and above with obstetric fistula	✓	✓	✓	✗	✗	✗	✗
Tebeu 2012[65]	Centre	Case-control	Women 16 years and above with or without obstetric fistula	✓	✗	✗	✗	✗	✗	✗
Tebeu 2009[66]	Far North	Case series	Women between 18 and 75 with obstetric fistula	✓	✗	✗	✗	✗	✗	✗
Sanou Sobze 2009[67]	Far North	Cross sectional	- Women between 20 and 84 who received surgery for obstetric fistula; - Patients' significant others and social network - health workers	✗	✓	✓	✓	✗	✓	✓
Mekeme 2011[68]	NR	Case series	Women between 15 and 44 with obstetric fistula	✗	✓	✓	✗	✗	✗	✗
Tebeu 2010[69]	Far north	Case series	Women with obstetric fistula	✗	✓	✓	✗	✗	✗	✗
Tebeu 2008[60]	Far North	Cross sectional	Women between the ages of 15 and 50	✓	✗	✗	✗	✗	✓	✗
Tebeu 2015[61]	Centre, Far North	Case-control	Women with obstetric fistula	✗	✓	✓	✗	✗	✗	✗
Tebeu 2019[70]	West	Cross sectional	Health care workers	✗	✗	✗	✗	✗	✗	✓

Types of Local Evidence

Mapping the content of local evidence to its uses in policymaking might not be enough to identify gaps and make recommendations for future research production. An analysis of the type of evidence (study design) is also needed to determine whether, in its

current state, the available literature provides the best available evidence for contextualisation. Therefore, we compared the study designs of included studies to the types of local evidence which are relevant for specific uses in policy making.[34]

All included studies on obstetric fistula identified through CAMHRED were observational studies. Therefore, studies mapped under "problem definition" in Table 8 would likely provide useful information about the risk factors for the problem (obstetric fistula) for which policy options are needed. Surveys addressing patient, community and health worker attitudes, preferences and practices also match relevant types of evidence for assessing policy options and exploring some barriers to implementation.

Notable gaps included:

- Costing studies and cost effectiveness evaluations to estimate the cost and savings of policy options.
- Experimental studies (randomized and non-randomized) to determine the impact of current interventions on patient outcomes.
- Rigorous programme evaluations to determine the impact of current interventions on patient outcomes and health system factors.
- Qualitative research (deliberative dialogues) with stakeholder groups to assess policy options and identify local barriers to implementation

iii. Recommendations

In our KT scenario, existing local evidence would contribute only minimally to strategies for contextualising and implementing obstetric fistula interventions for adolescent girls. First, none of the studies made distinctions between adolescent girls and older women. As previously discussed, the applicability of local evidence from a wide range of age groups to interventions and policies targeting adolescents is debatable. Second, none of the studies evaluated the cost or cost-effectiveness of current interventions or policy options in the Cameroonian context. Finally, currently implemented interventions, their outcomes; patients' values and preferences might need to be readdressed in future research using more suitable research designs to the ones currently available.

Two studies investigated implementation relevant issues such as health workers' knowledge and skills; or community perceptions and attitudes. Only one of these studies was conducted in a region where the prevalence of obstetric fistula is high. None of these studies used a qualitative research design which might be helpful to understand stakeholders' views and local barriers to implementation. Community perceptions and attitudes may reflect sociocultural values and belief systems which have the potential to influence intervention uptake in a given context.[34] Identifying these values and belief systems should not be limited to community members or persons affected by the health problem. It should be extended to cultural and religious leaders who exert considerable influence on individuals' decision making.[71] Such sociocultural influences are likely present in the northern regions of Cameroon. Hence, future

research (preferably qualitative in design) should assess the roles of cultural or religious leadership in the implementation of obstetric fistula interventions and policy options.

While assessing health worker capacity is important to identify implementation barriers[34]; the knowledge, skills, attitudes and practices of other (sometimes competing) service providers might be more informative. For instance, the regions with high obstetric fistula prevalence are regions with suboptimal levels of antenatal care service use and skilled birth attendance.[21] These trends might reflect a preference for care delivered by traditional birth attendants or other culturally competent service providers. As such, local evidence addressing traditional birth attendants' practices in pregnancy and delivery care would clarify their role as barriers or facilitators to the implementation of preventive interventions for obstetric fistula. We recommend using mixed methods designs to fully answer these questions.

Stakeholders' decision to prioritize reviews on interventions for obstetric fistula among adolescent girls indicates willingness to take action (policy or interventions) in this particular field. However, our analysis suggests that primary research on obstetric fistula should also be a priority. In its current state, the local evidence on obstetric fistula provides very limited information to adapt global evidence or recommendations to the local context. Future research should take into consideration the content, target population and study design gaps described above.

5.4 Strengths

The application section of this thesis provides an opportunity to test the intended uses of CAMHRED using questions which have already been identified as relevant and important for researchers and stakeholders in Cameroon. The likelihood that the findings from this study will inform future research production on these questions could be high provided we can mobilise local researchers' interest. The strengths of this study are outlined below:

First, by incorporating the results of an existing priority setting exercise into our local mapping initiative, we have demonstrated that CAMHRED and its derived products (evidence maps and gap maps) can be used to make the identification of research needs more specific. This specificity can be based on geographic(regions), residential (urban versus rural), target population or research design considerations. Therefore, CAMHRED can be used by researchers to prepare detailed background briefs to inform future research priority setting workshops and deliberations.

Second, this study shows how gaps in local evidence can be used to make recommendations about the type of research which should be produced to support health system and policy decision-making. Thus, we provide an opportunity to evaluate the impact of national research production and use (function of NHRS) on health systems.

5.5 Limitations

The second part of this thesis relied heavily on data extraction and coding conducted during the development of CAMHRED. As such limitations already discussed for the development of the database are also relevant here. Other limitations of this application section are outlined below:

First, the quality of the evidence maps, and gap analyses presented in this thesis was dependent on the reporting of CAMHRED studies. For example, study period was available for only 18/44 studies on contraceptive prevalence. Thus, any analysis of trends in prevalence over time will most likely be erroneous. We advocated for the use of our evidence maps for researchers interested in pooling such prevalence data or for clarifying the magnitude of this problem in adolescent populations. However, both uses would be limited if increases or decreases in contraceptive use over time cannot be determined accurately. To address this limitation, CAMHRED users could opt for proxy study periods such as data collection or recruitment period which can be extracted from full text publications. Similar issues with reporting were also present in our analysis of geographic research gaps and sources of funding. While these are limitations, they also represent reporting gaps in research produced in Cameroon. Therefore, we included suggestions for reporting studies in our recommendations for future research production.

Second, evidence maps are not intended to provide guidance for clinical practice when they do not include quality appraisal.[37] This was the case for the evidence maps created in this thesis, which were intended more as steppingstones for other synthesis initiatives. They provided information about what kind of research is needed, what is known about a health topic in Cameroon, and how that affects the implementation of other available practice recommendations from systematic reviews and guidelines. Hence, mitigating user expectations is of concern. Training target users about the intended applications of the database is one way to address this concern.

Third, the last search conducted for CAMHRED was in May of 2019. As such, any studies relevant to the questions addressed in this application section which were published after that date were not included in the evidence maps and gaps analysis. The process for updating the database is still in development. However, the methods developed in this study are easily adapted to an expanded search window and a preliminary timeframe for updates has been described in Chapter 4(section 4.2). Therefore, updating the evidence maps and gap analyses to reflect new information should be straightforward.

Finally, local evidence is not limited to peer reviewed articles. As demonstrated in this application section, some policy relevant questions can only be answered using other types of local evidence. Therefore, local evidence maps created using CAMHRED should be supplemented by other types of local evidence if available and relevant.

Chapter 6: Conclusion

Knowledge brokers in Cameroon involved at the interface between research and decision making have to produce syntheses of evidence which are relevant in a timely way. To do this, they need evidence from systematic reviews, guidelines and global health systems recommendations widely available through Cochrane and Campbell libraries, Health and Social Systems Evidence Databases etc. However, the scope of systematic reviews and guidelines is usually narrow[37,40] and global health system recommendations hardly account for contextual factors relevant at the national level.[15,16] Hence, local studies are vital to inform problem definition and implementation considerations during KT processes.[14,15,35]

Identifying local evidence in a systematic and comprehensive way takes time and resources which might act as deterrents to individual efforts for contextualization. Our local evidence mapping initiative solves this issue by systematically searching, reviewing and categorizing twenty years of peer-reviewed research from Cameroon. Centralizing local evidence in one online location (CAMHRED) will facilitate subsequent mapping initiatives like research syntheses, knowledge gap analysis etc.

Once local evidence has been identified, its quality and relevance to national priorities or to the KT processes underway is of utmost importance. Considerations here include the content of local evidence (research topics); the types of research (design); and the target population. If local evidence cannot be used, then resources allocated to producing research have been wasted. The generation of relevant and useful knowledge from research is a function of national health research systems (NHRS).

Research production is efficient when it addresses gaps in the literature and stakeholders' priorities. This study has shown that it is possible to use CAMHRED to create research gap maps to inform future research production on population health. CAMHRED can also be used to create gap maps to determine what research is needed locally to support health systems and policy decision-making. These gap maps can help generate the local evidence needed to contextualize global recommendations currently used to support national policy development. It should be noted that successfully achieving all this is also dependent on the other functions of the NHRS (stewardship, financing and capacity building).

Bibliography

1. Kirigia, J. M., Ota, M. O., Senkubuge, F., Wiysonge, C. S. & Mayosi, B. M. Developing the African national health research systems barometer. *Heal. Res. Policy Syst.* **14**, 53 (2016).
2. Pang, T. *et al.* Knowledge for better health - A conceptual framework and foundation for health research systems. *Bull. World Health Organ.* **81**, 815–820 (2003).
3. Hanney, S. R. & González-Block, M. A. Building health research systems: WHO is generating global perspectives, and who's celebrating national successes? *Heal. Res. Policy Syst.* **14**, 90 (2016).
4. Röhrig, B., Prel, J.-B. du, Wachtlin, D. & Blettner, M. Types of Study in Medical Research. *Dtsch. Aerzteblatt Online* **106**, 262–268 (2009).
5. Biomedical Research - CIHR. Available at: https://cihr-irsc.gc.ca/e/48804.html. (Accessed: 5th June 2020)
6. Alliance for Health Policy and Systems Research. Briefing Note 1: What is health policy and systems research and why does it matter? 1–7 (2007).
7. Hanney, S. R. & González Block, M. A. Building health research systems to achieve better health. *Heal. Res. Policy Syst.* **4**, 10 (2006).
8. Pantoja, T., Barreto, J. & Panisset, U. Improving public health and health systems through evidence informed policy in the Americas. *BMJ* **362**, k2469 (2018).
9. Kirigia, J. M., Ota, M. O., Motari, M., Bataringaya, J. E. & Mouhouelo, P. National health research systems in the WHO African Region: current status and the way forward. *Heal. Res. Policy Syst.* **13**, 61 (2015).
10. Kebede, D. *et al.* The way forward – narrowing the knowledge gap in sub-Saharan Africa to strengthen health systems. *Journal of the Royal Society of Medicine* **107**, 10–12 (2014).
11. McKee, M., Stuckler, D. & Basu, S. Where There Is No Health Research: What Can Be Done to Fill the Global Gaps in Health Research? *PLoS Med.* **9**, e1001209 (2012).
12. Hedt-Gauthier, B. L. *et al.* Stuck in the middle: a systematic review of authorship in collaborative health research in Africa, 2014–2016. *BMJ Glob. Heal.* **4**, e001853 (2019).
13. Jacobsen, K. H. Patterns of co-authorship in international epidemiology. *J. Epidemiol. Community Heal.* **63**, 665–669 (2009).
14. Dizon, J. M., Machingaidze, S. & Grimmer, K. To adopt, to adapt, or to contextualise? The big question in clinical practice guideline development. *BMC Res. Notes* **9**, 442 (2016).
15. Alvarez, E., Lavis, J. N., Brouwers, M. & Schwartz, L. Developing a workbook to support the contextualisation of global health systems guidance: a case study identifying steps and critical factors for success in this process at WHO. *Heal. Res. Policy Syst.* **16**, 19 (2018).
16. Lavis, J. N. *et al.* Guidance for Evidence-Informed Policies about Health Systems: Linking Guidance Development to Policy Development. *PLoS Med.* **9**, e1001186

(2012).
17. Rusakaniko, S. *et al.* Strengthening national health research systems in the WHO African Region – progress towards universal health coverage. *Global. Health* **15**, 50 (2019).
18. World Health Organisation & Regional Commitee for Africa. *Framework for the implementation of the Algiers Declaration on research for health in the African Region*. (2009).
19. World Health Organisation & Regional Commitee for Africa. *Research for health: a strategy for the African Region, 2016-2025: report of the Secretariat*. (2016).
20. Council on Health Research for Development (COHRED). *Alignment and Harmonisation in Health Research*. (2008).
21. Ministry of Public Health. *Health Analytical Profile: Cameroon*. (2016).
22. Republic of Cameroon & Ministry of Public Health. *Health Sector Strategy 2016-2027*. (2015).
23. Ongolo-Zogo, P. & Nsangou, M. M. *Connaissances sur la santé sexuelle et reproductive : Amélioration , évaluation et institutionnalisation de l'application des bases factuelles Rapport de l'étape d'identification des priorités*. (2018).
24. Ongolo-Zogo, P., Lavis, J. N., Tomson, G. & Sewankambo, N. K. Climate for evidence informed health system policymaking in Cameroon and Uganda before and after the introduction of knowledge translation platforms: a structured review of governmental policy documents. *Heal. Res. Policy Syst.* **13**, 2 (2015).
25. CDBPS-H. CDBPS-H: Presentation of the Centre. (2008). Available at: http://www.cdbph.org/index.php/en/presentation-du-centre-2/le-cdbps-h. (Accessed: 5th June 2020)
26. Ongolo-Zogo, P., Lavis, J. N., Tomson, G. & Sewankambo, N. K. Initiatives supporting evidence informed health system policymaking in Cameroon and Uganda: a comparative historical case study. *BMC Health Serv. Res.* **14**, 612 (2014).
27. Ongolo-Zogo, P., Lavis, J. N., Tomson, G. & Sewankambo, N. K. Assessing the influence of knowledge translation platforms on health system policy processes to achieve the health millennium development goals in Cameroon and Uganda: a comparative case study. *Health Policy Plan.* **33**, 539–554 (2018).
28. Mbuagbaw, L., Thabane, L. & Ongolo-Zogo, P. Setting the stage for randomized controlled trials in Cameroon: a workshop report. *Pan Afr. Med. J.* **15**, (2013).
29. Mbuagbaw, L., Thabane, L. & Ongolo-Zogo, P. Training cameroonian researchers on pragmatic knowledge translation trials: A workshop report. *Pan Afr. Med. J.* **19**, 190 (2014).
30. Mbuagbaw, L., Wiysonge, C. S., Nsagha, D. S., Ongolo-Zogo, P. & Pantoja, T. An introduction to systematic reviews and meta-analysis: a workshop report on promoting evidence based medical practice through capacity building in research synthesis. *Pan Afr. Med. J.* **8**, 15 (2011).
31. Mbuagbaw, L. & Cockburn, L. Challenges and opportunities in country-specific research synthesis: a case study from Cameroon. *Syst. Rev.* **6**, 159 (2017).
32. Schünemann, H. J. *et al.* GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations:

GRADE-ADOLOPMENT. *J. Clin. Epidemiol.* **81**, 101–110 (2017).
33. Dizon, J. M. *et al.* Barriers and enablers for the development and implementation of allied health clinical practice guidelines in South African primary healthcare settings: a qualitative study. *Heal. Res. Policy Syst.* **15**, 79 (2017).
34. Lewin, S. *et al.* SUPPORT Tools for evidence-informed Policymaking in health 11: Finding and using evidence about local conditions. *Heal. Res. Policy Syst.* **7**, S11 (2009).
35. Moat, K. A., Lavis, J. N. & Abelson, J. How Contexts and Issues Influence the Use of Policy-Relevant Research Syntheses: A Critical Interpretive Synthesis. *Milbank Q.* **91**, 604–648 (2013).
36. Ray, M., Wallace, L., Mbuagbaw, L. & Cockburn, L. Functioning and disability in recent research from Cameroon: a narrative synthesis. *Pan Afr. Med. J.* **27**, (2017).
37. Bragge, P. *et al.* The Global Evidence Mapping Initiative: Scoping research in broad topic areas. *BMC Med. Res. Methodol.* **11**, 92 (2011).
38. Saran, A. & White, H. Evidence and gap maps: a comparison of different approaches. *Campbell Syst. Rev.* **14**, 1–38 (2018).
39. Althuis, M. D. & Weed, D. L. Evidence mapping: Methodologic foundations and application to intervention and observational research on sugar-sweetened beverages and health outcomes. *Am. J. Clin. Nutr.* **98**, 755–768 (2013).
40. Miake-Lye, I. M., Hempel, S., Shanman, R. & Shekelle, P. G. What is an evidence map? A systematic review of published evidence maps and their definitions, methods, and products. *Syst. Rev.* **5**, 28 (2016).
41. Haddaway, N. R. *et al.* EviAtlas: a tool for visualising evidence synthesis databases. *Environ. Evid.* **8**, 22 (2019).
42. Arksey, H. & O'Malley, L. Scoping studies: towards a methodological framework. *Int. J. Soc. Res. Methodol.* **8**, 19–32 (2005).
43. Levac, D., Colquhoun, H. & O'Brien, K. K. Scoping studies: advancing the methodology. *Implement. Sci.* **5**, 69 (2010).
44. Ongolo-Zogo, C., Nsangou, M. M. & Ongolo-Zogo, P. Sexual and Reproductive Health in Cameroon: A thematic prioritization process. in *Health Research Methods, Evidence and Impact Research Day* (2019).
45. IBM Corp. IBM SPSS Statistics for MacIntosh. (2017).
46. Institut National de la Statistique. *Projection démographique et estimation des cibles prioritaires des différents programmes et interventions de santé*. (2016).
47. Evans, D. Hierarchy of evidence: A framework for ranking evidence evaluating healthcare interventions. *J. Clin. Nurs.* **12**, 77–84 (2003).
48. Burns, P. B., Rohrich, R. J. & Chung, K. C. The levels of evidence and their role in evidence-based medicine. *Plast. Reconstr. Surg.* **128**, 305–310 (2011).
49. Kyu, H. H. *et al.* Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Study 2017. *Lancet* **392**, 1859–1922 (2018).
50. Institute for Health Metrics and Evaluation. Country Profile (Cameroon). *Global Burden of Disease (GBD) 2017* (2018). Available at:

http://www.healthdata.org/cameroon. (Accessed: 9th June 2020)
51. Abdul Ghaffar, Téa Collins, Stephen A Matlin & Sylvie Olifson. *The 3D CombineD ApproACh mATrix: An improved tool for setting priorities in reseArch for heAlth*. (2009).
52. Lavis, J. N., Permanand, G., Oxman, A. D., Lewin, S. & Fretheim, A. SUPPORT Tools for evidence-informed health Policymaking (STP) 13: Preparing and using policy briefs to support evidence-informed policymaking. *Chinese Journal of Evidence-Based Medicine* **10**, 507–513 (2010).
53. Moat, K. A. EVIDENCE BRIEFS AS A MECHANISM FOR KNOWLEDGE TRANSFER AND EXCHANGE: ASSESSING VIEWS ABOUT, EXPERIENCES WITH, AND INFLUENCES OF POLICY-RELEVANT RESEARCH SYNTHESES IN LOW- AND MIDDLE-INCOME COUNTRIES. (McMaster University, 2014).
54. Community-directed interventions for priority health problems in Africa: results of a multicountry study. *Bull. World Health Organ.* **88**, 509–518 (2010).
55. Nsangou, M. M., Bonono, R. C. & Ongolo-Zogo, P. *Quelles données probantes pour éclairer le choix des stratégies de santé sexuelle et Reproductive des adolescents au Cameroun ? Note d'Information Stratégique de SURe-KT*. (2018).
56. WHO - Department of Child and Adolescent Health and Development. *Orientation Programme on Adolescent Health for Health-care Providers.* (2018).
57. Ministère de la Santé Publique. *Dossier d'investissement pour l'amélioration de la santé de la reproduction, santé de la mère, du nouveau-né, de l'enfant et de l'adolescent/jeune au Cameroon*. (2017).
58. Noubiap, J. J. N. *et al.* Prevalence and correlates of HIV-risky sexual behaviors among students attending the Medical and Social Welfare Center of the University of Maroua, Cameroon Public Health. *BMC Res. Notes* **8**, 1–11 (2015).
59. Mbu *et al.* The dilema of vesico-vaginal fistula in the Adamaoua province of Cameroon: A report of four cases and literature review. *Clin. Mother Child Heal.* **3**, (2006).
60. Tebeu, P. M. *et al.* Knowledge, attitude and perception about obstetric fistula by Cameroonian women. A clinical survey conducted in Maroua, the capital of far north province of Cameroon. *Prog. en Urol.* **18**, 379–389 (2008).
61. Tebeu, P. M. *et al.* Étude comparative du résultat de la cure des fistules vésico-vaginales avec et sans interposition du lambeau de Martius : une expérience camerounaise. *Prog. en Urol.* **25**, 1225–1231 (2015).
62. Ngaroua, A., Dah'Ngwa, D., Yaouba, D. & Eloundou, N. J. Clinical Features and Management of Obstetric Fistula at the Protestant Hospital of Ngaoundéré (Cameroon). *Heal. Sci. Dis.* **20**, 50–54 (2019).
63. Nkwabong, E. & Fomulu, J. N. Urethrovaginal fistula following vaginal prolapse of a pedunculated uterine myoma: A case report. *J. Med. Case Rep.* **11**, 292 (2017).
64. Tebeu, P. M. *et al.* Surgical outcome following treatment of obstetric vesicovaginal fistula among HIV-positive and HIV-negative patients in Cameroon. *Int. J. Gynecol. Obstet.* **125**, 168–169 (2014).
65. Tebeu, P. M. *et al.* Risk factors for obstetric vesicovaginal fistula at University Teaching Hospital, Yaoundé, Cameroon. *Int. J. Gynecol. Obstet.* **118**, 256–258 (2012).

66. Tebeu, P. M., de Bernis, L., Doh, A. S., Rochat, C. H. & Delvaux, T. Risk factors for obstetric fistula in the Far North Province of Cameroon. *Int. J. Gynecol. Obstet.* **107**, 12–15 (2009).
67. Sanou, S. *et al.* Condom perception and prevention of HIV/AIDS infection in Cameroon: appraisal of knowledge, attitudes and practices among level one students of the University of Dschang. *Ig. Sanita Pubbl.* **69**, 183–194 (2013).
68. Mekeme, M. *et al.* UP-01.076 Use of Vaginal Flap Neighbourhood for Improving Continence in Cervical Fistula, Cervico-Urethral and Urethral-Vaginal Obstetrical Origin. *Urology* **78**, S210 (2011).
69. Tebeu, P. M. *et al.* Case report hospital of Maroua-Cameroon. *Heal. Sci. Dis.* **5**, 1–7 (2010).
70. Tebeu, P. M. *et al.* Connaissances, Attitudes et Pratiques des Professionnels de Santé des Districts de Santé du Koung-Khi et De la Mifi à l'Ouest-Cameroun Vis-À-Vis. *Heal. Sci. Dis.* 45–51 (2019).
71. Walsh, A. *et al.* The role of the traditional leader in implementing maternal, newborn and child health policy in Malawi. *Health Policy Plan.* **33**, 879–887 (2018).
72. Ajong, A. B. *et al.* Determinants of unmet need for family planning among women in Urban Cameroon: A cross sectional survey in the Biyem-Assi Health District, Yaoundé. *BMC Womens. Health* **16**, 1–8 (2016).
73. Mankaa, W. E., Kollo, B. & Doh, A. S. Knowledge, attitudes and practice of contraception amongst secondary school students in Yaounde, Cameroon: a study of perception differences between males and females. *Clin. Mother Child Heal.* **2**, 365–368 (2005).
74. Tarkang, E. E. Sexual risk behaviours of high school female learners in Mbonge subdivision of rural Cameroon. *Pan Afr. Med. J.* **20**, 1–10 (2015).
75. Tarkang, E. Condom Use and Number of Sexual Partners among Secondary School Female Students in an Urban City of Cameroon. *Rwanda J. Heal. Sci.* **2**, 30 (2013).
76. Tarkang, E. E., Pencille, L. B., Dadah, E., Nzegge, M. M. & Komesuor, J. Highly prevalent at-risk sexual behaviours among out-of-school youths in urban Cameroon. *Pan Afr. Med. J.* **30**, 1–12 (2018).
77. Cumber, S. N. & Tsoka-Gwegweni, J. M. Knowledge and practice of condom use as well as perceived barriers among street adolescents in Cameroon. *South. Afr. J. HIV Med.* **17**, 1–7 (2016).
78. Rwenge, J. M. Comportements Sexuels parmi les Adolescents et Jeunes en Afrique subsaharienne Francophone et Facteurs Associés. *Afr. J. Reprod. Health* **17**, 49–66 (2013).
79. Yangsi, T. T., Florent, F. Y., Ngole, M. E. & Nelson, F. Modern Contraceptive Choice Among Patients Seen at the "Cameroon National Planning Association for Family Welfare" Clinic Yaoundé. *Clin. Med. Insights Reprod. Heal.* **11**, 1–6 (2017).
80. Tarkang, E. E. Factors associated with perception of risk of contracting HIV among secondary school female learners in Mbonge subdivision of rural Cameroon. *Pan Afr. Med. J.* **17**, 1–9 (2014).
81. Morris, L. *et al.* Factors associated with inconsistent condom use in adolescents

with negative or unknown HIV status in Northwest Cameroon. *AIDS Care - Psychol. Socio-Medical Asp. AIDS/HIV* **26**, 1440–1445 (2014).
82. Foumane, P. *et al.* Sexual activity of adolescent school girls in an urban secondary school in cameroon. *J. Reprod. Infertil.* **14**, 85–89 (2013).
83. Van Rossem, R. & Meekers, D. Perceived social approval and condom use with casual partners among youth in urban Cameroon. *BMC Public Health* **11**, 632 (2011).
84. Rwenge, M. Sexual Risk Behaviors among Young People in Bamenda, Cameroon. *Int. Fam. Plan. Perspect.* **26**, 118–123 (2000).
85. Meekers, D., Agha, S. & Klein, M. The impact on condom use of the '100% Jeune' social marketing program in Cameroon. *J. Adolesc. Heal.* **36**, (2005).
86. Pilapil, M. *et al.* Retrospective analysis of the prevalence of and factors associated with condom use among young HIV-infected women in Cameroon. *SAGE Open Med.* **4**, 1–6 (2016).
87. Kongnyuy, E. J. *et al.* A survey of knowledge, attitudes and practice of emergency contraception among university students in Cameroon. *BMC Emerg. Med.* **7**, 7 (2007).
88. Lagarde, E. *et al.* Educational level is associated with condom use within non-spousal partnerships in four cities of sub-Saharan Africa. *AIDS* **15**, 1399–1408 (2001).
89. Edietah, E. E. *et al.* Contraceptive use and determinants of unmet need for family planning; A cross sectional survey in the North West Region, Cameroon 11 Medical and Health Sciences 1117 Public Health and Health Services. *BMC Womens. Health* **18**, 1–8 (2018).
90. Nansseu, J. R. N., Nchinda, E. C., Katte, J.-C., Nchagnouot, F. M. & Nguetsa, G. D. Assessing the knowledge, attitude and practice of family planning among women living in the Mbouda health district, Cameroon. *Reprod. Health* **12**, 92 (2015).
91. Meekers, Dominique, Klein & Megan. Determinants of condom use among young people in urban Cameroon. *Stud. Fam. Plann.* **33**, 335–346 (2002).
92. Meekers, D., Klein, M. & Foyet, L. Patterns of HIV Risk Behavior and Condom Use among Youth in Yaoundé and Douala, Cameroon. *AIDS Behav.* **7**, 413–420 (2003).
93. Lagarde, E. *et al.* Condom use and its association with HIV/sexually transmitted diseases in four urban communities of sub-Saharan Africa. *AIDS* **15**, S71–S78 (2001).
94. Weir, S. S., Roddy, R. E., Zekeng, L. & Ryan, K. A. Association between condom use and HIV infection: A randomised study of self reported condom use measures. *J. Epidemiol. Community Health* **53**, 417–422 (1999).
95. Speizer *et al.* An evaluation of the 'Entre Nous Jeunes' peer-educator program for adolescents in Cameroon. *Stud. Fam. Plann.* **32**, 339–351 (2001).
96. Behrman, J. A., Wright, K. Q., Grant, M. J. & Soler-Hampejsek, E. Trends in Modern Contraceptive Use among Young Adult Women in sub-Saharan Africa 1990 to 2014. *Stud. Fam. Plann.* **49**, 319–344 (2018).
97. Sidze, E. M. & Defo, B. K. Effects of parenting practices on sexual risk-taking

among young people in Cameroon. *BMC Public Health* **13**, 616 (2013).
98. Tarkang, E. E. Perceived family support regarding condom use and condom use among secondary school female students in Limbe urban city of Cameroon. *BMC Public Health* **14**, 1–7 (2014).
99. Mbopi-Keou, F. X. *et al.* Facteurs de risque de l'infection par le VIH dans le district de santé de Meyomessala au Cameroun. *Pan Afr. Med. J.* **18**, 1–9 (2014).
100. Meekers, D. & Klein, M. Understanding gender differences in condom use self-efficacy among youth in urban Cameroon. *AIDS Educ. Prev.* **14**, 62–72 (2002).
101. Sanou Sobze, M. *et al.* Poor Acceptability of Female Condom by Young Cameroonians: an Unmet Programmatic Agenda for HIV Prevention. *Ig. Sanita Pubbl.* **72**, 191–201 (2016).
102. Nubed, C. K. & Akoachere, J. F. T. K. Knowledge, attitudes and practices regarding HIV/AIDS among senior secondary school students in Fako Division, South West Region, Cameroon. *BMC Public Health* **16**, 1–10 (2016).
103. Dupas, P., Huillery, E. & Seban, J. Risk information, risk salience, and adolescent sexual behavior: Experimental evidence from Cameroon. *J. Econ. Behav. Organ.* **145**, 151–175 (2018).
104. Donatus, L., Sama, D. J., Tsoka-Gwegweni, J. M. & Cumber, S. N. Factors associated with adolescent school girl's pregnancy in kumbo east health district north west region Cameroon. *Pan Afr. Med. J.* **31**, 1–11 (2018).
105. Mboua, C. P. & Touko, A. Vulnérabilité psychosociale et situation épidémiologique du VIH/sida chez les personnes handicapées auditives dans quatre villes du Cameroun. *Med. Sante Trop.* **26**, 391–395 (2016).
106. Alio, A. P. *et al.* Association between intimate partner violence and induced abortion in Cameroon. *Int. J. Gynecol. Obstet.* **112**, 83–87 (2011).
107. Auvert, B. *et al.* Ecological and individual level analysis of risk factors for HIV infection in four urban populations in sub-Saharan Africa with different levels of HIV infection. *AIDS* **15**, S15–S30 (2001).
108. Ferry, B. *et al.* Comparison of key parameters of sexual behaviour in four African urban populations with different levels of HIV infection. *AIDS* **15**, S41–S50 (2001).
109. Kuate-Defo & B. L'évolution de la nuptialité des adolescentes au Cameroun et ses déterminants. *Population (Paris).* **55**, 941–973 (2000).
110. Billong, S. C. *et al.* Prévalence de l ' Infection à VIH et Comportements Sexuels chez les Hommes Homosexuels dans la Ville de Yaoundé au Cameroun . **14**, 1–9 (2013).
111. Kongnyuy, E. J. & Wiysonge, C. S. Alcohol use and extramarital sex among men in Cameroon. *BMC Int. Health Hum. Rights* **7**, 1–7 (2007).

Appendix 1: Exclusion Criteria

Table 1. 1 : Reasons for Exclusion

Exclusion criteria	N (total = 1165)
Population not Cameroon	597
Not Health or health related outcomes	119
Animal based study without human samples	29
Editorial/ Letter to the Editor/ Commentary/ Book/ Report/ Protocol	320
Plant based study without human samples	30
Laboratory based study without human samples	22
Systematic/Scoping/Literature Review with articles from Cameroon among others	20
No abstract or full text available	9
Not English / French	8
Master or Doctoral Thesis	7
Published before 1999	4

Appendix 2: Evidence Maps

Table 2. 1 Evidence map on contraceptive prevalence among adolescents in Cameroon (Group A)

Author, Year	Language	Access	Study Period	Region	Setting	Population Description	Study Design	Contraceptive Use Measure
Ajong, 2016[72]	EN	OA	2015	Centre	(urban)	18 - 49 women	CSS	Use (Yes or No)
Mankaa 2005[73]	EN	OA	2000-2001	Centre	(urban)	10 - 19 Secondary students	CSS	Ever Used
Tarkang 2015[74]	EN	OA	NR	South West	(rural)	11-25 Students	CSS	Use during first sexual act Use during last sexual act Frequency of Use
Tarkang 2013[75]	EN	OA	NR	South West	(urban)	11-25 Students	CSS	Use during first sexual act Use during last sexual act Frequency of Use
Tarkang, 2018[76]	EN	OA	2013	South West	(urban)	15-24 Out of School Youth	CSS	Use during first sexual act Use during last sexual act Frequency of Use
Cumber, 2016[77]	EN	OA	2015	Centre Littoral North West	(urban),	12-17 Out of School Adolescents	CSS	Use during first sexual act Use during last sexual act Ever Used
Rwenge, 2013[78]	FR	OA	NC	N/R	NR	15 -24 adolescents and youth	SA (DHS)	Use during first sexual encounter Use during last high-risk sexual act Use during last pre-marital sexual act
Yangsi, 2017[79]	EN	OA	2010-2011	Centre	(urban)	15-58 patients at a FP clinic	CSS	Use (Yes or No)
Tarkang 2014 (b) [80]	EN	OA	2012	South West	(urban)	16 -24 female secondary students	CSS	Use during first sexual act Use during last sexual act Ever Used
Morris 2014[81]	EN	OA	2011	North West	(urban) (rural)	12-26 years	CSS	Use during last sexual act Ever Used
Foumane 2013[82]	EN	OA	2011	Centre	(urban)	10 - 19 female secondary school students	CSS	Frequency of use
Van Rossem 2011[83]	EN	OA	2000-2002	Centre) and Littoral (Urban)	(urban	15 - 24 adolescents and youth	CSS	Frequency of Use
Rwenge 2000[84]	EN	OA	1995	North West	Urban	12-25 adolescents and youth	CSS	Use (Yes or No)
Meekers 2005[85]	EN		2000-2002	Central and Littoral	Urban	15-24 adolescents and youth	CSS	Use during last sexual act Ever Used Frequency of Use
Pilapil 2016[86]	EN	OA	NR	North West	Rural	17-26 HIV positive women	CSS	Frequency of Use
Kongnyuy 2007(a)[87]	EN	OA	NR	South West	Urban	16-40 university Students	CSS	Ever used
Lagarde 2001 (a)[88]	EN	OA	NR	Centre	(Urban)	15-49	CSS	Frequency of Use
Edietah, 2018[89]	EN	OA	2016	North West	(rural)	15-49	CSS	Current use Use of atleast one contraceptive method since first sexual contact
Nansseu 2015[90]	EN	OA	2010	West	(rural)	18-58 women	CSS	Current use
Meekers 2002[91]	EN	OA	2000	Centre and Littoral	Urban	15 - 24 adolescents and youth	CSS	Use during last sexual act Ever Used

								Frequency of Use
Meekers 2003[92]	EN		2000-2002	Centre and Littoral	Urban	15 – 24 adolescents and youth	CSS	Ever Used Frequency of Use
Lagarde 2001 (b)[93]	EN		NC	Centre	(Urban)	15-49	CSS	Ever Used Frequency of Use
Weir 1999[94]	EN	OA	NR	Centre	Urban)	18 - 45 Female sex workers	CSS	Current use Ever Used Use with last client Use with last non-client Use in past 6months/ last 10 acts/ last 2 weeks
Speizer 2001[95]	EN	R	NC	Centre and Littoral	(urban)	10-25 adolescents and youth	NRSI	Use during last sexual act
Behrman 2018[96]	EN	R	NR		NR	15-24 women	SA (DHS)	Ever used

Key : EN : English; FR : French; OA : Open Access; NC: Not clear; NR : Not reported; CSS: Cross sectional study; SA(DHS) : secondary analysis of demographic and health survey data

Table 2. 2 : Evidence map on contraceptive prevalence among adolescents in Cameroon (Group B)

Author, Year	Language	Access	Study Period	Region	Setting	Population Description	Study Design	Contraceptive Use Measure	Study Focus
Sidze 2013[97]	EN	OA	NC	West	rural	(15-24).	CSS	Frequency of Use	Effect of Parenting Practices on sexual risk taking
Mosoko 2004	EN	OA	1998	Centre	(Urban)	15 >	CSS	Current Use	Induced Abortion among women attending ANC
Tarkang, 2014 (a)[98]	EN	OA	NR	South west	(rural)	11 – 24 female secondary school students	CSS	Use during first sexual act Use during last sexual act Frequency of Use	Perception of HIV risk
Mbopi Keou, 2014[99]	FR	OA	2011	South	rural	Greater than 15		Use during last sexual act Ever Used	Risk factors for HIV
Meekers 2002[100]	EN	R	2000	Centre & Littoral		15 – 24	CSS	Ever asked for contraceptive use Comfortable asking for contraceptive use	Gender differences in Condom Self efficacy
Sanou Sobze, 2016[101]	EN	OA	2011	West	urban	15-45 university students	CSS	Ever used	HIV/AIDS perceptions and acceptability of female condoms
Nubed, 2016[102]	EN	OA	2014	South West	urban and rural	13-24 secondary school students	CSS	Use during last 3 sexual acts	Knowledge, attitudes and practices

									regarding HIV/AIDS
Noubiap, 2015[58]	EN	OA	NC	Far North		17-50 university students	CSS	Use during first sexual act Frequency of use with new sexual partner	Prevalence and Correlates of HIV-risky behaviours
Dupas ,2018[103]	EN	OA	NR	Centre South West	(All urban	secondary school students	RCT	Use during first sexual act Ever Used	Effect of a school-based sex education intervention delivered by teachers and consultants for HIV/AIDS prevention
Arcand 2010	EN	R	NR	NR	NR	12-17 secondary students	Other	Use during last sexual act	Effect of Teacher training and HIV/AIDs prevention on knowledge, attitudes and sexual behaviours
Donatus 2018[104]	EN	OA	NC	North West	(rural)	15-19 pregnant students	CSS	Ever used	Determinants of adolescent pregnancy
Mboua, 2016[105]	FR	OA	NR	Littoral, South West, West	Urban	12-49	CSS	Use during last sexual act Ever used Frequency of Use	HIV Risk among Persons with Disability
Alio 2010[106]	EN	R	NR	Nationwide		15 >	SD DHS 2004	Current Use	Relationship between IPV and induced abortion
Kongnyuy 2008	EN	OA	NR	Nationwide		15-49	SD DHS	Ever used Current Use	HIV prevalence
Auvert 2001[107]	EN	OA	NC	Centre	(Urban)	15-49	CSS	Frequency of use with non-spousal partner	Ecological and Individual Level risk factors for HIV infection
Ferry 2001[108]	EN	OA	NC	Centre	(Urban)	15-49	CSS	Frequency of use with non-spousal partner	Sexual behaviors as determinant of HIV infection
Kuate Defo 2000[109]	FR	OA	NR	Nationwide		20-34	SD DHS	Ever used	Determinants of Early marriage
Billong, 2013[110]	FR	OA	2011	Centre	(urban)	18>	CSS	Use during last sexual act Frequency of Use	Prevalence of HIV infection among men who have sex with men
Kongnyuy 2007b[111]	EN	OA	NR	Nationwide		15-59	SD DHS 2004	Use during last sexual act	Alcohol Use and ExtraMarital Sex among men in Cameroon

Key : EN : English; FR : French; OA : Open Access; NC: Not clear; NR : Not reported; CSS: Cross sectional study; SA(DHS) : secondary analysis of demographic and health survey data

Table 2. 3 : Evidence gap map on funding and international collaboration

Funding Source	Cameroonian as first author		Non-Cameroonian as first author	
	International Collaboration	No International Collaboration	International Collaboration with Cameroonian authors	No International Collaboration
Public (Government, University, National Agencies)	✓	✓	✓	✓✓
Private			✓	✓
Self-Funded		✓✓		
None		✓✓		✓
Industry				
Not Reported	✓✓✓ ✓✓✓	✓✓✓✓ ✓✓✓	✓✓✓	✓✓✓✓ ✓✓✓