2021
ANNUAL REPORT

KINTAMPO HEALTH RESEARCH CENTRE

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ACRONYMS/ABBREVIATIONS

ACT	Artemisinin-based Combination Therapy
AEs	Adverse Events
AESI	Adverse Events of Special Interest
ALT	Alanine amino transferase
AMR	Antimicrobial Resistance
ANC	Antenatal Clinic
AST	Aspartate amino transferase
CEM-gH	Consortium to Evaluate Mosquirix in Ghana
CHPS	Community-Based Health Planning and Services
CO	Carbon Monoxide
COPD	Chronic Obstructive Pulmonary Disease
CTCAE	Common Terminology Criteria for Adverse Events
DHFR	Dihydrofolate reductase
DHPS	Dihydropteroate synthase
DNA	Deoxyribonucleic Acid
DSMb	Data Safety and Monitoring Board
EPI	Expanded Programme on Immunization
FDA	Food and Drugs Authority
FEV1	Forced Expiratory Volume in 1second
gbS	Group B streptococcus
gCS	Ghana Cookstove Study
gHS	Ghana Health Service
gHS ERC	Ghana Health Service Ethical Review Committee
gRAPHS	Ghana Randomized Air Pollution and Health Study
gRIP	Group B streptococcus (GBS), Respiratory syncytial virus (RSV) Influenza, and Pertussis
gSK	GlaxoSmithKline
HAP	Household Air Pollution
HAPIT	Household Air Pollution Intervention Tools
IPTp-SP	Intermittent preventive treatment in pregnancy using sulphadoxine-pyrimethamine
ISAAC	International Study of Asthma and Allergies in Childhood
KHRC	Kintampo Health Research Centre
KHRC IEC	Kintampo Health Research Centre Institutional Ethics Committee
KNUST	Kwame Nkrumah University of Science and Technology
LbW	Low Birth Weight
LPg	Liquified Petroleum Gas
LSHTM	London School of Hygiene and Tropical Medicine
NAAT	Nucleic Acid Amplification Test
NC/NT-SAE	Non- communicable and Traumatic Serious Adverse Events
NCDs	Non-communicable Diseases
NHLbI	National Heart Lung Blood Institute
NIH	National Institute of Health
PATH	Program for Appropriate Technology in Health
PE/E	Preeclampsia/eclampsia
PF	Practice Facilitation
PM2.5	Particulate Matter (PM) that have a diameter of less than 2.5 micrometers
PrCr	Protein Creatinine
RE-AIM	Reach Effectiveness Adoption Implementation Maintenance Framework
RSV	Respiratory syncytial virus
RTS,S/AS01E	Malaria Vaccine
SAbAUSE	Sociocultural determinants of antibiotic access and use
SEforALL	Sustainable Energy for All
SP	Sulphadoxine Pyrimethamine
SSA	Sub-Saharan Africa
TASSH	Task Strengthening Strategy for Hypertension Control
UC	Usual Care
WHO	World Health Organization

MISSION, VISION, CORE VALUES

Mission

Use our expertise and core values to:

- conduct public health and biomedical research that will influence policy direction and programme implementation that seek to significantly improve well-being and reduce ill-health.
- at all times be committed to the conduct of high-quality research that is ethical.
- ensure integrity of data generated.

Vision

Be a centre of excellence that conducts high quality research to shape local and international health policy, programs and practices.

Core Values

- Team work
- Excellence
- Collaboration
- Capacity development
- Integrity
- Accountability
- Innovation
- Equity
- Diversity

Guiding principles

- Population based research
- High quality and cost-effective research
- Strategic partnerships
- Formidable data management
- Inter sectorial collaboration
- Evidence-based practice.
- Publications and dissemination of findings.

Epidemiology study of malaria transmission intensity in Sub-Saharan Africa

Investigators

Kwaku Poku Asante, Seth Owusu-Agyei, Seyram Kaali, Owusu Boahen, Samuel Ekow Harrison and Prince Agyapong Darko

Funder:
GlaxoSmithKline Biologicals

Collaborator:
IQVIA

Project start date:
20 August, 2014

Project end date:
31 December, 2023

Study duration:

Background
This epidemiology study (EPI-MAL-005) is planned to run in parallel with two conservative safety monitoring vaccine studies (EPI-MAL-002 and EPI-MAL-003) which will monitor incidence rate of protocol defined adverse events of specific interest (AESI) and non-communicable and traumatic serious adverse events (NC/NT-SAE).

It is a multi-centric, epidemiology longitudinal cross-sectional study at centres in Sub-Saharan Africa that are participating in GSK's EPI-MAL-002 and EPI-MAL-003 studies. This study will involve up to 10 annual cross sectional surveys during malaria peak transmission.
Objectives:

- To obtain longitudinal estimates of P. falciparum parasite prevalence in order to characterise malaria transmission intensity in a standardised way at centres conducting the EPI-MAL-002 and EPI-MAL-003 studies before and after the introduction of the malaria vaccine RTS,S/AS01E in sub-Saharan Africa.
- To obtain longitudinal estimates of the use of malaria control interventions in centres conducting the EPI-MAL- 002 and EPI-MAL-003 studies before and after the introduction of the malaria vaccine RTS,S/AS01E in sub- Saharan Africa

Brief methodology:
A multi-centric, epidemiology longitudinal cross-sectional study at centre in Sub- Saharan Africa that are participating in GSK's EPI-MAL-002 and EPI-MAL-003 studies.

This study would involve up to 10 annual cross-sectional surveys during malaria peak transmission.

There would be no study vaccine administered in this epidemiology study. Subjects six months to <10 years of age are involved in the study. All medications that may influence malaria parasitemia within 14 days prior to each survey are being recorded. Axillary body temperature of all subjects at the time of the survey are being recorded. A capillary blood sample are being obtained for evaluation of malaria infection by blood slide and Nucleic Acid Amplification Test (NAAT). In the event of measured fever at the time of the visit (axillary temperature ≥37.5°C) or fever reported in the last 24 hours or other symptoms/signs of clinical malaria, a rapid diagnostic test (RDT) will be conducted. If the RDT is positive, treatment will be given according to National guidelines. Should a subject for whom no RDT was required is identified as being parasite positive following microscopy, National guidelines should be followed for clinical management of the subject. Microscopy and NAAT are been used to evaluate the level of asexual and sexual parasitemia. Serious adverse events (SAEs) associated with the study procedure (capillary blood sampling) are also being collected.

Expected outcome:
To obtain longitudinal estimates of P. falciparum parasite prevalence in order to characterise malaria transmission intensity in a standardised way at centres conducting the EPI-MAL-002 and EPI-MAL-003 studies and also lon-

gitudinal estimates of the use of malaria control interventions in centres conducting the EPI-MAL-002 and EPI-MAL-003 before and after the introduction of the malaria vaccine RTS,S/AS01E in sub-Saharan Africa.

Progress so far:
The study is progressing well. In all 6600 participants have been recruited into eight annual surveys. The team would conduct additional two annual surveys.

Publication: Estimating Annual Fluctuations in Malaria Transmission Intensity and in the use of Malaria Control Interventions in Five Sub-Sahara Africa Countries Am. J. Trop. Hyg., 2020

A prospective study to estimate the incidence of diseases specified as adverse events of special interest, of other adverse events leading to hospitalisation or death, and of meningitis in infants and young children in Sub-Saharan Africa prior to implementation of the RTS,S/AS01E candidate vaccine.

Investigators

Kwaku Poku Asante, Seth Owusu-Agyei, Owusu Boahen, Mathilda Tivura and Samuel Ekow Harrison.

Funder:

GlaxoSmithKline Biologicals

Collaborator:

IQVIA

Project start date:

20 August, 2014

09 February 2016

Project end date:

: June 2022

Study duration:

Background:

GSK Biologicals is developing a pre-erythrocytic P. falciparum malaria vaccine, RTS,S/AS01E, for routine immunisation of infants and children living in malaria-endemic countries of Sub-Saharan Africa. RTS,S/AS01E will be the first vaccine for the prevention of malaria. This will be the first AS01-adjuvanted vaccine used in the paediatric population. Most of these SSA countries have no baseline incidence data on rare diseases such as those that may be reported as Adverse Events (AEs) following vaccination. Lack of baseline data would compromise the interpretation of any Adverse Event detected following the implementation of the RTS,S/AS01E vaccine in the paediatric population.

GSK Biologicals has developed a set of studies to address this paucity of data, and to ensure optimal collection of information related to the occurrence of those events before and after implementation of the RTS,S/AS01E vaccine. This is one of those studies.

Objectives:

- To estimate the incidence of protocol-defined Adverse Event of Specific Interest (AESI) in a setting without existing surveillance systems designed to capture those rare events.
- To estimate the incidence of other Adverse Events leading to hospitalisation or death, meningitis and malaria morbidity and mortality at the same time.

In order to have a synergy with WHO pilot implementation, the study size has been reduced to 30,000 children.

Approximately 30,000 children have been recruited within the collaborating study site into the active surveillance. These participants were been actively followed up through home visits and through continuous monitoring of outpatient visits and hospitalizations at all health care facilities in the study areas. The study uses multiple data source, to increase opportunity to capture the event of interest. Among the 30,000 children, approximately 15, 000 children were enroled in the 6-12 weeks group and approximately 15,000 children were enroled in the 5-17 months group. Kintampo site recruited 11,950 children. The site would end the study on 30 June 2022.

Expected outcome:

To estimate the incidence of Adverse Events of Specific Interest, and of other Adverse Events leading to hospitalisation or death, and

an etiology confirmed meningitis in children prior to implementation of RTS, S/AS01E.

Progress so far:

The study went well. In all eleven thousand nine hundred and fifty (11,950) children have been enroled into the study. Eight thousand nine hundred (8900) children have been enroled into the active surveillance and three thousand and fifty (3050) into enhance hospitalisation cohort respectively. The enrolment into active surveillance ended in March 2018 and those in the enhance hospitalisation cohort ended in March 2019. However, we would continue with follow up visits till June 2022.

Malaria Vaccine Pilot Evaluation (MVPE)

An evaluation of the cluster-randomised pilot implementation of RTS,S/AS01 through routine health systems in Ghana. A Post-Authorisation Observation Study

Investigators

Dr. Kwaku Poku Asante, Dr Abraham Oduro, Prof. Col. Edwin Andrews Afari (rtd), Prof. Tsiri Agbenyega, Prof. Daniel Ansong, Dr Thomas Gyan, Prof. Fred Binka, Prof. Kwadwo Koram, Dr. Abraham Hodgson

Funder:
World Health Organisation (WHO)

Collaborator:
: Ministry of Health/Ghana Health Service, NMCP, EPI, FDA, PATH, Regional and District Health Directorates, Sentinel hospitals, chiefs and opinion leaders

Project start date:
27 September 2018

Project end date:
31 March 2023

Study duration:
5 years

Background
On 1st May, 2019, the Consortium to Evaluate Mosquirix in Ghana (CEM GH) coordinated by Kintampo Health Research Centre of the Research and Development Division of Ghana Health Service in collaboration with the Ministry of Health/Ghana Health Service and World Health Organisation (WHO) started the pilot evaluation of the RTS,S Malaria Vaccine in Ghana.

The 30th day of November 2021, marked thirty-one (31) months of active evaluation in six regions of Ghana. This milestone came at a difficult time as we confronted the threat of the COVID-19 pandemic.

Objectives
The project is evaluating the impact of RTS,S by collecting data to answer the following questions:

1. What is the feasibility of administering four doses of RTS,S and what is its impact on uptake of other routine immunisations and use of other malaria control measures (Feasibility module)?
2. Are there any safety signals that can be identified in the large administration of RTS,S (Safety module)?
3. What is the impact of administration on all-cause mortality among children (Mortality modules)?

Study design
This is an evaluation of the pilot implementation of RTS,S/AS01 by the Ministry of Health/Ghana Health Service using a cluster-randomised design, with some areas (Districts) introducing RTS,S/AS01 at the beginning of the programme and other areas, initially without RTS,S/AS01, acting as comparison areas.

General overview and update
On 6th October, 2021, the Director General of WHO, Dr Tedros Adhanom announced the WHO recommendations for widespread use of the RTS,S malaria vaccine among children in Sub-Saharan Africa and other regions with moderate to high malaria transmission. The recommendation was based on 24-month pooled results from the ongoing Malaria Vaccine Pilot Evaluation (MVPE) in Ghana, Kenya and Malawi. The immediate next steps for the RTS,S malaria vaccine include funding decisions by Governments and the international community for scale-up.

The evaluation activities in Ghana and the other participating countries including conduct of household surveys, sentinel hospitals surveillance, mortality surveillance and external monitoring by Ghana Health Service Ethical Review Committee (GHSERC), Food and Drugs Authority (FDA) and WHO contracted CRO Pharmalys, will continue to enable the team answer the remaining evaluation questions particularly the impact of the vaccine on mortality and long-term safety outcomes.

Malaria Vaccine Pilot Evaluation Case-Control (MVPE-CC) Study

Title: Strengthening the evidence on the RTS,S/AS01 malaria vaccine: assessment of safety and effectiveness using case-control studies

Investigators

Dr. Kwaku Poku Asante, Dr Thomas Gyan, Dr Abraham Oduro, Prof. Tsiri Agbenyega, Prof. Daniel Ansong

Funder:

The European & Developing Countries Clinical Trials Partnership (EDCTP)

Collaborator:

Ministry of Health/Ghana Health Service, NMCP, EPI, FDA, Regional and District Health Directorates, Sentinel hospitals, chiefs and opinion leaders

Project start date:

01 April 2021

Project end date:

30 June 2024

Study duration:

39 months

Background

Malaria remains a major killer of children in Africa, where over 90% of cases occur. The RTS,S malaria vaccine was shown in a large Phase-3 trial to be efficacious, with an acceptable safety profile. Modeling estimates indicate that its addition to current malaria-control measures could save tens of thousands of lives. Its wide implementation is delayed by a lack of data on effectiveness and safety when delivered through the national Expanded Programmes on Immunisation (EPI). WHO recommended pilot introduction to evaluate feasibility, impact and safety, with emphasis on the safety signals observed in the Phase-3 trial, in routine use to inform a global policy recommendation. Through the WHO-coordinated Malaria Vaccine Implementation Programme (MVIP), pilot implementation of RTS,S is well underway in three African countries, with more than 800,000 children vaccinated.

Community-based mortality surveillance and hospital-based disease surveillance systems and household surveys have been established as part of the Malaria Vaccine Pilot Evaluation (MVPE) to measure the effect of vaccine introduction on child mortality rates in boys and girls, on the incidence of hospital admission with severe malaria, and to determine if there is an increase in rates of admission with meningitis and with cerebral malaria when the vaccine is introduced, and vaccine coverage. The cluster-randomised evaluation estimates population-level effects. In order to estimate effects in vaccinated children, case control studies are needed.

Objectives

To determine the safety and effectiveness of the RTS,S/AS01 malaria vaccine in vaccinated children to complement the population level measures of impact obtained through the WHO's Malaria Vaccine Implementation Project. The study aims to answer the following research questions:

1. Are children who receive RTS,S vaccination (at least one dose) at increased risk of meningitis compared to unvaccinated children?
2. Are children who receive RTS,S vaccine (at least one dose), or children who receive three doses, at increased risk of cerebral malaria compared to unvaccinated children?
3. What is the increase in incidence of severe malaria in children who received three doses, but failed to receive a fourth dose, compared to children who did not receive the vaccine (the rebound effect)?
4. What is the effectiveness of RTS,S (following three doses, and following the fourth dose) in preventing severe malaria?
5. Is there any evidence that RTS,S vaccine increases mortality in girls, or is less effective in preventing death in girls than in boys?

Study design

Cases of three types will be studied: children admitted to hospital with meningitis, or with severe malaria, and children who died. The study is limited to children who

would have been eligible, based on their date of birth, to have received RTS,S/AS01 vaccine, and who were living in an RTS,S/AS01 implementation area in catchment area of sentinel hospital. For each case, four control children who were born within one month of the date of birth of the case child will be recruited from the same neighbourhood.

Progress so far

- Received ethical approval
- Recruited nine Research Officers for data collection on 01 October 2021
- Completed SOPs for clinical and mortality outcomes data collection
- Completed training of Research Officers and project managers on study protocol and SOPs 11-15 October, 2021
- Started data collection in the regions on 18 October, 2021

IMARA-687-PHASE IIB TRIAL OF IMR-687 IN ADULT SICKLE CELL PATIENTS

Sickle Cell Disease (SCD) is a rare inherited disorder of the red blood cell with a neonatal incidence of 294,000 to 330,000 patients worldwide that is both serious and life-threatening.

The most common manifestations include Vaso-occlusive crises (VOCs), chronic and acute severe pain, acute chest syndrome, acute anaemia, increased susceptibility to infections and progressive damage to major organs such as the brain, kidney and lungs.

Prior to July 2017, the only drug specifically approved for the treatment of SCD was hydroxyurea.

IMARA Inc is developing IMR-687 for the treatment of sickle cell disease and β-thalassemia. IMR-687 is a potent, specific and highly selective inhibitor of phosphodiesterase type 9 (PDE9) which stimulates the production of HbF.

Moreover, due to the specificity for PDE9, and the absence of evidence of genotoxicity and hepatoxicity in toxicology studies, IMR-687 could contribute to a meaningful improvement in the standard of care for patients.

Objectives

1. To evaluate the fetal haemoglobin (HbF) response to IMR-687 versus placebo.

2. To evaluate the safety of IMR-687 versus placebo.

Methods

This is a Phase IIb, randomised, double-blind, placebo-controlled, multicentre, study of subjects aged 18 to 65 years with sickle cell disease to evaluate safety and efficacy of IMR-687 tablets administered once daily for 52 weeks. The study seeks to enrol approximately 99 participants across sites.

This study consists of a screening period (up to four weeks) a double-blind treatment period (52 weeks), and a safety follow-up period (four weeks). After participants are deemed eligible during screening, they will be randomised to receive either the treatment (high or low dose) or placebo and return on specified dates to the site for refill and further assessments. Safety will be monitored throughout the study, and pharmacokinetic, pharmacodynamic, quality of life, and clinical outcome measures will be performed at specified visits.

Participants who complete this study may be eligible to enrol in an open-label extension (OLE) study.

Findings

There was a total of 15 screened participants with nine randomised participants to either receive IMR-687 or placebo. One participant withdrew consent in the course of the study. There have been 14 severe adverse events in the study.

The interim analysis revealed that while IMR687 was generally well tolerated, there was no meaningful difference observed in fetal haemoglobin (HbF) response in either the high or low dose groups, as compared to placebo. Also, although improvements in VOCs were seen in the low-dose group as compared to placebo, they were not statistically significant.

Based on the data generated by the interim analyses, Imara Inc, decided to discontinue the study as well as future development of IMR-687 in Sickle Cell Disease.

Participants have had their end of study visit and study close out activities are being undertaken.

Sanofi COVID-19 Phase III Vaccine Trial

Background

An outbreak of severe respiratory illnesses in Wuhan City, Hubei Province, China in December 2019 heralded the appearance of a novel coronavirus, SARS-CoV-2, in the human population. The clinical profile of COVID-19, the illness caused by SARS-CoV-2, is variable. In the majority of cases, the manifestations are mild, or individuals may be asymptomatic. Among those with symptoms, typical presentations include fever, cough, and shortness of breath. More severe manifestations include acute hypoxemic respiratory failure requiring intubation and mechanical ventilation, in some cases resulting in death. While mostly self-limited, symptoms such as fatigue and dyspnea (shortness of breath) appear to persist in many individuals for up to two months after illness onset despite viral clearance. Adults over 50 years of age and individuals with chronic medical conditions are at a higher risk of severe outcomes and death.

Sanofi Pasteur's candidate vaccine is being developed in the setting of a pandemic for the active immunisation and prevention of SARS-CoV-2 infection and COVID-19 disease.

The initial intended use of the vaccine is for adults, 18 years of age and older. The candidate antigen is a stabilised prefusion trimer of the SARS-CoV-2 S protein. The coronavirus S protein is the major viral envelope glycoprotein and mediates attachment and entry into host cells.

Objectives

1. To assess the clinical efficacy of the candidate vaccine for the prevention of asymptomatic COVID-19 occuring > 14 days after dose two.
2. To assess the safety of the candidate vaccine compared to placebo throughout the study.

Methods

This is a parallel multi-centre, multi-country, multistage phase III randomised double-blind placebo-controlled study. Participants will be screened for eligibility criteria at the time of inclusion and then randomised to either the investigational vaccine or placebo in a 1:1 ratio in each stage. In stage I, eligible participants will receive the monovalent D614 vaccine or placebo and in stage II, eligible participants will be randomised to receive the bivalent D614 + B.1.351 vaccine. A total of 21,046 participants aged ≥ 18 years are planned to be enroled in both stages. Randomised participants will be followed up for approximately 12 months. Active and passive surveillance will be used to identify and record COVID-19-like illnesses during the follow up period. All COVID-19-like cases will undergo nasopharyngeal and oropharyngeal sampling for confirmation of COVID-19 by Nucleic Acid Amplification Testing (NAAT). Participants will also be followed up for safety, beginning in the immediate post-vaccination period and throughout the study. All serious adverse events, medically attended events and adverse events of special interest will be recorded and reported as per protocol. In the event that either or both the monovalent and bivalent vaccines are deemed safe and effective, participant will undergo a blinded cross-over in which those who received the placebo will be given the beneficial vaccine.

Findings

There were a total of 1599 screened and 1116 randomised. Out of this, 766 were enroled in stage I and 350 in stage II. Participants are currently being followed up. There have been 57 COVID-19-like illnesses and 29 serious adverse events reported so far. Interim analysis of data across all participating sites shows 100% efficacy against severe COVID-19 and hospitalisations, 75% efficacy against moderate or severe COVID-19 and 57.9% efficacy against any symptomatic COVID-19. Both vaccines showed favourable safety profiles.

ENVIRONMENTAL HEALTH RESEARCH
Adoption Aim 4 Study:

Title: Understanding adoption of clean cookstoves

Investigators

KHRC: Kwaku Poku Asante, Rebecca Dwommoh Prah, Theresa Tawiah, Mohammed Mujtaba, Sulemana Watara Abubakari,

Columbia University: Georgette Owusu-Amankwah, Darby Jack

University of California, Santa Barbara: Kelsey Jack

Funder:
Columbia World Projects and J-Pal

Project start date:
February, 2021

Project end date:
November, 2021

Study duration:
39 months

Background
Household Air Pollution (HAP) from biomass fuel combustion is a major environmental health threat. Almost three million people in low- and middle-income countries rely on solid fuels for cooking and heating. Household Air Pollution from cooking is responsible for 4.3 million premature deaths each year which is more than deaths attributable to malaria, tuberculosis and HIV/AIDS combined. Health problems associated with household air pollution from use of solid fuels include acute lower respiratory infections in children under five, and ischemic heart disease, stroke, chronic obstructive pulmonary disease and lung cancer in adults. Smoke from use of solid fuels in households is a risk factor for asthma, perinatal mortality, cataracts, low birth weight, tuberculosis, and other cardiovascular disease. WHO recommends a need to reduce emissions of harmful pollutants from cooking and heating.

The main reason people use solid fuel for cooking is highly associated with poverty and lack of access to clean fuels and studies done in this area proved this statement. Access to clean fuels is difficult to address given that individuals may not be financially sound to purchase Liquefied Petroleum Gas (LPG) and the stove even when they are available in the communities. A study conducted in India revealed that LPG consumption increases when the government lowers the cost of LPG through subsidies, thus allowing more people to be able to access the cleaner fuel.

Therefore, in order to understand how to promote adoption and sustained use of LPG, the proposed study aims to subsidise the cost of LPG at different levels. This study is the Aim 4 of the Understanding adoption of clean cookstoves in Ghana.

Aim
The aim of the study is to assess if demand for LPG in rural settings in Ghana is influenced by price of LPG and distance to fuel distribution centres.

Methods
To achieve the above aim, participants received discounts on LPG prices. ANDEV LPG company established LPG exchange depots in some communities where participants went and changed their empty cylinders for already filled ones. Participants were visited by field staffs to obtain information on household, cooking practices, LPG and other cooking fuels used at the beginning of the study (baseline), in the middle of the study (three months after the start of the study) and at the end of the study (six months after the start of the study). Each participant was given the opportunity to select a discounted price and where to buy LPG through balloting. A sample of about 887 households in the Kintampo North Municipality and South Districts that were part of Aim 3 study were eligible to be interviewed. Data was obtained on tablets using Research Electronic Data Capture software (REDCap) and imported directly to the database servers at KHRC.

Figure 1: An LPG depot in a community

Figure 2: A depot manager serving a partcipant

Expected outcomes:

- Household's demand for LPG will be influenced by price and distance variations.

Progress

The baseline phase of the study was conducted from February to April and the midline also started from May to July, 2021 and the endline of the study also started in August to November, 2021. A total number enroled during baseline was 887, midline 865/887, six moved out and 16 were temporarily absent. During the endline, the team interviewed 854/865 which is about 98.7% success rate. The study ended in November and all the LPG depots have been closed. Data cleaning and analysis is ongoing.

Child Lung Function

Investigators

KHRC: Kwaku Poku Asante, Seyram Kaali, Sulemana Watara Abubakari, Mujtaba Mohammed Nuhu

Columbia University: Darby Jack, Steven Chillrud

Mount Sinai School of Medicine: Alison Lee

Funder:
National Institute of Health (NIH)

Project end date:
June 2023

Project start date:
April 2018

Background
Household air pollution (HAP) has emerged in the last 15 years as a top-priority global health issue.

About 2.8 billion people – 40% of the world's households – cook with solid fuels, and combustion typically occurs in inefficient cookstoves. Incomplete combustion generates a complex mixture of pollutants, many of which are known toxicants (e.g., particulate matter, carbon monoxide (CO), nitrous oxides, formaldehyde, and polycyclic aromatic hydrocarbons (PAHs). Exposure occurs indoors or in the immediate vicinity of the home, hence the term HAP. In utero, HAP exposure is associated with low birth weight and respiratory symptoms and infections in childhood and is an independent predictor of childhood mortality. In adults, WHO estimates that 35% of chronic obstructive pulmonary disease (COPD) worldwide is attributable to HAP.

A recent systematic assessment found that HAP causes 3.5 million premature deaths; women and children are most affected. However, there is evidence to suggest that improvement in indoor air quality using chimney woodstoves and biogas stoves is associated with:

1) reduced respiratory symptoms and

2) reduction in the annual decline in lung function.

Therefore, greater reductions in HAP by cleaner fuels such as LPG may have substantial health impacts. The hypothesis being tested is that use of LPG over a 16-month period during the Ghana Randomised Air Pollution and Health Study (GRAPHS) will result in:

1) Significant reduction in the incidence of respiratory symptoms and

2) Significant reduction in the annual decline in lung function (measured by pre- and post-bronchodilator Forced Expiratory Volume in 1second (FEV1).

Objectives
Do isolate, perinatal air pollution exposure reduction results in sustained improvements in childhood lung function and respiratory symptoms, important predictors of later life respiratory disease.

Aim 1: Early Life Cookstove Intervention Status Affects Respiratory Outcomes (Intention to Treat). We hypothesise that Cookstove intervention status (LPG versus 3-stone fire) used from the second trimester of pregnancy through age one will independently predict:

a) Outcome 1: Lung function at ages four (impulse oscillometry (IOS)) and seven (IOS and spirometry). We hypothesise that LPG will be associated with better lung function at ages four and seven.

b) Outcome 2: Prevalence of wheeze age 1-7. We hypothesise that LPG use will predict decreased wheeze.

Aim 2: Relationship Between Household Air Pollution (HAP) Exposures and Respiratory Outcomes (Exposure-Response).

a) We are of the opinion that, Early life (prenatal to year 1) HAP exposures, after adjustment for covariates/confounders will independently predict lung function at ages four (IOS) and seven (IOS and spirometry). Hence, we hypothesise that reduced early life exposures will be associated with better lung function at ages four and seven.

b) Early life (prenatal to year 1) HAP exposures, after adjustment for covariates/confounders, will independently predict the prevalence of wheeze age 1-7.

We again hypothesise that a reduced early life exposure will be associated with decreased risk of wheeze.

c) Later childhood (ages 1-7) exposure will be independently associated with lung function and lung growth, after adjustment for covariates/confounders including early-life exposure.

We hypothesise that increased latest childhood exposure will be associated with worse lung function at age seven and reduced lung function growth between ages four to seven.

Aim 3: Mechanisms of HAP injury
We will examine novel mechanisms in the placenta, which play a central role in the prenatal programming of lung growth. Using banked placenta samples from GRAPHS, we will measure microRNAs (miRNAs) and long non-coding RNAs (lncRNAs), two classes of RNAs that control messenger RNA (mRNA) expression, modulate placental functions and can be altered by HAP exposure.

Methods

This study takes advantage of a well-designed community randomised cookstove intervention trial, the Ghana Randomised Air Pollution and Health Study (GRAPHS), to evaluate the independent effect of LPG cookstoves on adult respiratory health. GRAPHS used a cluster-randomised design to compare two cookstove interventions: Liquefied Petroleum Gas stoves (LPG) and the Biolite improved cookstove to the traditional three-stone cookstove (control arm).

In all, 1415 maternal-infant pairs were recruited and followed up over a period of four years to quantify the impact of clean cookstove intervention on birth weight and incident pneumonia during the first year of life. In this Child Lung function study, a subset of 800 women belonging to the LPG, Biolite, and control arm is being followed up. During this extended follow-up, data on exposure monitoring will be collected on all participants at four-time points, while respiratory symptoms and lung function will be collected on all participants at two-time points when children are four years and seven years respectively.

Expected outcome

Effect of cookstove status on FEV1, other lung function parameters, and effect of HAP exposure during GRAPHS on FEV1 declined over the study period.

Progress

Enrolment in the study has ended after achieving a sample size of 700 in 2019. Phase 1 of the Exposure Monitoring for PM2.5 has also been completed as of December 2019. Six hundred and sixty-one Spirometry respiratory assessments for women alone, 715 impulse oscillometry (IOS) assessments for both infants and their mothers for the phase 1 respiratory assessment have also been done. So far months 3, 6, 12, 15, 18, 21, and 24 monthly follow-ups have been completed with less than 5% lost to follow-up. The project is currently on the monthly follow-up of the study cohort for months 27, 30, 33, 36 at their homes to ascertain caregivers' reports on symptoms, specifically wheeze, in the past month using the ISAAC study tool.

The study has started the next and final round of the exposure and the lung function assessment as the children are now age seven. And the team has so far done the respiratory assessments for about 200 hundred participants for both mother and child in 2021. In terms of ambient monitoring of the over 37 communities within the study area, the team has deployed 30 PurpleAir devices in 30 community day primary schools to ascertain the air pollution levels of the study children who have started schooling.

The team has the opportunity of switching from RTI microPEM to a more advanced technological device, UPAS, to measure PM2.5 air pollutants. There was the need for the change to UPAS because we had used microPEMs for over a decade and had challenges with data quality. The switch to the UPAS device has so far been very good.

Figure 1: Personal Air Monitor UPAS

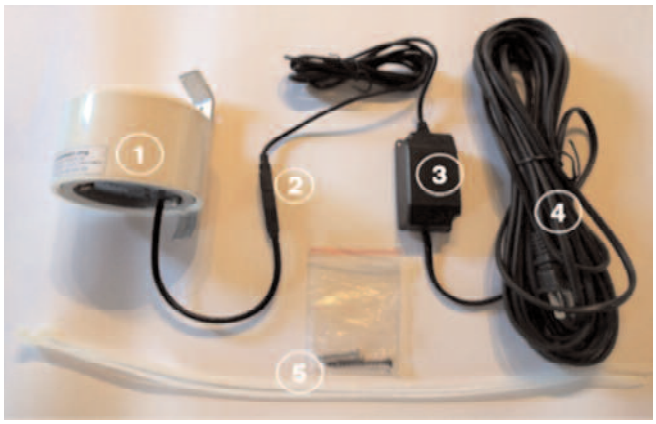


Figure 2: Ambient Purple Air Monitor

Figure 3: Some of the study team members

Clean Air Africa Study

Clean Energy Access for the prevention of non-communicable disease in Africa through Clean Air (CLEAN-Air (Africa)

Investigators

Kwaku Poku Asante, Theresa Tawiah, Rebecca K D Prah, Mujtaba Mohammed Nuhu, Samuel Asiedu-Afari, Daniel Pope, Elisa Puzzolo

Institutions:
1 Kintampo Health Research Centre
2 University of Liverpool

Funder:

National Health Institute of Research

Background

In Ghana, biomass fuels are the primary cooking fuel for about 70% of households. Consequently, exposure to Household Air Pollution (HAP) is responsible for 16,600 deaths and the loss of 502,000 disability-adjusted life-years. Ghana was the first country to publicise the Sustainable Energy for All Action Plan, as called for by the United Nation's Sustainable Energy for All (SEforALL) programme in June. Among other things, the plan emphasised the importance of promoting LPG as clean energy for cooking. Ghana's SEforALL plan also called for LPG cylinder recirculation as a model for the distribution of LPG to accelerate the adoption and safe use of LPG for cooking. The goal of this study was to examine what influence LPG adoption and evaluate the implementation of the LPG cylinder recirculation model in peri-urban and rural communities in the Obuasi municipality, Ashanti region, Ghana.

Objectives

1. To conduct surveys of fuel use patterns and health in peri-urban and rural communities in locations relevant to national plans to scale LPG use.

2. To measure household air pollution (small diameter particulate matter (PM2.5) in kitchens (concentrations), women and children (exposure) in a sub-set of biomass and LPG using households.

3. To conduct semi-structured interviews and focus group discussions of women and men using:
   (i) primary LPG,
   (ii) mixed LPG and biomass and
   (iii) exclusive biomass, to identify factors influencing fuel choice and exclusivity of using clean cooking fuel.

4. To conduct visual participatory methods to understand how best to support the adoption and use of clean fuel from a community perspective (Photo Elicitation).

5. To model health and climate impacts of LPG adoption and analyse routine data to identify health impacts from household fuel use.

6. To evaluate the LPG recirculation and delivery model to facilitate the adoption of LPG.

Methods

This was a rapid survey of 2000 compounds among representatives of households to provide a general overview in the context of the study. Following the rapid survey, another survey was done among a sample of 400 randomly selected exclusive biomass and primary LPG users. This included 200 exclusive biomass users and 200 primary LPG users. All women surveyed received blood pressure measurements for cross-sectional comparison by fuel group. Intensive 24hr PM2.5 monitoring of non-LPG vs LPG primary users (n=35 per group, for a total of 70 kitchens + 70 women primary cooks and 70 children). This included stove use monitoring (SUMs) over a seven-day period. There were qualitative semi-structured interviews (approx. n=10) with women and men about household energy, cooking practices and health. The photo-elicitation project involved two groups of participants (biomass exclusive (n=5) and mixed LPG/biomass LPG (n=5) users), selected from the community based on a short survey. For climate, the modelling will be led by CICERO and they might make (limited) requests for access to datasets from Ghana. Evaluation of the recirculation of LPG bottles included the collection of information on household characteristics, fuel use, cooking activities and health.

Expected outcome

1. Highlighted community solutions to scaling adoption and sustained use of LPG as a clean fuel.

2. Quantified reductions in household air pollution (HAP: PM2.5) concentrations and exposure from switching to LPG as a clean fuel.

3. Modelled quantitative estimates of the positive health and climate impact from scaling use of LPG.

Progress

The study has ended. Below are the links to the two papers published. Two manuscripts and one policy brief are under review.

https://www.nature.com/articles/s41560-021-00933-3
https://www.sciencedirect.com/science/article/pii/S2666560322000433

ISN COVID 19 Resilience Study:

Title: Impact of COVID-19 On Household Energy Use In Ghana

Investigators

KHRC: Kwaku Poku Asante, Rebecca K D Prah, Theresa Tawiah, Mujtaba Mohammed Nuhu, Sulemana Watara Abubakari

Columbia University: Darby Jack

University of Liverpool: Daniel Pope, Elisa Puzzolo,

Funder:
Columbia University and University of Liverpool

Project end date:
December, 2020

Project start date:
September, 2020

Background
Household Air Pollution (HAP) is a public health concern globally including Ghana. The adoption and sustained use of clean fuels and cookstoves is a viable solution to reducing HAP exposure and associated problems. Ghana's energy policy seeks to enhance clean fuel use through promotion of Liquefied Petroleum Gas (LPG) use with the aim of achieving 50% of LPG adoption by 2030. A key strategy is the Cylinder Recirculation Model (CRM) which is the Government of Ghana's response to safety issues associated with consumers owning their cylinders and fire outbreaks/explosions at LPG refilling stations. CRM was being piloted in areas including Obuasi Municipality (our study area) when Ghana recorded its first COVID-19 case in March 2020. The outbreak of the COVID-19 pandemic has caused immense havoc to health systems and economies, causing major disruptions across the world including Ghana. It is unknown how the pandemic and the different government response and control measures have affected the clean energy landscape in Ghana, including the demand and supply of clean energy and government policies on clean energy. The aim of this study is, therefore, to assess the impact of the COVID-19 pandemic on household access to and sustained use of clean energy for cooking (LPG and electricity) in Ghana and also the implementation of the CRM.

Overall aim
The overarching aim of this research is to assess the impact of the COVID-19 pandemic on household access to and sustained use of clean cooking fuels (LPG and electricity) in Ghana.

Study objectives
1. To assess the impact of COVID-19 on existing and planned implementation of the CRM policy across the national territories and strategies that can be adopted to enhance it.

2. To explore factors that have influenced supply of clean cooking fuels by fuel suppliers during the pandemic and strategies that can be employed to sustain supply.

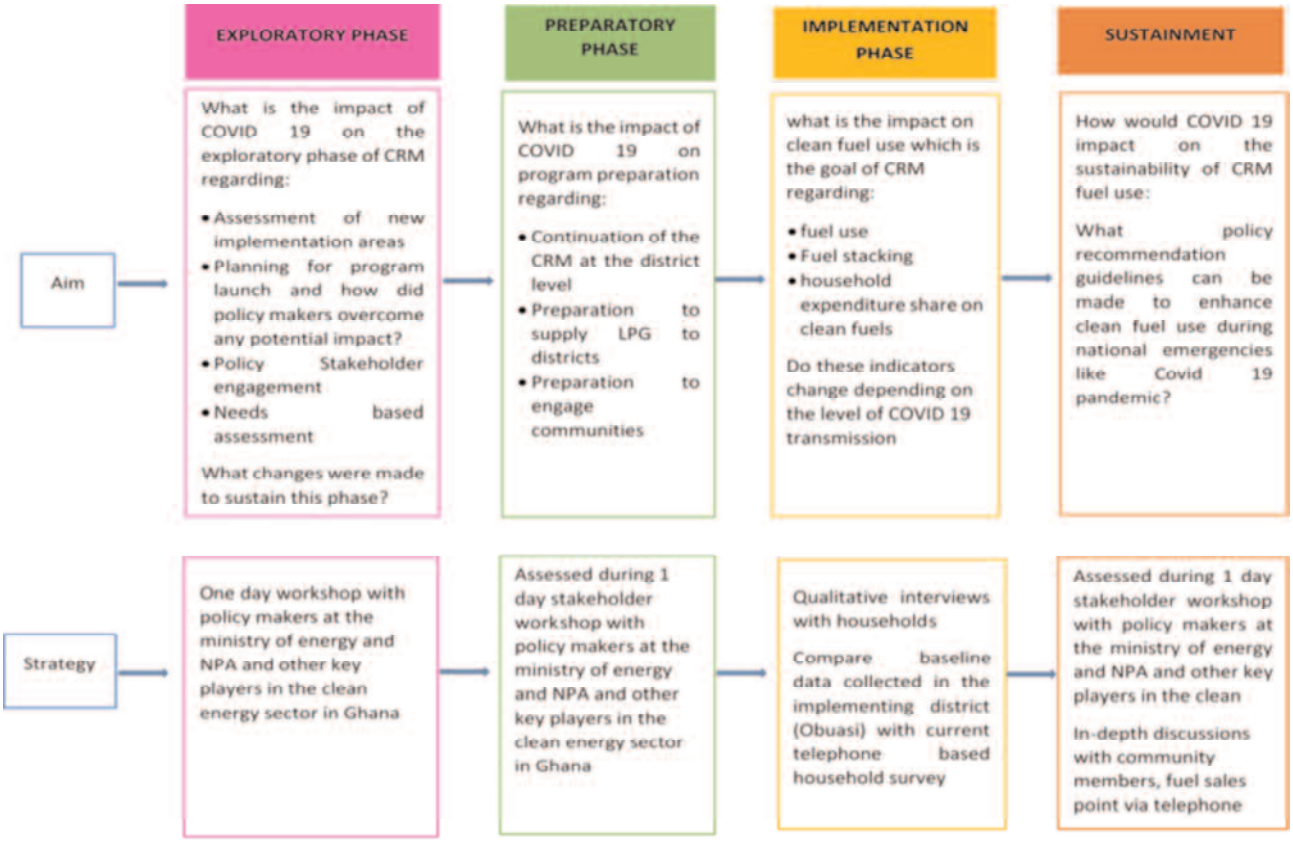
3. To assess how COVID-19 has influenced household access to and sustained use of clean fuels use and cooking practices and how clean fuels use can be sustained during the pandemic.

4. To assess how affordable clean fuels are to households and to find out if household expenditure on clean fuels shifted during the pandemic.

5. To develop recommendations and guidelines that can be used to guide clean fuel access and use during COVID-19 outbreak to ensure sustainable gains of the national CRM policy.

Methods
This was a comparative cross-sectional study which employed a mixed methods approach for data collection. The study was conducted in the Kintampo Municipality located in the Bono East Region and the Obuasi Municipality in the Ashanti Region. It involved key players in the clean energy sector such as households, LPG purveyors and relevant policy makers and implementers.

The impact of COVID-19 was assessed using the EPIS framework. The framework guided the study from inception through to project completion; including designing the study stages, structuring the research questions, approaches and outcomes (see figure 1). A sample of 800 households (400 from each study area) who were primary LPG users were randomly selected and interviewed. Stakeholders in the energy sector of Ghana were purposively selected to be part of stakeholder workshop while LPG sellers were also purposively selected to be part of In-depth interviews. Qualitative data was analysed with Nvivo and STATA for the quantitative data.



Progress

Data collection, analysis, and writing of the project report have all ended. A draft manuscript is also ready for submission to a journal.

ISN Fuel Stacking Study

Constructing a clean cookstove stack in Ghana

Investigators

KHRC: Kwaku Poku Asante, Rebecca K D Prah, Theresa Tawiah, Mujtaba Mohammed Nuhu

Columbia University: Darby Jack

Funder:
Columbia University

Project end date:
July, 2020

Project start date:
December, 2020

Background
The adoption of Liquefied petroleum gas (LPG), is low in Ghana, and those that do adopt are highly likely to stack LPG with biomass fuels. The primary barrier to biomass fuels cessation is cost, poor performance of LPG for cooking specific foods, LPG safety, and logistical barriers to LPG purchase. The potential for combinations of fuels and appliances to address these barriers is unknown. We hypothesise that households that have access to a range of clean cooking options with different performance characteristics will meet a larger share of their cooking energy needs with clean fuels, holding cost constant. These alternative clean fuels may, in the long run, help overcome the cost barriers that limit LPG adoption. Although Ghana is a significant producer of LPG, its price is driven by the world market price. Electricity, ethanol, and processed biomass fuels can be produced throughout Ghana. Significant up-front investment will be required, marginal cost of production will be low and lack of global market. The overall aim is to assess the feasibility and acceptability of ethanol, LPG, processed biomass and induction electric stoves/fuels.

Overall Aim
To identify promising "clean stacks" of stoves and fuels that are relevant to household energy needs in Ghana, where clean cooking is currently limited to liquefied petroleum gas (LPG).

Study objectives
1. To categorise and quantify household energy needs.

2. To assess the potential for clean stacks to speed the transition to clean cooking.

3. To model the results from objective 1 and 2 to scale-up a clean stack in Ghana.

Methods
This study was conducted in the Kintampo Municipality in the Bono East region using quantitative and qualitative methods. A total of ten households who were exclusive users of biomass fuel were randomly selected from the Kintampo Health Demographic Surveillance Survey. For each household (n = 10), we provided participants with four clean stove and fuel combinations (one after the other). These stoves were then used for two weeks and fuels were provided for free (zero cost to the household). After each two-week trial period, interviews were carried out to determine stove acceptability, with a focus on identifying the specific energy needs that a given stove met. All stoves were fitted with stove use monitors. After the single technology assessment period, households were provided with their most preferred intervention stove for one month. During this period, household air pollution (HAP) was monitored through the use of personal exposure monitors (MicroPEM). KHRC IEC gave the approval and written informed consent were sought from study participants.

Key results
The results showed that LPG and ethanol stoves were the most acceptable to rural households. These two stoves were generally preferred because they were easy to use, cooked faster, easy to clean, considered safe and supported fairly different types of cooking.

It also emerged from the findings that participants' stove preferences appeared to have been strongly influenced by factors that fall into two domains:

1) recognising the advantages of clean stove technologies – including but not limited to time savings from fuel gathering; convenience and faster cooking; and

2) overcoming initial fear of clean stove use particularly LPG.

Progress
Data collection, analysis, and writing of the project report have all been completed. A draft manuscript is also ready for submission to a journal.

Targeting subsidy for LPG Adoption (Targeting study)

Constructing a clean cookstove stack in Ghana

Investigators

KHRC: Kwaku Poku Asante, Sulemana Watara Abubakari, Theresa Tawiah, Seidu Iddrisu

Columbia University: Darby Jack

University of California, Santa Barbara: Kelsey Jack

Funder:
Columbia World Projects and J-Pal

Project end date:
September, 2021

Project start date:
June, 2022

Background
Globally, nearly three billion people cook with traditional stoves and fuels. These inefficient and polluting energy sources produce one-quarter of all black carbon emissions globally. Household air pollution also represents the largest energy-related health risk, leading to nearly 2.3 million preventable pollution-related deaths per year. Recognising the costs associated with the use of biomass fuels for cooking, the Government of Ghana has committed to giving 50 per cent of Ghanaian households' access to LPG fuel for cooking, but progress towards this goal has been slow.

Previous efforts in other countries to drive clean fuel transitions by targeting subsidies to the poor have largely been unsuccessful. Adopting a "smart subsidy" approach, this project relies on targeting strategies that aim to balance the heavy cost of subsidisation with the social benefits of clean fuel use. In the context of a randomised controlled trial in Techiman, Ghana, the project will evaluate the role of smart subsidies in increasing LPG use among the poor, characterise the intra-household distribution of air pollution reduction benefits, and assess gender dynamics in the context of energy-related decision making. The results of this study will inform the Government of Ghana's energy policy efforts, which are currently focused on improving the country's LPG distribution system.

Specific aims
This study will be structured around the following specific aims:

1. **Aim 1:** Assess the feasibility and effectiveness of a targeting strategy designed to increase LPG uptake among poorer households in Techiman, Ghana.

2. **Aim 2:** Quantify the air pollution reduction benefits from LPG adoption and characterise gender-dependent distribution of air pollution exposure within the home.

Sub-aim 2A: Measure stove use to assess the contribution of cookstove emissions to personal exposure.

3. **Aim 3:** Comparatively evaluate men and women household heads' motivations for selecting household energy sources, and assess their implications for decision-making related to clean fuel adoption.

Methods
The study will use a randomised controlled trial (RCT) to design (Aim 1) and test (Aim 2), the feasibility and effectiveness of a pricing mechanism designed to target larger LPG subsidies to poorer households. We also aim to disaggregate based on gender the air pollution reduction benefits that can be obtained through LPG adoption (Aim 3) and the motivations for clean fuel adoption (Aim 4). The results of this RCT will inform the design of policies aimed at increasing the uptake of clean cooking technologies among the poor. A sample of about 1200 households in Techiman town will be randomly assigned to two treatment arms and a control group.

Expected outcomes
The proposed study is to generate data that will allow the Government of Ghana to create efficient subsidy mechanisms to maximise LPG uptake by low-income households.

This study is also expected to increase understanding of the distribution of HAP reduction benefits within the home, which is currently poorly characterised.

Progress
The pilot phase of the study was conducted in September and October, 2021. Smaller additional exposure assessments pilot activities are ongoing and expected to end by the second week of December, 2021. The main study protocol has also been finalised and submitted to the Scientific Review Committee and subsequently to ethics for consideration.

Figure 1: Different cylinder sizes to target various households

CWP Study

Reducing Household Air Pollution in Ghana through Community-Level Transitions to Clean Cookstoves and Fuels

Investigators

KHRC: Kwaku Poku Asante, Sulemana Watara Abubakari, Edward Anane Apraku

Columbia University: Darby Jack

University of California, Santa Barbara: Kelsey Jack

Funder:
Columbia World Projects

Project end date:
November, 2019

Project start date:
November, 2024

Background
Globally, nearly three billion people use traditional cookstoves and fuels. In Ghana, about 70% of the population generates energy for cooking by burning biomass and other solid fuels in open fires. These inefficient energy sources produce one-quarter of all black carbon emissions globally, and lead to nearly four million preventable pollution-related deaths per year, including half a million children under the age of five years who die from pneumonia. Women are also particularly impacted, both because of their exposure in the home and because the burden of collecting firewood and other fuels falls to them. A number of interventions over the last decade have not significantly reduced the negative impact of the use of traditional cookstoves. Study participants continue to use polluting energy systems, and emissions from neighbours, effectively negating the health benefits of any one household's transition to clean energy systems. This study consolidates past experiences with clean household energy – with a particular focus on behavioural and cultural questions – and also draws on novel insights into both clean cooking technologies and behavioural antecedents to their sustained use.

Objectives
The primary objective is to reduce household air pollution exposure by promoting community-level transitions to clean cooking with the target of achieving WHO health-based air quality targets. Specifically:

1. Develop and integrate new – but evidence based – behaviour change approaches that consider decision-making within the home and at the community level to encourage exclusive, sustained use of clean cooking technologies.

2. Develop a portfolio or stack of clean options (fuels, stoves, and practices) that together can fully displace traditional open fires in homes and small businesses, and enable exclusive, sustained use of clean alternatives.

3. Aim to transition entire communities towards clean alternatives, rather than being focused on the number of households affected, in order to achieve anticipated air-quality improvements.

4. Identify broader energy system changes that will support and sustain household- and community-level transitions.

Methods
The project will have two main phases: an assessment phase and an intervention phase. The assessment phase will develop a detailed quantitative picture of Ghana's current household energy systems, and will evaluate constraints and opportunities. To accomplish this, four main tasks will be carried out:

1. Nationally representative household energy use survey. This will entail a detailed questionnaire, to be designed in close consultation with Government of Ghana partners, to understand household energy needs, strategies for meeting those needs, and expenditures on household energy.

2. National-level assessment of exposure to household air pollution. In a subset of households surveyed, we will deploy both personal air pollution monitors and neighbourhood air pollution monitors.

3. Evaluation of behavioural constraints and opportunities surrounding adoption and sustained use of clean household energy. We will carry out a series of studies that will provide novel insight into factors including but not limited to cost.

4. Systematic review of potential household energy technologies. Previous experience with clean household energy in

Ghana has centered on LPG. We will assess the feasibility and cost of ethanol, electricity, and processed biomass (pellets) to coexist with LPG in the Ghanaian market. We will also assess the viability of novel business models for fuel delivery.

In the intervention phase we will deploy a set of promising technologies, business models and behaviour change approaches in a carefully monitored, large scale test programme in a to-be-determined set of communities in Ghana. This will give us the opportunity to evaluate how well the technologies and business models meet household energy needs, and also to track the costs and logistical challenges associated with delivering clean energy services at scale.

Expected outcomes

· Nationally representative dataset with a strong empirical understanding of energy use patterns, prices end users are currently paying, and spatial distribution of air pollution risk.

- It is expected that behaviour change intervention will improve clean cookstove adoption and sustained use.
- The Government of Ghana will have a state-of-the art system for tracking household energy and resulting air pollution exposures.

Progress

We organised a stakeholder virtual dissemination workshop for the national household energy and health survey in July 2021, and an in-person meeting that included policy makers in November 2021. We are also working through four manuscripts:

1) High level summary of the household survey and the potential for cooking transitions in Ghana,

2) Health consequences of biomass fuels in Ghana,

3) Household and community determinants of energy use in Ghana, and

4) LPG scale up potential in Ghana.

Figure 1: A section of participants at the Accra dissemination workshop for stakeholders

COVID-19 National Survey Manuscripts:

Community and Health System Response to the Coronavirus Pandemic at the District Level in Ghana

Investigators

Sulemana Watara Abubakari, Lawrence Gyabaa Febir, Edward Anane Apraku, Francis Agbokey, Grace Manu, Samuel Afari Asiedu, Wisdom Adeapena, Solomon Nyame, Stephany Gyaase, Eliezer Odai Lartey, Mieks Twumasi, Samuel Bernard Ekow Harrison, Dennis Adu Gyasi, Thomas Gyan, Charles Zandoh, Livesy Abokyi, Kwaku Poku Asante

Funder:

Kintampo Health Research Centre and Ghana Health Service

Project end date:

February, 2020

Project start date:

July, 2020

Background

The threat posed by the coronavirus disease (COVID-19) that started in December 2019 is reported as the most serious since the outbreak of the 1918 H1N1 influenza pandemic. It has since been classified as a pandemic by the World Health Organisation (WHO). As of 31st May, 2020, 5,934.936 confirmed cases and more than 367.166 deaths were confirmed globally. The Ministry of Health (MOH) and the Ghana Health Service (GHS) reported Ghana's first two cases of confirmed COVID-19 on March 12, 2020, and the number of confirmed cases has been increasing exponentially by the day. The President of Ghana on 29th March, 2020, declared partial lockdown in some selected areas of Greater Accra and Kumasi as a measure to reduce local transmission. Testing was intensified in these areas, and this resulted in an increasing number of horizontal transmissions. The partial lockdown of Greater Accra and Kumasi was lifted on 20th April, 2020, but compulsory wearing of face masks in public places and social distancing were enforced in some markets in order to prevent the spread of the disease. The number of COVID-19 cases as of 30th May, 2020 had reached 8,070, with 2,947 recovered and 36 deaths.

People's misunderstanding and misconceptions coupled with misinformation about the novel COVID-19 may delay controlling efforts to provide the necessary intervention with the potential to increase the rapid spread of infection in the community and health facilities. This situation may put community members', patients' and health care providers' lives at risk. Lessons learned from the SARS outbreak in 2003 suggest that knowledge and attitudes towards infectious diseases are associated with the level of panic emotion among the population, which can further complicate attempts to prevent the spread of the disease. Front line health care workers at the primary health care level play a critical role in disease surveillance and response to control and contain disease outbreaks.

The study seeks to assess the level of knowledge, attitude, perceptions and preventive practices regarding COVID-19 among community members in the northern, middle and southern zones of Ghana. In addition, the study determines the readiness and response to the COVID-19 pandemic at the primary health care level. This was done through interviews with CHPS zones' incharges or their representatives, and their respective Metropolitan, Municipal, District Health Directors (MMDHS) or their representatives through telephone conversation.

General objective

To document baseline knowledge, perceptions, attitudes and preventive practices of COVID-19 and to determine readiness of the health system to contain the pandemic at the primary health care level in Ghana.

Specific objective

1. Assess community level knowledge, attitude, perceptions and preventive practices of COVID-19 in Ghana.
2. Explore the knowledge, attitude, perceptions and preventive practices of community stakeholders/opinion leaders in Ghana towards COVID-19.
3. Evaluate handwashing practices of community members in Ghana before and during the COVID-19 pandemic.
4. Explore the knowledge, attitude, perceptions of CHPS health workers and preparedness of MMDHS on COVID-19 pandemic response in Ghana.

Methods

A cross sectional mixed method employing both quantitative and qualitative methods of data collection was used. For the quantitative component, a close-ended questionnaire designed based on WHO guidelines was administered to

community members and CHPS zones' in- charges or their representatives who were between 18 to 65 years in sampled districts. For the qualitative component, in-depth interviews (IDIs) were conducted among selected stakeholders/opinion leaders as well as MMDHS or their representatives who were 18 years or older. Their selection was as a result of the fact that they are considered to be essential stakeholders in communities regarding decision making and their implementation, including critical decisions on health.

Progress

The study has successfully ended, and five manuscripts are at various stages of development. Three have been submitted to peer-reviewed journals and drafts for the remaining two manuscripts are being reviewed by co-authors prior to submission for publication.

ARISE COVID-19 Survey Round 2:

Rapid monitoring surveys to inform response to the COVID-19 crisis across sub-Saharan Africa

Investigators

KHRC: Sulemana Watara Abubakari, Edward Anane Apraku, Lawrence Gyabaa Febir, Livesy Abokyi, Kwaku Poku Asante

Collaborators:

Africa Research, Implementation Science, and Education (ARISE) Network

Funder:

ARISE Network

Project end date:

June, 2021

Project start date:

December, 2022

Background

The COVID-19 pandemic has potentially catastrophic implications for Sub-Saharan Africa (SSA), given widespread poverty, fragile health systems and high prevalence of malnutrition, HIV, tuberculosis and other comorbidities. In November 2019, the first COVID-19 cases were reported in Wuhan, China; by April 15, 2020 over two million cases were reported in nearly all countries worldwide. Africa's first case was recorded in Egypt on 14th February, 2020; by April 2021, there were 4.3 million confirmed cases and 116, 265 deaths reported across the continent. However, the actual burden is likely much higher due to severely limited testing capacity resulting from weak health systems in SSA.

In addition to the morbidity and mortality directly caused by COVID-19, the pandemic has significant economic ramifications and serious health consequences in other domains such as food security and hunger; access to routine health and preventive services; and mental health. Physical distancing measures including lockdowns, travel restrictions, and school closures have been implemented across much of Africa, which has disrupted livelihoods and suspended critical health and education services. Many African countries are still in the early stages of organising their responses and leaders have expressed the need for more data on the health and economic impacts of this crisis to inform focused, prioritised efforts to maximise impact amidst severe constraints on time and resources.

Partnerships and infrastructure of the Africa Research, Implementation Science, and Education (ARISE) Network – comprising 21 member institutions from nine SSA countries were leveraged on to conduct this study. This Network was convened by Dr. Wafaie Fawzi in 2014 and has a strong track record of epidemiologic research focused on infectious disease, nutrition and public health across SSA.

General objective

This study aims at establishing a novel mobile platform to assess knowledge and practices related to COVID-19 prevention and management, vaccine perceptions and readiness and impacts of the outbreak on other health domains across Sub–Saharan Africa.

Specific objective

1. Establish a mobile survey platform across five countries in Sub-Saharan Africa (SSA) to rapidly generate data from healthcare workers and the general population (adults and adolescents) on:
   a) knowledge and practices related to COVID-19 prevention and management
   b) impact of the outbreak on other health domains
   c) vaccine perceptions and hesitancy

2. Develop methods, collect formative data and assess lessons learned from the first five countries to enable scale-up of this mobile platform across all nine ARISE countries.

Methods

Longitudinal mobile phone surveys utilising computer-assisted telephone interviewing (CATI) were conducted among the three participant groups. Research staff conducted the interviews from virtual call centres and obtained informed consent before the interview. The surveys are planned to be conducted for a maximum of three times to assess changes in the rapidly evolving COVID-19 pandemic over time. The study population consists of:

1) Healthcare providers

2) Adults 20 years of age and above in selected households; and

3) Adolescents between 10-19 years of age in selected households.

Each survey is expected to last 20-40 minutes. The surveys were conducted in five Sub-Saharan African countries: Tanzania, Burkina Faso, Ethiopia, Nigeria and Ghana.

Progress

The second round of data collection among healthcare providers, adults and adolescents in selected households were conducted between July and October 2021. Seven papers including the following themes are planned to be submitted for publication by end of December 2021: COVID-19 vaccine perception/hesitancy and its determinants among healthcare providers, adults and adolescents; impacts of the COVID-19 pandemic on education, nutrition, and mental health among adolescents. The rest are impacts of the COVID-19 pandemic on food security, diet quality, dietary diversity, and young child feeding practice; and impacts of the COVID-19 pandemic on mental health and routine healthcare services from the perspectives of adult community members and healthcare providers.

Ghana Malaria Slide Bank

Investigators

Kwaku Poku Asante, Seth Owusu-Agyei, David Dosoo, Dennis Adu-Gyasi (KHRC); Nicole Whitehurst (MCDI); Samuel Kaba, Williams Mills-Pappoe (ICD); Ralph Ntumy, Felicia Amoo-Sakyi (Impact Malaria), Mohammed Adams (MCDI)

Collaborating Institutions:

1. Institutional Care Division (ICD), Ghana Health Service
2. Impact Malaria
3. PATH MalariaCare
4. Improving Malaria Diagnosis (IMaD)
5. Centres for Disease Control & Prevention (CDC)
6. World Health Organisation (WHO)
7. Medical Care Development International (MCDI)
8. United States Agency for International Development (USAID)
9. Partners

Funder:

: Kintampo Health Research Centre, Medical Care Development International (MCDI); PATH MalariaCare; World Health Organisation

Background

Malaria microscopy continues to be a cornerstone for malaria diagnosis. Training and competency validation of microscopists is required for reliable results. Standardised sets of malaria blood slides are needed for the training and competency validation. KHRC with support from the collaborating partners is restocking the malaria slide bank (MSB) with new sets of validated blood slides to achieve the aim.

Activities

The protocol to recruit participants was developed and submitted for ethical approval by the Kintampo Health Research Centre Institutional Ethics Committee (KHRC-IEC). Meetings were held to discuss the implementation of the project among partners. Requests for consumables to be procured were made.

The project is to restock the MSB with over 6,000 validated slides comprising negative, p. faliciparum (different densities), P. malariae, P. ovale, and mixed infection slides organised in slide cabinets. Information on each slide will be stored in a database which makes it easy to select required slide sets for training and competency assessment.

Currently, slides from the MSB have been used for training of medical laboratory professionals and other institutions. The slides from the MSB have also been used for competency assessments, and Outreach Training and Support Supervision (OTSS) for malaria diagnosis by the Clinical Laboratory Unit of the Institutional Care Division, Ghana Health Service.

Added to the bank are more than 2000 placental tissue blocks fixed in paraffin wax and the corresponding H & E stained tissues from the placental tissues. These samples were prepared from a birth cohort study that enroled and followed about 2000 pregnant women till at least one year after their new born babies.

Activities in the year under review have been to replenish the slides to be able to maintain the number of slides always needed in the bank for the intended purposes.

Mosquito and Tick-borne Infections Surveillance

Investigators

Dr. Kwaku Poku Asante, Ms. Dorcas Atibilla, Yussif Tawfiq, Mr. David Dosoo

Collaborating Institutions:

The Kintampo Health Research Centre (KHRC) collaborated with NAMRU-3, the Noguchi Memorial Institute for medical research (NMIMR), Kumasi Centre for Collaborative Research in Tropical medicine (KCCR) and Navrongo Health Research Centre (NHRC).

Background

Geographic difference, climate change among other factors can have adverse effects on the distribution of vectors and vector-borne diseases. Thus, there is the need to pool data on vector-borne diseases from different geographical areas for analysis to get a clearer picture of the transmission pattern of other emerging pathogens from across the world.

The Kintampo Health Research Centre (KHRC) collaborated with NAMRU-3, the Noguchi Memorial Institute for medical research (NMIMR), Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR) and Navrongo Health Research Centre (NHRC) to conduct arthropod surveillance effort in Southern, Central Middle belt and Northern Ghana. KHRC was responsible for collecting samples from the middle belt of Ghana where the vegetation is mainly of the forest-savannah transition type. Collections targeted areas of close contact between human and animal populations. Surveillance centred on ticks and mosquitoes using specific trapping methods and after which samples collected were identified morphologically.

Methods

Sampling Site, Sampling Procedures and Questionnaire Administration

The study was conducted in Kintampo North Municipality. Tick collections have so far been in the cattle market, the main Kintampo Abattoir, Kraals in Babator, Bui Power Distribution station area and Ahenakom all in Kintampo North Municipality. Communities where mosquito trappings were done include: Kintampo KHRC premises, Chiranda, Surounoasi Techira Number 1 and Techira Number 2. These communities were randomly selected from the Kintampo Health Demographic Surveillance System (KHDSS) listings.

All information pertaining to the tick data were collected using structured questionnaires to capture basic information about the cattle, age, origin, the vaccination records as well as parts of the animal where ticks were picked. Ticks were collected with assistance from cattle herdsmen to pick ticks mainly from the ear, stifle, brisket, fore flank and tail. Compound identification numbers of households, humidity and GPS readings using a simple hand- held GPS receiver (GARMIN series) ArcGIS 9.2 version were the main information recorded during trapping.

Mosquito and Tick Collections

The Centre for Disease Control (CDC) light traps were used to collect mosquitoes in rooms of randomly selected households as well as outdoors trappings. Mosquitoes were trapped six days in a month and sometimes two weeks depending on the numbers collected in each month using CDC Light traps and Biogent (BG) traps as per the protocol. Consent was sought from household heads and occupants of each room. All mosquitoes collected were identified and stored in silica gel and Aedes aegypti and Culex quinquefasciatus stored in RNA later. The ticks, however, were collected twice in each month depending on the availability, identified and preserved in RNA later (Sigma, Life Science). All tick samples have since been stored in the -80 freezer for later processing.

Logistical support

The team received some equipment to support the work. These include: Two boxes of 12 volts and 6 volts rechargeable batteries, a dry ice making machine, a dissecting microscope, a desktop computer and modem as well as Laboratory chill table.

Results

Mosquitoes

For the period under review, a total of 7242 mosquitoes were collected. Table 1 shows details of the species collected with their respective percentages. All mosquitoes were collected mainly using the BG trap and the CDC light traps.

Table 1: Monthly collection of mosquitoes and species distribution from January 2021 to December 2021 in Kintampo.

Month	Mosquito Species							
	Culex quin.	*Mansonia uniformis*	*An. gam*	*An. Funestus*	*An. Pharoensis*	*An. Rufipis*	*Aedes aegypti*	Totals
Jan	129						3	132
Feb	57						2	59
Mar	62						3	65
Apr	74	3	4	10			4	95
May	65	27	133				16	241
Jun	108	74	472	2			18	674
Jul	70	106	1368			14	11	1569
Aug	179	44	667			16	3	909
Sep	138	14	2580		3	38	6	2779
Oct	60	174	251	4	2	48	4	543
Nov	91	4	7					102
Dec	74							74
Total	1107	446	5482	16	5	116	70	7242
Percentage	15.29%	6.15%	75.70%	0.22%	0.07%	1.60%	0.97%	100%

Ticks

From the month of January 2021 to December 2021, a total of 4026 ticks have been handpicked from cattle. Table 2 shows details of the species collected as well as percentages.

Table 2: Total number of ticks collected from January 2021 to December 2021 in Kintampo

Month	Tick Species			
	Repi boo. geigyi	*Hylomma trun*	*Amblyomma var.*	Totals
Jan	210	20	15	245
Feb	128	75	54	257
Mar	118	194	76	388
Apr	37	63	313	413
May	2	6	197	205
Jun	157	94	18	269
Jul	164	53	59	276
Aug	141	72	8	221
Sep	385	13	9	407
Oct	227	139	18	384
Nov	269	117	142	528
Dec	348	18	67	433
Total	2186	864	976	4026
Percentage	54.29%	21.46%	24.24%	100%

Conclusion

Insect collections are still ongoing. A lot of samples have been stored awaiting training and analysis. The study site is promising with high species richness when it comes to mosquitoes. The entomology team has improved on the technical capacity through the various training and hands on experience.

Study on the Burden of Diseases Potentially Preventable by Maternal Immunisation in Sub-Saharan Africa

Investigators (Ghana):

Dr. Kwaku Poku Asante, David Dosoo, Irene Apewe Adjei

Zimbabwe: Dr. Zivai Mupambireyi, Patience Musasa and Maye Masomera (late)

Liverpool School of Tropical Medicine: Prof. Matthews Mathai, Dr. Alexander Manu, Elizabeth Mathai, Clara Burton and Prof. Frances Cowan

Collaborators:

Liverpool School of Tropical Medicine

Funder:

European Commission

Project end date:

October 2018

Project start date:

June 2022

Background

Infections contribute to over 10% of maternal deaths and approximately a quarter of newborn deaths worldwide. These infections are commoner in low and middle-income countries (LMICs) particularly in Sub-Saharan Africa. Pregnancy could result in increased susceptibility of women to infections which they can pass on to babies in utero or around the time of birth resulting in adverse outcomes for infants. These are further compounded by co-infection with malaria, human immunodeficiency virus (HIV) or tuberculosis (TB). However, pregnancy also provides an opportunity to use vaccines (maternal immunisation) to protect newborns in the riskiest time of life - the first month of life – when over 44% of all deaths in children under five years occur. The near elimination of neonatal tetanus in many countries is partly attributed to improved coverage of the tetanus toxoid immunisation in pregnancy. This study aims to quantify the burden of vaccine-preventable diseases due to group B streptococcus (GBS), respiratory syncytial virus (RSV) influenza, and pertussis (GRIP) in pregnant women and their infants in Ghana and Zimbabwe and bridge the knowledge gaps that impede the advancement of maternal immunisation in Sub-Saharan Africa. It will explore the impact of co-morbidities with HIV, TB and Malaria.

Objectives

1. To provide evidence on the burden of GRIP infection among pregnant women and infants and to identify the gaps in current knowledge in Sub-Saharan Africa.

2. To quantify the burden of group B streptococcus, respiratory syncytial virus disease, influenza, and pertussis among pregnant women and their infants in Ghana and Zimbabwe.

Methods

This was a multi-country (Ghana and Zimbabwe) study carried out by the Kintampo Health Research Centre in Ghana and the Centre for Sexual Health and HIV/AIDS Research Zimbabwe (CeSHHAR, Zimbabwe). The study was a population-based prospective cohort study that recruited and followed-up mothers from pregnancy until childbirth; and their infants for up to the first year of life. The target population was pregnant women residing in the catchment areas within the two countries and all infants born to them during the period of the study. Pregnant women with gestational ages of 13 weeks or more but less than 28 weeks residing in the study area were eligible for the study. A total of 12,000 pregnant women were to be recruited from both sites.

Progress

Following ethical approvals, field and laboratory staff were trained on the project activities. Potential participants were consented and recruited into the study and followed till the end of their pregnancy. For participants who had live births their infants were also followed for the first year of life. The Kintampo site started recruitment on 30th October, 2018 to 27th March, 2019. A total of 613 participants were recruited. Field activities for the study has been completed. A total of 564 babies were born into the study and the last follow up of infants was in October, 2020.

Samples have been shipped to the University of the Witwatersrand Vaccines and Infectious Diseases Analytics (Wits-VIDA) research unit formerly Respiratory and Meningeal Pathogens Research Unit (RMPRU) in South Africa and Public Health England in the United Kingdom for analysis. A no cost extension was obtained to allow time for analysis samples at collaborating laboratories.

AdOPT

Title: Antenatal, Intrapartum and Postnatal Care: A Prospective, Longitudinal Study of Maternal and Newborn Health of the Pregnancy Risk Stratification Innovation and Measurement Alliance.

Investigators (Ghana):

Dr. Kwaku Poku Asante, Prof. Sam Newton, Mrs. Charlotte Tawiah Agyemang, Mrs. Irene Apewe Adjei, Mrs. Ellen Boamah-Kaali, Mr. Seeba Amenga-Etego, Ms. Stephaney Gyaase, Mr. Eliezer Ofori Odei-Lartey, Dr. Dennis Adu-Gyasi, Mr. Lawrence Gyabaah Febir, Mr. Kenneth Wiru, Mrs. Veronica Agyemang and Mr. Dennis Konadu Gyasi.

George Washington University: Dr. Emily Rose Smith and Sasha Baumann.
Beth Israel Deaconess Medical Centre: Dr. Blair Wylie

Funder:
Bill and Melinda Gates Foundation

Project end date:
November 2020

Project start date:
December 2022

Background
Quality antenatal and postnatal care services are important and gaining recognition with increasing antenatal care coverages in low- and middle-income countries. However, the ANC coverage rate is much lower among more vulnerable populations (e.g. lower quintile, rural regions), and the quality of care that women receive is inconsistent, often poor, and frequently fails to detect risks in a timely fashion or to prepare women for the birth process. While most women access skilled antenatal care at least once during pregnancy, there is poor continuity of care and only about 60% of women receive the recommended four ANC visits by WHO.

From a surveillance perspective, there is a lack of robust population-level burden data to inform global and local estimation of key risk factors, vulnerabilities and morbidity and mortality outcomes among pregnant women and mother-infant pairs during the duration of antenatal and postnatal care. Robust data on pregnancy risks, including medical history, clinical symptoms and diagnostics, social determinants, as well as antenatal and intrapartum care are critical to developing strategies to effectively manage pregnancy risk and improve outcomes, within resource-constrained environments.

Goal
The goal of this study is to develop a harmonised data set to improve our understanding of pregnancy risk factors, vulnerabilities, and morbidity and mortality and to estimate the burden of these risk factors and outcomes in Low and Middle-Income Countries. Ultimately, these data will inform the development of innovative strategies to optimise pregnancy outcomes for mothers and their newborns.

Methods
This is a multi-country population-based study involving four countries including Ghana. For Ghana, this study forms part of the Adverse Outcomes in Pregnancy Trial (AdOPT) research study which would be conducted in two phases. Phase 1 of the study (current study) is an observational study to provide data to inform the AdOPT phase 2 intervention study. A total of 16,000 pregnant women would be enroled from all sites on the study. For Ghana, 3,500 pregnant women would be enroled on the study. Monthly visits would be made to women of reproductive age and pregnant women would be enroled on the study. Women who agree to be part of the study are scheduled to have an ultrasound scan to determine the viability of the foetus and gestational age. Monthly follow up visits are made to the pregnant women at home. At delivery pregnancy, outcome and delivery information are collected by facility-based field workers. In the case of home delivery, such information is collected by community-based fieldworkers. Biological samples including vaginal swabs and maternal blood samples are collected from study participants at each trimester and cord blood and placental tissues at delivery. Enroled participants are followed up monthly from pregnancy till they deliver. After delivery, those who have a live birth are also followed up till their babies are a year old to collect information on vital status, morbidity and nutrition.

Progress
Regulatory approvals have been obtained from the Scientific Review Committee of Kintampo Health Research Centre (KHRC), the KHRC Institutional Ethics Committee and the Ghana Health Service Ethics Review Committee. Community sensitisation was conducted in study communities be-

fore the commencement of the study. Ultrasound training was organised for 16 midwives and a public health nurse from health facilities in the study area to enable them confirm pregnancies and estimate gestational ages of study participants.

Figure 1: Community sensitisation in a study community

Figure 2: A section of study team members

Recruitment into the study started on 15th March, 2021. As of 30th November 2021, 1,507 pregnant women have been consented and enroled on the study. The study has recorded eight miscarriages, 1077 deliveries, 1050 live births and 24 stillbirths. Recruitment and follow up is still ongoing. So far none of the study participants has completed the one year follow up activities and exited the study.

Anaemia Sub Study
ReMAPP_Redefining Maternal Anaemia in Pregnancy and Postpartum

(Title: Redefining anaemia: A multicentre, international, population-based study to establish and validate global reference values for anaemia in pregnancy)

Investigators:

KHRC, Ghana: Dr. Kwaku Poku Asante, Mrs. Charlotte Tawiah, Prof. Sam Newton, Ms. Veronica Agyemang

Korle Bu Teaching Hospital, Ghana: Dr. Amma Benneh Kwasi-Kuma

George Washington University, United States: Prof. Emily Smith, Ms. Sasha Bauman.

Anaemia is defined as a deficiency in oxygen-rich blood and is characterised by low blood haemoglobin concentration and/or low red blood cell (RBC) count insufficient to meet physiological needs. Women of reproductive age (WRA) especially pregnant and lactating are disproportionately affected by anaemia affecting about 613 million and this is associated with increased risk of adverse outcomes for both mother and newborn. The burden of anaemia is more pronounced in low and middle-income countries (LMICs). The World Health Assembly aims to reduce anaemia in WRA by 50% by the year 2025. The causes of anaemia are multifaceted, however, iron deficiency accounts for over 50% in WRA.

The overarching objective of this study is to leverage the Antenatal/Postnatal Research Collective (ARC) network to advance clinical knowledge of anaemia during pregnancy and contribute high quality, globally representative data toward establishing haemoglobin thresholds linked to functional outcomes. Nested within a subset of ARC sites (Ghana, Kenya, Zambia, and Pakistan) implementing a Pregnancy Risk Stratification Innovation and Measurement Alliance (PRiSMA) Maternal and Newborn Health (MNH) Study, three primary aims of this study will be:

Aim 1: To define normal haemoglobin values in healthy women during pregnancy and within 42 days and six months postpartum and estimate related statistical thresholds for anaemia diagnosis in these populations;

Aim 2: To establish haemoglobin thresholds for anaemia diagnosis in pregnancy based on the link with adverse maternal, foetal, and newborn health outcomes;

Aim 3: To describe the underlying contributing factors to anaemia during pregnancy.

Each participating site will recruit 1600 to 2000 pregnant women from the MNH study into the Aim 2 cohort at gestational age 14 weeks. Serial haemoglobin measurements will be done during the antenatal period (13 weeks, 20 weeks, 28 weeks, 36 weeks) and 42 days and 6 months postpartum . A sub cohort of 1200 to 2000 women from the Aim 2 cohort will be further screened to identify a healthy pregnant population of 600 participants for the Aim 1 (establishing reference values). Aim 3 will include a cross-section of 300 women (100 per trimester), randomly sampled from those screened for the Aim 1 sub-cohort, to participate in the biomarker intensive sub-study to describe the underlying contributing factors to anaemia.

The proposed study would contribute to a growing body of evidence that could inform new global guidelines for diagnosing maternal anaemia and identifying high-risk pregnancies based on haemoglobin. The project is anticipated to take three years, expected to start recruitment in first quarter of 2022 and funded by the Bill and Melinda Gates' Foundation.

TASSH

Title: Uptake of Task-Shifting Strategy for Blood Pressure Control in Community Health Planning Services: A Mixed-Method Study.

Study Team:

Dr. Kwaku Poku Asante, Prof. Jacob Plange-Rhule, Prof. Gbenga Ogedegbe, Prof. Juliet Iwelunmor, Joyce Gyamfi, William Chaplin, Kezia Mantey, Kingsley Apusiga, Solomon Nyame, Kwame Adjei, Dr. John Amoah

Collaborators:

New York University (USA), Saint Louis University (USA), Kwame Nkrumah University of Science and Technology (Ghana)

Funder:

National Institute of Health (NIH)/NHLBI

Project end date:

28th May, 2017

Project start date:

31st May 2022

Study duration:

60 months

Background:

In countries like Ghana, hypertension, once a rare disease, has become a major public health problem, and the second leading cause of morbidity in adults. Results from an epidemiological study on hypertension conducted between October 2015 and December 2016 as part of the Kintampo Non-Communicable Disease Initiative revealed that the prevalence of hypertension was 24.6%. Also, approximately 55% of those with hypertension did not know their status, hence, were not on any medication. Thus, an intervention was needed. One of the greatest challenges to optimal hypertension control in Sub-Saharan Africa (SSA) is the acute shortage of healthcare workers. The World Health Organisation (WHO) launched a series of evidence-based practices for low middle-income countries including WHO Cardiovascular Disease (CVD) Risk package utilizing the Task Shifting strategy to improve the shortage of health workers for CVD prevention and control. These strategies of using non-physician health workers, such as community health workers and nurses are proven to be viable and cost-effective.

Objectives

1. Identify practice capacity for the adoption of TAASH at CHPS compounds and develop a culturally tailored Practice Facilitation (PF) strategy using qualitative methods.

2. Evaluate in a stepped-wedge cluster randomised control trial, the uptake of a PF strategy versus the Usual Care (UC) in the control and management of blood pressure in Community Health Planning Services

3. Compare in a stepped-wedge cluster RCT, the clinical effectiveness of the PF strategy vs. UC on systolic BP reduction among adults with uncontrolled hypertension.

Brief methodology

This mixed-methods, "Hybrid Type II" Effectiveness-Implementation study will take place in three (3) contiguous districts in the Brong Ahafo of Ghana (Kintampo North, Kintampo South, and Nkoranza North). A culturally acceptable practice facilitation strategy will be developed based on recommendations from key stakeholders guided by Damshroeder's Consolidated Framework for Implementation Research (CFIR). Community Health Officers will be trained based on the practice facilitation strategy developed. Seventy (70) CHPS zones will be selected and randomised into intervention and control groups. The intervention group will implement the practice facilitation strategy whereas the control group will provide the usual care in the first year. In the second year, the usual care group will implement the facilitation strategy whereas the implementation group will provide the usual care. At the post-implementation phase, the study team will evaluate the adoption and sustainability of TASSH in participating CHPS zones using the Reach Effectiveness Adoption Implementation and Maintenance (RE-AIM) framework.

Expected outcome/Key findings

Primary Outcome: The rate of adoption of TASSH at the CHPS compounds.

The primary outcome will be assessed by the following measures:

1. The number of newly detected hypertensive patients by the CHOs using the WHO Risk Prediction Chart

2. Proportion of patients who received lifestyle counseling by the CHOs

3. The proportion of eligible patients that were referred to physicians and specialist for further care.

Secondary Outcomes
1. The between-group difference in systolic BP

2. Mediators of adoption of TASSH at the CHPS compounds

3. The sustainability of TASSH uptake.

Key activities to date

Practice Capacity Survey

The study team assessed the capacity for the management of hypertension within six contiguous districts (Techiman North District, Techiman Municipality, Nkoranza North District, Nkoranza South Municipality, Kintampo North Municipality and Kintampo South District). This practice capacity survey was guided by the Consolidated Framework for Implementation Research (CFIR). A total of 179 CHPS zones were surveyed. The survey result revealed that 78.77% of the respondents did not know the first line Hypertension (HTN) medication. Respondents' characteristics such as participants training (p=0.001) and years of HTN management (p=0.033) were significantly associated with diastolic Blood Pressure (BP) threshold for initiation of HTN treatment. Furthermore, in terms of the BP threshold (both systolic and diastolic) for initiation of HTN treatment, participants training (p=0.028) and number of years of HTN management (p=0.019) was significantly associated with correct responses. Results also showed that there was high level of receptivity (75.42%) for the proposed intervention, high confidence (82.68%) and participants are highly prepared (82.68%) to use the proposed study intervention.

Concept Mapping Exercise

We developed a concept map, consisting of 46 strategies needed for implementing evidence based TASSH, organised into 6 clusters:
1) Referral Systems;
2) Availability of Equipment;
3) Protocols and Guidelines;
4) Capacity Building/Training;
5) Policy Reform, and
6) Technical Support and Supervision.

Availability of equipment was rated as the most important strategy (mean 4.80 out of 5) needed to implement evidence based TASSH, while Capacity Building/Training was rated as the most feasible strategy (mean 4.20 out of 5) to address. Although important (mean 4.40 out of 5), policy reform was rated as the least important and feasible strategy to address.
These findings demonstrate strategies that can help inform future interventions focused on the adoption and sustainability of evidence based TASSH within Ghana's CHPS zones. Also, national, regional and district health stakeholders can support healthcare workers by facilitating access to equipment and strategies for enhancing capacity and training with implementing evidence-based task-shifting hypertension interventions in Ghana.

Participant recruitment

Currently, participant recruitment is ongoing in 70 randomised CHPS zones. Since the start of participant recruitment, the community health workers were able to screen a total of 3759 individuals across 70 CHPS zones. They have identified a total of 657 hypertensive patients and referred to the next level of care. The study team has been able to complete the baseline for 484 study participants.

Figure 1: Participants of one of the training sessions.

Title: Effectiveness and Safety of Four or More Doses of SulphadoxinePyrimethamine (SP) Administered as Intermittent Preventive Treatment against Malaria during pregnancy among Ghanaian Women

KHRC: David Dosoo, Dorcas Atibilla, Seth Owusu-Agyei, Kwaku Poku Asante

London School of Hygiene & Tropical Medicine: Daniel Chandramohan, Jane Bruce, Brian Greenwood

Collaborators:

London School of Hygiene & Tropical Medicine (LSHTM), London, UK
Brown University, RI, USA

Funder:

Kintampo Health Research Centre

Project end date:

July 2017

Project start date:

December 2020

Background

Malaria in pregnancy is a major public health problem, causing maternal, foetal and infant morbidity in malaria endemic areas of Sub-Saharan Africa. It is the cause of unfavourable pregnancy outcomes such as stillbirth, low birth weight (LBW), preterm delivery, abortion, maternal anaemia and neonatal mortality. Intermittent preventive treatment in pregnancy using sulphadoxine-pyrimethamine (IPTp-SP) clears parasites in mothers and prevents subsequent infections. Ghana has adopted the new WHO IPTp-SP policy which recommends monthly SP administration starting early in the second trimester to as close as possible to delivery.

Objectives

- Determine the impact of four or more doses of IPTp-SP, compared to three doses, on the prevalence of active (acute or chronic) placental malaria, peripheral, cord and placental bloods smear parasites in mothers and their newborns, and adverse pregnancy outcomes (abortion, stillbirth, preterm delivery, LBW, congenital malformations.
- Estimate the prevalence and risk factors of malaria parasitaemia and anaemia at first antenatal care clinic visit.
- Estimate the current frequencies of P. falciparum dihydroxyfolate reductase (dhfr) and dihydropteroate synthase (dhps) gene mutations responsible for resistance to SP in the study area.

Methods

This cohort study enroled 1700 pregnant women early in the second trimester, prior to commencement of IPTp-SP at Antenatal Care Clinics in the Kintampo Districts and adjourning Nkoranza Districts in the middle belt of Ghana. Pregnant women were followed up to delivery and a month after. At enrolment, samples were collected for malaria microscopy, haemoglobin estimation, SP resistance markers genotyping. Placental samples (approximately 2.5cm3), cord blood, maternal peripheral blood were collected at delivery for placental, peripheral and cord blood parasitaemia and haemoglobin estimation. Babies were weighed within 24 hours after delivery. Children were followed up monthly up to six months and samples capillary blood samples collected for malaria parasites and haemoglobin estimation.

Outcomes: The following are some publications from the study:
Epidemiology of malaria among pregnant women during their first antenatal clinic visit in the middle belt of Ghana: a cross sectional study.

Dosoo DK, Chandramohan D, Atibilla D, Oppong FB, Ankrah L, Kayan K, Agyemang V, Adu-Gyasi D, Twumasi M, Amenga-Etego S, Bruce J, Asante KP, Greenwood B, Owusu-Agyei S. Malar J. 2020 Oct 23;19(1):381. doi: 10.1186/s12936-020-03457-5.

Effectiveness of intermittent preventive treatment in pregnancy with sulphadoxine-pyrimethamine (IPTp-SP) in Ghana.

Dosoo DK, Malm K, Oppong FB, Gyasi R, Oduro A, Williams J, Atibilla D, Peprah NY, Twumasi M, Owusu-Agyei S, Greenwood B, Chandramohan D, Asante KP.BMJ Glob Health. 2021 Aug;6(8):e005877. doi: 10.1136/bmjgh-2021-005877.

Title: Programme for the Effective Promotion of maternal psychosocial WELLbeing (PREPWELL)-intervention development study

KHRC: Solomon Nyame; Kenneth Ae-Ngibise; and Dr. Kwaku Poku Asante

University of Ghana: Dr. Benedict Weobong: Professor Philip Adongo; Professor Angela Ofori-Ata; Professor Joseph Osafo

London School of Hygiene and Tropical Medicine: Professor Betty Kirkwood

Funder:
University of Ghana, School of Public Health

Project end date:
22nd August 2020

Project start date:
28th July 2022

Study duration:
Two years

Background

It is now established that the burden of perinatal depression in low and middle-income countries (LMIC) (11.3% during pregnancy and 18.3% after birth) is higher than in developed countries (10.2% during pregnancy and 12.9% after birth). Maternal psychosocial well-being is a concept that defines the psychological and social aspects of motherhood. At one of its extremes this concept encounters maternal perinatal depression, a condition that is now recognised as a major public health issue world-wide.

The goal of PREPWELL is threefold and will be achieved in two phases through a systematic methodology to:

1) formative phase: develop PREPWELL as a culturally appropriate behavioural activation-based (positive psychology) self-help intervention for delivery to all pregnant women and women who have recently given birth, through CHPS nurses supported by mHealth, and evaluate its comprehensibility, acceptability, and saliency for pregnant and women who have recently given birth;

2) evaluation phase: evaluate acceptability, feasibility, affordability, and perceived impact on perinatal depression of integrating PREPWELL into reproductive and child health services; and

3) develop a protocol for a definitive individually randomised controlled trial (RCT) to evaluate its effectiveness.

The goal of the formative phase of the Programme for Effective Promotion of maternal psychosocial WELL-being, (PREPWELL) is to check whether this intervention would be a good idea (acceptability). Also, we want to know what should be included in this programme to make it work or beneficial to mothers (feasibility)

The study area is Kintampo North Municipality and Kintampo South District.

Formative phase activities conducted are:

In-depth Interviews (IDIs) with key stakeholders: Health Directors, Public Health Nurses, Midwives, Community Psychiatric Nurses, Clinical Psychologist, Community Mental Health Officers, Community Psychiatric Officer, CHPS Co-ordinators, Disease Control Officers.

Participatory workshops: Pregnant women, women who have recently delivered, and Consultative meeting with key stakeholders for the intervention development

Findings from the situational analysis

The observation activity conducted at the ANC unit showed that it is feasible to incorporate the PREPWELL intervention to the various activities being performed at the ANC unit.
Also, the scoping review conducted highlighted five key focus areas that are identified as crucial when intervention uses digital health to improve health outcomes in LMIC. These include:

- Intrinsic characteristics of the intervention must offer tangible benefit to address an unmet need.
- All stakeholders must be engaged, trained, and motivated to implement a new initiative.
- The technical profile of the intervention should be simplicity,

adaptable and acceptable

- Focus area is the policy environment in which the digital healthcare intervention is intended to function
- The extrinsic factors should also be considered

Next steps

- Developing the intervention manual and intervention prototype
- Setting up the mobile components
- Piloting the intervention prototype

Figure 2: Picture of Group Work activities during stakeholder participatory workshop

ABACUS 2
Antimicrobial Resistance Studies

Investigators:

Kwaku Poku Asante, Samuel Afari-Asiedu, Ellen Boamah-Kaali, Martha Ali Abdulai, Wisdom Adeapena, Theresa Tawiah, Dennis Adu Gyasi, Latifatu Abubakar Alhassan

Collaborating institutions:

Kintampo Health Research Centre (KHRC), Radboud University Medical Center, Netherlands, National Antimicrobial Resistance Platform/Ministry of Health, Ghana

Introduction

Antimicrobial resistance (AMR) is still a threat to public health especially in low and middle income countries (LMIC) largely due to inappropriate antibiotic access and use. AMR is becoming more alarming because the discovery of new antibiotics have been on the decline for the past four decades. In fact, the few antibiotics that have been produced since the 1980s have been a variation of drugs that already exist. KHRC continued to conduct studies to understand the context of antibiotic access and use. Below are updates for 2021.

Community-level antibiotic access and use (ABACUS II)

Background

Findings from our previous studies on antibiotic access and use show that inappropriate antibiotic use is influenced by confusing antibiotics for other medicines which are in capsules, tablets and antibiotics with similar colours. Building on the findings from the previous study (ABACUS-Scientific Publications – ABACUS project (abacus-project.org) the team through another Wellcome Trust initiative is currently exploring the case for a standardised appearance of oral antibiotics ABACUS II project in Africa, Asia, Europe and the UK. The study is expected to end by August, 2022.

Methods

Using a mixed methods approach, the study is concurrently being implemented under four sub-studies.

a. Assessing the potential impact of and obstacles to standardising the physical appearance of commonly used oral antibiotics to be followed by co-creation of prototypes

b. Assessing how identification of oral antibiotics impacts appropriate community-based antibiotic use

c. Perform a health economics analysis related to inappropriate identification of oral antibiotics.

d. Assess the proportion of substandard and falsified oral antibiotics among three commonly sold antibiotics.

Progress

The sub-studies are currently at different stages of implementation. Assessing the potential impact of and obstacles to standardising the physical appearance of commonly used oral antibiotics

This sub-study explored the perspective of experts and stakeholders to inform the co-creation of an international system to facilitate the recognition of oral antibiotics. A total of six round table meetings were held in Africa, Asia and Europe. KHRC in collaboration with the Radboudumc, organised the Africa roundtable meeting among experts from African-based public health organisations. The meeting was successfully held on 18th December, 2020. In all 10/13 participants who confirmed their participation were able to attend the zoom meeting. Report from this roundtable meeting has been shared with experts who participated in the meeting.

Essentially, all experts agreed that addressing the physical appearance of medicine is an important issue in view of the increase in AMR and patient safety issues. Several experts, however, indicated that the problem goes beyond difficulty in 'recognition' as antibiotics are prescription only drugs that should be regulated. Beyond appearance and recognition, experts suggested complementary strategies including adequate implementation of existing regulations, the empowerment of communities and capacity building for both prescribers and dispensers.

Health economics analysis related to inappropriate identification of oral antibiotics

KHRC in collaboration with Raboudumc, explored the economic impact of inappropriate antibiotic use adopting the example of upper respiratory tract infections (URIs) in Ghana. A top-down, retrospective economic impact analysis of inappropriate antibiotic use for URIs was conducted. Two inappropriate antibiotic use situations were considered:

1. URIs that were treated with antibiotics, against recommendations from evidence-based clinical guidelines; and

2. URIs that should have been treated with antibiotics according to evidence-based clinical guidelines but were not. The analysis included data collected in Ghana during the ABACUS project (i.e., household surveys and exit-interviews among consumers), scientific literature and stakeholder consultations. Cost saving projections were computed based on potential effects of future interventions to improve antibiotic use.

Inappropriate antibiotic use for URIs was estimated at around $975 million (M) annually including $689 M for situation 1 and $286 M for situation 2. For both situations, productivity losses accounted for ≥95% of the total costs. Health care costs incurred were estimated around $20 M. Possible future cost savings ranged from $69 to $482 M for situation 1 and from $29 to $200 M for situation 2. Our finding showed that inappropriate antibiotic use for URIs in Ghana has a substantial economic impact. Understanding the economic consequences and community antibiotic consumption practices is crucial to mobilise key stakeholders and design sustainable strategies to improve use.

An abstract from this manuscript was submitted for the 2021 European conference of Clinical Microbiology and Infectious Diseases. The manuscript has also been submitted to the Journal of antimicrobial resistance and infection control.

Assessing how identification of oral antibiotics impacts appropriate community-based antibiotic use

In addition to the stakeholder roundtable meetings, this substudy also assessing the potential impact of and obstacles to standardising the appearance of commonly used oral antibiotics. The focus of this is to engage on formal and informal supplier/dispensers as well as consumers. This substudy is currently ongoing in four LMIC (Mozambique, Bangladesh, Ghana and Vietnam) and two Upper Middle-Income countries (UMIC) (South Africa and Thailand).

Together with our lead collaborators from the Oxford University, UK and the other participating sites, a generic qualitative study protocol and interview guides were developed. KHRC adapted the generic protocol to the local context and submitted it to the KHRC scientific and ethics committees for approval. Data collection started in the first week of November and ended by mid-December, 2021. A total of 8/10 focus group discussions and 17/20 in-depth interview were conducted. Audio recordings for all the focus groups and 14/17 in-depth interviews have been transcribed. Data cleaning is currently ongoing for analysis in January, 2022.

Assess the proportion of substandard and falsified oral antibiotics among three commonly sold antibiotics

This study is at the initial stage of implementation. The primary objective of this sub-study is to estimate the quality of three essential antibiotics in four LMIC including Ghana, using laboratory tests against reference criteria. The antibiotics will be sampled by mystery shoppers where possible, or using an overt approach in outlets where prescription/medical examination is required. The trade in substandard and falsified (SF) medicines is a public health challenge. Though a global challenge, the epidemiology of SF medicines suggests that LMIC are hotspots. KHRC in collaboration with the Medicine Quality Research Group in Oxford University, UK, Radboudumc and the other sites drafted a generic proposal for this study. The protocol was adopted and submitted to the KHRC scientific and ethics committees approvals. In Ghana, KHRC is collaborating with the Ghana Food and Drugs Authority in the conduct of this study. Following the initial contact for collaboration by KHRC, the Food and Drugs Authority has shared with KHRC the condition under which the study should be conducted including shipment of samples to the central laboratory in Kenya for analysis. KHRC has also shared the approved proposal with the Ghana Food and Drugs Authority and the study is being conducted according to the condition outlined by them. Database management system is being developed to be followed by the training of mystery shoppers and data collection in early 2022.

SABAUSE
Sociocultural determinants of antibiotic access and use study (SABAUSE)

Background
SABAUSE is a sandwiched PhD study between the Radboud University Medical Centre in the Netherlands and the Kintampo Health Research Centre, Ghana. This study seeks to examine contextual determinants of antibiotic access and use in rural Ghana.

Methods
The study involves the use of quantitative and qualitative methods to identify the main contextual determinants of antibiotic access and use at the community level.

Progress
The thesis has been completed and is being finalised for submission. In all, seven chapters including five papers have been included in this thesis. Four out of the five papers have been published and one has been submitted to a journal.

Generally, over-the-counter medicine sellers sell almost all types of antibiotics because of both structural and individual contextual factors. Paying for healthcare without health insurance, not seeking healthcare from health centres, or pharmacies were significantly associated with inappropriate antibiotic use. Antibiotic users with low socioeconomic status purchased antibiotics in instalments which could facilitate inappropriate use. Inappropriate antibiotic use was also influenced by general lack of knowledge on antibiotics and identification of antibiotics by colours of capsules which could lead to confusion and inappropriate use.

Structured operational research and training initiative (SORT IT)

Characterising antibiotic use in a Municipal Veterinary clinic in part of rural Ghana.

Background
This is a WHO training programme which aims to document the antibiotic consumption in animal husbandry within a veterinary clinic in the Kintampo North Municipality of Ghana. As a vehicle for capacity building the study is being conducted through four modules that are meant to equip researchers from participating institutions in Africa.

Methods
The study is using existing data (from 01 Jan 2013 to 31 Dec 2018) to characterise the use of antibiotics in a veterinary clinic in the Kintampo North Municipality.

Progress
This training programme has been completed successfully and the paper that emerged from it has been published. This was followed by a dissemination workshop organised by the WHO county office in Ghana.

Noguchi Institute Initiative For Neglected Tropical Diseases Elimination (NIINE) Study

Investigators:
Professor Michael David Wilson, Dr Kwaku Poku Asante, Dr Mike Yaw Osei-Atweneboana, Dr Irene Larbi

Funder:
National Institutes of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH), 9000 Rockville Pike, Bethesda, Maryland 20892, USA.

Project end date:
June, 2018

Project start date:
June, 2022

Sample size:
560

Background
Hookworm infection is among the leading cause of anaemia and malnutrition in resource-limited countries. Current global strategies to control hookworm and other soil transmitted helminths rely on regular mass drug administration of single dose albendazole (400mg). Recent evidence confirms that deworming drugs are losing effectiveness against hookworm in endemic areas, and our previous studies in Kintampo North Municipality, Ghana confirm this. The emergence of genetically mediated resistance would have potentially devastating public health implications.

Methods
The study is being carried out in nine (9) communities selected along the Kintampo-Buipe Highway which we know from our past studies that hookworm infection is predominant. Participants were consented at baseline (Visit 0) and are to be followed up every nine months till they exit the study on the 36th month. Stool and blood samples were taken and transported to the laboratory for analysis. Kato Katz method was used for the detection of ova/egg of helminthes especially hookworm ova. Blood samples were for malaria microscopy, haematology, serum and plasma for albendazole and immunological analysis.

Expected outcomes / results
The measurement of albendazole absorption will allow an objective assessment of both the role of recent dietary patterns on albendazole absorption and the importance of albendazole absorption for clearing hookworm infections. The GIS spatial analysis and the GPS movement monitoring will allow the innovative assessment of the intersection of environmental and behavioural influences on reinfection. The inclusion of all household members will allow more comprehensive analysis of household level influences on exposure and risk of reinfection.

Progress of work
The team is to carry out analysis of the samples that are in storage to conclude on study activities. As previously described, the study consented and enroled 560 participants at baseline (Visit 0) which started on the 30th June, 2018. All 560 participants provided stool and blood samples. For GPS movement monitoring, 15 hookworm positive and 15 hookworm negatives participants were tag to monitor their movement and specific location were identified for soil samples collection.

Participants found with infections were treated with single dose Albendazole and the pharmacokinetics of the drug will be monitored using blood sample that were collected.

Spatio-tmporal Distribution of Helminth Infection Among A Population of The Kintampo District In The Middle Belt of Ghana

Investigators:

Dennis Adu-Gyasi, Kwaku Poku Asante, Kenneth Wiru, Dennis Konadu Gyasi, Louisa Fatahiya Iddrisu, Love Ankrah, David Dosoo, Elisha Adeniji, Oscar Agyei, Stephaney Gyaase, Seeba Amenga-Etego, Frank B. Osei

Collaborating Institutions:

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Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, P. O. Box 217, Enschede, 7500 AE, Enschede, the Netherlands; f.b.osei@utwente.nl

Abstract

About 2.7 billion people in low-income countries have helminth infections. Such infections remain the most common in preschool-aged children. This exploratory analysis assessed spatially the influence of factors identified to affect helminth infection in two districts in the middle-belt of Ghana, West Africa to advise on the implications for helminth control and elimination programmes. The data used were from 1543 consented and recruited participants that were infected with helminths at baseline and were followed up at 14 days post-treatment. We fitted and compared univariate and multivariate models. The models had similar structures except the structures for the spatially structured and non-structured random effects. The risks of soil transmitted helminth (STH) infections in younger age groups were higher compared to older individuals. Decrease in body mass index (BMI) increased risk of STH infection. The residual spatially correlated and uncorrelated effects for the two periods revealed high risks at the central part compared to the peripheries of the study region. The residual correlated risks that remained after the intervention suggests that STH infection control measures and programmes need to be continued in the study area. The uncorrelated effects revealed a random distribution of the risks of STH infections in the area.

Epidemiology and Spatio-Temporal Distribution of SARS COV-2 Infection Among A Population of the Bono and Bono East Regions of Ghana

Investigators:

Dennis Adu-Gyasi, Thomas Gyan, Livesy N. Abokyi, Farrid Boadu, Latifatu Alhassan, Kenneth Wiru, David Dosoo, Nicholas Amoako, Stephaney Gyaase, Seeba Amenga-Etego, Kofi Amo-Kodieh, Fred Adomako Boateng, Frank B. Osei, Gordon Awandare, Kwaku Poku Asante

Collaborating Institutions:

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Bono Regional Health Directorate (RHD), Ghana Health Service, Sunyani, Ghana

Bono East Regional Health Directorate (RHD), Ghana Health Service, Sunyani, Ghana

University of Ghana, West African Centre for Cell Biology of Infectious Pathogens (WACCBIP)

Background

Winning the fight against the pandemic needs continual testing to completely break the chain of transmission. We formalise the strategy - test, trace contacts, quarantine, isolate and treat (TTQIT). The current TTQIT has predominantly been a passive practice, i.e. suspected patients rather approach hospitals for subsequent testing. In order to improve the surveillance, active testing by health officials is to be implemented. Knowing the whole population cannot be tested due to limited resources, optimal selection of households/localities for testing is, therefore, essential to guide frontline public health professionals. This will further aid in developing accurate risk maps of COVID-19 infection in Ghana.

The team sought to institute this study to understand the natural history of SARS-CoV-2 infection to better define the period of infectiousness and transmissibility; improve surveillance capabilities to more accurately estimate the reproductive number in various outbreak settings and improve understanding of the impact of new variants on the effectiveness of first-generation COVID-19 vaccines in Africa.

Main objective

To understand the epidemiology of SARS-CoV-2 infection to improve surveillance capabilities in resource limited setting and improve understanding of the impact of new variants on the effectiveness of first-generation COVID-19 vaccines in Ghana, West Africa.

Methods

The information that was collected from patients diagnosed with COVID-19 in the two regions of Ghana as well as the laboratory results of the patients were to be reviewed to inform on the objective of the project. The periodic sequencing of the virus by the GHS was going to provide information on the variants that were circulating in the two regions during the pandemic.

Statistical analysis and expected outcome

Statistical analysis: Basic frequencies and description of the population will be done, and stratified by COVID-19 status and location (low, moderate or high burden). A description of the variants identified from the PCR and sequence analysis will be made to see the emergence of new variants. Determination of infectiousness and transmissibility of SARS-CoV-2 will be calculated. Chi-squared tests will be used to determine the association between the risk factors and severity of COVID-19. Poisson/negative binomial regression will be used to model the relationship between COVID-19 and identified factors (age, gender, immunological, genetic and participants with or without underlying conditions). A hierarchical geostatistical model with Markov chain Monte Carlo simulations to optimise localities to implement mass/voluntary testing and to identify areas to implement TTQIT will be done.

Expected outcome: To describe the epidemiology of SARS-CoV-2 infection with better understanding of the infectiousness of the virus and its transmissibility in a low, moderate and high dense population in Ghana to improve surveillance. The study team expects to describe the variants of the virus

that are responsible for the identified infections in the study. As Ghana has adopted the use of COVID-19 vaccines to combat the pandemic, the team expects to obtain insight on the impact of new variants on the effectiveness of first-generation COVID-19 vaccines in Ghana, West Africa. The team will produce maps (digital or hard copy) that could explain the spatial distribution of COVID-19 risk to improve on surveillance and implementation of interventions to control the pandemic. The analysis will enhance the capacity of the disease surveillance units of our health systems to institute effective contact tracing.

Effect of Helminth Infection On P. Falciparum Malaria Intra-Infection Diversity and Variation

Investigators:

Adu-Gyasi Dennis, Kwaku Poku Asante (KHRC), Dr. Anita Ghansah (Noguchi Memorial Institute for Medical Research (NMIMR), Prof Jeffrey Bailey (University of Massachusetts Medical School (UMMS))

Background

Helminth infections and malaria are still major causes of morbidity and mortality in Sub-Saharan Africa. Despite great inroads into controlling these infections both remain challenging public health problems and both are still prevalent in West Africa and Ghana. Both pathogens cause chronic and repeated infections that have ample opportunity to interact within the host and with the host's immune system. Maternal infections of both organisms have been shown to impact birth outcome as well as newborn growth and development.

In a previous study in Ghana, we demonstrated that malaria parasite infections co-exist with hookworm (Ancylostoma duodenalis, Necator americanus), Ascaris lumbricoides, Hymenolepis nana/diminuta, Strongyloides stercoralis, Trichuris trichuria, Microfilalria (undifferentiated) and Intestinal flagellates (undifferentiated) and these infections influence the immune response elicited to the parasites within their host. Specifically, we examined the correlations between worm infections and malaria parasitemia along with major measures of immune response. We found helminth and malaria co-infected individuals had increased cytokine producing T cell populations while as well including CD4+IL-4+ and CD8+Foxp3+IFN-γ+ while dendritic and TCR-γδ cell populations were decreased. It was also evident that hookworm infections with malaria parasites largely stimulate Th2 effector cells. These differences highlight the possibility of these infections to interact with each other and dysregulate the immune system.

Method

In this study we propose to build upon this work using newer molecular techniques to dissect the malaria infections with regard to helminth infections. Our examination of helminth and malaria parasite interactions was not able to completely examine the pattern and nature of the malaria infections. We will use high-throughput next generation sequencing to determine the strain complexity and genetic diversity of the malaria parasites within each individual comparing helminth infected and uninfected individuals.

Malaria infection could be impacted not only in terms of presence and level of parasitemia, but also more subtly in terms of longevity of infection, type of parasites infecting. In this study, we will specifically test the hypothesis that helminth infections decrease immunity and clearance of malaria parasites which will result in increased longevity and number of strains. Our primary objective will be to determine if the complexity of infection (COI or number of strains), correlates with helminth infections. Secondary objectives include examining correlations with specific helminths, immunologic status as measured in the parent study, and household and demographic data. The overall prevalence data will also importantly provide primary descriptive data of the parasite population including drug resistance that can further inform malaria control efforts.

Interim Results

Summary statistics for HelGIS MIP recapture					
	IBC	DR2	Hcom e96	P-value	Correlation Coeff
Read count (median[Q1 - Q3])	8441[1412 - 33336]	1172.5 [225 - 5374.5]	71[20 - 266]	<0.001	
Barcode count (median[Q1 - Q3])	2990[589 - 11747]	231[53 - 956.75]	12[4 - 37]	<0.001	
Barcode coverage/redundancy (median[Q1 - Q3])	3.1[1.6 - 4.0]	6.1[2.5 - 8.2]	7.2[2.6 - 10.8]	<0.001	IBC vs. DR2: R = 0.12 (p=0.002); IBC vs. Heome: R=0.072; Heome vs. DR2:R=0.048
Targets_with_1_barcode (median[Q1 - Q3])	1338[469 - 1728]	170.5 [47.25 - 468]	9 [3 - 18]	<0.001	
Targets_with_5_barcode (median[Q1 - Q3])	106 [0 - 1134]	2.5 [0 - 23]	0 [0 - 1]	<0.001	
Targets_with_10_barcode (median[Q1 - Q3])	1 [0 - 400]	0 [0 - 6]	0	<0.001	
Capture rate (%)*	73.7[25.8 - 95.2]	20.9[5.8 - 57.5]	9.4[3.1 - 18.8]	<0.001	IBC vs. DR2: R = 0.005; IBC vs. Heome: R=0.05; Hcome vs. DR2:R=0.043
*Capture rate (%) = 100 x (targets_with_1_barcode/total number of targets to be captured)					

Kintampo Health and Demographic Surveillance System (KHDSS)

Background

The Kintampo Health and Demographic Surveillance System (KHDSS) aims to document accurate health and demographic information of the resident population within its catchment area through the conduct of routine data collection and updates. This serves as an important resource for health research at the Kintampo Health Research Centre. The KHDSS covers the resident population of six administrative districts within the Bono East Region of Ghana and these have been categorised into three (3) HDSS sites for data management purposes. These are the Kintampo site (Kintampo North Municipal and Kintampo South District), Techiman site (Techiman South Municipal and Techiman North District) and the Nkoranza site (Nkoranza South Municipal and Nkoranza North District). The Kintampo site covers a total of 161 communities with 34,384 active households. The Nkoranza site operates in 97 communities with 23,465 active households while the Techiman site operates in 84 communities with 46,097 active households. In all, the KHDSS covers over 98% of the population in the three sites.

Field operations

Routine updates and other data collection are done electronically since its data management system was migrated from FoxPro (i.e. the Household Registration System2 (HRS2)) to the Open Health and Demographic System (OpenHDS) platform in 2018. Two update rounds were conducted in 2021. In both update rounds, data on the core demographic events (pregnancy, births, deaths and migration) were collected. Also, the socio-economic status (profile), of all households was updated and Socio-demographic data (Women Form) of all women within the reproductive age was collected. Again, verbal post-mortems (VPMs) are conducted electronically by trained field workers using the WHO 2016 InterVA tool.

Demographic Characteristics of the HDSS

The total resident population of the HDSS as of 2020 was 456,478 across its three sites, with 52.3% being females. The HDSS surveillance area is largely rural (53.1%) with an average household size of 4.7. With regard to births, over 9900 events were recorded in 2020 while 2147 deaths were recorded. Of these deaths, verbal autopsy was conducted for about 2000 of them representing about 93% of all deaths recorded. Characteristics of the resident population of the HDSS as of December 2020 is presented in the table below by site.

Table 1: Demographic Characteristics of the HDSS by site as of 2020

Characteristics of the resident population	Kintampo	Nkoranza	Techiman	Total
Total Population	162,351	101,349	192,778	456,478
Male Population (n, %)	79,933 (49.0)	47,904 (47.0)	90,110 (46.7)	217,947 (47.7)
Female Population (n, %)	82,418 (51.0)	53,445 (53.0)	102,668 (53.3)	238,531 (52.3)
Rural Population (n, %) *	102,242 (63.0)	70,730 (70.0)	69,615 (36.1)	242,587 (53.1)

Urban Population (n, %) *	60,109 (37.0)	30,619 (30.0)	123,163 (63.9)	213,891 (46.9)
Number of Communities Covered by the HDSS	161	97	84	342
Number of Active Compounds	26351	19002	30289	75,642
Number of Active Households	34,384	23,465	46,097	103,946
Average Household size	5.0	4.6	4.5	4.7
Some Demographic Events Recorded in 2020				
Number of Births Recorded	3692	2108	4105	9,905
Total Number of Deaths	834	564	749	2,147
Number of Under Five Deaths	60	34	25	119
Verbal Autopsy Conducted	776	536	720	2,032
In-Migration	9131	17750	27607	54,488
Out-Migration	10904	7340	15588	33,832

NB: *Rural and Urban population are classified based on the population size of an area, where areas with a population of less than 5,000 are classified as rural while areas with a population of 5,000 or more are classified as urban.

KHDSS staff

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Clinical laboratory
Seth Owusu-Agyei Medical Laboratory

The Seth Owusu-Agyei Medical Laboratory, named after a former director, Prof. Seth Owusu-Agyei during the grand durbar of the 25th Anniversary of KHRC, consists of the following units: Bacteriology, Clinical Chemistry, Entomology, Haematology, Immunology, Micronutrients, Molecular Biology, and Parasitology. The Virology unit was developed in the course of the year as a testing centre to support the fight against the COVID-19 pandemic in the three former Brong Ahafo Regions. These units are well resourced with staff and equipment to run the activities of the units. The laboratory during the year under review, prepared to support COVID-19 vaccine clinical trials and other biomedical research in KHRC. The laboratory's capacities in the various areas, as well as quality assurance systems are described below:

Bacteriology

The unit is equipped with a class II biosafety cabinet which is the main workstation a carbon dioxide (CO2) incubator, two BACTEC machines for blood cultures and an autoclave. Samples processed include blood, Cerebrospinal Fluid (CSF), urine, nasopharyngeal swab, ear swab and stool. Culturing, identification and antimicrobial susceptibility testing are performed according to Clinical Laboratory Standard Institute (CLSI) guidelines. To ensure that results generated from this unit are of high quality and reliable, the unit was previously enrolled in External Quality Assessments provided by World Health Organisation/National Institute for Communicable Diseases (WHO/NICD) and currently with the United Kingdom National External Quality Assessment Scheme (UK NEQAS). Excellent results have been obtained from these schemes in both the identification of microorganisms and antimicrobial susceptibility testing. In addition to the participation in EQAs, daily, weekly and monthly internal quality controls on both equipment and reagents are performed to ensure they are all working effectively.

The unit provides support to the children's ward of the Kintampo Municipal Hospital by processing patient samples. The unit was instrumental in providing Quality Management System training in bacteriology to medical laboratory personnel from the sentinel sites of the Malaria Vaccine Pilot Implementation and Evaluation study. To support with continuous QMS at the various sites, the unit is serving to provide external quality assurance services on the malaria vaccine project in Ghana.

Clinical Chemistry

A Horiba Medical Pentra C200 automated clinical chemistry analyser is available in the unit for carrying out analyses such as liver function tests, kidney function tests, lipid profile, glucose and uric acid. The equipment has the capacity to be programmed and used for quantitative estimation of other substances including G6PD activity, Urine protein and creatinine, etc. The analyser replaces the VitaLab Flexor E clinical chemistry analysers previously used. In addition to internal quality control systems, the unit is enroled onto the External Quality Assessment (EQA) schemes organised by the Royal College of Pathologists, Australasia (RCPA) and the International External Quality Assessment Scheme (IEQAS) from the United Kingdom.

Entomology

The unit has one Entomologist and two Research Officers. The unit has been pivotal in studies that collect insects (mosquitoes at various stages and ticks) for speciation and classification as well as further molecular analysis.

Major equipment in the unit include:

- An ELISA plate reader (DYNEX®) with Revelation 4.2 software
- An automated ASYS Atlantis plate washer
- CDC light traps and accessories
- WHO vertical test tubes for susceptibility bioassays
- Insecticide susceptibility papers
- Mosquitoes rearing cages
- Stereo Dissecting Microscope

Figure: A presentation of set up for insect identification and dissection

The unit has plans to build an insectary to be able to engage in projects to test the efficacy of insecticides and other interventions.

Haematology

This is a very active unit since most studies require a full blood count to assess health status in recruiting participants for clinical trials and other studies and also for the management of study participants as well as determination of absolute parasite counts for the various malaria studies. The unit is equipped with an ABX Pentra 60 C+ (5-part differential) Haematology analyser, ABX Micros 60 (3-part differential) analyser, electrophoresis equipment for haemoglobin genotyping, and two photometers for quantitative determination of Glucose-6-phosphate dehydrogenase (G6PD). The unit participates in external quality assessment scheme organised by the United Kingdom National External Quality Assessment Scheme (UK NEQAS) with great performance over the years.

Immunology

The unit has separate sections for cellular and humoral assays, with equipment such as a class II biosafety cabinet, refrigerated centrifuge, microplate washer and pipetting accessories. The unit is also equipped with a laminar flow cabinet, a carbon dioxide incubator, -80oC and -150oC freezers and liquid nitrogen tanks. Currently, isolation and cryopreservation of peripheral blood mononuclear cells (PBMCs) is being done at the unit.

Molecular Biology

The unit has a newly installed Applied biosystems 7500 Fast Real Time PCR in addition to C1000 Thermal Cycler with 96-Well Fast Reaction.

The qPCR equipment was purchased and installed with the support of a philanthropist and a former Kintampo Municipal Chief Executive Officer. The support was towards the setting up of KHRC as a testing centre for COVID-19 in the former Brong Ahafo Region.

The molecular biology unit with the presence of the qPCR is establishing protocols for bacterial and parasitological molecular analysis to minimise the shipment of samples to external laboratories after sample collection on most projects within KHRC.

The following are among tests the unit is capable of carrying out:

- Plasmodium species identification
- Merozoite Surface Protein – 2 (MSP-2) genotyping
- Glucose-6-phosphate dehydrogenase (G6PD) genotyping
- Haemoglobin genotyping
- Knock-down-resistance (kdr)
- Anti-malarial drug resistance

Figure: Some selected equipment and qPCR set up in the Clinical Laboratory of KHRC.

Micronutrient

A High Performance Liquid Chromatography (HPLC) machine with auto-sampling, UV Scanning Spectrophotometer and a Zinc Protoporphyrin (ZPP) analyser are the major equipment at the unit. Following the support of Novartis to develop capacity in the development and validation of an HPLC method for the determination of efavirenz concentrations in plasma, the unit is now adequately prepared to perform bio-equivalence studies for both local and international pharmaceutical companies prior to registration of the drugs locally. The unit also has the capacity to determine vitamin concentrations in blood (especially serum retinol), ELISA assays (e.g. for ferritin, transferrin, etc) and C-Reactive Protein (CRP).

Parasitology

This unit is one of the most active in the Clinical Laboratory Department as most studies require malaria microscopy results. For quality purposes, each malaria blood smear is examined by two independent certified microscopists. Discordant slides are examined by a third microscopist. For external quality assessment, the unit participates in the following malaria External Quality Assessment Schemes: Clinical Laboratory Services/National Institute for Communicable Diseases (CLS/NICD), South Africa, and UK NEQAS. There are currently at least 10 malaria microscopists certified at “Expert” level by CLS/NICD. The unit also has capacity for detection and quantification of parasites in stool specimen using the wet mount, formol-ether concentration and the Kato-Katz techniques.

Quality Assurance Systems

The Clinical Laboratory complies with Good Clinical Laboratory (GCLP) and ISO 15189:2012 standards. The laboratory, which enroled with the World Health Organisation Regional Office (WHO-AFRO) Strengthening Laboratory Quality Improvement Process Towards Accreditation

(SLIPTA) was rated 4 Stars (out of the maximum 5 Stars). The laboratory is providing technical support to the laboratories of the Kintampo Municipal Hospital, Kintampo South District Hospital (Jema), St. Theresah Hospital, Nkoranza and the Holy Family Hospital (Techiman) in the development and maintenance of laboratory QA systems. The laboratory undergoes periodic assessments by sponsors (such as GSK, Sanaria, Novartic) and regulatory inspections (Foods and Drugs Authority, Ghana). We acknowledge the support of Clinical Lab Services (CLS), South Africa for the quality management system.

Seth Owusu-Agyei Medical Laboratory

The clinical laboratory has eight departments that support the biomedical components of projects in KHRC.

Collaborators

The Kintampo Health Research Centre maintained its working relationship with a number of organisations including a few new ones. The centre collaborated with the institutions listed below:

External	Internal
GlaxoSmithKline Biologicals S.A.	Ghana Health Service
Columbia University, NY	Newmont Ghana Gold Limited
National Institute of Health	Kwame Nkrumah University of Science and Technology
Program for Appropriate Technology in Health (PATH)	University of Ghana, School of Public Health
United Nations Foundation	National Malaria Control Programme (NMCP) - Ghana
World Health Organisation (WHO)	Noguchi Memorial Institute for Medical Research (NMIMR)
Barcelona Institute for Global Health (ISGLOBAL)	West African Centre for Cell Biology of Infectious Pathogens (WACCBIP)
University of Massachusetts	USAID/Ghana Evaluate for Health
European Commission/Liverpool School of Tropical Medicine	
Novartis Pharma AG/Quintiles Clindepharm (Pty)	
Makerere University School of Public Health ('MakSPH'), Uganda	
Brown University	
Massachusetts General Hospital	
Fogarty International Center	
Bill & Melinda Gates Foundation	
NIHR CLEAN-Air(Africa) Global Health Research Group	
The University of Wyoming	
New York University (NYU) School of Medicine, University of Illinois at Urbana-Champaign	
London School of Hygiene and Tropical Medicine (LSHTM)	
George Town University	
The University of Liverpool	
Radboud University Medical Center	
Beth Israel Deaconess Medical Center	

Staff
KHRC recorded a total staff strength of 559 during the year under review. This figure represented an increase of 89 staff from the previous year. These staff worked on different projects.

In line with the Centre's strategic plan to make it attractive to partners, the existence of a Health and Demographic Surveillance System (KHDSS) offers support to all projects at the Centre. Again, there is a database that informs prospective collaborators in making informed decisions about research activities. The KHDSS currently has 70 staff.

Study areas
The centre continued to operate in seven (7) contiguous districts of the Bono East and Bono regions namely the Kintampo North and Techiman Municipalities, the Kintampo South, Nkoranza North and South, Wenchi and Tain districts with the Kintampo North municipality being the Headquarters. However, the centre maintained links with Afrancho, Akumadan and Nkenkesu communities in the Ashanti Region. KHRC will carry out studies in these communities if the need arises.

Transport
The centre has six 4X4 pickups, one Tata truck and 23 station wagons. The total number of motorbikes during the year under review stood at seventy three (73).

Guest House
The facility offers decent accommodation for visitors to KHRC. The guest house is about a 15 minute-walk from the centre. It has a 24-hour security service. The rooms are fitted with air conditioners and fans. Also, it has a 24/7 Internet service. There are mosquito nets fitted in all the rooms. All of that is to ensure visitors have a comfortable stay.

The rate per night at the guest house is US$50, while meals are $5 for breakfast and $7 for lunch and dinner. There is a bar which is stocked with a large variety of drinks. There is also a standby generator to provide power when the national grid goes off.
The guest house received 49 visitors within the period under review.

"The Pentagon"
This is the staff eating place. Breakfast, lunch and dinner can be arranged at The Pentagon. Special meals can also be requested for. This can be served at either the Pentagon or the at the guest house depending on the visitor's preference.

Website
The centre's website continues to be the outlet which provides information to the outside world about activities at the centre.

Auditing
To ensure that funds given to the centre by funders and donors are judiciously used and accounted for, the centre hosted Deloitte and Touché and the Audit Service during year under review.

Visitors
The centre was privileged to host important personalities during the 2021 fiscal year.