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Editorial

The future of COVID-19: May the uncertainty deepen or a glimpse of hope comes?

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Could there be any other infectious disease outbreak in the history of modern medicine that challenges the human intelligence in predicting the epidemiology and detecting the pathophysiology as COVID-19?

It was not in the best mind's thought that the top ten richest countries would be the most overwhelmed by the fast spreading SARS CoV-2, and contribute to three-fourths of COVID-19-related global mortality during the first wave of the current pandemic. Even in Europe and North America, the positive correlation of the caseload and deaths with the economic power of the respective countries is still unprecedented experience. It is not only the remarkable difference in caseload and deaths among rich and poor countries what makes this pandemic inscrutable, but also the lack of significant regional difference in the proportion of recovery.

Among others, the world mind people have publicly predicted as the worst of all to be in Africa. After four months since the first COVID-19 patient was reported in Africa, we have realized that the continent has contributed only about 1% to the global mortality figure, with the nearly global average proportion of recovery. The slow but ongoing increment of new infections with nearly equivalent recovery is a blessing in disguise, in a continent where health facilities and the health workforce are meager.

By extrapolating the accumulated knowledge from other viral infections, patients with autoimmune disease, pregnant women, and children were initially anticipated to have the highest morbidity and mortality. Because of the different degrees of immune modulation and immune suppression (partly due to the disease nature, and partly due to cytotoxic chemotherapy and high dose corticosteroid), it is known that patients with autoimmune disease are at higher risk of viral infection (Pope 2020).

However, as a global review of 110 rheumatoid arthritis patients, who also contracted COVID-19, showed that the mortality risk was not different from the general population (Gianfrancesco 2020). Furthermore, against earlier thought, anecdotal evidence from case series studies did not demonstrate an increased risk of COVID-19 in people with

autoimmune disease who were on immunosuppressive treatment. Initially, some patients were even advised to discontinue medications. The current recommendation, however, is not to discontinue immunosuppressive treatments for cancer, transplant, or autoimmune diseases, fearing increased risk of COVID-19 (Gianfrancesco 202; Monti 2020).

Similarly, many authors initially predicted the increased risk of COVID-19 among pregnant women and their babies by postulating an altered maternal immune response, and extrapolating the higher risk of viral infection and the physiologically increased expression of the ACE2 receptors in pregnant women (Liu 2020; Silasi 2015; Zhao 2020). The author has reviewed 841 pregnant women with COVID-19 from five studies and found that the maternal death risk was 0.6%, which was by 13-50 fold lower than hepatitis E virus, H1N1 influenza virus, SARS CoV and MERS CoV epidemics and pandemics in the last two decades (unpublished study).

There are a lot of immunological responses in which autoimmune diseases and pregnancy do share, which are attributed to be protective from worsening COVID-19. For instance, the bilateral activation of the immune system (the proinflammatory and anti-inflammatory cytokines and chemokines) in both systemic sclerosis and COVID-19 is a unique phenomenon, which has probably made both disease conditions have a benign course or more or less similar illness with the non-pregnant women. Of note, the increased risk of flares among patients with Th-1 and Th-17 autoimmune diseases in the postpartum period may signal that postpartum women with a significant drop in immune-modulating placental hormones, anti-inflammatory and antifibrotic cytokines could be at an increased risk of COVID-19.

Beyond the immunological distinctiveness of SARS Cov2 as compared with SARS CoV and MERS CoV, the pathological and hematological manifestations of COVID-19 have been as well creating a lot of confusion among experts in the field. Taking the experience of the Influenza virus and other Coronaviruses, the imaging diagnosis of viral pneumonia was initially popular.

However, as the autopsy studies demonstrated, pulmonary microangiopathy (diffused pulmonary microthrombi) appearing as interstitial pneumonia is becoming evident (Kollias 2020, Belen-Apak 2020). The kind of adult respiratory syndrome (ARDS) developed in COVID-19 patients is also a bit bizarre from other causes; the lung compliance is preserved; alveolar-arterial oxygen gradient remains high. The very prominent finding is occlusion of the pulmonary microvasculature by the fibrin rich microthrombi (Wang 2020), which implies that the coagulopathy in pulmonary microvessels (in other organs too) progresses to occlusive microangiopathy.

In severely ill COVID-19 patients, disseminated intravascular coagulation (DIC) is not uncommon; however, unlike other causes, severe thrombocytopenia, hypofibrinogenemia, hemolytic anemia, bleeding tendency, markedly prolonged partial thromboplastin and prothrombin time are not prominent characteristics of COVID-19-related DIC, even in severe cases (Levi 2020). As one of the indicators of COVID-19 disease severity (most likely from non-erythrocyte cells source), lactate dehydrogenase (LDH) is markedly elevated. A meta-analysis has shown that elevated LDH levels were associated with about 6-fold increased risk of developing severe disease and about 16-fold increased risk of mortality (Henry 2020). High intravascular fibrin deposition with increased capillary leakage and significantly elevated serum D-dimer are consistent findings in severe COVID-19 patients, but not as such remarkable in other causes of DIC.

Luminal fibrin deposition (commonly in the pulmonary microvascular system) is probably initiated as a result of endothelial injury and dysregulated fibrinolysis leading to atypical disseminated coagulopathy and multiorgan failure (Whyte 2020; Ackermann 2020). This is again likely to be due to a significant increment in the major fibrogenic cytokines (IL-4, IL-6, TNF- α , and TGF- β 1). Interestingly, despite the subtle changes in coagulopathy indicators, the thromboembolic phenomenon can also occur in the veins and arteries (Thachil 2020; Tang 2020).

Overall, the accumulating evidence persuades to conclude atypical coagulopathy-microangiopathy (vascular disease) leading to respiratory and multiorgan failure. What is priming the coagulopathy/micro thrombosis is severe endothelial damage in the lung alveoli (Ackermann 2020). The extra respiratory failures (including stroke, renal and cardiac failures) are also thought to be due to systemic microvasculitis and thrombosis.

Apart from the atypical nature in the pathophysiology and the confirmatory diagnostic challenge, the treatment modality is still limited to supportive therapy and treating secondary complications. When we look into the possible therapeutic and prophylactic research works on progress, there are a lot of uncertainties and a glimpse of hope. COVID-19 mobilizes the scientific society across the globe either to prevent its occurrence or cure it. As of 9 June 2020, the number of registered COVID-19 clinical trials worldwide is 1982.

Among several therapeutic clinical trials for the management of COVID-19, antivirals, anti-inflammatory agents (monoclonal antibodies, Bruton Tyrosine Kinase inhibitors, non-steroidal anti-inflammatory drugs, Vitamin D), anticoagulants, tissue plasminogen activators, and many more are on the frontline. Among the promising antivirals, the preliminary result has shown that Remdesivir was superior to placebo in shortening the time to recovery in hospitalized 1059 COVID-19 patients (Beigel 2020).

The second panel of basic science research and clinical trial is on vaccine development. Without going into the detail, as there are green lights, there are also anticipated challenges and uncertainties. The first challenge is the very long process to identify an effective vaccine, manufacture, and deliver to the beneficiaries. Although many are hoping in less than a year period, there are a lot of hurdles, which may let it pass the schedule.

The estimation of the spread using the mathematical model is still with very wide uncertainty. Nonetheless, will the virus infect most of the people before the vaccine is ready is a catching question. In other words, will the herd immunity be faster than the vaccine development and distribution? To date, nobody knows exactly how many asymptomatic infections are spreading in the community. As the purpose of the vaccine is for the COVID-19 naïve individuals, will it be a wastage of resources with the current ultrafast speed of spread?

SARS CoV-2 has the potential to infect anybody. It is also well noted that quite a fraction of the SARS CoV-2 carriers become symptomatic unless otherwise get tested and recognized as infected. Therefore, this will be another challenge in selecting the right candidates for the vaccination, as it will not be possible to blindly vaccinate close to eight billion people. Or else to go for vaccination after conducting the mass antibody screening, which is also damn expensive and logistically burdensome. Whichever the approach is, there will be a wastage and disproportionate coverage

while attempting the development of herd immunity by vaccinating a certain percentage of the population.

Secondly, COVID-19 is primarily a disease of aged people; however, as previous experiences and the immunogenicity studies showed, vaccinating aged people is not as successful as it is in children. Aged persons usually require repeated doses of vaccine to have an improved protection. Nevertheless, COVID-19 is likely to be a global endemic disease. Therefore, the future generation may benefit from being vaccinated early in childhood if an effective and safe vaccine is identified.

Thirdly, how long the vaccine can prevent reinfection (if not lifelong protection) is still unknown and unpredictable. Many of the viruses by their nature either do not reinfect or can cause milder disease in subsequent infection; a few exceptions (like human papillomavirus) are not in this domain. The lack of an approved vaccine for other coronaviruses (SARS CoV and MERS CoV, in particular) (Natalie 2020) may further widen the uncertainty.

One of the promising and groundbreaking vaccines under development is the RNA vaccine. However, it is not known whether this vaccine will have an exaggerated immune enhancement, probably similar to the SARS CoV-2 infection in susceptible individuals. Earlier, it was recognized that SARS CoV-2 susceptible individuals deteriorate because of the development of “cytokine storm” (Nile 2020), and the risk of immune enhancement with vaccines is still a serious concern (de Alwis 2020). One of the challenges in vaccine development for SARS CoV and MERS CoV in an animal model was that trial vaccines caused lung damage and peritonitis (Gretebeck 2015).

In general, with existing therapeutic interventions, the case fatality rate (CFR) of COVID-19 may continue being proportional in the developed and developing countries, but it is much lower than many other viral pandemics of the 21st century. However, the global lower CFR should not mask the overall deaths caused by or associated with this virus, which may reach about one million before the coming Christmas. As learnt from dozens of countries which are curbing the outbreak curve, the author is optimistic that the world is transiting from a state of uncertainty, confusion, and hopelessness to a glimpse of hope, primarily by taking the natural course of the disease as a learning curve. Though the vaccine development and equitable distribution seem unrealistic sooner or later, fairly effective therapeutic agents are likely to be available within a year. As a result, COVID-19 is very unlikely to be the superbug of the 21st century.

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Review article

Rapid evidence synthesis on COVID-19 pandemic to inform the Ethiopian Ministry of Health

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Abstract

Introduction: At the end of December 2019, Chinese scientists identified a novel coronavirus as the main causative agent for COVID-19, which was declared a pandemic by the WH on March 11, 2020, and had affected more than 1.9 million people. Since this novel infection is overwhelming, the research community has responded promptly to the virus and many preliminary research articles have already been published about different aspects of this pandemic.

Objective: To summarize the best available research evidences on COVID-19 pandemic and to inform the Ethiopian Ministry of Health.

Methods: A rapid evidence review approach was applied to search, appraise and summarize the available evidence on the COVID-19 pandemic. We identified the Population, Concept, and Context with respect to the objective of the review to facilitate searching of relevant articles and unpublished ministry documents. Searching was done on the PubMed database, and Cochrane Library from 01 December 2019 to 07 April 2020. Accordingly, we found a total of 473 studies. By the eligibility criteria, 51 articles are included in this review.

Results: The findings of this review are organized into two major parts. The first part shows the COVID-19 situation in Ethiopia in terms of WHO outbreak scenarios, and readiness of the Ethiopian health system. Though the government of Ethiopia recently adopted different measures, these may not have come in time to prevent the surge of cases. The second part focuses on a review of global research evidence in terms of mode of transmission, pathophysiology and clinical manifestation, risk group, screening and diagnosis, treatment, prognosis, and prevention and control. Current evidence shows COVID-19 is transmitted between people through respiratory droplets and contact routes though the pathophysiologic data is limited. So far there is no known specific, effective, and proved pharmacological treatment for the disease and the only option of case management is infection prevention and supportive care.

Conclusion: Since COVID-19 is a new disease, much is unknown about it. Researchers and scientists around the globe are undertaking many studies to uncover the hidden facts of this pandemic. As of this time, the available evidence shows isolating, testing, treating, and tracing of new cases along with social distancing measures are effective to control the virus spread.

Keywords: COVID-19, SARS-CoV-2, rapid evidence synthesis

Introduction

By the end of December 2019, Chinese public health authorities reported several cases of acute respiratory syndrome in Wuhan City, Hubei province, China. Soon after, Chinese scientists identified a novel coronavirus with the main causative agent named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) where the disease is now referred to as coronavirus disease 2019 (COVID-19). The coronavirus generally belongs to a family of viruses that may cause various symptoms such as pneumonia, fever, breathing difficulty, and lung infection (Wuhan Municipal Health Commission, 2019). These viruses are common in animals worldwide, but very few cases have been known to affect humans (CDC 2020a). This respiratory illness caused by a new coronavirus (COVID-19) is believed to arise from animal markets in Wuhan city and came into health care workers attention for the first time on December 8, 2019. This

illness was declared a pandemic by the world health organization (WHO) on March 11, 2020. By the time this report was being written the virus had affected more than 1.9 million people causing more than 120,400 deaths in over 210 countries and territories around the world and two international conveyances where confirmed COVID-19 cases in Africa were more than 10,000 (CDC 2020; Worldometer 2020). Since this novel infection is spreading rapidly and is overwhelming the most advanced and toughest medical science and technology, everyone is curious about what is there to know and what to contemplate with this pandemic. Consequently, the research community has responded promptly to the virus and many preliminary research articles have already been published about this pandemic. The amount of evidence produced in this short period is overwhelming and needs to be filtered for any decision to be made on the best available evidence.

Accordingly, we conducted a rapid evidence synthesis to summarize and critically analyze the published scientific articles regarding the new coronavirus. This review aims to provide the evidence of early findings on the mode of transmission, pathophysiology and clinical manifestations, screening and diagnostic methods, treatment, prognosis, prevention, and control and risk groups. This review can provide meaningful information for decision-making on strategies to handle this public health emergency at the community or national levels.

Materials and Methods

Rapid evidence review approach was applied to search, appraise and summarize the available evidence on COVID-19 pandemic. We identified the Population, Concept and Context (PCC) on which studies on human population with a concept focus on the mode of transmission, pathophysiology, clinical manifestation, diagnosis, treatment Prognosis, prevention and Control, and risk groups of COVID-19 are included without restriction to any geographical context, with respect to the objective of the review to facilitate searching of relevant articles and unpublished ministry documents. All human studies conducted starting from December 1, 2019, with the last search made on April 07, 2020 on COVID-19 with regard to mode of transmission, pathophysiology and clinical manifestations, screening and diagnostic methods, treatment, prognosis, prevention and control, risk groups were included while reviews that are not systematic and transparent (e.g. literature reviews, news, letters, editorials, reports, communications, comments, and correspondence) with the exception of the Ethiopian Ministry of Health document; studies published other than the English language, and studies conducted before December 1st, 2019 were excluded from this rapid synthesis. Unpublished literature were retrieved from WHO website and Ministry's documents and reports were accessed via personal contacts and retrieval. This review was due on April 8, 2020. PubMed database, the Cochrane Library, Ethiopian Public Health Emergency Operation Center (PHEOC), MoH documents and reports, and WHO website were used as data sources. "COVID-19" OR COVID OR coronavirus OR Corona OR "SARS-CoV-2" OR Coronaviridae OR "novel corona" OR "coronavirus" (limited to human and English) were used for Search strategy.

Results

The findings in this review are organized into two major parts. The first part addresses the COVID-19 situation in Ethiopia in terms of WHO outbreak scenarios, and readiness of the Ethiopian health

system in terms of human and material resources. The second part focuses on a review of global research evidence in terms of mode of transmission, pathophysiology and clinical manifestation, risk group, screening and diagnosis, treatment, prognosis, and prevention and control.

Part I: COVID-19 situation in Ethiopia

Timeline of Ethiopia's COVID-19 Situation and measures taken so far: Ethiopia confirmed the first case of COVID-19 on March 13, 2020. The first confirmed case of COVID-19 in Ethiopia was a 48 years old Japanese citizen who was tested positive on March 12, 2020, by the Ethiopian Public Health Institute after coming from Burkina Faso eight days prior to being identified as a case. Ethiopia recorded the first death of COVID-19 as of March 29, 2020 (Figure 1).

The WHO has defined four transmission scenarios for COVID-19 where Scenario 1 indicates countries with no cases (No Cases); scenario 2 shows countries with 1 or more cases, imported or locally detected (Sporadic Cases); scenario 3 indicates countries experiencing cases clusters in time, geographic location and/or common exposure (Clusters of cases); and scenario 4 indicates countries experiencing larger outbreaks of local transmission or community transmission (World Health Organization 2020).

Countries could experience one or more of these scenarios at the national and sub-national levels. Accordingly, estimation was done for Ethiopia based on the currently available epidemiological data in the globe and literature (Ferguson et al. 2020; Han and Yang 2020; Khalid et al. 2020; Krupp 2020; Ministry of Public Health 2020). Consequently, considering WHO transmission scenario four for a population of 110,000,000 million populations, approximately 11,000,000 persons (10%) might contract the symptomatic infection, over a period of the next few months. Of these cases; 1,650,000 (15%) might seek healthcare, out of which 330,000 (20%) would require hospital admission and 33,000 (2%) would be admitted to the intensive care unit (ICU) with an estimated death toll of 24,750 (1.5% of those seeking healthcare) considering that Ethiopia has a relatively young population compared to those high-income countries with high comorbidities. If the outbreak is not contained in a timely manner, the Ethiopian health system will be overwhelmed; patients with coronavirus or other urgent medical conditions will not receive their needed care, and a substantial number of unnecessary deaths will become inevitable (Fisher and Heymann 2020).

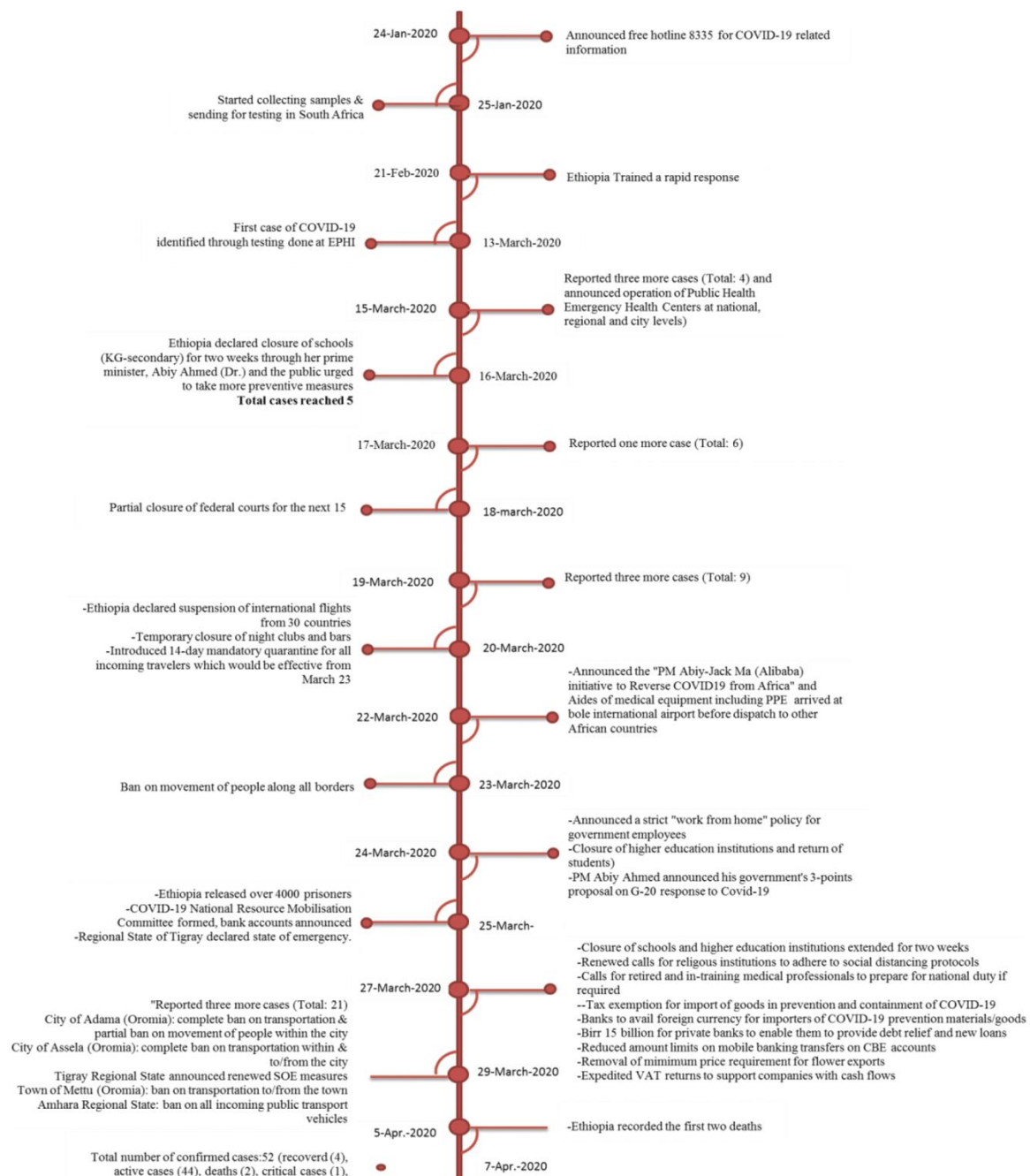


Figure 1: Ethiopia's timeline of COVID-19 situation, April, 7, 2020

Ethiopia's Readiness: To tackle the possible consequences of COVID-19, the Ethiopian government has enacted a range of measures to control the epidemic, starting with temperature screening at the airport and testing of suspected cases (including contact tracing) before moving to closure of schools, universities and international travel ban to and from 80 countries and quarantining any remaining

international travelers coming to the country for a mandatory of 14 days in dedicated centers for this purpose. A national structure and functional relationship of the COVID-19 response at the higher level and the structural arrangements of the Public Health Emergency Operation Center (PHEOC) at Ethiopian Public Health Institute is also created where the technical leadership responsibility is under the

Ethiopian Public Health Institutes through its Public Health Emergency Management (PHEM). According to the 2020 data from the Ministry of Health Ethiopia, there are a total of 7,198 medical doctors, 0.7 per 10,000 ratio, which is well below the WHO recommendation of 2.3 per 10,000 (WHO 2016). Across the ten regions and two administrative cities of Ethiopia, there are about 410 public and private hospitals of different categories with only 29,748 beds in total (MoH 2019).

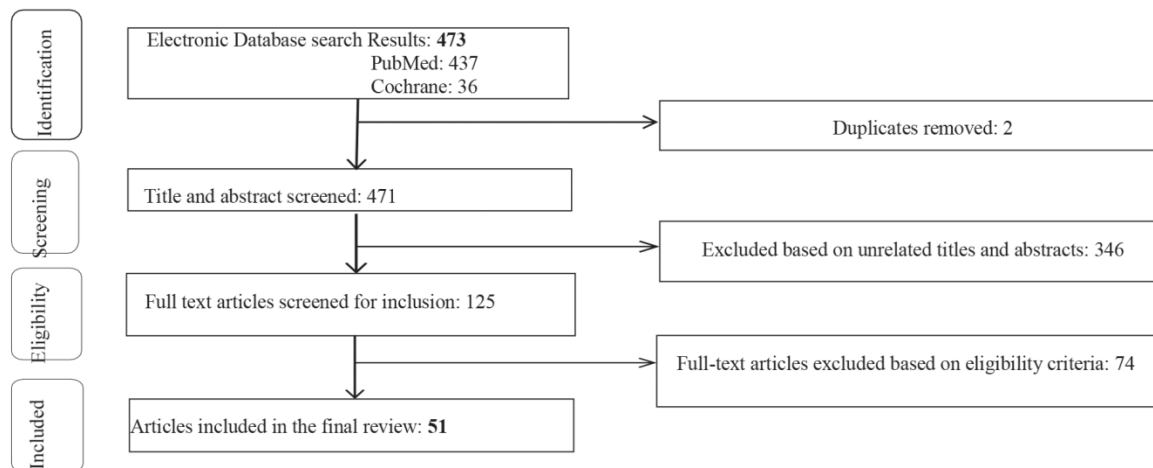


Figure 2: PRISMA diagram

The included articles in this review are summarized into different thematic areas: mode of transmission, pathophysiology and clinical manifestation, risk group, screening and diagnosis, treatment, prognosis, and prevention and control. The summary of the findings of each theme is presented below.

Mode of Transmission: As per different research evidence, the COVID-19 virus is primarily transmitted between people through respiratory droplets and contact with infected individual, even asymptomatic ones (Ceccarelli et al. 2020; Zou et al. 2020). Droplet transmission occurs when a person is in close contact (within 1 meter) with someone who has respiratory symptoms.

Transmission may also occur through fomites in the immediate environment around the infected person (Wu et al. 2020). In an analysis of 75,465 COVID-19 cases in China, airborne transmission was not reported but may be possible in specific circumstances and settings in which procedures or support treatments that generate aerosols like endotracheal intubation and bronchoscopy are performed (Xu 2020). The study recalled that the early evidence was most consistent with limited human-to-human transmissibility (Wu et al. 2020). Another study showed that stool samples were positive until the 17th day since symptom onset

Part II: Summary of global research evidence for COVID-19

Based on the search strategy we found a total of 473 studies from PubMed and Cochrane library. Using the eligibility criteria 51 articles were reviewed and summarized (See PRISMA diagram). The table indicating the characteristics of the included study is not annexed in this document and can be obtained upon request to the authors at any time.

(Park et al. 2020). However, there have been no reports of faeco-oral transmission of the COVID-19 virus to date (WHO 2020b). Regarding the potential risk of mother to newborn vertical transmission, we only found one study that included nine women with confirmed COVID-19 pneumonia. This study did not find any evidence of the presence of SARS-CoV-2 viral particles in the products of conception or in neonates (Qiao 2020). Regarding transmission of the virus with animal food, there is only one study conducted on 99 patients with 2019-nCoV pneumonia of which 49% had a history of exposure to the Huanan seafood market (Chen et al. 2020). However, we could not find a study that confirms animal foods to transmit the virus.

Pathophysiology and clinical manifestation: Though there is limited pathophysiologic data on COVID-19, studies indicate that the entry receptor for COVID-19 in humans is Angiotensin-converting enzyme2 (ACE2). The virus replicates efficiently in the upper respiratory tract and infected people produce a large quantity of the virus at the beginning of the infection. As the body gets infected a cytokine response is triggered whereby immune cells attack the virus. In some cases and for reasons unknown, the virus may trigger an over-reactive response from the

immune system, which can further diminish recovery efforts (Fung et al. 2020; IFLScience 2020).

The lung appears to be the most vulnerable target organ of this virus and one reason is that the vast surface area of the lung makes it highly susceptible to inhaled viruses. This is coupled with another biological factor where 83% of ACE2-expressing cells are alveolar epithelial type II cells (AECII) that can serve as a reservoir for viral invasion. The expression of the ACE2 receptor is found in many extrapulmonary tissues including heart, kidney, endothelium, and intestine. Consequently, a study has predicted the intestine might be a major entry site for SARS-CoV-2 which has an important implication for fecal–oral transmission and containment of viral spread (Zhang et al. 2020). Patients with this infection could also be asymptomatic carriers or could experience different complications including ARDS, RNAemia, acute cardiac injury, gastrointestinal infection, secondary (super) infections, and multiple organ failure.

The incubation period for COVID-19 is thought to be within 14 days following exposure, with most cases occurring approximately 4–5 days after exposure (Xu et al. 2020). A study suggests that individuals with compromised immune status might be subjected to a longer incubation period (Jin et al. 2020). Major clinical presentations of this infection include fever, dry cough, myalgia, fatigue, dyspnea, diarrhea, muscle ache, confusion, headache, sore throat, rhinorrhea, chest pain, nausea, and vomiting. In addition to the above symptoms, chest radiology findings showed changes in the lung and thorax. These include chest X-ray presentation of bilateral, multi-lobe ground-glass opacities; chest CT showing patchy or nodular consolidations with peripheral ground-glass opacities in sub-pleural areas of the right lower lobe; and CT scan of thorax displaying diffuse ground-glass opacities and consolidation on both lungs consistent with ARDS. Laboratory abnormalities of lymphopenia or elevated LDH could potentially serve as early surrogate markers in the absence of clear dysregulated host response to infection (Li et al. 2020; Park et al. 2020; Wei et al. 2020; Yoon et al. 2020).

Risk group: Based on articles reviewed, the virus that causes COVID-19 infects people of all ages. However, evidence to date suggests that older people (that is people over 60 years old) and those with underlying medical conditions (such as cardiovascular disease like hypertension, diabetes, chronic respiratory disease, and cancer) are at a higher risk of getting severe COVID-19 disease. The risk of severe disease gradually increases with age starting from around 40 years (Chen et al. 2020; Liu et al. 2020; Shi et al. 2020;

WHO 2020c). Although we could not find a published primary study relating smoking and COVID-10, the limited available data show that smoking is most likely associated with the negative progression and adverse outcomes of COVID-19. So, being a smoker makes it more likely to fall into one of the main risk groups (Vardavas and Nikitara 2020).

Screening and diagnosis for COVID-19: Tests that are currently under consideration and already being used in the COVID-19 pandemic include screening tests (mainly thermal) and various forms of laboratory diagnostic tests among which serology, molecular and viral strain sequencing are included (Li et al. 2020).

The WHO recommends a combination of measures of rapid diagnosis and immediate isolation of cases, rigorous tracking, and precautionary self-isolation of close contacts. Thermal screening is currently considered as the primary tool for screening. With thermal screening, there are likely many people who would be missed during the screening processes at the airports as well in clinical settings, because of the poor sensitivity nature of the thermal screening, as the majority of COVID-19 are asymptomatic. According to a report, the effectiveness of thermal passenger screening for 2019-nCoV infection at airport exit and entry is only about 56% (Han et al. 2020). Serological tests for diagnosis of COVID-19 are also entering the market and used for diagnosis in some countries (Johns Hopkins Center for Health 2020). WHO has made available some molecular diagnostic protocols for testing coronavirus-19 in suspected human cases. Accordingly, real-time-PCR (the gold standard method) is the diagnostic tool in place at the global level and throat, or a nasal swab is used as a sample (Corman et al. 2020; Zou et al. 2020; WHO 2020a). However, we found one study that indicated the real-time PCR test showed false-negative results where the authors call for the use of real-time PCR combined with clinical manifestations, and chest CT to diagnose SARS-CoV-2 infection (Li et al. 2020; Wu et al. 2020).

Treatment: Apart from studies showing promising results, there is no known specific, effective, and proven pharmacological treatment for COVID-19 as of this time. Current clinical management includes infection prevention and control measures and supportive care, including supplemental oxygen and mechanical ventilator support when indicated (CDC 2020b). Several clinical trials of pre-exposure prophylaxis, post-exposure prophylaxis, or treatment of COVID-19 are currently underway. In-vitro studies have indicated that chloroquine is effective in reducing viral replication in infections, including the SARS-associated coronavirus and MERS-CoV. Although chloroquine has been used worldwide for more than 70

years the efficacy and safety of chloroquine for the treatment of COVID-19 pneumonia remains unclear (Cortegiani et al. 2020; Gao et al. 2020).

A combination of antiviral treatments, such as lopinavir/ritonavir, litonavir, Fabiravir, ribavirin, Baricitinib, and interferon- β are newly identified treatments of COVID-19 at an in-vitro level (Lim et al. 2020; Wang et al. 2020). Beside in-vitro level testing, a combination of lopinavir/ritonavir was tested in a single patient in South Korea, the result indicates the decrease in viral level after the first dose administration of the medication (Lim et al. 2020). Remdesivir has been recently recognized as a promising antiviral drug against a wide array of RNA viruses (including SARS/MERS-CoV) infection in cultured cells, mice and nonhuman primate (NHP) models (Wang et al. 2020).

Prognosis: WHO estimates the case fatality rate of COVID-19 at an average of 3.4%. Compared to other viruses, the case fatality rate for COVID-19 is less (SARS: 9.6%, MERS: 34%) (Worldometer 2020).

From the previous experiences, coronavirus infections (SARS/MERS-CoV) in pregnancy indicate that these agents are capable of causing adverse clinical outcomes including life-threatening maternal disease that in some cases requires hospitalization, intensive care, and ventilator support. Both of these coronaviruses can result in maternal death in a small but significant number of cases, but the specific risk factors for a fatal outcome during pregnancy have not been clarified (Schwartz and Graham 2020).

A small proportion of recovered patients may test positive after discharge, calling for post-discharge surveillances thus the need for post-discharge surveillance and isolation strengthening. A study on post-discharge surveillance after clinical recovery indicated that swabs were positive in two asymptomatic cases (3.23%). One of the two cases was presented with typical clinical and radiological manifestations on admission, while manifestation in the remaining was very mild (Xing et al. 2020).

Prevention and Control: The research findings summarized here suggest combination measures to help the prevention and control of the COVID-19. After initial assessment for symptoms and epidemiological risk factors, including travel to affected areas and exposure to confirmed 2019-nCoV patients within 14 days, patients are classified in a risk-stratified system. Upon confirmation of a suspected 2019-nCoV case, affected persons must immediately be placed in airborne infection isolation and the appropriate public health agencies notified. The modified 3I's tool could assist emergency and primary

care clinicians, as well as out-of-hospital providers, in effectively managing persons with suspected or confirmed 2019-nCoV. The concise nature of the 2019-nCoV 3I's tool allows for the rapid and effective management of a novel COVID-19 disease by healthcare providers (Zou et al. 2020). With regard to contact tracing and isolation of cases, a mathematical model which bases on 2.5 reproduction number scenarios, suggests the need for tracing and isolating 80% of contacts to achieve control of 90% of outbreak (Zhan et al. 2020). The probability of control decreases with long delays from symptom onset to isolation, fewer cases ascertained by contact tracing, and increasing transmission before symptoms (Hellewell et al. 2020).

The WHO guideline recommends frequent, regular, and thorough hand washing, practicing respiratory hygiene, and maintaining physical distancing (UCRG 2020). A study by (Ceccarelli et al. 2020), also shows that one way of preventing COVID-19 pandemic is through hand hygiene. Front line health workers should also take appropriate measures to protect themselves and their other patients from COVID-19 (Razai et al. 2020).

In general, the available public health tools to control person-to-person transmittable diseases are isolation and quarantine, social distancing, and community containment measures (Wilder-Smith and Freedman 2020). Specific up-to-date and accurate health information and precautionary measures (e.g., hand hygiene, wearing a mask) were associated with a lower psychological impact of the outbreak and lower levels of stress, anxiety, and depression. This same study found, about 36.3% of subjects who would wear masks can not wear it correctly, with common mistakes of nose exposure to the air and long-time mask wear without replacement (Zhan et al. 2020).

Conclusion

To tackle the possible consequences of COVID-19, the Ethiopian government has enacted a range of measures to control the epidemic. However, with the current progression of the disease, the outbreak needs to be contained to prevent the Ethiopian health system from becoming overwhelmed. Though evidences on COVID-19 are still developing this review shows that COVID-19 is transmitted between humans through respiratory droplets and contact routes. The virus replicates efficiently in the upper respiratory tract and the lung appears to be the most vulnerable target organ. The incubation period for COVID-19 is thought to be within 14 days following exposure, with most cases occurring approximately 4-5 days after exposure. We have seen in this review that COVID-19 presents with major clinical symptoms including

fever, dry cough, myalgia, fatigue, dyspnea, diarrhea, muscle ache, confusion, headache, sore throat, rhinorrhea, chest pain, nausea and vomiting where older adults and people who have chronic underlying conditions might be at higher risk for severe illness from COVID-19. There is limited evidence regarding risk factors for severe disease. However, based on currently available evidence, older adults and people of any age who have chronic underlying conditions might be at higher risk for severe illness from COVID-19. Thermal screening is currently considered as the primary tool to screen patients though its effectiveness is under question as the majority of COVID-19 are asymptomatic. Real-time-PCR is the diagnostic tool in place at the global level and the use of integrated criteria to diagnose SARS-CoV-2 infection should be considered as well.

As for management, infection prevention and control measures and supportive care, including supplemental oxygen and mechanical ventilator support, when indicated, are the currently practiced interventions. In addition to the available public health tools such as proper handwashing, respiratory hygiene, quarantine, social distancing, and containment measures the backbone to effectively suppress and control this infection in every country includes isolating, testing, treating, and tracing of new cases. As of this time, there is no treatment developed for COVID-19 and the available evidence shows isolating, testing, treating, and tracing of new cases to effectively suppress and control the virus spread are the backbone of the response in every country. In general, the public health measures to control the spread of COVID-19 includes social distancing measures (schools and workplace closures, isolation of sick and quarantine of exposed, and stay at home); protective measures (hygiene and surface cleaning); and travel-related measures. Supportive care, including oxygen supplementation and mechanical ventilator support for severely ill patients, is practicing when indicated.

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Original article

COVID-19 community transmission and clustering in Addis Ababa; what does this entail to the country's pandemic response?

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Abstract

Background: The early phase of the COVID 19 response in Ethiopia focuses primarily on containment of transmission linked to foreign travels and has significantly contributed to flatten the epidemic curve for about two months. From mid-May, the number of cases reported daily has seen a dramatic increase especially in the capital, Addis Ababa.

Objective: To describe how community and cluster transmission grows exponentially and the trends and what the country should do differently to control the epidemic.

Methods: Secondary data were abstracted from Ethiopian Public Health Institute, Emergency Operating Center and Incident Management reports, situation updates, from Health Minister's daily epidemic updates, and detailed epidemiologic investigation reports. A narrative and descriptive analysis were used.

Results: Primary case C1 had 67 contacts. Of these, five close contacts have become secondary cases. Of the 96 contact identified with the secondary cases, 16 become tertiary cases. From the 75 contacts identified with the tertiary cases, seven become quaternary cases and three quinary cases. One of the secondary cases was a super spreader, which infected 9 people. Most of these cases were clustered in one area of the city. Primary case C2 had 50 contacts. Of which four of his close family members have become positive for COVID-19. Except for the primary cases, all subsequent cases were asymptomatic. The number of positive cases identified in the community has been growing fast. End of April, 63% of the cumulative cases were among people who had travel history; while in mid-June 83% of the cumulative cases were identified in the community. From mid-May, the epidemic has shown exponential growth.

Conclusions: Exponential growth of the COVID-19 outbreak has followed the occurrence of community and cluster transmissions and is likely to overwhelm the county's emergency response facilities and the health care system in the near future. Tailored containment and mitigation strategies and responses that match the magnitude of the problem is needed. Comprehensive surveillance, increasing testing capacity; self/home isolation of cases and quarantining of contacts; implementation of non-pharmacological public health interventions; increasing awareness and community engagement, and ensuring compliance through low enforcement are important aspects to be strengthened.

Keywords: Addis Ababa, case, cluster transmission, community transmission, contact, COVID-19, Ethiopia, intervention, isolation, quarantine, preparedness, primary case, response, surveillance

Introduction

Ethiopia is a continental hub for air travel through the Addis Ababa, Bole international airport, and sits for the African Union and headquarters of many international organizations. The country is surrounded by fragile states and has porous borders with over 13 land crossing sites. All these expose the country to trans-boundary public health threats (1). According to the WHO, Ethiopia is one of the 13 high-risk African countries for COVID-19 (WHO 2020). Health security is a serious issue for Ethiopia for the aforementioned reasons. Under the Health minister, there is a Public Health Emergency Management (PHEM) unit lead by the Ethiopia Public Health Institute (EPHI) responsible for managing public health emergencies and health security

concerns. Both the institute and the Public Health Emergency Management (PHEM) have good track records to effectively and timely respond to public health emergencies of global concern such as Ebola. The systems established for Ebola have been used to kick-start point of entry screening at Bole international airport and at land crossings for COVID-19 (WHO 2015). Body temperature checking of travellers coming from Ebola affected countries has been extended to those coming from COVID-19 affected countries; isolation, quarantine, and treatment facilities dedicated to Ebola have been used for COVID-19.

On March 13, Ethiopia reported its first COVID-19 case; a male non-Ethiopian traveller entered the country through Bole International airport from

Burkina Faso. This was long before the country enforced mandatory quarantine of travellers at the point of entries. Later five of his close contacts were found to be positive. Until mid-May there was a gradual increase in the number of new cases, where most of the cases were having either travel history or contacts with known cases. COVID-19 cases among travellers entering the country through ground crossings have been increasing according to reports from mandatory quarantine sites located at the sub-national states (Federal Ministry of Health /FMOHa 2020). With strong point of entry surveillance, quarantine, contact tracing and case isolation, Ethiopia has succeeded in containing imported COVID 19 infections. This remarkable achievement spared the country from uncontrolled epidemic that would have devastating consequences to the already constrained health system.

Ethiopia has seen fast growth in the numbers of new cases and deaths seen mid-May, 2020. Just in a week time, the cumulative cases have increased by 32% jumping from 2,670 on June 11, to 3,954 on June 18. The deaths have increased by 38% from 40 deaths on June 11, to 65 on June 18, 2020. The number of recoveries has shown a 53% increase. The total number of tests stands at 202, 214. Addis Ababa the capital has carried the brunt of the pandemic, reporting about 75% of the total COVID-19 cases and the majority of the deaths in the country as of Mid-June (FMOHa 2020). The second on the line in reporting the highest cases is the Amhara sub-national state where most of the cases are travellers from mandatory quarantines at Ethiopia-Sudan border. This is inline with the accelerated growth in the COVID-19 pandemic in neighbouring countries. The numbers of new cases in Sudan have increased to 7,435, in Kenya to 3,860, in Djibouti 4,505 and Somalia 2, 642 as of June 16, 2020 (FMOHa 2020). Although tightening border control, enhancing point of entry screening and mandatory quarantine are the most important measures the sub-national states have been implementing, they should prepare themselves for the eventual community/ cluster transmission.

WHO has classified COVID-19 transmission in countries/territories as 1) no case 2) Sporadic cases, where countries with one or more cases, imported or locally detected; 3) Clusters of case, where countries experience cases, clustered in time, geographic location and/or by common exposures, and 4) Community transmission, where countries experience larger outbreaks of local transmission with large numbers of cases not linkable to transmission chains or large numbers of cases from sentinel lab surveillance or multiple unrelated clusters in several areas of the country (WHO 2020). Understanding

these outbreak classifications is important to implement tailored emergency preparedness and response actions and public health interventions to contain and mitigate the epidemic. Using two index cases and their contacts, this paper describes how the community and cluster transmission in Addis Ababa grows exponentially and what the country should do differently to control the pandemic. Moreover, the paper presents trends in epidemic progression in Addis Ababa since March 13.

Materials and Methods

Ethiopia activated its national Incident Management (IM) for COVID-19 end of February. The IM and the national public health emergency operation centre have different layers of coordination platforms revitalized for COVID-19 preparedness and response activities. As per the WHO recommendations, the IM has a surveillance section, responsible for undertaking and overseeing national and sub-national surveillance activities (FMOHb 2020). Surveillance data are collected from rumours, telephone hotline, health facility, and community, point of entry, hotels, investment areas, closed facilities and quarantine centres. Case definitions have been continuously updated to match transmission scenarios.

Rumours coming from all sources including the hotline will further be investigated by a rapid response team (RRT), which is organized based on WHO recommendations. The RRT team have clinicians, epidemiologists, infection prevention experts and laboratory professions (WHO 2020, FMOH 2020). This team is expected to evaluate rumours and classify them as suspects, who will be admitted to isolation centres eventually or not a suspect. The RRT is also expected to investigate solitary cases if the confirmed case has no travel history in the two weeks prior to areas where there is wide spread community transmission or has no known contact history. This investigation will be done once the person is found to be positive with RT-PCR. This is different from the routine rumour investigation and will require detailed information of the patient in the two weeks prior from date of symptom onset or date of confirmation if the patient is asymptomatic. The information obtained from these will help to map the activity of the patient in that period and aims to find the possible index case, find more cases around the confirmed case and test all identified contacts in that period. A team of contact tracers do contact tracing for the patient to find forward transmission of the virus from the confirmed case. Their role is to do contact tracing & listing starting two days prior to symptom onset or date of confirmation if asymptomatic until the date the cases are isolated. Contacts are kept in quarantine for 14 days after the last possible exposure to a confirmed

COVID-19 case then get tested before discharge. The positive cases are admitted to treatment centres for care and close follow up irrespective of symptomatology. Laboratory testing is done between 7-10 days of admission to treatment centre if the case is symptom free for the last three consecutive days. COVID-19 cases who tested negative are discharged after a repeat test within 24 hours.

The IM produces reports, situation updates, briefings and dashboard for monitoring and tracking the epidemic at national, local and sub-national levels. The present study used secondary data abstracted from reports, daily briefings and daily situation updates and ethical approval was obtained from EPHI-IRB. Index cases data were abstracted from the narrative of IM report submitted to the FMOH and from detailed epidemiologic investigation reports for the cases. Two index community cases having extensive data on the cases and their contacts have been examined in this paper. Data showing the epidemic trajectory were abstracted from the daily briefings made by the health minister and from the daily situation updates on the epidemic shared by the IM. Study findings have been presented in narrative description. Each index case was linked to subsequent cases and contacts. The number of cases and contacts linked to each case has been presented. Descriptive statistics were used for trend analysis. Daily cases were aggregated on weekly basis and presented as cumulative cases. The study has given focus to Addis Ababa, as it was the first location in Ethiopia that experienced community and cluster COVID-19 transmission.

Results

Primary Case -C1 (ET-COVID-19-143): A 75-year-old female chronic diabetic patient from Addis Ababa was admitted to hospital for her chronic condition on May 02, 2020. She had visited a private clinic a week before her admission to the hospital. She neither had travel history nor contact with suspected or confirmed COVID-19 cases. She was confined to home for a long time except for a church visit on April 26, 2020. Due to her poor health, she was frequently visited by her children, close friends, neighbours and relatives. On admission she was pre-screened for COVID-19 and she did not fulfil the case definition to undertake testing. Then decision was made to treat the patient for her diabetes mellitus. On the next day, May 03, the patient suddenly started exhibiting respiratory distress. She was then transferred to Intensive Care Unit. Meanwhile, swab sample was taken for COVID-19 test. The patient passed away the same day. The sample result returned to the hospital on May 04 showed positive for COVID-19. She has become the primary case and the first community case (Figure 1).

In connection with this primary case *ET-COVID-19-143*, 67 contacts were identified including family members. Twenty-seven were offered testing immediately following contact investigation. Of which, four of her children and one close neighbour who were having very close contact with the deceased, while providing care at home and in hospital were found positive, i.e. *ET-COVID-19-201-205*. All of them were asymptomatic and have become secondary cases. The other contacts who were kept in mandatory quarantine for 14 days found to be negative (Figure 1).

From the five secondary cases, a total of 75 contacts were identified and followed up. Sixteen of the contact were tested positive and became tertiary cases. Of these, nine of the transmissions were from a single secondary case (*ET-COVID-19-201*) and considered as a super spreader. There were seven quaternary cases and three quinary cases. Three of the tertiary cases, half of the quaternary cases and three out to the four quinary cases were identified and early isolated and did not make contacts with people and hence further transmission did not happen. Except the primary case, all of them were asymptomatic. This has become the first evidence of community transmission. Moreover, the primary and the great majority of the secondary and tertiary cases were living in close proximity and formed a cluster in one of the busiest and overcrowded district of Addis Ababa (Figure 1).

Primary case C2 (ET-COVID-19-169): On April 28, a 65 years old man sought care in a private hospital for epigastria burning pain, intermittent high grade fever, chills and rigors that lasted for three days. Later he visited another private hospital three times between April 30 and May 03, 2020 as he did not get better. When the patient failed to respond to routine treatment, the hospital reported the patient as a COVID-19 suspect. The patient was then transferred to St. Peter hospital COVID-19 isolation centre. Sample taken from the patient tested positive on May 04. Following the result, the patient was transferred to Eka Kotebe, another hospital designated for critical COVID-19 cases on May 7, 2020. He passed away on May 08, 2020 and he has become the primary case. With the primary case *ET-COVID-19-169*, a total of 50 contacts were identified. Of which 10 of them were family members who had been living together with the deceased. They were tested on May 07 and four of his children were found to be positive i.e. *ET-COVID-19-195, 196, 197 and 232* and have become secondary cases. The rest of contacts linked to the primary case have completed their 14 days quarantine and all of them have tested negative. All of the secondary cases were asymptomatic. This primary case neither had travel history nor contact with suspected or confirmed COVID 19 case.

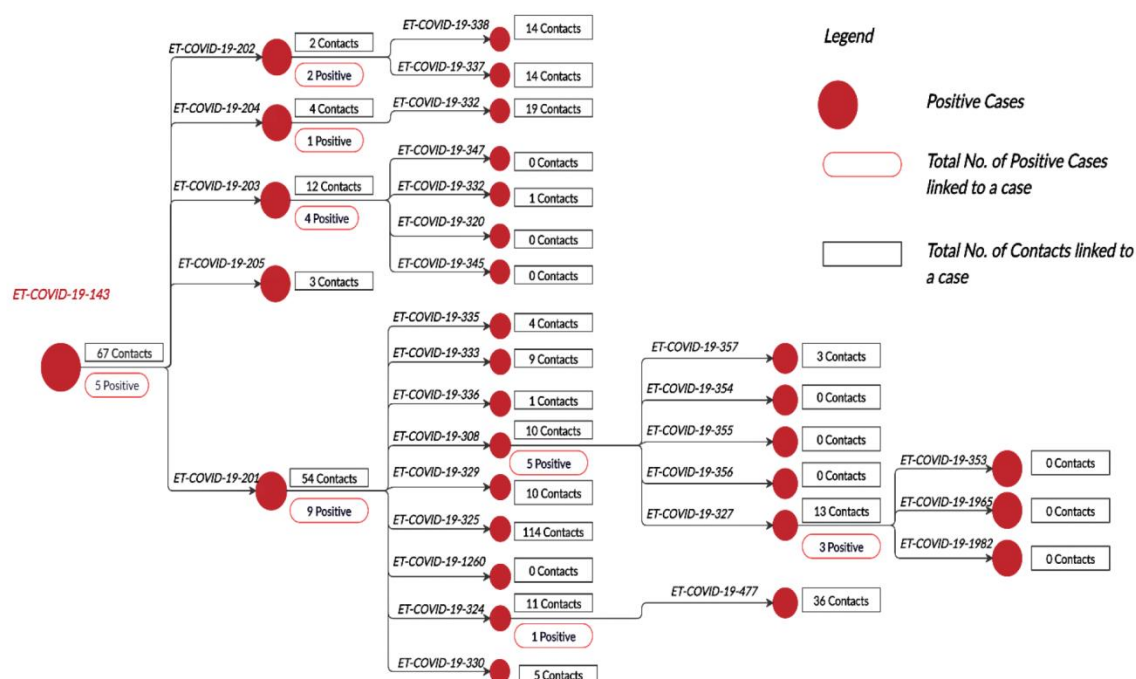


Figure 1: Chain of transmission linked to the first index community case

On June 18, 2020 Addis Ababa reported 144 new cases, which made the cumulative number 2,887 since the first COVID-19 case report on March 13. In total 53 COVID-19 related deaths reported as of June 18,

2020. The age range of the affected individuals was between <1 and 115 years. The great majority of the cases were male.



Figure 2: Proportions of COVID-19 cases with source of infection in Addis Ababa from the week of March 13 to June 14, 2020

As shown in figure 2, from mid-May, 2020, the number of cases having neither travel no history or contact with known COVID-19 cases has been increasing exponentially, indicating the country is

entering into a phase of cluster and/or community transmission (Fig 2). The data has shown exponential growth of the epidemic in Addis Ababa (Fig 3).

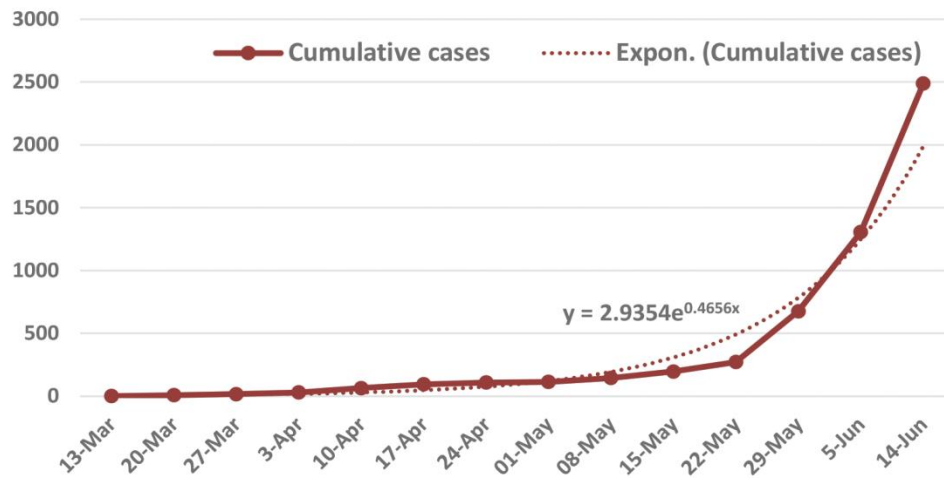


Figure 3: Cumulative COVID-19 cases fitted with exponential trend line in Addis Ababa, Ethiopia, 2020

Discussion

The cases have demonstrated the silent exponential growth of the epidemic in the community following the two incident cases. The first index case was also responsible for the first geographic clustering of COVID-19 in one of the busiest district of Addis Ababa. This happened in one of the busiest and overcrowded area of the city. The chain of transmission data for the first linked to the first index case has shown the effectiveness of early detection and isolation of cases and quarantining of contacts as evidenced by transmission interruption for tertiary and subsequent cases. Following evidence of community transmission, the proportion of cases reportedly linked to travel and known contact have reduced significantly. On March and April, almost all the COVID-19 cases reported in the city were among travellers, while from May 20, the trend has reversed with most of the cases being linked with community transmission.

The present evidence on the community transmission is an indication that Ethiopia is having multiple COVID-19 transmission phases simultaneously. The cluster and community transmission is happening in Addis Ababa while, the sub-national states still having sporadic and cluster of cases among travellers. This require a shift in public health emergency preparedness and response actions including intensifying tailored screening and case identification, contact tracing and follow up, case isolation and quarantining of contacts.

Galvanizing the health systems response to match the enormous demand for health care services and to minimize negative impact of the pandemic on the people and the health system at large accrue community transmission is imperative.

Intensifying surveillance, screening and case detection activities to capture community and cluster cases is necessary. Comprehensive surveillance through strengthening of existing systems to include COVID-19 as mandatory and immediately notifiable case, routine screening for Severe Acute Respiratory Infection (SARI) and pneumonia at the health care facility, strengthening the existing SARI sentinel surveillance sites, community surveillance, and enhanced surveillance from congregate settings is required (WHOc 2020). Community based morbidity surveillance of symptomatic cases and mortality surveillance through collection of data from cemeteries using COVID-19 death notification tool and verbal autopsy could complement the routine surveillance approach. The later approach could help to estimate the burden of COVID-19 in the community, where most deaths are happening and for tracing back those who had close contacts with the deceased.

Contact tracing and tracking require active community engagement especially in settings where widespread COVID-19 community transmissions occur. Contact tracing and tracking Apps that have shown promises for early case detection in many high resourced settings as part of easing lockdown measures could be tried in cities having high phone penetration as in Addis Ababa (Mark 2020). All these surveillance systems need to be integrated with testing and the DHIS 2 electronic platforms developed for COVID-19 to ensure data integration, real time tracking, reporting, fast response and accountability.

The community transmission has triggered exponential growth of COVID-19 cases unlike the gradual epidemic growth linked to travel and known contacts seen in earlier months. Such case growth

could easily overwhelm the existing health care systems unless strategies are designed to screen out those who need treatment and care and those who do not. This requires revisiting the current strategies, which promotes admission of all positive individuals to isolation/treatment centres. A study has shown that about 80% of COVID-19 cases in Africa are asymptomatic and 8% have mild symptoms (Cabore et al. 2020). These groups do not need treatment and close follow up but can transmit the virus although they are generally less infectious than symptomatic cases. Our result also showed that except the two index cases, all the subsequent cases were asymptomatic. One of the cases was a super spreader who infected nine contacts. Super spreaders are people who infect more than 8 individuals and have significant contributions in driving epidemic (Yunjun et al. 2020). This could explain the silent and fast growth of cases observed in Addis Ababa. Home or self-isolation of asymptomatic and mild cases is a response action highly recommended to contain community transmissions (Bondy et al. 2020, Cabore et al. 2020). Once community transmission has established there will be large number of COVID 19 cases to be identified. It is neither necessary nor practical to isolate all of them in treatment centres. Evidence suggests that only 30% of the COVID-19 patients require hospitalization (Cabore et al. 2020). Home isolation helps to relief the strain from the health care system. But require high level compliance by the affected individuals. This can be ensured through close follow up, active community engagement and putting in place some legal enforcement strategies and accountability mechanisms for those who breach the rules. Many people who experienced isolation have expressed their psychosocial challenges and frustrations towards isolation procedures and facilities and hence, encouraging home isolation could also help to address such grievances (Hossain et al. 2020).

On March 24, Ethiopia enforced mandatory quarantine for foreign travellers in designated places, as most of the COVID-19 cases in the country were among travellers and their contacts. This has contributed significantly to slows down the transmission to a manageable size, flatten the curve for about two months and has given more time for the government and the systems to prepare. However, this approach would have little practical value once community transmission has established. Due to the large number of cases to be identified in the community, the number of close contacts for each case will be remarkably large. Therefore, considering home quarantine with strict government control is a practical and cost effective approach to contain transmission (Ngonghala et al. 2020, Bondy et al. 2020). This approach could

also help to alleviate the psychosocial impact of quarantine to the individuals and their families (Hossain et al. 2020).

Complementing the emergency responses through implementation of non-pharmacological public health interventions are deemed necessary for epidemic containment and mitigation. Social distancing is one of the best interventions proved to break transmission cycle. China, the first country hit by the pandemic followed by Europe and the USA practiced lockdowns to ensure social distancing and have managed to reduce the transmission (Ngonghala et al. 2020; Bondy et al. 2020). However, the economic and social tolls of lockdown measures have devastating consequences to the majority of the people and to the country's economy. Counter measures to lockdown restrictions as riot and demonstration seen in some resource poor settings in Asia and Africa have caused more devastation than the epidemic itself. Hence, it is crucial to understand the local contexts to best implement social distancing measures and ensuring high level community engagement is important to its success.

Ethiopia has been implementing social distancing measures since mid-March through closing of schools and universities; closing of non-essential services; banning of gatherings more than four people; closing of religious facilities; banning of gathering at social events as in wedding and funeral; cutting carrying capacity of public and private transportation services by half and reducing the number of public service employee coming to office and encouraging working from home. In recent days complacency and non-compliance have been observed among the general public to the social distancing recommendations. Increasing public awareness and engagement and law enforcement need to be revitalized for the city to succeed in the containment of community and cluster transmission.

The other non-pharmacologic public health intervention showing promise in cutting COVID-19 transmission is mouth and nose cover (face mask). A study reported that the N95 mask reduces respiratory disease transmission by 90%, surgical mask by 80% and cloth mask by 20-80% (Ngonghala et al. 2020). Face mask have dual advantages, i.e to prevent people from getting infection and to prevent them passing infection to others. High level coverage and compliance is required especially for cloth mask to have impact in cutting the transmission. It is one of the easiest, affordable and non-disruptive preventive interventions that the government should capitalize on. Mandatory face-mask use irrespective of the type of the mask is one of the landmark measures imposed by

Ethiopian government in Addis Ababa requiring all people to wear outside their home. Though improper use of this masks continued to be a challenge, their values in slowing the transmission is undeniable. Due attention should be given to enforce routine and persistent use of it to ensure effectiveness.

Frequent hand washing is another non-pharmacological intervention recommended for the prevention of COVID-19 transmission. A study reported that hand washing can prevent the transmission of virus infections by 50% (Brauer et al. 2020). In Ethiopia, particularly in the capital Addis Ababa hand washing has been promoted as important public health prevention measure to reduce COVID-19 transmission. Efforts have been made to increase population level awareness about the benefit and to encourage consistent practice through media, short plays and by prominent public figures. This effort has improved awareness and compliance. However, poor access to clean water and sanitation facilities are challenging the effectiveness of this interventions especially in rural areas and need thorough consideration (Brauer et al. 2020, Mirkuzie et al. 2020). One fourth of the global population and over 50% of the Ethiopian population do not have access to hand washing (Brauer et al. 2020).

Conclusion

The early phase of the COVID 19 response in Ethiopia focuses on containment of transmission linked to foreign travels. That has helped to flatten the epidemic curve for about two months. As the country enters in to a phase of community and cluster transmissions, tailored emergency containment responses are required to match the magnitude of the problem and its coverage as recommended by the WHO.

Competing interest: No competing interest.

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Original article

***Aedes* Mosquitoes distribution and risk of Yellow Fever transmission in Gurage Zone, Southwest Ethiopia**Abate Waldetensai^{1*}, Wondatir Nigatu¹, Yosef Asrat¹, Chalachew Sisay¹, Mesay Gunta², Desalegn Belay¹ and Geremew Tasew¹¹Ethiopian Public Health Institute, Addis Ababa, Ethiopia²Wolayta Zonal Health Department, Wolayta, Ethiopia

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Abstract**Introduction:** Yellow fever is a serious arboviral disease present with a variety of clinical signs and outcomes ranging from mild to severe fatal cases transmitted by *Aedes* mosquito.**Objective:** To determine the distribution and specific species of *Aedes* mosquitoes present in the Gurage zone, Southwest Ethiopia, following the yellow fever outbreak in the area.**Methods:** An entomological cross-sectional study design was used with simple random sampling techniques following the yellow fever outbreak report starting from February to April, 2020 for two months.**Results:** A total of 748 houses were investigated, of these 621 (83%) houses were found to be positive for larvae/pupae. From a total of 168 water containers inspected, 78 (46%) were productive for larvae/pupae collections. The highest house index was recorded in Doba (95.7%) and Shumuro (95.3%) followed by Wodesha (89.5%), Woyera (89%), Terbieishikure (75%), Genideterbe (67%) and Lankatore (65% Kebeles. The most preferred breeding sites of *Aedes* were found Enset (*Ensete ventricosum*) with Container Index (CI), Breteau index (BI) of (65.5%, 19), (54.8%, 13.7), (46.7%, 6.5), (45.7%, 13.7), (42.9%, 3), (44.4%, 12) and (19%, 4) in Genideterbe, Wodesha, Shumuro, Doba, Terbieishikure, Woyera and Lankatore Kebeles, respectively. From a total of 293 *Aedes* mosquito, 209 (71.3%) were collected from false banana. The mosquito species of *Ae. simpsoni* complex 199 (67.9%), *Ae. africanus* 40 (13.7%), *Ae. aegypti* 27 (9.2%) and *Ae. vittatus* 27 (9.2%) were collected from all types of breeding sites.**Conclusion:** This study reveals that *Aedes* mosquitoes are abundant and widely distributed across the study sites. Larval indices were significantly associated with yellow fever transmission. The study found that *Aedes* larval indices were above the critical level which strongly suggests that there is high risk of yellow fever transmission. The abundance of *Aedes simpsoni* complex was found higher than *Ae. aegypti*, *Ae. africanus* and *Ae. vittatus*. Sustained surveillance must be standardized for adequate comparisons within and among regions.**Keywords:** *Aedes*, Yellow Fever, Larval Indices, houses, containers, Gurage**Introduction**

Aedes mosquitoes are usually black with white or silver markings on their bodies and nuisance species. They are the potential transmitters of human and animal infections, and are found distributing throughout the world by occupying many biotopes (Patrick et al. 2018). They are found to be spread to all continents excluding Antarctica primarily and hugely aided by man-made activities. The abundant distribution of different arboviral vectors is dependent on climate, topography, and anthropogenic changes in environments (Chimaeze et al. 2018). Temperature, rainfall, and relative humidity can influence the density of *Aedes* mosquito's population to cause a severe and potentially fatal illness in humans and are a cause of serious epidemics and pandemics (Lutomiah et al. 2013). In West Africa and parts of East Africa, during the rainy and early dry seasons, tree-hole breeding anthropophilic *Aedes* reach high densities (Torres et al. 2018) and linked closely to the

forest-savanna ecotone (Monath and Vasconcelos 2015). *Aedes* mosquito is considered one of the most relevant groups of mosquito in public health and got interested because of their role in the transmission of many arboviral diseases (Mint et al. 2017) causing large-scale outbreaks throughout the world (Chimaeze et al. 2018). The female *Aedes* acquires blood meals by simply extracting from people, birds, and other animals to obtain proteins needed to develop her eggs (Morris and Soule 2016). Dynamics interest in the mosquitoes of Africa has been derived from their ability to thrive mostly in the tropics and act as the vectors of the most debilitating human diseases caused by bio-agents (Cornel et al. 2018a; Das et al. 2018). The role of the mosquito in the transmission of disease to humans and animals increased research interest on mosquitoes especially in Africa (Leta et al. 2018).

Because of the outbreaks of arboviral disease, the rapid spread and increasing challenge in Africa is

posed by mosquito-borne viruses resulted in high public health problems (Cornel et al. 2018). This constitutes serious health, economic and social problems (Raphaelle et al. 2018). Yellow fever (YF) is a serious viral disease including mild illness and severe with fever, jaundice or hemorrhage and cause death that transmitted by *Aedes* mosquito. YF is known to be endemic in tropical and subtropical areas of South America and Africa. Annually, YF continues to occur in epidemic situations, and it is estimated to result in 130,000 human cases and 78,000 deaths in Africa (Mulchandani et al. 2019). In Ethiopia, the first YF epidemic occurred between 1960 and 1962 caused 100,000 cases with 30,000 deaths followed by the second YF outbreak between 2012 and 2013 (Legesse et al. 2018). In 2016, Ethiopia reported 22 suspected yellow fever cases, including five deaths in the South Omo zone (African Union Permanent Representatives Committee (PRC) 2016). More recently, in October 2018 and March 2020, an outbreak of YF has been confirmed in Southwest Ethiopia leads to the death of 4 peoples (Ministry of Health (MoH) 2020). Rapid urbanization, population movement and human activities are the main factors for expanding the geographical range of the YF virus and creating a high density of vectors at the unvaccinated population (Mulchandani et al. 2019).

High densities of mosquito vectors closer to human dwellings and reservoir hosts within unvaccinated and highly populated areas are the major factors expanding the geographical spread of this virus (World Health Organization (WHO) 2014). The capacity of disease transmission will be determined by the degree of anthropophilic (Nnanna et al. 2016). The YF virus and the vectors live together adopting one another to maintain the transmission cycles. *Aedes* and *Haemagogus* mosquitoes are the responsible vectors of the YF virus in many endemic areas (Samaroo 2015). Sporadic yellow fever infection occurs almost exclusively in forestry and agricultural workers because of occupational exposure (Eni et al. 2014). For instance, across regions of Africa, the vectors and associated ecological patterns of YFV transmission is different (Monath and Vasconcelos 2015). The transmission of YFV is characterized by three and two types of cycles in Africa and South America respectively (WHO 2014). The amplification of the YF virus involved a variety of vector species, including *Ae. aegypti*, *Ae. simpsoni* complex, *Ae. furcifer-taylori*, *Ae. luteocephalus*, *Ae. metallicus*, *Ae. africanus* and *Ae. vittatus* (Couto-lima et al. 2017; Monath and Vasconcelos 2015; Tomor 2002; Zettel and Kaufman 2016). In parts of Africa (East Africa), during yellow fever epidemic, the current most important vector is *Aedes simpsoni sensu latu* (s.l.),

likely *Ae. bromeliae* and *Ae. africanus*, were the principal vectors during the largest recorded epidemic of yellow fever in between 1960 and 1962 (Ellis et al. 2012), and 2012 in Ethiopia (Lilay et al. 2017).

Various fruitful approaches have been attempted to prevent and control the spread of YF virus. YF vaccine linked with vector control is proving to be the best approach until YF specific drugs are developed (Basker and Kannan 2013).

Disease surveillance, vector surveillance, and monitoring of environmental and social risks are among the YF surveillance program (Sitepu et al. 2018). From these surveillances, entomological surveillance is used to establish changes in the environmental provision and density of the vectors to evaluate control programs, obtain comparative measurements of the vector population over time. This is also can be used to decide and facilitate appropriate interventions on time. In general, the objectives of *Aedes* mosquitoes investigation methods are to obtain baseline information on infestation and re-infestation, evaluate and recommend control methods through larval and adult mosquito surveys (Basker and Kannan 2013).

Though YFV is well known in Ethiopia, there is no complete information documented with regards to vector species involved in transmission according to geographic distribution because of under-reported infections due to lack of laboratory facilities and inaccessibility of some of the endemic areas (Getachew et al. 2015). As a result, YF prevention and control requires strong and continuous collection and collation of data on *Aedes* species. The present study is therefore sought to determine the diversity and distribution of *Aedes* mosquitoes in Gurage Zone, Southwest Ethiopia, during the time of YF outbreak.

Methods and Materials

Study area: The Gurage Zone is 155 kilo meters far from Addis Ababa, the capital city of Ethiopia. Geographically, Gurage zone is located to the southwest direction between 7.8°C - 8.5°C N and 37.5°C- 38.7°C E with altitude ranging from 1,001 to 3,500 meters above sea level (m.a.s.l) (Aduna and Ayalew 2019). It comprises three agro-climatic zones: Dega (28.3%) with high altitude (25000-3662m ASL), Woina Dega (64.9%) with mid-altitude (1500 – 2500 m ASL) and Kolla (6.8%) with lowland altitude (1000 – 1500m ASL). It is known with bimodal rainfall pattern Kiremt (with 80% of rainfall from June to August) and Belg (with 20% of rainfall from February to May). The annual temperature and mean annual rainfall of the area is 13-30°C and 600-1600 mm in range, respectively. According to the land utilization

data of the region 298,369 hectares (ha) cultivated land (mostly with Enset), 70,249.31 ha grazing land, 67,678 ha forest, bushes and shrub-covered land, and 14,234

ha of land is covered by others (Hailemariam et al. 2018) (Figure 1).

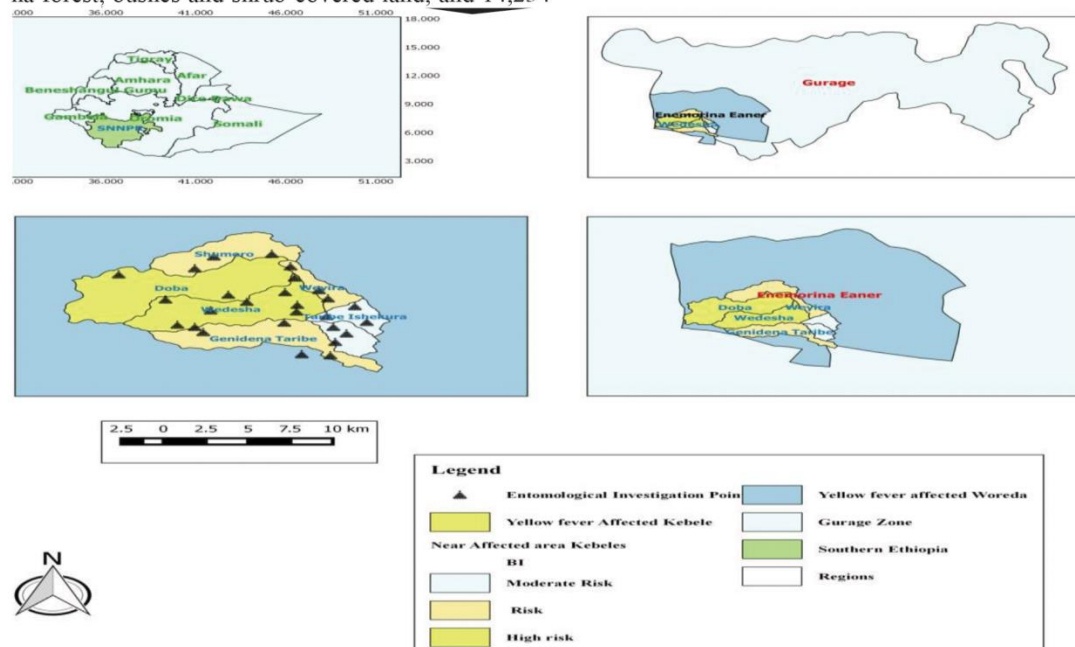


Figure 1: Entomological investigation maps for yellow fever risk assessment in Gurage Zone, South Western Ethiopia

Study design, sampling, and sample collection techniques:

An entomological cross-sectional study was conducted in the Gurage zone, southwest Ethiopia following a yellow fever outbreak report starting from February to April, 2020 for two months. Simple random sampling techniques was applied to select the hundred meters (100m) transect households using the cases reported households as a start point. Due to time shortage and some sites were hard to reach, only seven lowest administrative Kebeles namely, Wodesha, Woyra, Shumoro, Lankatore, Genideteribe, Doba, and Teribeishekure were selected. To conduct this investigation, the outbreak point and distributions of forests with non-human primates were considered due to the condition that YF may spread from jungle to rural or urban. This means nearby villages to forest environments were selected at relatively high human population densities and large-scale land alterations due to human involved activities. Discussions were undergone with the area authorities and house owners before sampling to assure their involvement in the study. Next, to check the presence of immature stages of mosquitoes, appropriate environmental variables for breeding sites of mosquitoes were determined through community's recommendations and observation

All preferred resting places of *Aedes* mosquito and breeding sites were identified before sample collection employment. Following the WHO (2016) guideline, at least 100 houses were selected from each identified Kebeles. The mosquito collection was undertaken focusing only on immature stages with dipper and pipetting techniques (WHO 2014). Each identified household and its vicinity have been investigated for possible mosquito vectors. Artificial and natural mosquitoes breeding sites were inspected. Since only aquatic habitats harboring at least one larva or pupae of *Aedes* spp. were considered positive, samples were collected from infested containers. Larvae/pupae were sampled from various water storage containers (Jerycans, Barrels, Clay Pots, Plastic Pans, and Rotoes) (Figure 2). The collections were entered into well-labeled plastic containers and taken to the temporary established laboratory (insectary) for rearing to the adult stage to identify the species level. All count of larvae or pupae with inspected containers were recorded by types and localities. The presence of *Aedes* larvae in natural breeding habitats was also recorded. While larval indices were used to quantify vector breeding potential in each cluster, the pupae counts were also taken as a proxy for adult vector abundance.

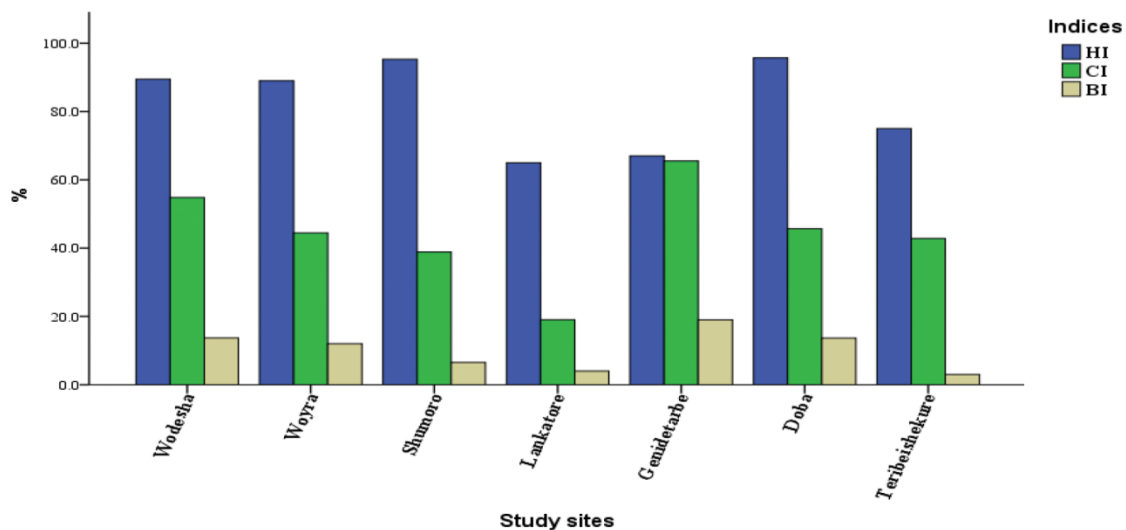


Figure 2: The distribution pattern of *Aedes* larvae with indicative larvae indices

Mosquito identification: This was done at frozen and sorted on a chill table adult stage emerged immature stages using the morphological identification keys and by reference to morphological descriptions (Huang 1990 and 2004); Huang and Rueda 2017) under light compound microscope. The identified *Aedes* species were pooled based on collection sites and preserved in 96% ethanol for farther arboviruses screening.

Data management and Analysis: All information about *Aedes* mosquitoes was entered into the excel spreadsheet and imported to SPSS (version 20) for statistical analysis. Descriptive statistics were used to determine the most preferred breeding sites, density, and abundances of *Aedes* mosquitoes. ANOVA was used to compare the different habitat types of these vectors at 95% confidence intervals (P value, 0.05). House index (i.e. percentage (%) number of positive house per 100 houses inspected), Breteau (i.e. the total number of containers with larvae or pupae per 100 houses) and container (i.e. percentage (%) number of positive containers divided by the number of containers inspected) index risks were estimated with collected databased on the WHO protocol. Entomological indices were interpreted according to the WHO guideline (WHO 2016).

Results

YF outbreak case investigation: On March 2020 three yellow fever cases were reported from the same households (father, mother and son) from Wodesha rural Kebele located in Enor Ener District of Gurage zone, Southern Nation and Nationalities Peoples Region. Serum samples were collected from these patients and transported to the Ethiopian Public Health

Institute (EPHI) laboratory. Two of the three samples tested by reverse transcriptase polymerase chain reaction (RT-PCR) were found positive for yellow fever virus acute infections. As of 6 April 2020, a total of 4 deaths and 85 suspected cases have been notified from 6 Kebeles, of which 54 were from Wodesha Kebele. Among the total suspected cases, 6 samples tested positive at EPHI national laboratory. In response to the problem, EPHI and MoH preformed an in-depth investigation and response, supported by partners including WHO. Accordingly, this study made entomological investigation and active case search on 1275 households and schools. At the same time vaccination on 27,178 individuals were done.

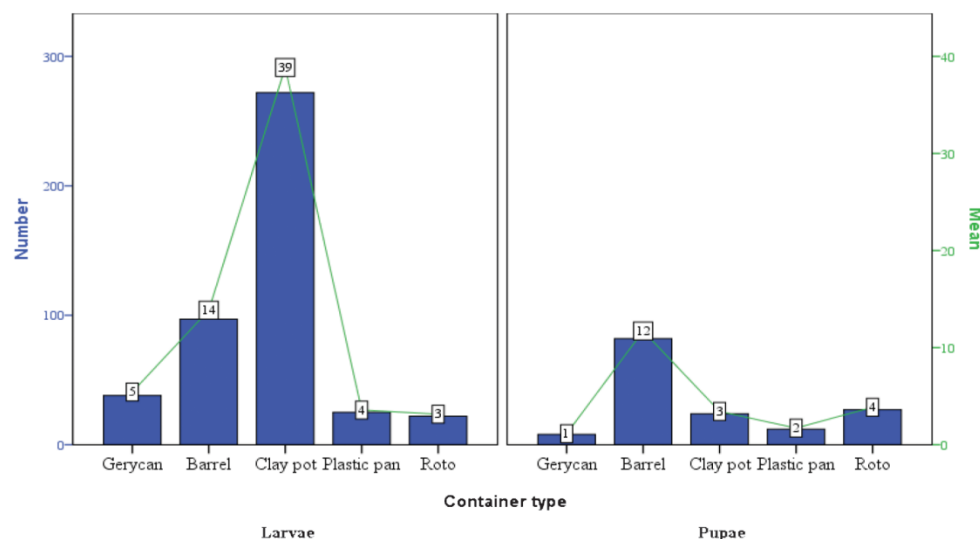
Immature Stage (Larvae and Pupae) Surveys: A total of 748 houses were investigated in the Enomorenor district in Guraghe Zone (South Western Ethiopia) to detect the existence of *Aedes* mosquito breeding sites after checkup of mosquito's larvae/pupae presences. Potential breeding sites such as artificial and natural breeding places which include Enset (Ensete ventricosum) or false banana and containers were found in the study sites. Of the total, 621 (83%) houses were found to be larvae/pupae positive. Within this scenario, about 168 water containers, suspected or expected to be best for mosquito breeding were inspected. Of these, 78 (46%) containers or water storages were found positive for larvae/pupae collection. Out of the identified containers contain immature stages, 468 larvae and 138 pupae were collected and reared to the next adult stage. The overall inspection results were tabulated for the study sites and presented in Table 1.

Table 1: Distribution of houses, containers inspected for positivity of immature stage across the study sites, Gurage zone, March 2020

Sites	# house inspected	# houses +ve	# container inspected	#containers +ve	# larvae	# pupae
Wodesha	124	111 (89.5)	31	17 (54.8)	200	139
Woyra	100	89(89)	27	12 (44.4)	75	36
Shumoro	107	102 (95.3)	18	7 (46.7)	29	22
Lanka Tore	100	65 (65)	21	4 (19)	20	17
Genidetaribe	100	67 (67)	29	19 (65.5)	17	10
Doba	117	112 (95.7)	35	16 (45.7))	96	58
Teribeishekure	100	75 (75)	7	3 (42.9)	31	17
Total	748	621 (83)	168	78 (46.4)	468	299

The result confirmed that there were big positivity differences in number of houses, containers and larvae/pupae across all the study sites. Among the listed and inspected water holding containers, *Aedes* mosquito larval/pupae positive breeding's were found on containers placed outside the homes. Clay pots with the highest rate of positivity for *Aedes* mosquito larvae (n = 272 and mean = 39) followed by Barrel (n=97 and mean = 14), Gerycan, (n = 38 and mean = 5), Plastic

Pan (n= 25 and mean = 4) and Roto (n = 22 and mean = 4). In regards of Pupae positive containers, Barrel was found with highest pupae (n = 82 and mean = 12) followed by Clay Pot (n = 24 and mean = 3), and Roto (n = 27 and mean = 4). It has been found that there is a difference in all types of containers between larvae and pupae positivity; that may be due to different factors associated on the impacting of developmental stages (Figure 3).

**Figure 3: Distribution of larvae and pupae by water holding container types, Gurage Zone South Western Ethiopia, March 2020**

Aedes mosquito immature stage indices: The numbers of *Aedes* mosquitoes were calculated as *Aedes* mosquito larval indices (HI, CI, and BI) from all study areas to determine if they were associated with YF transmission (Figure 3). The proportion of houses infested with *Aedes* mosquito larvae can be expressed as the HI by study sites. High proportional infestation of *Aedes* mosquitoes were observed in Doba (95.7%) and Shumuro (95.3%) followed by Wodesha (89.5%), Woyera (89%), Terbieishikure (75%), Genideterbe (67%) and Lankatore (65%). In specific breeding habitats (containers) BI were found to be higher in Genideterbe 19 (CI, 65.5%; BI, 19) and Wodesha 17 (CI, 54.8%; BI, 13.7) ranged above 50% and followed by Shumoro 7 (CI, 46.7%; BI, 6.5), Doba

3 (CI, 45.7%; BI, 13.7), Terbieishikure 16 (CI, 42.9%; BI, 3), Woyera 12 (CI, 44.4%; BI, 12) being below 50 % of breeding habitats. Low infestation level was observed at Lankatore with BI 4 (CI, 19%; BI, 4). In total, 767 water stage mosquitoes were collected from 7 study sites across Gurage Zone. Among these, 293 (38.2%) were *Aedes* mosquitoes. The rest 437 (57%) and 37 (4.8%) were found *Culex* and *Anopheles* mosquitoes respectively. The *Aedes* mosquito larvae were identified to species level found to be *Ae. Aedes simpsoni* complex (199 (67.9%)), *Ae. aegypti* (27 (9.2%)), *Ae. africanus* (40 (13.7%)), and *Ae. vittatus* (27 (9.2%)). Though small number of *Aedes* mosquito recorded, all member species were abundant in all the study sites (Table 2).

Table 2: Distribution and abundance of *Aedes* mosquito species across study sites, March 2020

	Wodesha	Woyra	Shumoro	Study sites (%)		Doba	Teribeish ekure	Total
				Lanka Tore	Genidet aribe			
<i>Ae. simpsoni</i> complex	47 (16)	37 (12.6)	39 (13.3)	4 (1.4)	6 (2)	63 (21.5)	3 (1)	199 (67.9)
<i>Ae. aegypti</i>	3 (1)	10 (3.4)	9 (3.1)			5 (1.7)		27 (9.2)
<i>Ae. africanus</i>	13 (4.4)	6 (2)	5 (1.7)	1 (0.3)		15 (5.1)		40 (13.7)
<i>Ae. vittatus</i>	10 (3.4)	4 (1.4)	6 (2)			7 (2.4)		27 (9.2)
Total	73 (24.9)	57 (19.5)	59 (20.1)	5 (1.7)	6 (2)	90 (30.7)	3 (1)	293 (100)
<i>Culex</i>	150 (31.6)	68 (14.3)	32 (6.8)	51 (10.8)	39 (8.2)	44 (9.3)	53 (11.2)	437 (92.2)
<i>Anopheles</i>	9 (1.9)	12 (2.5)	5 (1.1)			11 (2.3)		37 (7.8)
Total	159 (335)	80 (16.9)	37 (7.8)	51 (10.8)	39 (8.2)	55 (11.6)	53 (11.2)	474 (100)

Of all (293) *Aedes* mosquitos collected from all types of breeding habitats, 209 (71.3%) were collected from Enset which was the most preferred breeding site and dominantly found in the study areas. The abundance of *Ae. simpsoni* complex were recorded high from all breeding types (199 (67.9%)), followed by Enset (*Ensete ventricosum*) (153 (52.2%)), Barrel (13 (4.4%)), Gery can (7 (2.4%)), Clay pots (16 (5.5%)), Roto (6 (2%)), Plastic Pan (4 (1.4%)). The species of *Ae. africanus* (40 (13.7%)), *Ae. aegypti* (27 (9.2%)) and *Ae. vittatus* (27 (9.2%)) were collected from all

breeding types. The collection of *Ae. aegypti* from Enset (false banana), Clay Pots, Gerycan, Roto and Barrel were found to be 10 (10%), 9 (3.1%), 4 (1.4%) and 1 (0.3%) respectively. *Ae. aegypti* were not found from Plastic Pan. Relatively the abundance of *Ae. africanus* was found to be the second following *Ae. simpsoni* complex. In the decreasing order of 29 (10%), 8 (2.7%) and 3 (1%) numbers, *Ae. africanus* were collected from Enset, Clay Pots and Roto respectively.

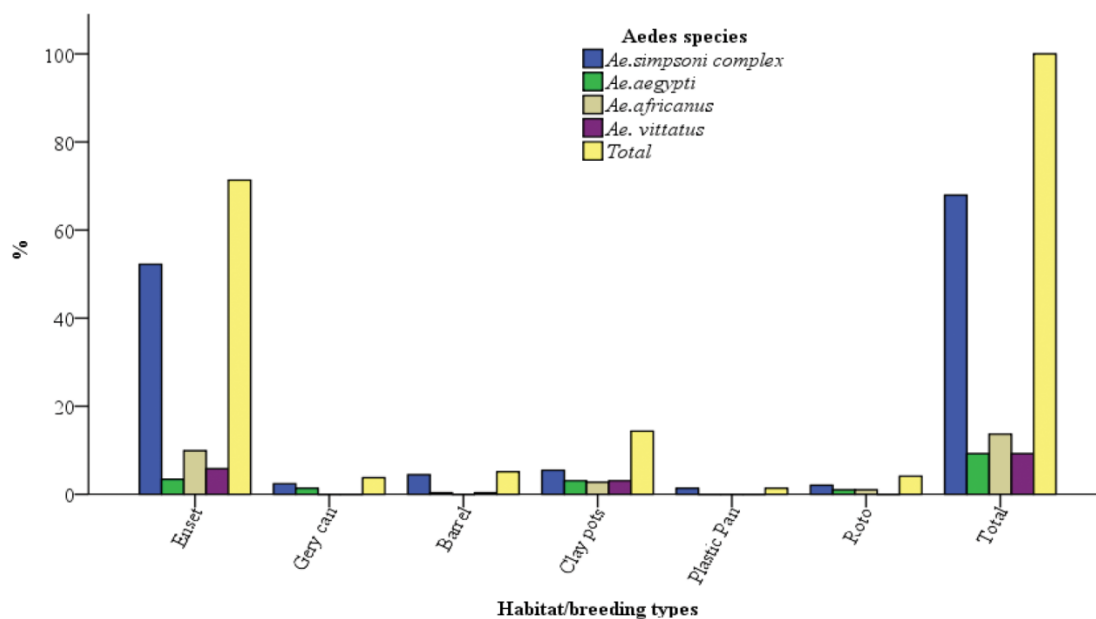


Figure 2: *Aedes* mosquito species distribution by container habitat/breeding type, Gurage Zone South Western Ethiopia, March 2020

Ae. africanus was not observed from Gerycan, Barrel and Plastic pans. The *Ae. vittatus* collected from Enset, Clay Pots and Barrel was found 17 (5.8%) 9 (3.1%) and 1 (0.1%) correspondingly. Totally, next to Enset collection, 42 (14%) *Aedes* were collected from Clay

Pots followed by 15 (5.1%), 12 (4.1%), 11 (3.8%), 4 (1.4%) from Barrel, Roto, Gerycan and Plastic pan consecutively. Clay Pot was found the second preferred breeding types of *Aedes* mosquitoes in the study areas which are followed by Roto and Gerycan (Figure 4).

Discussion

Though an outbreak of arboviral infections has always been associated with *Aedes* mosquitoes, there is still a lack of adequate information on the ecological distribution of *Aedes* species and the diseases they transmit in different parts of Ethiopia. Since the transmission of yellow fever is directly related to its vectors, information on density, species identification, and breeding places are essential for effective vector control (Chimaeze et al. 2018). This is because, in a place where relatively little is known about mosquito populations, or the presence of arboviruses, understanding the potential for arbovirus transmission is dependent on species occurrence and their abundances and variation of species in time and space (Cornel et al. 2018).

In the present study, both artificial and natural sites were found the potential breeding places for mosquitoes. This is consistent with another study (Simard et al. 2005) in which Enset (*Ensete ventricosum*) and containers play a major role in *Aedes* breeding (Lilay et al. 2017). Though there was sample size difference in the number of houses inspected, the houses and containers infested with larvae/pupae were high across all study sites compared to the study conducted in Dire Dawa, Eastern Ethiopia (Getachew et al. 2015).

In this study, the most common breeding habitats observed were false banana (*Ensete ventricosum*), Barrels, Clay Pots, Jerycan, Plastic drums/pans, and Roto. Similar to a study carried out in Ethiopia (Lilay et al. 2017), this investigation found that the average number of larvae per breeding place was higher in the natural than in the artificial breeding sites. According to this study, a false-banana (*Ensete ventricosum*) which is traditionally cultivated close to the residential home was found to be a highly preferred breeding site of *Aedes* species followed by Clay pots. The property of Ensete with large plant stem resists evaporation making mosquito breeding possible all year round. Regarding this, the current study is in agreement with another study which conducted in Southern Ethiopia (Mulchandani et al. 2019). In the study area due to the absence of piped water, the community used the ground, rain, and spring water sources that may be contributed to the factor of mosquito water preferences for breeding (Getachew et al. 2015). Discarded containers (like Barrel Jerycan, Plastic Pans, and Roto) may also differently favorable to the proliferation of

mosquitoes in this study, which is in parallel with the study performed in Cote d'Ivoire (Konan et al. 2013). All containers inspected for the *Aedes* larvae/pupae were found positive outside of the home which is similar to a study conducted in Kenya (Agha et al. 2017). This information might have important implications in the design of arbovirus vector control strategies. The population of YF vectors can be greatly reduced by reducing their sources such as small containers on the premises of human dwellings. These activities can also be supported by advocacy, social mobilization and legislation, collaboration within different sectors, integrated approach to disease control, evidence-based decision making, and capacity building (Basker and Kannan 2013). The habitats of *Aedes* mosquitoes can also be eliminated by preventing access to these containers through frequently emptying and cleaning them (WHO 2019).

In this study, efforts have been made to understand the significance of entomological surveillance using the HI, CI, and BI. These indices help to design the implementation of the outbreak prevention and control measures. The meaning of using *Aedes* indices has been proven an effective tool for the rapid prevention and control of YF (Basker and Kannan 2013). The larval indices of HI and CI found in this study are relatively comparable with the study conducted in Dire Dawa (Ferede et al. 2018; Getachew et al. 2015). The larval indices were also significantly associated with yellow fever transmission, which is in parallel with the study conducted in Indonesia (Siregar and Makmur 2018). The presence of suitable containers for larvae breeding can increase the *Aedes* mosquito population, associated with the risk of YF virus transmission (Lutomiah et al. 2013).

In the current study, all the investigated sites had high *Aedes* larval indices that indicate the fact of high risk of YF possible transmission, when arboviral cases become established (Sharma et al. 2015). This is in contrast to the study results found elsewhere (Huang et al. 2014). The variability of mosquito abundance depends on ecological and climatic factors (temperatures and rainfall), and chemical composition of the water for the development and the distribution of mosquito species (Patrick et al. 2018). The current population growth, demographic shifts to urban areas, and its prominence with the presence of competent

vectors linked with imported cases of arboviruses infections pose continuous outbreaks in different places (Hasty et al. 2020).

In this study, the dominant *Aedes* mosquito species that emerged from the collected larvae were *Ae. simpsoni* complex followed by *Ae. Africanus* with the vectors of sylvatic yellow fever which is consistent with the study conducted in southern Ethiopia (Lilay et al., 2017). But, this is in contrast with the study conducted in North West Ethiopia (Ferede et al. 2018). *Ae. vittatus*, which is known as a vector of chikungunya and yellow fever around the forest, and *Ae. aegypti*, the urban vector (Ali et al. 2014) found to be less dominant in all of the current study areas which is opposite to the study carried out in North West Ethiopia (Ferede et al. 2018). It is worthy to note that the members of the *Ae. simpsoni* complex collected from study Zone suggesting that the species may be *Ae. bromeliae*, as observed in Nigeria (Chimaeze et al. 2018), the widely distributed anthropophilic member of the complex in Ethiopia (Mulchandani et al. 2019). This indicated that *Ae. simpsoni* complex and *Ae. africanus* were involved in the transmission of YF more dominantly in the study area which makes the transmission may be rural/sylvatic (Lilay et al. 2017). The sylvatic cycles involves the circulation of the YF virus between non-human primates and tree-dwelling mosquitoes in which the risk the virus transmission tends to be higher toward the end of the rainy season and at the beginning of the dry season, due to increased vector density (Young et al. 2017). This study provides a valuable clue on *Aedes* mosquitoes distribution in YF virus outbreak reported in rural areas. The result therefore suggest that the urban and sylvan areas also need to be considered for the implementation of arbovirus vector surveillance and control strategies.

Conclusion

This study reveals that *Aedes* mosquitoes are abundant and widely distributed across the study sites in Gurage Zone. The habitats preference of *Aedes* species has found to be both natural (false banana) and artificial containers (Clay Pots, Gerycan, Roto, Barrel, and Plastic Pan). The most preferred *Aedes* mosquito breeding habitat was a false banana (*Ensete ventricosum*) followed by Clay Pots. Larval indices were significantly associated with YF transmission. Larval indices tabulated for all the current study sites shows that there is a potential of high-risk YF

transmission in the areas. *Aedes simpsoni* complex immature stages were higher than *Ae. aegypti*, *Ae. africanus* and *Ae. vittatus* but all of them are found co-existed that may again facilitate for high risk of YF transmission. The presence of diverse habitats and water availability and the progressing history of disease outbreak by *Aedes* species in the study area may inspire an intensification of the vector surveillance activities. Variation in mosquito abundances is the highest important epidemiological risk parameters that may impacts differentially on transmission risk of YFV in the Zone. This study provides the first baseline data on the presence of *Aedes* species, the potential for the emergence of viral diseases in the vulnerable populations and high risk areas based on densities of mosquitoes. It may also suggest establishing a continuous and systematic surveillance program across the different geopolitical and ecozones of the country. Monitoring vector density is essential as a basis for health professionals in designing more effective prevention strategies. Such sustained surveillance must be standardized for adequate comparisons within and among regions. All important breeding containers should be subjected to appropriate control measures (source reduction via the removal of these containers) around the premises of living and working areas. Routine activities for eliminating mosquito breeding sites such as managing the natural and artificial water-filled containers should be required. Managing the breeding habitat of *Aedes* mosquito on Enset/false banana (*Ensete ventricosum*) should be established and strengthened through cooperative work plans with agricultural sectors. The distribution of the vectors of YFV in the study areas indicates relatively a wide diversity of vector species, suggesting that surveillance and vector control programmers should take into account the ecological specificity of each species. Finally, similar studies are recommended to be carried out on different geopolitical, hydrological, and agricultural development corridors and ecological zones of the country that have conducive habitats for the breeding of *Aedes* species.

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Competing interests: The authors declare that they do not have competing interests.

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Original article

Bacterial profile and antimicrobial susceptibility pattern of isolates recovered from sterile body fluids referred to the National Reference Laboratory at the Ethiopian Public Health Institute

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Abstract

Introduction: Assessing the presence of bacterial etiologies and their antimicrobial susceptibility patterns is very crucial for proper diagnosis of different infections and controlling antimicrobial resistance in the clinical setting with the ultimate goal of better patient care and outcome.

Objective: To assess bacterial etiologies and the antimicrobial susceptibility pattern of isolates recovered from sterile body fluids from patient specimens referred to National Bacteriology and Mycology Reference Laboratory in Ethiopia. **Method:** This is a retrospective study that used routine data from laboratory records from April 1, 2014, to August 30, 2018 from patients in which culture was performed from sterile body fluids in the National Bacteriology and Mycology Laboratory, Ethiopian Public Health Institute. Data were extracted from the laboratory registration book. The data collection sheet was prepared to collect the data and was entered and analyzed using SPSS version 23. Groups were compared using Chi2 and descriptive analysis was performed.

Results: Out of the total 654 body fluid specimens processed in the laboratory, the culture-positive result was documented on 75 (11.5%) of which 19 (25.4%) of them were Gram-positive bacteria and 56 (74.6%) were Gram-negative. The predominant bacteria species isolated were *Escherichia coli* (n=13; 17.3 %), followed by *Acinetobacter spp.* (n=12; 16%), *Klebsiella pneumoniae* (n=10; 13.3 %), *Staphylococcus aureus* (n=10; 13.3%) *Neisseria meningitidis* (n=9; 9.3%). *Pseudomonas spp.* (n=5; 6.3%). The highest bacterial isolation rate was obtained in the age group between 1-10 years old. From the Gram-negative, *Escherichia coli* were the dominant isolates and of which 6 (46.2%) isolates were multidrug-resistant. From the Gram-positives bacteria, *Staphylococcus aureus* was the dominant isolate with one isolate being multidrug-resistant.

Conclusion: Emerging ESKAPE (*Enterobacter species*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter species*, *Pseudomonas species*, and *Enterococcus faecium*) organisms have been isolated in this study and this remains crucial and occurrence of multidrug resistance patterns of bacterial isolates of great public health importance indicating that farther researches also must be conducted in different parts of the country.

Keywords: Body fluid, bacterial etiologies, antimicrobial susceptibility testing

Introduction

Body fluids are important in transporting nutrients, regulating body temperature, and assess in the respiration process (Abdinia et al. 2014). Generally, body fluids like cerebrospinal fluid (CSF), pleural, peritoneal, synovial and pericardial fluids are naturally free of microorganisms under normal circumstances. (Deb et al. 2014). Microorganisms like bacteria, fungi, viruses, and parasites may invade and infect the body fluids and results in severe morbidity and mortality (Hasbun et al. 2013). Therefore, early detection and rapid identification of microorganisms infecting body fluids is crucial for the appropriate patient management and helps the clinician to initiate early and more specific treatment and reduced lengths of stay of the patients in the hospital (Sujatha et al. 2015).

In developing nations, bacterial infection and antimicrobial resistance are of great public health concern. For empirical treatment, awareness of local antimicrobial susceptibility pattern and causative bacteria is essential. Moreover, for better management of patients and framing the antibiotic policy, the knowledge of likely prevalent strains along with their antimicrobial resistance pattern is essential (Vishalakshi et al. 2016). CSF is produced by ultra-filtration or secretion and circulates through the ventricles and spinal cord, when compared to with plasma has less protein concentration. Bacterial, fungal and viral infections could result in meningitis. Among these microorganisms, bacterial meningitis is the leading cause of meningitis which often presents acutely in a medical emergency (Greenhow et al. 2014).

Peritoneal effusions are the term of 'ascites' refers to the detection and pathologic collection of fluid in the peritoneal cavity (Reginato et al. 2011). Peritonitis is a frequent, and severe complication in cirrhotic patients with ascites, the study described that the risk of Severe Bacterial Peritonitis increased in hospitalized patients with a prevalence of 10% to 30%, although the mortality rate reported up to 90%. (De et al. 2014). Pleural effusions a result of excessive fluid accumulation in the pleural space the appearance is clear, straw-colored, odorless and non-viscous fluids. (Milevoj and Culej 2014) Accumulation of pus in the pleural space remains a very significant cause of childhood mortality and morbidity in children caused by *S.aureus*, *S. pneumoniae*; group *A streptococci* and *H.Influenzae* (Lisboa et al. 2011).

Various microorganisms may be involved in arthritis like viruses, fungi, bacteria such as; *Mycoplasma* species, *S.aureus*, *S.epidermidis*, *S.pyogenes*, *N. gonorrhoeae*, Gram-negative bacilli, and *M. tuberculosis* (Lafi et al. 2010). Assessing the bacterial etiologies and their antimicrobial susceptibility patterns from body fluids is very crucial for clinicians, microbiologists, and pharmacist and policymakers for proper diagnosis of different infections and for prudent antibiotic use. Therefore, this study aimed to assess the bacterial etiologies and their antimicrobial susceptibility pattern from various sterile body fluids from patient specimens referred to National bacteriology and mycology laboratory from April 1, 2014-August 30, 2018. Ethiopian public health institute (EPHI), Addis Ababa, Ethiopia.

Materials and Methods

This was a retrospective study using routine data from laboratory records from April 1, 2014 –August 30, 2018, at the National bacteriology and mycology laboratory of EPHI. In this laboratory, patient samples are analyzed using standard operating procedures starting from sample reception to release according to international and national guidelines. All patients prescribed for sterile body fluids that were diagnosed in the Ethiopian public health Institute, National Bacteriology, and Mycology laboratory for sterile body fluid culture from April 1, 2014 –August 30, 2018, were the study population. Laboratory records of all patient body fluids cultured from sterile body sites in the specified period were included and patients with incomplete laboratory information were excluded. The data collection sheet was prepared to collect the data and was entered and analyzed using SPSS version 23. Groups were compared using Chi2 and descriptive analysis was performed.

Ethics approval was obtained from the EPHI scientific research ethical review Committee. No patient name

and Identification number were used. Data was entered in the data extraction sheet from patients' laboratory record. No patient names were collected. No detailed address was collected. Confidentiality was maintained by keeping data collection forms locked in a secured cabinet, while the electronic data file was kept in a password-protected computer.

Result

Socio-demographic characteristics and culture positivity:

A total of 654 patient's body fluids were analyzed for isolation, identification and antimicrobial susceptibility testing among which 75 (11.6%) of them were culture positive. Forty-nine (7.5%) culture positives specimens were obtained from female patients while 26 (4%) were from males. The age range of study participants was between 2 days-74 years. The highest bacterial isolation was obtained in the age group between 1-10 years old 17(22.6%) (Table 1).

Table 1: Distribution of bacterial isolates from sterile body fluids

Age in years	Males with positive culture N (%)	Females with positive culture N (%)	Total N (%)
<1 (n=58)	4(6.9)	6(10.3)	10(17.2)
1-10 (n=29)	13(44.8)	4(13.8)	17(55.2)
11-20 (n=13)	8(61.5)	2(15.4)	10(76.9)
21-30 (n=103)	0(0)	1(0.9)	1(0.9)
31-40 (n=64)	10(15.6)	6(9.4)	16(26.5)
41-50 (n=53)	8(15.1)	7(13.2)	15(28.3)
50+ (n=334)	6(1.8)	0(0)	6(1.8)
Total (n=654)	49(7.5)	26(3.9)	75(11.4)

From the total body fluid specimen submitted for laboratory analysis, cerebrospinal fluid (CSF) was the most frequently encountered body fluid accounting for 423(90.3%) followed by pleural fluid 166 (86.1%). (Table-2).

Table 2: Sterile body fluid specimens submitted to Bacteriology and Mycology Reference Laboratory, EPHI from April 1, 2014-August 30, 2018. Addis Ababa, Ethiopia

Samples	Total no. of samples	Growth n (%)	No growth n (%)
CSF	423	41(9.7)	382(90.3)
Pleural fluid	166	23(13.9)	143(86.1)
Peritoneal fluid	29	8(27.6)	21(72.4)
Synovial fluid	13	1(7.8)	12(92.2)
Pericardial fluid	1	0(0)	1(100)
Joint Fluid	1	0(0)	1(100)
Ascetic fluid	21	2(9.5)	19(90.5)
Total	654	75(11.5)	579(89.5)

Proportion of bacterial pathogens from body fluids:

From the total culture-positive specimens, Gram-negative and Gram-positive isolates constituted 56 (74.6%) and 19 (25.4%) respectively. The predominant bacteria species isolated comprise *Escherichia coli* 13 (17.3 %), *Acinetobacter* species. 12 (16%), *Klebsiella pneumoniae* 10 (13.3 %), *S aureus* 10 (10.3%) *Neisseria meningitidis*, 9 (9.3%). *Pseudomonas* species 5 (6.3%) (Table 3).

Table 3: Different organisms isolated from different samples from sterile body fluids referred to Ethiopian Public Health Institute Bacteriology and Mycology Reference Laboratory, from April 1, 2014- August 30, 2018. Addis Ababa, Ethiopia

Organism	CSF N (%)	Pleural fluid N (%)	Peritonea l fluid N (%)	Ascitic fluid N (%)	Synovial fluid N (%)	Total body fluids N (%)	Average from the total positive N (%)
<i>Escherichia coli</i>	4 (0.94)	8(4.8)	1(3.4)	-	-	13(1.99)	13(17.3)
<i>Klebsiella ozenea</i>	-	1(0.6)	-	-	-	1(0.15)	1(1.3)
<i>Klebsiella pneumoniae</i>	4(0.95)	5(3)	1(3.4)	-	-	10(1.53)	10(13.3)
<i>Pseudomonas spp.</i>	2(0.5)	2(1.2)	-	-	1(7.7)	5(0.76)	5(6.6)
<i>Acinetobacter spp.</i>	7(1.65)	4(2.4)	1(3.4)	-	-	12(1.83)	12(16)
<i>Enterobacter spp.</i>	1(0.23)	3(1.8)	1(3.4)	-	-	5(0.76)	5(6.6)
<i>Staphylococcus aureus</i>	4(0.94)	-	4(13.8)	2(9.5)	-	10(1.53)	10(13.3)
<i>Haemophilus influenza</i>	2(0.5)	-	-	-	-	2(0.3)	2(2.6)
<i>Enterococcus spp.</i>	3(0.7)	-	-	-	-	3(0.45)	3(4)
<i>Neisseria meningitides</i>	7(1.65)	-	-	-	-	7(1.07)	7(9.3)
<i>Coagulase Negative Staphylococcus</i>	1(0.23)	-	-	-	-	1(0.15)	1(1.3)
<i>β-Hemolytic Strep.(S.pyogen)</i>	2(0.5)	-	-	-	-	2(0.3)	2(2.6)
<i>Proteus spp.</i>	1(0.23)	-	-	-	-	1(0.15)	1(1.3)
<i>S.milleri</i>	1(0.23)	-	-	-	-	1(0.15)	1(1.3)
<i>Streptococcus spp.Viridans Group</i>	2(0.5)	-	-	-	-	2(0.3)	2(2.6)
Total	41(9.7)	23(13.8)	8(27.5)	2(9.5)	1(7.7)	75(11.5)	-

Antimicrobial drug resistance pattern of bacteria isolated from body Fluids:

The antimicrobial drug resistance profiles of bacteria ranged from 0 to 100%. The highest resistance rate for Gram-Negative isolates were recorded for Ampicillin 56(100%), Amikacin 38 (68.2%) and Gentamycin 21 (38.5%). *Proteus spp.* hasn't shown any resistance to Chloramphenicol, Ceftriaxone, Gentamycin, and Meropenem. Among the Gram-Positives, bacteria those showed a relatively higher resistance rate were *Enterococcus spp.* to penicillin 3(100%), and *Staphylococcus aureus* to vancomycin 4(36.7%) and Oxacillin 4 (36.4). The non-*Enterobacteriaceae* *Pseudomonas* species and *Acinetobacter* species were resistant to ceftriaxone, Gentamycin, Amikacin and Ceftazidime. Of the bacterial isolated *E.coli* 3(18%)

of *S.aureus* 5 (46.2%) are resistant to three groups of antibiotic while of *E.coli* 7 (54.7%) *Pseudomonas* species 2 (45.5%) of *Acinetobacter* species 5 (40%) of the bacteria are resistant to four or more group of antibiotics, or more drugs belonging to different classes of antibiotics. The level of MDR for Gram-Negative *Enterobacteriaceae*, Gram-Negative non-*Enterobacteriaceae* and Gram-Positive isolates was found to be 20(36.6%) 3 (16.6%) and 6(28.9%) (n=29.8 respectively. *E.coli* was the dominant isolate and of these isolates from Gram-Negative 6 (46.2%) were MDR. From non-*Enterobacteriaceae* *Pseudomonas* species, 3(54.7%) were Multi-drug resistance (MDR). and among the Gram Positives isolates *S.aureus*, were dominant and 2(18 %) were MDR (Table 4).

Table 4: Resistance patterns of Gram Negative Enterobacteriaceae isolates from different sterile body fluids samples referred to Bacteriology and Mycology Reference Laboratory, Ethiopian Public Health Institute from April 1, 2014- August 30, 2018. Addis Ababa, Ethiopia

Antibacterial agent	Gram Negative N (%)				Gram Positive N (%)		Gram Negative non-Enterobacteriaceae		Average resistance
	<i>E.coli</i>	<i>K. pneumoniae</i>	<i>Protus spp</i>	<i>Enterobacter spp</i>	<i>S.aureus</i>	<i>Enterococci</i>	<i>Pseudomonas spp</i>	<i>Acinetobacter spp</i>	
Ampicillin	100	100	100	100	-	-	-	-	100
Amikacin	53.8	36.4	100	40	-	-	-	-	68.2
Amikacin	-	-	-	-	-	-	40	75	57.5
Cefoxitin(Oxacillin)	-	-	-	-	-	-	-	-	-
Ceftriaxone	53.8	72.7	0	40	-	-	-	-	36.4
Ceftriaxone	-	-	-	-	-	-	NA	83.3	83.3
Gentamycin	76.9	72.7	0	60	-	-	-	-	38.5
Gentamycin	-	-	-	-	-	-	60	83.3	71.7
Chloramphenicol	46.1	36.4	0	20	-	-	-	-	23.05
Chloramphenicol	-	-	-	-	33.3	-	-	-	33.3
Ceftazidime	-	-	-	-	36.4	NA	-	-	36.4
Ceftazidime	-	-	-	-	-	-	40	75	57.5
Cefepime	-	-	-	-	40	58.3	-	-	49.2
Penicillin	-	-	-	-	NA	100	-	-	100
Meropenem	46.2	36.4	0	40	-	-	-	-	23.1
Meropenem	-	-	-	-	-	-	40	33.3	36.7
Tobramycin	-	-	-	-	-	-	40	NA	40
Vancomycin (MIC)	-	-	-	-	36.7	36.7	-	-	36.7

Discussion

The overall 11.6% (n=75/654) prevalence of bacteria from fluid was 11.6% relatively lower than the finding from a study conducted in Tikur Anbesa Hospital in Addis Abeba, Ethiopia. (Teklehmanot, et al. 2017) This might be due to that most of the patients have exposure to antibiotics. The predominant organisms were *Escherichia coli* 13(17.3 %), *Acinetobacter* spp. 12(16%), *Klebsiella pneumoniae* 10 (13.3 %), *S aureus* 10 (10.3%) *Neisseria meningitidis* 9(9.3%), *Pseudomonas* species 5 (6.3%) in another study conducted in North India, *Escherichia coli* and *Acinetobacter* spp., each with 19 isolates (5.9%), were predominant (Rouf and Nazir 2019).

Staphylococci and *Escherichia coli* were the most frequent pathogens a study conducted in Ethiopia (Ten Hove, et al. 2017) in a study also conducted in Nepal (Shrestha et al. 2015). The most prevalent pathogens were *E. coli* (28.5%). This can be due to the ability of these pathogens to cause nosocomial infections, poor infection control practice in hospitals, lack of standard facilities, poor sterilization of all gowns and equipment. The detection of *Enterococci*, *Acinetobacter* species, and *Klebsiella pneumoniae* may be associated with this reason. meningitides were the most common pathogens causing meningitis where our report *Neisseria meningitidis* 9 (9.3%) which is in agreement with previous studies in Ethiopia (Mengistu et al. 2013).

Hundred percent resistance level to penicillin was reported in a study in Iran, Namibia and Ethiopia (Abdinia et al. 2014; Teklehmanot et al. 2017; Mengistu et al. 2013). This is similar to our study. This can be due to the emerging resistance characteristics of the gram-positive bacteria. Similarly, *K. pneumoniae*, *E.coli* showed relatively higher resistance 100% to Ampicillin compared to a study done in Iran that reported 87.5% resistance to ampicillin (Reginato et al. 2011). This could be the number of bacterial isolates and differences in the use of antibiotics in each country. From Gram Negatives, 6 (46.2%) were MDR. From non-Enterobacteriaceae *Pseudomonas* species 3(54.7%) were MDR among the Gram Positives isolates, *S.aureus* 2(18 %) were MDR. The high level of MDR resistance (75%) in this study is in agreement with a previous study conducted in Gondar, Ethiopia (Mulu et al. 2005). This high MDR level may be due to the inappropriate use of commonly prescribed antibiotics. A previous study in Ethiopia and Iran reported high-level MDR resistance among gram-negative bacteria that is similar to the current study in Iran and Ethiopia (Abdinia et al. 2014; Mulu et al. 2005). Lack to identify the sources of infection and the ward/OPD were taken as limitations or this study.

Conclusion

Emerging ESKAPE (*Enterobacter* species, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter* species, *Pseudomonas* species, *Enterococcus faecium*) organisms have been isolated in this study and this remains crucial and the occurrence of multidrug resistance patterns of bacteria isolates of great public health importance indicating that further researches also must be conducted in different parts of the country.

Declaration: The authors declare that this is their original work.

Specific patient benefit: As this is a retrospective study, there is no direct benefit for the study participants. However, this study will provide additional information on bacterial isolates and their antimicrobial susceptibility patterns from sterile body fluids for control program and strategy development in clinical settings in the country.

Competing interests: The authors declare that, they do not have competing interests.

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Original article

Assessment of animal guinea worm infection intervention in Gog and Abobo woreda's of Gambella region, Ethiopia

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Introduction: Dracunculiasis (guinea worm disease) is caused by a parasitic worm called *Dracunculus medinensis*. Ethiopia is an endemic country since 2013. Dog, cat, and baboons are infected species. Proactive dog chaining intervention was implemented to interrupt transmission.

Objective: To assess animal guinea worm infection and interventions in Abobo and Gog Woreda, Gambella region, Ethiopia, from March to April 2019.

Methods: Cross-sectional study design was used. Data were collected using a semi-structured questionnaire interview with key informants in the program and community, facility-based document review, and observational methods. Data were analyzed using SPSS version 23.

Results: A total of 69 animal infections were reported in the Gambella region from 2013 to March 2019. Dog, cat, and baboon are found infected. Baboon infections reported only in Ethiopia (Table 1). Out of the total infections, 54 (78%) were dogs, and 9 (13%) Olive baboons. Most of the infections occurred in Gog woreda. Animal infection was increased from 4 cases during 2013 to 17 cases in 2017; but, the containment rate was still low 27 (39%). Animal welfare is not considered; no provision of balanced food and water, unable to naturally mate and reproduce; there is no proper housing protective from sun and animal attack. Of the total observed dogs, 175/352 (50%) were found with poor and medium body condition. There was no selection criterion to chain dogs. Out of 118 households interviewed around 46 (39%) of the owners had encounter the death of dogs during the intervention. Poor management of stray dogs, weak collaboration, animal welfare, poor reporting and documentation, lack of veterinary facilities are the major challenges assessed upon the program.

Conclusion: Animal guinea worm infection is increased over time, but the containment rate is low. Chaining intervention lacks welfare considerations. Government sectors were not responsible for animal infection and death. Communities are fighting against hunger and guinea worm. Addressing the challenges of the intervention must be considered as a top priority to enhance the effectiveness of the eradication program. The program should apologize to the community or compensate for the death of dogs.

Keywords: Animals, guinea worm, animal welfare, proactive chaining, Ethiopia

Introduction

Dracunculiasis (guinea worm disease) is caused by a parasitic worm called *Dracunculus medinensis*. Approximately 1 year after a person or an animal acquires infection from contaminated drinking water, the worm emerges through the skin, usually on a lower limb. (Donald 2017; Sandy 2002). The campaign to eradicate dracunculiasis worldwide began in 1980 at CDC. In 1986, the global Guinea Worm Eradication Program (GWEP) began assisting ministries of health in countries with endemic dracunculiasis. In 1986, an estimated 3.5 million cases occurred each year in 20 countries in Africa and Asia (CDC 2016; WHO 2019; Watts1986). After the global eradication program begins, the number of endemic countries was reduced to only 5 which are Chad, Ethiopia, South Sudan, Mali, and recently Angola. Dracunculiasis was rediscovered in Chad in 2010 after an apparent absence of 10 years (CDC 2010; Ebehard 2014). The global number of human infections in 2018 has fallen to 25 cases (WHO 2019). However, animal infection was persistently increased. From 2012 to 2018, there

are a total of 3625 dogs and 31 cats infection reported in the world (GWEP 2019).

Ethiopian Dracunculiasis Eradication Program (EDEP) was established in 1992 and the elimination of the disease among humans seems to be to the end because no human cases reported since 2018; however, another challenging scenario has emerged with the occurrences of animal infection and it is increasing over time. Dogs, cats, and olive baboons were infected. Infection among olive baboons was the first to be reported in Ethiopia (Habtamu et.al. 2017). Unlike the other regions, dogs value greater than other livestock's; because of wider forestation and community lives close to the wildlife. Dogs are serving as a guardian, farm keepers, and hunting assistances.

The EDEP has applied different strategies interrupt transmission of the disease between animals; among the interventions; what is called "Proactive chaining or tethering of Dogs and Cats" is one of the major interventions recently implemented. However, there

has been no comprehensive assessment conducted on it. Besides, the intervention has faced a serious challenge including animal welfare, community acceptance, feeding, and animal death and the reason for the death of dogs has not been investigated and assessed. Since, the establishment and implementation of the intervention have not included veterinary professionals the animals' welfare issues are not properly maintained. The community awareness on animal guinea worm infection is not assessed. Finally, since dogs are playing a vital role in the community, losing the value of them due to chaining has compliance with the community. Therefore, a team was established from different sectors and assessed the overall progress of the animal guinea worm infection and intervention strategies that have been conducted by EDEP.

The team has assessed the animal infection, proactive chaining strategy/tethering, animal welfare issues, and cash reward awareness of animal guinea worm intervention. The assessment will help to improve and fill gaps up on the interventions; by providing strong operational recommendations. As the global GWEP certification process criteria and according to WHO standard eradication definition; one country to be certified there should be the interruption of transmission GWD in humans and animals for three consecutive years or longer. In addition, the community and health care provider awareness on cash reward and the disease; including reporting sites and documentation of surveillance data is mandatory. So, conducting such kind of assessment is important to facilitate the certification process.

Material and Methods

A descriptive cross-sectional study was employed in Gog and Abobo woreda Gambella region, Ethiopia, from March to April 2019. *Animal tethering/proactive chaining Intervention*: It is intervened to control the

movement of dogs and cats or to be kept under the supervision of an owner until the guinea worm sign and symptom is shown or the worm is extracted and dogs are expected to be tethered for 1 year.

Households in Gog and Abobo woreda, Gambella region who are under animal guinea worm intervention program was the study population. A stratified random sampling technique was used. A total of 118 households were randomly selected and interviewed and 346 dogs and 10 cats were observed and assessed. Facility document review and questionnaire-based interviews with key informants in the program and the community and observational assessment tools were used to collect data.

Age, sex, and occupation, species of chained animals, animal body condition are some of the variables collected. Data were analyzed using SPSS version 23. Expertise from Zoonoses, Public Health Emergency Management, and Ministry of Agriculture was deployed. Ethical clearance was obtained from EPHI-IRB. Informed oral consent was taken. The questionnaire was translated orally by the local translators. Specific anonymity of the study participants was kept confidential.

Results

Animal Guinea worm infection: A total of 69 animals were found infected by guinea worm since 2013. Dogs, cats and baboons have identified and confirmed infected. Infection among *Olive baboons* was reported only in Ethiopia. Almost all of the infections (68/69) were reported in Gog woreda. Out of the total infections, 54/69 (78%) were dogs and 9/69 (13%) were *Olive baboons*. The overall animal infection containment rate during the last 6 years was 27/69 (39%); however, the containment rate was not improved after the intervention begins in 2018 which was 7/17(41%) (Table 1).

Table 1: Animal guinea worm infection in Abobo and Gog Woreda during 2013-2018, Gambella region, Ethiopia.

Year	Gog Woreda			Abobo Woreda			Total infection	contained infection
	dog	cat	baboon	dog	cat	baboon		
2013	3	0	1	0	0	0	4	0
2014	3	0	0	0	0	0	3	0
2015	13	0	1	0	0	0	14	4
2016	13	0	2	1	0	0	16	10
2017	11	0	4	0	0	0	15	6
2018	11	5	1	0	0	0	17	7

The trend of guinea worm infection among animals in Gambella region for the past 6 years is increased shown in (Figure 1).

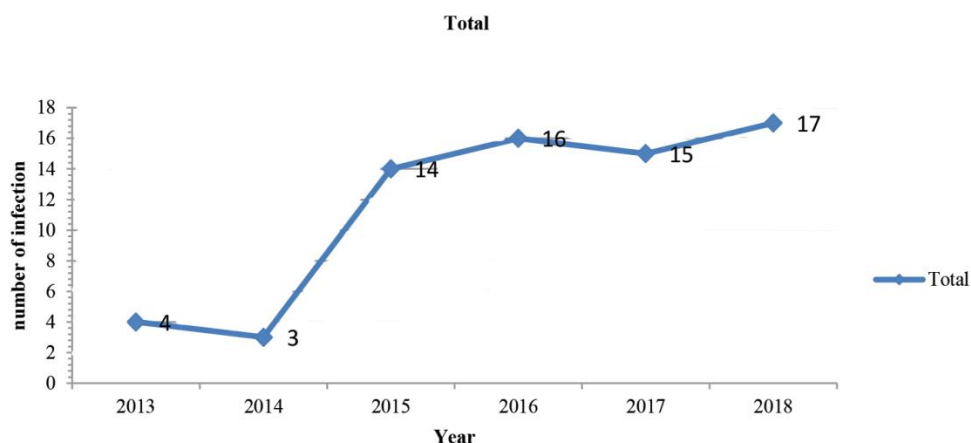


Figure1: Trend on guinea worm infection among animals in Abobo and Gog woreda, Gambella region, Ethiopia, from 2013-2018.



Figure 2: Picture showing an infected dog up on worm extraction, 2013-2018

Animal tethering intervention: Abobo and Gog woredas in Gambella region are two guinea endemic areas. There are 77 households in Abobo and 447 households in Gog under chining intervention. Out of the total, 497 of them are implementing chaining of dogs and cats. A total of 118 individuals were interviewed; 22(18.6%) from Abobo and 96 (81.4%) from Gog. Most of the study participants 93 (78.8%) were females. Majority of the study participants were at the age group of 15 to 30 comprising 52 (44.1%). A total of 346 dogs and 10 cats were owned by the study participants; dogs are tethered with the range from 1 to 13 per household. Most of the study participants own with an average of 4 dogs per households.

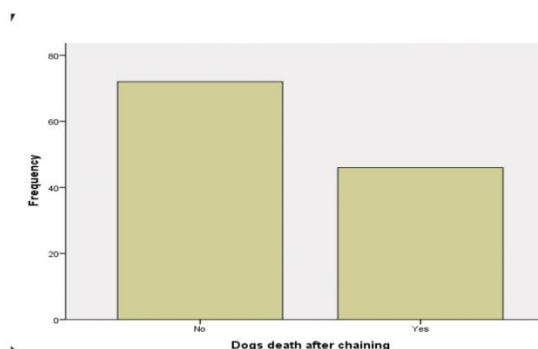


Figure 3: Percentage of dog's death after chaining in Abobo and Gog woreda, Gambella region, Ethiopia, 2013-2018

Interventional assessments: The program has providing only 4kg of maize and 2kg of lentil for dogs. Majority of the owners 61/118 (51.7%) didn't give additional food. Our result shows that there is no sufficient and quality of food provided for tethered dogs. Out of the total study participants, 46(39%) were reported death of dogs during the intervention (Figure

3). A high number of death of dogs occurred and there was no any such death reported in the area before. Among the different reasons for the death of dogs, suffocation, feed change and stress due to chaining were some of the mentioned reasons by the communities (Table 3).

Table 3: Reasons listed for the death of dogs reported by the community in Abobo and Gog woreda, Gambella region, Ethiopia, 2013-2018

Possible Reasons	Frequency	Percentage	Remark
Died after showing signs and symptoms	24	20.3%	Bloody diarrhea, coughing, ectoparasites infestation
Animal bite	4	3.3%	Animal bites include snake bite, baboon and dog bite
Died as a result of suffocation due to chaining (problem of selection)	12	10.2%	This includes dogs which were pregnant and died due to unknown reason during the chaining process
Killed by the owner	1	.8	Killed after biting the owner
Died due to hunger/scarcity of food	3	2.5%	Unbalanced ration for the dogs (food shortage)
Died due to unknown reason	74	62.7%	Needs a special study
Total	118		

Regarding the role of dogs; among the study participants, 57 (48%) and 34 (29%) used dogs as guardian and farm keepers respectively. The impact of the intervention were assessed; out of the study participants, 34/118(28.8%) of them affected due to chained dogs. They complained the intervention with regards to security impact 20/34 and 18/34 food safeties. A total of 4 standard questions about animal guinea worm cash reward were asked to evaluate their awareness. Around 28 (24%) of them responded that they chain their dogs to get cash reward. Most of the study participants 114 (96.6%) have heard about the cash reward and 99/114 (86.8%) responded the exact amount which is 500 ETB. Village Based Volunteers (VBV) was found the primary source of information and GWO was found second (Table 4). An observational assessment on tethered dogs was made

with a total of 352 dogs. Up on body condition scoring, 53(15.1%) and 122(34.7) have found in poor and medium body condition. About 29(24.6%) and 64(54.2%) of tethered dogs have not provided water and food consecutively and 17(14%) of the dogs have no clean and properly built houses that protect from sun and attack.

Program challenges: The Community argument, problem of stray dogs, lack of budget and vehicle for government stakeholders, food provision for tethered animal, problem of wild animal, poor animal health professional engagement, poor documentation and reporting, weak coordination and collaborative with stakeholders, lack of responsible government body and lack of veterinary services were the major challenges of the program identified during the assessment.

Table 4: Cash reward status of the community in Abobo and Gog, Gambella region, Ethiopia, 2013-2018

No	Questions	Responses	Frequency	Percentage
1	Have you heard about cash reward?	No	4	3.4
		Yes	114	96.6
		Total	118	100
2	How much is exact amount of cash reward?	500 ETB	99	83.9
		Others	11	9.3
		Don't know	8	4.2
		Total	118	100
3	Source of information	Via GWO	26	22.02%
		Via VBV	91	77.12%
		Other sources	1	0.80%
		Total	118	100.00%

Discussion

This assessment is a supportive study showing the status of infection, identify gaps and suggesting recommendation. There are limited descriptive study published to show the intervention and animal infection in Ethiopia so far. A total of 69 animals were infected since 2013. Dog, cat and olive baboons were found infected in Ethiopia. Ethiopia is the only country

reporting guinea worm infection among olive baboons as described in a study published reporting infection among animals in Ethiopia (Habtamu et al. 2017). Similarly, Chad and Mali were the known countries reporting infection among dogs and cats. The burden of the infection among animal was much higher in Chad compared to Ethiopia and Mali (GWEP 2019). Globally, the infection rate among animals especially

in dogs and cats were increasing from 27 animal infections during 2012 to 3665 in the year 2018 (GWEP 2019; CDC 2016; WHO 2018).

In Ethiopia, the peculiar rise of infection among animals was reported since 2013. Almost all infections were in Gog woreda (68/69); so that, targeted multi-sectorial and scientific plan is needed. Unlike the other areas, dogs have a great role in Gambella; because, the community lives inside the dense forest and closer to the wildlife. Dogs are used for hunting, farming and wood collecting and generally as source of income for the community.

Animal welfare in disease outbreaks and eradication programs has received considerable attention in recent years as, throughout the world and concerns have raised over human options for impacted animals (Sebastian 2012). Similarly, in our study animal welfare issues were not considered by the program; physical, physiological health condition, naturalness and the behavior changes were ignored (Leach 2008). Since, there are limited similar studies published, we have failed to discuss our result. However, we have discussed our result as professional expertise, scientific facts and through observing the intervention. The “dog tethering intervention” by itself is the difficult intervention with regards to the different situations like; unable to chain all animals, community argument and understanding, community practices, life style, unknown disease transmission dynamics in the wild life, temperature, altitude and others.

Even though, there are challenges, the intervention is conducted in two woreda's of Gambella region; Abobo and Gog. The intervention was implemented without any professional inclusiveness and sectorial incorporation. It was conducted simply by trial and error experiment among animals which is inhuman and violating animal welfare. Most of the trials conducted have no any professional suggestion and the decisions costs animals' life in death. The program begins without planned activities; not consider source of the animal feed, selection criteria of tethered dogs (pregnant, diseased and adult or some other unthreatened physiological condition) and possible potential diseases in the area was not identified and vaccination was not delivered and given.

Animals were confined together without any precondition and understanding their health conditions, lack of food, water and medication; so that, dogs could be died due to neglect of animal's welfare. Around 46/118 (39%) of households have reported death of dogs. However, there was no responsible body for the death and not recognized as a fault of intervention and action was not taken to assess the cause. But we believe that, the program should

investigate the root cause of death on time and solve the problems. The team has observed; the intervention didn't meet the basic standards of animal welfare upon physical, behavioral and naturalness conditions. Dogs were tethered with no appropriate feed, water, housing, selection criteria, unable to naturally met and reproduce and didn't consider the puppies.

All dogs and cats were provided only lentil and corn. There was no any protein source food that was given either by the program or owners. The dogs had no experience of eating lentil, 173/180 (96%). Since, dogs and cats are carnivore's they don't have the efficiency to convert protein from cereals. Therefore, most of dogs failed to gain weight easily; showing BCS, out of the total dogs observed 175/353 (49.6%) are found in poor and medium body condition. About 29/118 (24.6%) and 64/118 (54.2%) of respondents has not provided water and food during the assessment consecutively. Most of the housing is not properly designed to protect animals from the natural and physical phenomenon. Even if the intervention has come up with some improvements; there is still a gap because, all dogs and cats are not under the intervention, there are a number of released dogs and communities had no practice of reporting for the released dogs. Dogs were released at night time and communities were argued and complained to chain their dogs. So that, it is difficult to say it is well implemented up on all those challenges.

A total of four questions were asked for evaluating awareness on the cash reward on animal GWI and more than 96% of the communities have heard about the disease and 86.8% of them know the exact amount of the cash reward. However, around 30/118 (25.4%) of the respondents have reasoned why did they chained their dogs was to get the cash reward. This showed to work more on the attitude and behavior of the community. Because, the communities are now considering the intervention as source of income.

The two worst scenarios observed in the intervention; most of the communities have keeping more dogs and even adopting dogs to be paid. The dog population are rising for sake of cash; we have seen 5 dog houses for 15 dogs in one house hold in Gog woreda (we have called it “Dog Condominium”). However, the small puppies are in a very poor BCS and not supported by the program to get food and water, so that it is difficult to determine their survival and are dying.

Conclusion and recommendations

Guinea worm infection among animals was increasing but the containment rate was low. The right stakeholders were not yet collaborating to front line on animal infection. Therefore, we advise the following recommendations 1) The program should be a holistic

and multi sectoral 2) should improve reporting and documentation in government sectors 3) animal welfare should be considered all time 4) the intervention should be transparent to the community; take responsibilities and risks 5) should work on potential intervention challenges; like, feeding, water, housing, veterinary facilities, communities food security issue, vaccination, operational research, cash reward, attitude and practice, should consider puppies and Finally, we request the program either to apologize or compensate the community for the death of dogs.

Competing interest: The authors declare that they do not have competing interest.

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Original article

Patients' satisfaction with laboratory services at Anti-Retroviral Therapy clinic of Felegehiwot Hospital, Bahirdar, North West Ethiopia

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Abstract

Introduction: The level of patient satisfaction with laboratory services influences adherence and retention to health care services. Likewise, monitoring of satisfaction of patients with laboratory services helps to identify opportunities for service improvements. However, it is often unnoticed in research and practice, which occasionally subjected to scientific inquiry.

Objective: To assess the magnitude and factors influencing satisfaction of patients with services at Felegehiwot Hospital ART Clinic Laboratory, Bahirdar, North West Ethiopia.

Methods: Facility-based cross-sectional study was conducted on 422 HIV/AIDS patients who were recruited on a systematic random sampling technique from March to June 2017. Data were analyzed using SPSS version 20.00 statistical software. Independent variables with P-value ≤ 0.05 on multiple logistic regression were taken as statistically significant.

Results: The overall satisfaction of patients on ART laboratory services was found to be 53.3 % (AOR 95% CI: 48.6–58.1). Patients who participated in the facility health education program were 2.18 times (AOR 95% CI: 1.24–3.84) to be more satisfied with ART laboratory services compared to those who did not participate. Besides, patients who frequently visited the ART laboratory were 5.2 times (AOR 95% CI: 1.96–13.81) to be more satisfied with laboratory services compared to those who did not. Furthermore, Patients who got sit benches at the laboratory waiting area were 2.22 times (AOR 95% CI: 1.42–3.46) to be more satisfied with laboratory services compared to those who did not. Besides, patients with lower levels of education were 2.43 times (AOR 95% CI: 1.47–4.03) to be more satisfied with the ART laboratory services compared to patients who attained higher education. Moreover, non-government employed patients were 2.77 times (AOR 95% CI: 1.20–6.38) to be more satisfied with the laboratory services compared to government-employed patients.

Conclusion: Overall, the satisfaction level of study participants toward medical laboratory services was 53.3 %. Customer satisfaction, particularly patients' satisfaction is the cornerstone of the medical laboratory and it is one part of a quality indicator. Thus, it is very essential to improve the quality of services provided in hospital laboratories to fulfill the expectation of patients.

Keywords: HIV/AIDS patients, patient satisfaction, laboratory services

Introduction

Satisfaction is one of the core outcome measures for health care services. The goal of the healthcare team is to provide the patient with the best possible health care services. Through interaction with patients seems routine to the hospital staff, the experience of receiving health care is not routine to the patients. The attention, attitude, and the information the hospital staff provides are very important to the patients. (Jawaid et al. 2009). Assessing to what extent patients are satisfied with health services is clinically relevant, as satisfied patients are more likely to comply with treatment, take an active role in their care, continue using medical care services and stay with the health care provider and maintain or adhere to a specific system. On the other hand, clients who are not satisfied with a service may have worse outcomes than others may. Because they miss appointments, live against

advice, and fail to follow treatment plans (Mindaye and Taye 2012). Patient satisfaction studies on laboratory services revealed different magnitudes around the globe and published literature are few on patient satisfaction in developing countries whereas a high volume of publications is available in developed countries (Al-Abri and Al-Balushi 2014; Emilia et al. 2014; Young et al. 2014). A study conducted in India has shown overall patients' satisfaction scores of more than 60% and several dissatisfactions were identified in the clinical laboratory and phlebotomy services (Ranjeeta et al. 2009). Another study conducted in Kuyet showed that the mean score of overall satisfaction was 4.59 out of a maximum of 5 points (Ibrahim et al. 2005). Further study in Pakistan indicated that the overall patient's experiences and satisfaction from Surgical OPD were fair to good and highlighted several areas in which improvement can

be made to increase the quality of care and patient satisfaction (Jawaid et al. 2009). Another study conducted in the UK revealed that most patients were satisfied with health care services (Mubashir et al. 2013). A similar study done in Bangladesh also showed that more than half of the study participants were satisfied with health care services (Jorge et al. 2001). Another study conducted in Bulgaria showed an affirmative response of 67% and 33% of dissatisfaction on laboratory services (Emilia et al. 2014) and a study in Korea revealed that there was 70.5% satisfaction on laboratory services (Young et al. 2014). Other studies have also shown a variable magnitude of patients' satisfaction with laboratory and other health services in Africa (Magoro et al. 2011). A study in Nigeria revealed that overall 8.9% of participants were dissatisfied with the general quality of health services (Olusimbo and Cynthia 2010).

In Ethiopia, HIV/AIDS and outpatients' satisfaction surveys were done and had different magnitudes (Birhanu et al. 2010; Mequanint and Demissie 2012). According to a study conducted at the University of Gondar Hospital, 36.4% of admitted customers were satisfied, and more than half of the study participants, (63.6%) were dissatisfied in the hospital health care services (Mequanint and Demissie 2012). According to the studies conducted particularly in ART monitoring laboratory services in Addis Ababa and Sidama Zone, the overall satisfaction of HIV/AIDS patients were 85.5% and 90.8% respectively (Mindaye and Taye 2012; Belay et al. 2013) which showed higher satisfaction level (85.5% and 90.8%) than studies conducted in Jima (77%), University of Gondar (36.4%) and Tigray (43.6%) (Getenet et al. 2008; Girmay 2006). This study was intended to assess the satisfaction of patients living with HIV/AIDS and associated factors in ART laboratory services in the fact that little was known about the satisfaction of patients at the ART clinic laboratory of Felegehiwot Hospital, Bahirdar, Ethiopia.

Methods and materials

A hospital-based cross-sectional study design was conducted at Felegehiwot Hospital, Bahirdar, Ethiopia. The study was conducted from March to June 2017. The population included in the study were age above 18yrs who have at least 3 months stay in the ART clinic and received ART laboratory services at least once in his/her time of stay. The sample size of 422 was determined using a single population proportion formula. The study participants from the sampling frame were selected by lottery method. The data were collected via face-to-face interviews using pre-tested, structured questionnaires that contains satisfaction indicators that are related to the socio-demographic characteristics and different dimensions

of ART monitoring laboratory services. Standardized 5-point Likert scales ranging from strongly disagree to strongly agree (1 to 5 points) were used for all indicators. Data were coded, cleaned, entered, and analyzed using SPSS window version 20 statistical packages for descriptive and inferential analysis. Variables having $P \leq 0.05$ on the bivariate analysis were the candidates for the multivariate analysis and factors with $p \leq 0.05$ were taken as statistically significant. The degree of association between dependent and independent variables was assessed using AOR at 95% CI. Patients' satisfaction was classified; into two categories: satisfied and dissatisfied by using the demarcation threshold formula: $\{(total\ highest\ score - total\ lowest\ score) / 2\} + Total\ lowest\ score$ (Mubashir et al. 2013).

Descriptive statistics were computed to ascertain the percentage of patient satisfaction in each satisfaction indicators. Data of sixteen satisfaction questions with Likert scale having a sum range of scores from 16-90 were transformed and computed into one new binary outcome variable and the median, 61, was taken as a cut off for satisfaction since the distribution was not normally distributed as testified by normality check of Kolmogorov-Smirnov and Shapiro-Wilk tests of normality. Scores below the median were considered as dissatisfied and scores at and above the median were considered as satisfied. Ethical clearance was obtained from the IRB of Mekelle University and ACIPH. Data were collected anonymously and confidentiality of study participants was maintained.

Results

Socio-demographic characteristics of study participants:

The study was conducted with the response rate of 100%. The mean age of the study participants was 35.28 years ($SD \pm 8.63$ years). Majority 359 (85%) of them were in the age group of 25-45 years. Fifty two percent of the study participants were married, 33% were unemployed, (27%) were unable to read and write, 89% were urban residents 340 (80%) were Orthodox in religion, and 232 (55%) of study participants belonged to the low-income class with a monthly income of < 1000 birr/month.

Level of satisfaction: The overall ART patients' satisfaction in ART laboratory service was 53.3%. According to this study, 60% and 40% of females and males satisfied with the service respectively. Relatively high satisfaction rate was also observed in language clarity of laboratories while communicating with patients 383(90.8%) and confidentiality issues 360(85.3%). In contrast, a low level of satisfaction was observed about the availability of suggestion box 70 (16.6%) through which patients could reflect their complaints and desires to the services being delivered.

Table 1: Socio-demographic characteristics of the study participants

Characteristics	Frequency (n=224)	Percent
Sex		
Male	177	42
Female	245	58
Age		
18-24	15	3.55
25-45	359	85.1
46-65	47	11.1
>65	1	0.2
Marital status		
Single	75	17.8
Married	219	52
Divorced	79	19
widowed	49	12
Educational status		
Unable to read & write	113	26.8
1 -4 grade	43	10.2
5-8 grade	82	19.4
9-12 grades	74	17.5
Place of Residence		
Urban	374	88.6
Rural	48	11.4
Occupation		
Merchant	58	13.7
Unemployed	35	8.3
Employed	139	32.9
Farmer	17	4.0
Student	15	3.6
House wife	72	17.1
Other	86	20.4
Religion		
Orthodox	340	80
Muslim	63	15
Protestant	19	5
Average monthly income		
<1000	230	54.5
1000-2000	99	23.5
2000-5000	84	20
>5000	9	2

Comparable rate of satisfaction was observed on ART laboratory cleanliness 338(80%), keeping of patient privacy 341(80.8%), patient safety during phlebotomy 337(79.9%) location of the laboratory 327(77.5%), courtesy (politeness) of laboratorians 343(81.3%), patient welcoming and greeting 342 (81%), test result mixes up and loss 349(82.7%) and impartiality 334(79.1%).

Furthermore, more than half satisfaction level was seen in the time interval between specimen collection and result dispatch 246(58.3%), test result notification and communication 281(66.6%), length of time before phlebotomy 239(56.6%), laboratory staff availability during working hours 286(67.8%) and scientific information provision on sampling issues 264(62.6%).

Factors associated with the level of satisfaction on ART Laboratory services: Finding of this research showed that significant factors were, patients who participated the facility's health education program were 2.18 times (95% CI AOR: 1.24–3.84) more likely to be satisfied with ART monitoring laboratory services compared to those who did not participate. Patients who frequently visited the ART laboratory were 5.2 times (95% CI AOR: 1.96–13.81) more likely to be satisfied with ART monitoring laboratory services compared to those who did not visit, Patients who got sit benches at the laboratory waiting area were 2.22 times (95% CI AOR: 1.42–3.46) to be more satisfied with ART laboratory services compared to those who did not get.

Table 2: Satisfaction level of patients with laboratory services at ART Clinic of Felegehiwot Hospital, Amhara Region, North West Ethiopia variables

	Category, frequency, percent									
	Very Dissatisfied		Dissatisfied		Somewhat Satisfied		Satisfied		Very Satisfied	
	N	%	N	%	N	%	N	%	N	%
Accessibility of the laboratory in the hospital	3	0.7	13	3.1	79	18.7	231	54.7	96	22.7
Cleanliness and attractiveness of the laboratory	5	1.2	11	2.6	68	16.1	288	68.2	50	11.8
Availability of suggestion box for laboratory services	115	27.3	151	35.8	86	20.4	57	13.5	13	3.1
Availability of laboratory staff during working hours	9	2.1	28	6.6	99	23.5	214	50.7	72	17.1
Courtesy of laboratory staff in specimen collection	3	0.7	17	4	59	14	272	64.5	71	16.8
Communication language b/n lab staff and patients	4	0.9	4	0.9	31	7.3	280	66.4	103	24.4
Given information to patients in specimen collection	6	1.4	80	19	72	17.1	233	52.8	41	9.7
Privacy during visit to the laboratory	3	7	16	3.8	62	14.7	257	60.9	84	19.9
Safety of the phlebotomy procedure	3	0.7	21	21.5	61	14.5	239	56.6	98	23.2
Phlebotomist well coming towards HIV /AIDS pts	5	1.2	9	2.1	66	15.6	245	58.1	97	23
Length of time waited before phlebotomy	5	1.2	61	14.5	117	27.7	198	46.9	41	9.7
Result notification and communication	12	2.8	60	14.2	69	16.4	225	53.3	56	13.3
Results delivery to clinic(without being missed)	11	2.6	9	2.1	53	12.6	143	33.9	206	48.8
Confidentiality of test result by the laboratory Staff	3	0.7	20	4.7	39	9.2	211	50	114	37.7
Fairness of lab staff to treat patients	5	1.2	19	4.5	64	15.2	161	38.2	173	41
Waited time b/n phlebotomy and report of results	12	2.8	81	19.2	83	19.7	199	42.7	47	11.1

Besides, unable to read and write patients were 2.43 times (95% CI AOR: 1.47–4.03) more likely to be satisfied with the ART laboratory services compared to literate patients. Non-government employed patients were 2.77 times (95% CI AOR: 1.20–3.8)

more likely to be satisfied with the ART laboratory services compared to government-employed patients. Patients who got married were 2.32 times (95% CI AOR: 1.51–3.58) more likely to be satisfied with ART laboratory services compared to non-married patients.

Table 3: Factors that affect satisfaction level of ART clients at Felegehiwot Hospital ART clinic laboratory, Amhara Region, Ethiopia, 2017

Characteristics	Sub-category	Satisfaction		COR 95%CI	AOD 95%CI
		Satisfied	Dissatisfied		
Marital Status	Non-married	88	115	1	1
	Married	137	82	2.18(1.48-3.22)***	2.32(1.51-3.58)***
Education	Unable to read & write	81	32	2.9(1.82-4.62)***	2.43(1.47-4.03)**
	Literate	144	165	1	1
Occupation	Non-government employed	215	172	3.13(1.46-6.68)**	2.77(1.20-6.38)*
	Government Employed	10	25	1	1
Health education participation	Yes	196	152	2.00(1.20-3.34)**	2.18(1.24-3.84)**
	No	29	45	1	1
Regular visit to the ART laboratory	Yes	218	174	4.12(1.73-9.82)**	5.2(1.96-13.81)**
	No	7	23	1	1
Availability of adequate laboratory sit benches	Yes	159	102	2.24(1.50-3.35)***	2.22(1.42-3.46)***
	No	66	95	1	1

NB: *=*p* less than 0.05- statistically significant, **=*P* b/n 0.001 and 0.01-strong statistical significance, ***=*p* less than 0.001-very strong statistical significance, *p*>0.05&if CI includes 1-notstatistically significant.

Discussion

According to this study, the overall level of client satisfaction with the ART monitoring laboratory services was 53.3 %. However, this finding is lower than the studies conducted in University of Gondar (36.4%) (Mequanint D & Demissie A (2012), Nekemte hospital, where 60.4% (Geletta et al. (2014), Addis Ababa (85.5%) (Mindaye and Taye 2012), Sidama (90.8%) (Belay et al. 2013). Also the level of client satisfaction with laboratory services was low compared to other studies conducted in Bulgaria (67%) (Emilia et al. (2014), Korea (70.5%) (Young et al. (2014). The study conducted in government teaching hospitals in Tehran by Akhtari-Zavare M et al in which 82% of the patients were satisfied (Akhtari-ZM et al. 2010).

The current study is higher than the study conducted in Tigray in which the patients' satisfaction rate was found to be 43.6% (Girmay 2006). The possible justification for higher satisfaction rate might be due to the focus of attention on laboratory services by Ethiopian ministry of health, the commitment of the laboratory personnel towards providing quality of laboratory services as well as the shift of manual laboratory procedure to automation is also increasing the patients' satisfaction. Patients who participated in the facility's health education program were 2.18 times more likely to be satisfied with ART monitoring laboratory services compared to those who did not participate, patients who frequently visited the ART laboratory were 5.2 times more likely to be satisfied with ART monitoring laboratory services compared to those who did not visit. Patients who got sit benches at the laboratory waiting area were 2.22 times to be more satisfied with ART laboratory services compared to those who did not get. Also, patients those unable to read and write were 2.43 times more likely to be satisfied with the ART laboratory services compared to literate patients. Moreover, non-government employed patients were 2.77 times more likely to be

satisfied with the ART laboratory services compared to government-employed patients. Patients who got married were 2.32 times more likely to be satisfied with ART laboratory services compared to non-married patients.

Conclusion

Overall, the satisfaction level of study participants toward medical laboratory services was 53.3 %. Customer satisfaction, particularly patients' satisfaction is the cornerstone of medical laboratory medicine and it is one part of quality indicators. Thus, it is very essential to improve the quality of laboratory services of hospitals to fulfill the prospect of patients.

Competing interest: The authors declare that they have no competing interest.

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Original article

Determinant of malaria service readiness at health facilities in Ethiopia: Evidence from 2018 service availability and readiness assessment: Cross-sectional study

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Abstract

Introduction: Globally, an estimated 3.3 billion people are at risk of getting malaria. The majority of cases have occurred in the African Region. This study aims to assess the determinant of malaria service readiness at the health facility level.

Method: Data from the 2018 Service Availability and Readiness Assessment was used for this analysis. The study was a facility-based cross-sectional study and a stratified sampling technique was used. Data was collected from October - December 2017. Mean readiness score was used by computing six tracer items (Availability of at least one trained staff for malaria diagnosis & treatment, Availability of malaria diagnosis & treatment guideline, Malaria diagnostic capacity, First-line anti-malarial drug in-stock, Paracetamol cap/tab, and ITN). Linear regression was used to identify factors associated with the mean readiness score of health facility to provide malaria service. The proportion test was used to check any change between 2016 and 2018 malaria service readiness.

Result: A total of 764 health facilities were included in the study, of these only 682(89.3%) provided malaria service. Eighty-nine percent of the facilities offered diagnosis or treatment service for malaria and 70% of the facilities diagnose malaria by clinical symptoms followed by microscopy (67%) and Rapid Diagnostic Tests (RDT) (46%). Only 3% of the facilities had all the six tracer items. Hospitals and health centers had the availability of tracer items above the average mean readiness score (52%). Facilities managed by other than public authorities had lower mean score readiness for malaria service compared with those managed by the public. Higher and Medium clinics, lower clinics as well as health posts had lower mean score readiness for malaria service compared with hospitals. A significant change was not observed for malaria service readiness of tracer items between 2016 and 2018 (p-value=0.732).

Conclusion: The current study revealed that higher and medium clinics, lower clinics, health posts, facilities managed by other authority and regions (Addis Ababa, Harrari, SNNP, Somali, Amhara, and Oromia) were the significant determinants of malaria service readiness and no significant change was observed on malaria service readiness score between 2016 and 2018 Service Availability and Readiness Assessment Survey.

Keyword: Malaria, Service availability, and readiness

Introduction

Malaria is a life-threatening disease caused by the protozoan parasite of the genus *Plasmodium* which is transmitted by female *Anopheles* mosquitoes through biting (WHO 2015). There are four human malaria parasite species which are *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, and *Plasmodium ovale* (WHO 2017). *Plasmodium falciparum* is the most dangerous and responsible for the majority of malaria-related deaths (WHO 2017). Malaria is a preventable and curable disease yet remains an important cause of illness and death in children and adults (WHO 2015). Malaria has a significant effect on the health and wealth of individuals as well as nations. In pregnancy, it imposes a serious threat to the mother, fetus, and neonate. It is also one of the main reasons that children miss school and adults miss work which in turn hampers further educational achievement, contributes to food

insecurity, and entrenches poverty (Karunamoorthi K 2012; US Agency international development 2017).

According to the 2017 global malaria report, more than 3.3 billion people were at risk of malaria (WHO 2018). Of these, the majority of cases (92%) were found in the African Region followed by South-East Asia Region (5%) and the Eastern Mediterranean Region (2%) (WHO 2018). More than 480 million malaria cases were reported from sub-Saharan Africa (US Agency international development 2017). Malaria is one of the fatal causes of death that affect the public health of the country. In the region of Africa, 2017 global malaria reports show that there are an estimated 435,000 deaths and among these 61% were children (WHO 2018).

Malaria is a major public health problem in Ethiopia. It is more dominant in areas with an altitude of less than 2000 meters above sea level. In Ethiopia, more than two-thirds of the population live in areas that are highly

affected by malaria (Communication for CHANGE 2012). About 60% of the population living in these areas are at risk for malaria and more than 1.5 million malaria cases are reported annually (Ministry of Health 2016; ICAP 2018; Ministry of Health 2018). Based on the President's Malaria Initiative annual performance report in 2015, 2.2 million cases and 662 deaths were reported (U.S President's malaria initiative 2017). According to the Ethiopian Federal Ministry of Health Public Health Emergency Management (PHEM) report in 2018 shows that more than 1.2 million malaria cases and 158 deaths were reported annually. Out of these cases, 88% were confirmed cases through microscopy or rapid diagnostic tests (RDT), of these majority (83%) were *Plasmodium falciparum* and 17% were *Plasmodium vivax* cases (Ministry of Health 2018).

As compared to the previous year, there is a significant reduction of a new case of malaria in Ethiopia. The number of new cases of malaria declined from 2.8 million in 1990 to 621,345 in 2015 and malaria death was also reduced from 30,323 in 1990 to 1,561 in 2015. Age-standardized mortality rate declined by 96.5% between 1990 and 2015 and the number of disability-adjusted life years lost (DALY) due to malaria decreased from 2.2 million in 1990 to 0.18 million in 2015, with a total reduction of 91.7% (Deribew et al. 2017). This was achieved by ensuring the availability of rapid diagnostic tests, anti-malaria drugs, trained health care workers, diagnostic capacity at the health facility level, and high coverage of ITNs distribution and spraying of households (Ministry of Health 2014). But, despite this reduction or improvement, malaria remains among the 10 most common causes of death and serious public health problem in Ethiopia (CDC 2014). The possible barriers to achieving a further reduction in disease burden might be associated with service availability and readiness of each level of the health facility and community involvement in prevention activities.

Due to this global burden of malaria and the previous rapid signs of progress, WHO developed a Global technical strategy for malaria 2016–2030 with different milestones for measuring progress in 2020 and 2025 (WHO 2017). Through this, all countries set their own national or sub-national targets to accelerate activities for eliminating malaria transmission and prevention of its re-establishment (WHO 2017).

The National Malaria Prevention, Control and Elimination Program (NMCP) strategy (NSP 2014–2020) in Ethiopia aim to achieve the goals of near-zero malaria deaths, reduction of malaria cases by 75% from a baseline of 2013 and elimination of malaria in the selected low transmission areas (U.S President's malaria initiative 2017). To achieve these goals and the stated objectives, the NMCP appropriately planned and

targeted delivery of essential malaria interventions, including, early diagnose of suspected malaria cases, treatment of confirmed malaria cases with the effective anti-malarial drug, and application of appropriate vector control interventions, particularly the use of insecticide-treated nets (ITN) and indoor residual spraying (IRS) (WHO 2018). Ethiopia develops a strategic plan to eliminate malaria by 2020 and to eradicate it by 2030, and go for a sub-national malaria elimination program. Therefore, there is a critical need for having well-trained health care workers, availability of adequate logistics and supply to offer malaria diagnosis and treatment services at all times in each level of health facility by strengthening the public-private partnership. To achieve those strategic goals, availability, and readiness of health facilities for malaria diagnosis and treatment services are mandatory. Thus, the aim of this study was to assess the determinant of malaria service availability and readiness of the health facility.

Materials and Methods

Study design and area, sample size, and sampling technique: A facility-based cross-sectional study was conducted in nine regions (Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, SNNP, Gambella, and Harari) and two city administrations (Addis Ababa and Dire Dawa) of Ethiopia. Data was collected from October to December 2017. A stratified sampling technique was used to select the facilities. Through this, all health facilities were stratified by region. From all-regions and administrative cities, all hospitals, selected health centers, clinics, and health posts were included in the sample. The total sample size for the study was 764. The readiness of health facility to provide malaria diagnosis and treatment service was the dependent variable while region, location of health facility, managing authority, health facility type were taken as the independent variables of the study. In this study, the readiness of the health facility is the capacity of the health facility to provide malaria diagnosis and treatment. It is measured by the availability of six tracer items: availability of at least one trained staff for malaria diagnosis and treatment, availability of malaria diagnosis and treatment guideline, Malaria diagnostic capacity, First-line anti-malarial drug in-stock, Paracetamol cap/tab, and ITN.

Data source: Data was obtained from Ethiopia Service Availability and Readiness Assessment 2018.

Data management and analysis: English and Amharic translation of the facility inventory questionnaire was used to collect the data. The collected data was sent daily based on EPHI central server. Errors and inconsistencies were reviewed and checked at the central level, and corrections were made accordingly. Internal consistency also validated through data

cleaning. Proportion, percentage, and frequency distribution were used to present the results through tables. Mean readiness score was obtained from computing the six tracer items (availability of at least one trained staff for malaria diagnosis and treatment, availability malaria diagnosis and treatment guideline, Malaria diagnostic capacity, First-line anti-malarial drug in-stock, Paracetamol cap/tab, and ITN) of malaria service. Multiple linear regression analysis was used to identify factors related to mean readiness score trace items for the provision of malaria diagnosis and treatment service. In linear regression analysis, all independent variables with a p-value of less than 0.25 in simple linear regression were included in multiple linear regression backward models. Finally, variables with P-value < 0.05 were considered as significant predictors of the outcome variable. The Proportion test was also used to compare the progress or any change of health facility readiness on the provision of malaria service between 2016 and 2018 Service Availability and Readiness Assessment using the overall mean score of tracer items.

Ethical Clearance was obtained from the Ethiopian Public Health institute scientific and ethical review office. Different levels of the study area were communicated through official letters from EPHI. The purpose of the study, its procedure, assurance of confidentiality, and privacy was informed. Written Informed Consent was taken from all facilities in charge and individual facility level identifier was not used. Data were maintained in a password protected EPHI server

Results

Health facility distribution: Seven hundred sixty-four facilities were selected for malaria service availability and readiness. Of these, 40% were hospitals, 21% health centers, 17% health posts, 12% higher and medium clinics and 9% were lower clinics. Concerning the regional distribution of health facilities, a large proportion of the health facilities were found in the Oromia region 16% (125), Amhara region 15% (114) and SNNP region 14% (105). Seventy-one percent of health facilities were public facilities and 66% were found in Urban (Table 1).

Table 1: Distribution of health facility across regions, managing authority and location, in Ethiopia 2018 (N=764).

Variable	Hospital		Health Centre		Health post		Higher and medium clinic		Lower clinic		Total
Region	n	%	n	%	n	%	n	%	n	%	
Tigray	39	51	14	18	11	14	9	12	3	4	76
Afar	6	12	16	33	12	24	12	24	3	6	49
Amhara	65	57	17	15	16	14	4	4	12	11	114
Oromia	75	60	16	13	16	13	1	1	17	14	125
Somali	11	19	16	28	13	23	17	30	0	0	57
Benishangul-Gumuz	2	4	15	33	14	31	3	7	11	24	45
SNNP	58	55	16	15	16	15	6	6	9	9	105
Gambella	3	7	13	31	12	29	5	12	9	21	42
Harrari	5	14	8	23	11	31	10	29	1	3	35
Addis Ababa	32	42	22	29	0	0	17	22	6	8	77
DeriDawa	7	18	11	28	11	28	9	23	1	3	39
Managing Authority											
Public	243	45	160	30	132	24	5	1	2	0	542
Other	60	27	4	2	0	0	88	40	70	32	222
Urban/Rural											
Urban	273	54	86	17	10	2	89	18	46	9	504
Rural	30	12	78	30	122	47	4	2	26	10	260
Total	303	40	164	21	132	17	93	12	72	9	764

Malaria Service Availability of health facility:

Nationally malaria service is given in all the tier health systems of each health facility. Thus, 89% of facilities offered malaria diagnosis or treatment services. Facilities found in the Gambela region offered malaria service and 46% of facilities found in this region diagnose malaria by microscopy, through Rapid Diagnostic Test (RDT) (76%) and clinical symptoms (83%). Almost all (98%) hospitals and health centers provide malaria diagnosis or treatment service and 53% of lower clinics offer malaria service. Except for RDT service (35%), more than 75% of malaria services were available in urban facilities. Seventy-two percent of

facilities managed by other than the public were diagnosing malaria through clinical symptoms (Table 2).

The readiness of the health facility to provide Malaria diagnosis and treatment:

The readiness of a health facility to offer malaria diagnosis or treatment service was assessed by the availability of the six tracer items (Table 3). Six hundred eighty-two facilities were assessed for malaria readiness service based on the availability of tracer items. Of which, 85% of facilities had malaria diagnostic capacity, 72% had Paracetamol tab and 65% had first-line anti-malaria drugs.

Table 2: Malaria service availability by region, facility type, managing authority and urban/rural in Ethiopia, 2018(N =764).

Variable	Offer Dxis or treatment of malaria		Malaria diagnosis		Malaria diagnosis testing		Malaria Dxis by clinical symptoms		Malaria Dxis by RDT		Malaria diagnosis by microscopy		Malaria treatment		Total n
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Region															
Tigray	72	95	72	95	71	93	40	53	43	57	56	74	71	93	76
Afar	48	98	48	98	48	98	47	96	33	67	32	65	48	98	49
Amhara	101	89	101	89	98	86	52	46	35	31	79	69	100	88	114
Oromia	106	85	105	84	98	78	92	74	47	38	84	67	104	83	125
Somali	47	82	47	82	45	79	47	82	44	77	35	61	44	77	57
Bensh-Gumz	39	87	39	87	37	82	13	29	29	64	19	42	39	87	45
SNNP	91	87	91	87	88	84	82	78	34	32	75	71	91	87	105
Gambella	42	100	40	95	38	90	35	83	32	76	20	48	42	100	42
Harari	32	91	32	91	31	89	31	89	13	37	22	63	31	89	35
Addis Ababa	68	88	68	88	65	84	59	77	26	34	64	83	68	88	77
Deri-Dawa	36	92	36	92	36	92	36	92	19	49	26	67	35	90	39
Facility Type															
Hospital	297	98	297	98	297	98	237	78	102	34	293	97	296	98	303
Health Centre	160	98	160	98	158	96	118	72	103	63	131	80	160	98	164
Health post	102	77	101	77	99	75	67	51	99	75	1	1	99	75	132
Higher & med clinic	85	91	85	91	85	91	78	84	37	40	84	90	82	88	93
Lower clinic	38	53	36	50	16	22	34	47	14	19	3	4	36	50	72
Managing Authority															
Public	502	93	501	92	496	92	375	69	273	50	369	68	499	92	542
Other	180	81	178	80	159	72	159	72	82	37	143	64	174	78	222
Location															
Urban	463	92	463	92	448	89	377	75	178	35	427	85	456	90	504
Rural	219	84	216	83	207	80	157	60	177	68	85	33	217	83	260
Total	682	89	679	89	655	86	534	70	355	46	512	67	673	88	764

Only 19% of the facilities had ITN and lower clinics had no ITN service. Eighty-two percent of health posts had a malaria diagnostic capacity through RDT and 58% of the health posts had first-line anti-malarial drugs in-stock. Facilities managed by the public authority had a more likely availability of all tracer items compared with facilities managed by others (4% Vs 1.7%). Seven percent of the facilities found in the Tigray region had availability of all tracer items. Nearly, 7% of the health centers and 4% of hospitals had all the malaria tracer items. But, the rest health facilities did not have any of the tracer items. Overall, 3% (23) of the facilities had all the six tracer items, 40% (274) had more than three tracer items and nearly 4% (25) of the facilities had no malaria tracer items. Facilities found in Tigray, Amhara, Oromia, Gambela, Deri-Dawa region were scored above the average mean score readiness of tracer items (52%). Nearly 62% of health centers and 59% of hospitals had the availability of tracer items above the average mean score readiness (52%) (Table 3).

The Determinant of Malaria service readiness: Malaria service readiness score was assessed by computing the mean score of the six-tracer item of malaria service. Based on this, the mean score of the

tracer items was taken as the dependent variable. In simple linear regression, the independent variables which are Facility type (Higher & medium clinic, Lower clinic, and health post), Facility managed by other than public, Region (Afar, Amhara, Oromia, Somali, Benishangul-Gumz, SNNP, Harari and Addis Ababa) and Facility found in rural area were significantly associated with the mean score of tracer items for malaria service readiness. After these, variables were entered into multiple linear regressions using the backward model to avoid the possibility of confounding effect. Finally, facility type (higher & medium clinic, lower clinic, and health post), facility managed by other than public and region (Amhara, Oromia, Somali, SNNP, Harari and Addis Ababa) were the determinants of the mean score of tracer item for malaria service readiness. Based on the finding, higher and medium clinic ($B=-0.2[95\%CI: -0.26, -0.14]$), health post ($B=-0.33[95\%CI: -0.38, -0.28]$) and lower clinic ($B=-0.48[95\%CI: -0.54, -0.41]$) had lower mean score of tracer items for malaria service readiness compared with hospitals. Facilities managed by other than public authority had lower mean score of tracer items for malaria service readiness ($B=-0.07[95\%CI: -0.18, -0.01]$) compared with those managed by public authority counterpart.

Table 3: Distribution of malaria service tracer items by region, managing authority, type and location of the facility, Ethiopia 2018 (N=682).

Variable	At least 1										Mean availability of tracer items																																			
	Guidelines available diagnosis and treatment of malaria					trained staff diagnosis and treatment of malaria					Malaria diagnostic capacity					First-line anti-malarial in-stock					Paracetamol cap/tab					ITN					had no tracer item					had >3 tracer items					had all tracer items					Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%												
Region																																														
Tigray	49	68.1	38	52.8	64	88.9	55	76.4	56	77.8	10	13.9	3	4.2	47	65.3	5	6.9	72	63.0%																										
Afar	20	41.7	11	22.9	44	91.7	32	66.7	30	62.5	8	16.7	1	2.1	17	35.4	1	2.1	48	50.3%																										
Amhara	42	41.6	31	30.7	82	81.2	84	83.2	85	84.2	12	11.9	0	0	43	42.6	3	3	101	55.4																										
Oromia	40	37.7	31	29.2	84	79.2	75	70.8	86	81.1	18	17.0	7	6.6	47	44.3	3	2.8	106	52.5%																										
Somali	6	12.8	11	23.4	43	91.5	24	51.1	34	72.3	21	44.7	0	0	14	29.8	3	6.4	47	49.3%																										
Benish-Gumuz	7	17.9	6	15.4	31	79.5	29	74.4	21	53.8	15	38.5	3	7.7	13	33.3	1	2.6	39	46.6%																										
SNNP	36	39.6	17	18.7	80	87.9	64	70.3	72	79.1	14	15.4	3	3.3	31	34.1	2	2.2	91	51.8%																										
Gambella	17	40.5	23	54.8	34	81.0	27	64.3	20	47.6	12	28.6	4	9.5	21	50	3	7.1	42	52.8%																										
Harrari	17	53.1	9	28.1	29	90.6	14	43.8	13	40.6	1	3.1	0	0	8	25	0	0	32	43.2%																										
Addis Ababa	35	51.5	7	10.3	61	89.7	18	26.5	51	75.0	0	0	2	2.9	14	20.6	0	0	68	42.2%																										
Deri-Dawa	11	30.6	19	52.8	27	75.0	23	63.9	25	69.4	19	52.8	2	5.6	19	52.8	2	5.6	36	57.4%																										
Facility Type																																														
Hospital	130	43.8	85	28.6	269	90.6	240	80.8	289	97.3	42	14.1	1	3	144	48.5	12	4	297	59.2%																										
Health Centre	73	45.6	52	32.5	141	88.1	124	77.5	154	96.3	49	30.6	0	0	92	57.5	11	6.9	160	61.8%																										
Health post	30	29.4	45	44.1	84	82.4	59	57.8	0	0.0	38	37.3	5	4.9	25	24.5	0	0	102	41.8%																										
Higher /med clinic	44	51.8	19	22.4	72	84.7	19	22.4	37	43.5	1	1.2	4	4.7	13	15.3	0	0	85	37.6%																										
Lower clinic	3	7.9	2	5.3	13	34.2	3	7.9	13	34.2	0	0	15	39.5	0	0	0	0	38	14.9%																										
Managed authority																																														
Public	206	41.0	169	33.7	441	87.8	397	79.1	387	77.1	124	24.7	6	1.2	241	48	20	4	502	57.2%																										
Other	74	41.1	34	18.9	138	76.7	48	26.7	106	58.9	6	3.3	19	10.6	33	18.3	3	1.7	180	37.6%																										
Location																																														
Urban	191	41.3	121	26.1	398	86.0	305	65.9	384	82.9	59	12.7	13	2.8	187	40.4	15	3.2	463	52.5%																										
Rural	89	40.6	82	37.4	181	82.6	140	63.9	109	49.8	71	32.4	12	5.5	87	39.7	8	3.7	219	51.1%																										
Total	280	41.1	203	29.8	579	84.9	445	65.2	493	72.3	130	19.1	25	3.7	274	40.2	23	3.4	682	52.1%																										

Region was also one of the determinant factor of mean score readiness of tracer items to provide malaria service. From these, Addis Ababa (B= -0.17[95%CI: -0.24, -0.11]), SNNP (B= -0.13[95%CI: -0.19, -0.07]), Oromia (B= -0.12[95% CI: -0.18, -0.06]), Somali (B=

0.12[95% CI: -0.19, -0.05]), Harari (B= -0.1[95% CI: -0.18, -0.02]) and Amhara region (B= -0.09[95% CI: (-0.15, -0.03)]) had lower mean score of tracer item for malaria service readiness as compared with Tigray region (Table 4).

Table 4: Determinant of the mean score of tracer item for malaria service readiness, in Ethiopian health facilities, 2018.

Variable	Mean score	SE	Unadjusted coefficient		Adjusted coefficient	
			Beta	95% CI	Beta	95% CI
Facility type						
Hospital (Ref)	0.588	0.01				
Health center	0.607	0.02	0.02	(-0.02, 0.06)	-0.03	(-0.07, 0.02)
Health post	0.328	0.02	-0.26	(-0.30, -0.22) **	-0.33	(-0.38, -0.28) **
Higher & medium clinic	0.355	0.02	-0.23	(-0.28, -0.19) **	-0.2	(-0.26, -0.14) **
Lower clinic	0.093	0.03	-0.5	(-0.55, -0.44) **	-0.48	(-0.54, -0.41) **
Managing authority						
Public (Ref)	0.547	0.01				
Others	0.315	0.02	-0.22	(-0.26, -0.18) **	-0.07	(-0.18, -0.01) *
Region						
Tigray (Ref)	0.596	0.03				
Afar	0.493	0.05	-0.103	(-0.19, -0.01) *	-0.03	(-0.10, 0.04)
Amhara	0.493	0.04	-0.104	(-0.18, -0.03) *	-0.09	(-0.15, -0.03) *
Oromia	0.456	0.04	-0.14	(-0.21, -0.07) **	-0.12	(-0.18, -0.06) **
Somali	0.421	0.46	-0.18	(-0.26, -0.09) **	-0.12	(-0.19, -0.05) *
Benishandul-Gumuz	0.415	0.05	-0.18	(-0.28, -0.09) **	-0.03	(-0.11, 0.04)
SNNP	0.456	0.04	-0.14	(-0.22, -0.06) **	0.13	(-0.19, -0.07) **
Gambella	0.528	0.05	-0.07	(-0.17, .03)	0.07	(-0.01, 0.14)
Harrari	0.4	0.05	-0.196	(-0.3, -0.09) **	-0.1	(-0.18, -0.02) *
Addis Ababa	0.394	0.04	-0.2	(-0.29, -0.12) **	-0.17	(-0.24, -0.11) **
DeriDawa	0.543	0.05	-0.05	(-0.15, 0.05)	0.02	(-0.06, 0.09)
Urban/Rural						
Urban (Ref)	0.489	0.01				
Rural	0.439	0.02	-0.05	(-0.09, -0.01)*	0.02	(-0.02, 0.06)

CI = Confidence Interval, SE=Standard Error, *P-value< 0.05, **p-value<0.001, Ref-Reference

Discussion

Health facility readiness to offer malaria diagnosis or treatment service is basic and boldly seen in each level of health facility to control, eliminate, and eradicate malaria from its public health problem. At 5% level of significant, facility type (Higher and medium clinic, Lower clinic, and health post), facilities managed by other than public authority and region (Amhara, Oromia Somali, SNNP, Harari and Addis Ababa) were the determinant of mean score readiness of tracer items for malaria service. The current study revealed that 89% of health facilities offered malaria diagnosis or treatment services. Which is higher than another study conducted in Ethiopia (81%) (Ministry of Health and EPHI 2016), in Somalia (57%) (Somali Health Authorities 2016) but lower than the study conducted in Tanzania (93%) (Ministry of Health 2013). This might be due to the presence of a security problem in Somalia to address malaria service and a scale-up of different interventions in Ethiopia. Seventy percent of the facilities conduct malaria diagnosis by clinical symptoms followed by RDT (67%) and microscopy (46 %). This is higher than the result from the previous study conducted in Ethiopia, 81% offer malaria diagnosis or treatment, 69% diagnosed by

clinical symptom, 54% by microscopy, and 39% by RDT (Ministry of Health and EPHI 2016). It is also higher than the result of the study done in Somalia, 32% by clinical symptom, 14% malaria by microscopy and 52% malaria by RDT(Somali Health Authorities 2016). In this study, facilities that are managed by government authority were more likely to provide malaria service compared to non-governmental facilities (93% Vs 81%) which are in line with the study in Tanzania (95% Vs 86%) (Ministry of Health 2013). In contrast, the results from Somalia indicate that facilities managed by government authorities were less likely to offer malaria diagnosis or treatment services compared with facilities managed by others (59% Vs 56%) (Somali Health Authorities 2016). Urban facilities in Ethiopia were more likely to offer malaria diagnosis or treatment services (92% Vs 82%) and also health centers were more likely to offer malaria service than health posts which is supported by other studies (Ministry of Health & EPHI 2016; Somali Health Authorities 2016).

Concerning malaria service readiness, 3% of the facilities had the availability of all malaria tracer items which is nearly similar to the previous study in Ethiopia 3% (Ministry of Health and EPHI 2016) and

higher than the study conducted in Somalia 1% (Somali Health Authorities 2016). This difference might be due to the unequal number of tracer items used for malaria service readiness and instability of the country to improve malaria service through the implementation of malaria prevention and controlling strategy. The availability of trained health workers, a first-line anti-malaria drug, and paracetamol tab in each level of health facility was mandatory. In the current study, 65% and 72% of the facilities had the availability of ACT and Paracetamol tab in their facilities which is lower than studies done in Tanzania and Kenya (Ministry of Health 2013; Njogu, et al. 2008; Ministry of Health, Kenya 2013; Group Act et al. 2017). Nearly 30% of the facilities had availability of at least one trained health worker/Staff for malaria diagnosis and treatment service which is lower than the study conducted in Tanzania 59% (Ministry of Health, Tanzania 2013) but higher than a previous study conducted in Ethiopia (17%) and Nigeria (24%) (Ministry of Health and EPHI 2016; Ojo A et al.2014).

Overall, 52% of the facilities were ready to provide malaria service which higher compared with study in Somalia (42%) and lower compared with Tanzania (64%) (Somali Health Authorities 2016; Ministry of Health, Tanzania 2013). Facilities which are managed by other than public authority had lower mean score readiness of trace items by 7% compared with those facility managed by public authority. A significant regional difference was observed on the mean score readiness of the tracer items.

This study revealed that facilities found in Addis Ababa, SNNP, Oromia, Somali and Amhara region had lower mean score readiness of trace items for malaria service ($\beta = -0.17$, $\beta = -0.13$, $\beta = -0.12$, $\beta = -0.12$, $\beta = -0.1$ and $\beta = -0.09$) respectively compared with Tigray region. In addition to this, there was a significant association between facility types on the mean score readiness of tracer items. Thus, the current study indicates that the mean score readiness of tracer items in the lower clinic, health post, and higher and medium clinics were negatively associated with hospitals. This might be as a result of the availability of well-trained health workers in hospitals and also hospitals were able to utilize malaria service-related supply and logistic materials on their own. Overall there is no significant change in the readiness of health facility for malaria service between 2016 and 2018 Service Availability and Readiness Assessment (SARA) survey ($P=0.732$). Therefore, the government and other stakeholders need to pay more attention to the readiness of health facilities for malaria service provision order to achieve the national malaria control strategy for the elimination of malaria by 2020 and eradication by 2030.

Conclusions

The mean score readiness of tracer items for malaria service is lower and only a few facilities had the availability of all tracer items. The current study revealed that facility type, managing authority, and region were the significant determinants of malaria service readiness. A significant change in malaria service readiness has not been observed between 2016 and 2018 SARA surveys. Therefore, to achieve national malaria controlling and elimination strategy by 2020 and eradication by 2030, both the government and stakeholders should give more emphasis on the readiness of malaria service provision by availing all the trace items across the region and each level of health facilities. Managing authorities are critical to ensure facility readiness for malaria service. Also, the public-private partnership needs more attention to improve malaria service at each level of health facilities.

Availability of data and materials: The data of this study cannot be shared publicly due to the presence of sensitive (confidential) participants' information.

Competing interests: The authors declare that they do not have competing interests

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Original article

HIV/AIDS service provision in Ethiopia: Evidence from service provision assessment plus survey

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Abstract

Introduction: The epidemic of HIV/AIDS has rapidly spread throughout the country after the detection of the first two reported AIDS cases in 1986 in Ethiopia. There are multiple factors for combating the high prevalence of HIV/AIDS. Service availability and readiness are among the factors.

Objective: To assess the availability and preparedness of health facilities in Ethiopia to provide quality HIV/AIDS services.

Methods: The data used in this study came from the 2014 Ethiopian Service Provision Assessment Plus survey. Data were collected using a facility inventory questionnaire. All hospitals were included in the survey. A total of 363 health facilities were selected. The sample for the survey was a stratified random sample designed. Health posts were excluded from this analysis.

Result: Among all health facilities, 59% of them report having an HIV testing system in the facility or else agreed to the external testing site (or in affiliated laboratory). Out of that, 97%, 27%, and 17% of facilities offer opportunistic disease treatment, HIV/AIDS care and support services, and ART for HIV/AIDS patients respectively. Concerning the trained staff on HIV testing, 47% HIV testing service providers received in-service training during 24 months preceding the survey. As well, 31% of Ethiopian health facilities have Post Exposure Prophylaxis service for HIV that can be accessed by their staff working in the facilities.

Conclusion: HIV testing system in Ethiopia was low. Less than half of the HIV testing service providers received in-service training. Similarly, more than 2/3 of health facilities workers did not have access to PEP.

Keywords: HIV/AIDS, Service Provision, Service Provision Assessment plus, Health facilities

Introduction

Approximately 37.9 million people across the globe were living with HIV/AIDS in 2018. Of these, 36.2 million were adults and 1.7 million were children (<15 years old) (Global Statistics 2019). Sub-Saharan Africa remains most severely affected, with nearly one in every 25 adults (4.2%) living with HIV and accounting for nearly two-thirds of the people living with HIV worldwide (WHO 2018). In 2018, 23.3 million people with HIV (62%) were accessing antiretroviral therapy (ART) globally, an increase of 1.6 million since 2017, and up from 8 million in 2010 (Global Statistics 2019). About 32 million people have died from AIDS-related illnesses since the start of the epidemic (UNAIDS 2019). Since the detection of the first two reported AIDS cases in 1986 in Ethiopia, the epidemic has rapidly spread throughout the country. According to the Ethiopian Demographic Health Survey (EDHS) 2016, the adult prevalence of HIV/AIDS is 0.9 (DHS 2016). The epidemic expanded rapidly and reached a plateau around the mid-1990s. In major urban settings, the epidemic is on the decline while stabilizing in rural areas (UNHCR 2018).

Since 2008 HIV incidence rate began to rise by 10% and the number of new infections diagnosed each year

increased by 36% among all ages and doubled among adults. Antiretroviral therapy coverage has increased by 90% of all age and tripled among pregnant women within six years. Nationally, 67% of people living with HIV know their status, 88% of them are on treatment and 86% of people on treatment have viral suppression (Tadele Girum, 2018). However, limited availability of laboratory services such as HIV RNA load and drug resistance testing and monitoring due to lack of experience of health professionals, and weak infrastructure and health care system contribute to delay in diagnosis of treatment failure (Adal 2019). Africa facing the same scenario, particularly Malawi was struggling to strengthen HIV care services. Malawi's district (Blantyre and Thyolo) health system strengthening and quality improvement for service delivery were above the national average of 87% in quarter one (Q1) of 2017. The two districts addressing the root causes of poor performance in linkage to HIV care services contributed to this indicator improvement. These include, implementing same-day ART initiation, tracing patients that did not start treatment, and having expert clients physically escort new clients to the ART clinic (Management Sciences for Health, 2018).

There are multiple factors for combating the high prevalence of HIV/AIDS. To prevent further escalation of the HIV epidemic, efforts to scale up HIV prevention programs addressing females, people with low education, lower age at marriage, alcohol consumption, condom use and multiple sexual partners for all age groups remains a top priority. Care and treatment are urgently needed for those infected (Elia J Mmbaga, 2007). Since the main route through which access to health services impacts on the HIV/AIDS epidemic is the non-treatment of STIs (Temah, 2009). In fragile health systems, as is the case in most resource-constrained countries, the human resource crisis is the result of many macroeconomic and governance factors. The crisis is further compounded by the impacts of the HIV/AIDS pandemic. Key policies need to urgently respond to the need to strengthen the broken health systems and accelerate production, retention, and replacement of health workers through proper human resource development, management, and provision of necessary incentives. Health services are an essential service and health workers should be treated as an essential and vital national resource, especially in the current state of the HIV/AIDS epidemic (Linda Tawfik, 2006). Knowing that service availability and readiness are among the factors, this study is to assess the availability and preparedness of health facilities in Ethiopia to provide quality HIV/AIDS services.

Materials and Methods

Study area and design: A total of 23,144 functional and formal sector health facilities are available in Ethiopia which includes 214 hospitals, 3,317 health centers, 15,525 health posts, and 4,088 private clinics. The information for this cross-sectional study was collected from the health facilities that managed by the government, NGO and private for-profit organizations.

Data sources and data collection instrument: The data used in this study came from the 2014 Ethiopian Service Provision Assessment Plus (SPA+) survey that are nationally and sub-nationally representative. Data were collected using a facility inventory questionnaires which initially prepared in English, then translated into Amharic and finally translated back to English to check for clarity, consistency, and completeness. English and Amharic translation of the questionnaires were loaded onto tablet computers, which were used during interviews to ask questions and also record responses (computer-assisted personal interviewing–CAPI) designed using CSpro.

Sampling: The sample size for the study was determined by a combination of census and random samples. A list of all health facilities in Ethiopia was obtained from the Federal Ministry of Health. Ethiopia

has a skewed population distribution at the regional level and the sample allocation for the assessment takes the skewed population distribution of the country into account. Out of the eleven regions, the three most populated regions (Amhara, Oromia and SNNR) represent 83% of the total population of the country (CSA and ICF International, 2012). Thus, a large proportion of facilities will come from these regions. Because of their importance and their limited numbers, all hospitals were included in the survey and allowing for the inclusion of newly identified hospitals in the survey. The sample for the survey was a stratified random sample designed. A representative sample of health centers and clinics were selected and included in the survey. The sample size determination has been achieved by controlling the survey precision at the regional level and by facility type at the national level. A total sample size of 1,327 health facilities was selected by using the formula:

$$n = \frac{(1 - p)}{\epsilon^2 p}$$

Where ϵ is the requested relative standard error for estimating a proportion p . With the proposed sample size, for an indicator at a 30% level a “good” survey precision was achieved at the national level by facility type; a “good-to-acceptable” precision was achieved at the regional level for the higher-level health facilities.

Training and data collection: The questionnaires were pre-tested in Adama within 30 health facilities to detect any possible problems in the flow of the questionnaires, gauge the length of time required for interviews, as well as any problems in the translations. The pre-test also helped to detect any problems with the data entry programs. Data collectors were BSc degree holders in health-related fields and experienced with data collection. The main data collection took place from March 10, 2014, to July 25, 2014.

Data management and analysis: The interviewer sent the downloaded information regularly to the central office Ethiopian Public Health Institute (EPHI). Data were cleaned by checking of range, structure, and selected set of checks for internal consistency. All data editing programs were conducted using CSPro software. Descriptive analysis was performed using CSPro tabulation.

Ethical clearance: Ethical clearance was obtained from the Institutional Review Board of Scientific and Ethical Review Office (SERO) of EPHI. Copies of letters of approval by SERO were presented to regional health bureaus. On top of that, informed consent was obtained from the facility in-charge, from all study participants for the facility inventory questionnaires, and from interviewed providers.

Result

Availability of basic services for HIV/AIDS: Overall, 59% of facilities report having an HIV testing system in the facility or else agreed to the external testing site (or in the affiliated laboratory). Lower clinics (6%) are among the least likely to report having an HIV testing system. While referral hospitals, primary hospitals, general hospitals, and health centers were conducting HIV testing in the facility or else in an external testing site and having an agreement with that external site that test results will be returned to the facility with 100%, 98%, 96%, and 94% respectively. All facilities report conducting HIV testing in the facility and had HIV rapid diagnostic test kits or ELISA testing

capacity or dynabeads testing capacity or western blot testing capacity observed in the facility to support the provision of quality HIV testing and counseling services or in the affiliated laboratory. About six in every ten facilities managed by NGO's (mission/faith-based, non-profit) and more than nine in every ten health facilities managed by government and other governmental (military, prison and federal) have HIV testing available in their facility or in the affiliated laboratory than facilities managed by other authorities. Facilities in Tigray (83%) and Afar (78%) are more likely to have HIV testing systems than facilities in other regions. Particularly, the Gambella region (22%), the lowest to has HIV testing systems (Table 1).

Table 1: Availability of HIV testing and counselling services, Ethiopia SPA+ 2014

Background characteristics	Percentage of facilities with HIV testing system that have									Number of facilities having HIV testing system
	Percentage of all facilities with HIV testing system ¹	Number of facilities	HIV testing capacity ²	HIV testing and counseling guidelines	Trained provider ³	Visual and auditory privacy ⁴	Client record ⁵	Condoms ⁶	Access to HIV PEP ⁷	
Facility type										
Referral Hospital	100	2	100	56	78	94	66	75	91	2
General Hospital	98	7	100	60	84	98	65	64	79	7
Primary Hospital	96	3	100	60	76	98	54	72	82	3
Health Center	94	182	100	23	43	95	51	76	33	171
Higher Clinic	72	13	96	36	50	99	70	64	12	10
Medium Clinic	45	37	100	23	59	94	51	50	3	17
Lower Clinic	6	119	100	1	36	84	26	73	0	7
Managing authority										
Government/ Public	94	190	100	25	45	96	51	76	35	179
Other governmental*	94	2	100	9	77	100	100	94	6	2
Private for profit	19	163	99	26	55	93	48	59	8	31
NGOs	58	8	100	21	43	100	59	33	32	5
Region										
Tigray	83	22	100	51	61	100	58	72	49	18
Afar	78	5	100	10	62	100	32	60	27	4
Amhara	58	87	100	30	54	92	36	86	34	51
Oromia	63	116	100	21	42	92	59	69	26	73
Somali	72	8	100	12	49	99	32	68	17	6
Benish. Gumuz	44	4	100	54	93	100	64	79	50	2
SNNP	55	80	100	12	28	100	51	68	29	44
Gambella	22	6	100	31	41	100	62	73	25	1
Harari	49	2	100	35	76	100	59	29	35	1
Addis Ababa	45	31	97	37	67	98	68	72	33	14
Dire Dawa	72	3	100	42	83	100	64	50	44	2
Urban/rural										
Urban	54	149	99	36	61	94	56	72	46	81
Rural	63	214	100	18	38	96	48	73	22	135
Total	59	363	100	25	47	95	51	73	31	216

¹* = Military, prison, federal police)

²** = NGO (Mission/ Faith-based, non-profit)

As shown in table 1, among all facilities reporting having HIV testing system, 25% of them have an HIV testing and counselling guidelines. Lower clinics (1%) and other governmental managing facilities (9%) are less likely to have HIV testing and counselling guidelines than other facility types and managing facilities respectively. Records of HIV test results are moderately (51%) available. Likewise, among all health facilities assessed, 31% of Ethiopian health facilities have PEP for HIV that can be accessed by their staff working in the facilities. Referral, primary

and general hospitals have high access to PEP for HIV with 91%, 82%, 79% respectively. Whereas lower clinic has no access to PEP for HIV. Concerning the trained staff on HIV testing, from all facilities with HIV testing system about 47% an HIV testing service providers received in-service training during 24 months preceding the survey. Lower clinic (36%) was less likely than other facility types to have a trained HIV testing service provider. On top of these, 95% of facilities with an HIV testing system offer visual and auditory privacy that means a private room or

screened-off space available at HIV testing and counselling service site. Seventy-three percent of them have condoms at the HIV testing and counselling site on the day of the survey (Table 1).

Guidelines, trained staff, medicines, and items for HIV/AIDS care and support services: Overall, 27% of facilities offer HIV/AIDS care and support services (CSS). Referral hospitals (91%), general hospitals (82%), and primary hospitals (85%) are more likely to offer HIV/AIDS care and support services. Whereas, private for-profit (15%) and lower clinics (10%) were less likely to offer HIV/AIDS care and support services. The higher (66%) HIV/AIDS care and support services were given in Dire Dawa city administration and the lower (7%) were found in Gambella region facilities (Table 2).

Facilities were assessed for the availability of specific service guidelines. Ninety-five percent of facilities have no guideline for palliative care. The guidelines for palliative care is more likely available in higher clinics (17%) than other facility types. Among all facilities, 43% of them have at least one trained staff who received in-service training on aspects of HIV/AIDS care and support service during the 24 months preceding the survey. Other governmental (military, prison, federal police) were found the highest (85%) and lower clinics were the lowest (less than 1%) received in-service training. There was no staff received in-service training in the Gambella region. In addition, the assessed health facilities show one in every two facilities has a system for screening and testing HIV+ clients for TB. It was more likely available in NGOs managing health facilities (89%), and less likely available in the lower clinic (2%) as indicated in table 2.

Among all facilities assessed that offer HIV/AIDS care and support service, 83% of them have IV solution with an infusion set, which is less likely available in the lower clinic (58%) than other facility types. Thirty-five percent of assessed facilities have fluconazole/IV treatment for fungal infections; this is not available among medium clinics and lower clinics than other health facilities. Seventy-seven percent of all health facilities have cotrimoxazole tablet and which is less likely available in the higher clinic (11%) than other managing authority facilities. Nine in every ten health facilities that offer HIV/AIDS care and support service have a male condom that directly supports the quality of the provision of the service. Regarding pain management, 83% of health facilities have pain management medicines. This is least likely available in lower clinics (32%) and private for-profit organizations (53%) than other facility types and managing authority. On top of that, 71% of facilities

that offer HIV/AIDS care and support services have first-line treatment for TB. Lower clinics (less than 1%) and private for-profit health facilities (13%) are least likely to have first-line TB drugs (Table 2).

Primary preventive, and treatment of Opportunistic Infections: Among all facilities that offer HIV/AIDS care and support services, 97% of them reported that they provide opportunistic disease treatment. The service is fully available in all types of hospitals, health centers, and all managing authority facilities except private for-profit health facilities (90%). Forty-six percent of the facilities that offer HIV care and support services offered systemic intravenous treatment for specific fungal infections (e.g., cryptococcal). Systemic intravenous treatment for specific fungal infections is more likely offered in referral hospitals (90%), and less likely offered in medium clinics (20%). Among all facilities that offer HIV care and support service for HIV clients, 32% of them offer treatment for Kaposi sarcoma, and the service is more likely offered in referral hospitals (79%), and less likely offered in medium clinics (13%) and lower clinics (11%) than other facility types.

Palliative care offered in seven of every ten facilities. NGOs (mission/ faith-based, nonprofit) were fully providing palliative care, and other governmental (military, prison, federal police) offer the least (30%) palliative care. As well, facility type, general hospitals (95%), and higher clinics (94%) are more likely to offer palliative care, and medium clinics (45%) are less likely to offer this service. Overall, seven in every ten health facilities that offer specific HIV/AIDS care and support services offer nutritional rehabilitation services. All primary hospitals offer the service fully; however, lower clinics (56%) are less likely to offer the service than other facility types (Table 3).

Similarly, managing authority of other governmental (military, prison, federal police) offers the least (30%) services on nutritional rehabilitation. Fortified protein supplementation offered in 51%, of which less likely offered in lower clinics (2%) and private for-profit (7%) than other facility type and managing authority. Eight-three percent of all health facilities assessed that offer HIV care and support service on paediatric HIV client care. All primary hospitals and NGOs provided HIV care and support services on paediatric HIV client care. Among all health facilities that offer HIV CSS, 79% of them have primary preventive treatment for opportunistic infection such as cotrimoxazole preventive treatment (CPT). All referral hospitals offer full CPT. Somali and Gambella regions fully providing CPT than other regions. Sixty-three percent of health facilities that offer HIV care and support service offer preventive treatment for TB.

Table 2: Guidelines, trained staff, medicines, and items for HIV/AIDS care and support services, Ethiopia SPA+ 2014

Table 2. Guidelines, trained staff, medicines, and items for HIV/AIDS care and support services, Ethiopia 2014													
Background characteristic	% of facilities offering HIV/AIDS care and support services	Number of facilities	Percentage of facilities offering HIV/AIDS care and support services that have:						Medicines				Number of facilities offering HIV/AIDS care and support services
			Guidelines for the clinical management of HIV/AIDS	Guidelines for palliative care	Trained staff ²	System for screening and testing HIV+ clients for TB ³	IV solution with infusion set	Fluconazole/ IV treatment for fungal infections	Cotrimoxazole tablets	First-line treatment for TB ⁴	Pain management	Male condoms	
Facility type													
Referral Hospital	91	2	45	7	62	79	93	79	97	86	100	100	2
General Hospital	82	7	75	6	71	74	96	79	94	91	100	92	6
Primary Hospital	85	3	66	9	55	77	98	84	95	100	98	98	2
Health Center	34	182	43	5	52	62	88	40	97	91	92	97	63
Higher Clinic	19	13	26	17	58	22	60	16	11	23	66	55	2
Medium Clinic	24	37	15	5	13	13	71	0	14	22	76	64	9
Lower Clinic	10	119	2	3	0	2	58	0	20	0	32	65	12
Managing authority													
Government/ public	37	190	46	5	54	64	89	44	97	92	93	98	70
Other governmental	19	2	15	15	85	15	100	30	100	30	100	100	0
Private for profit	15	163	10	6	15	9	64	7	18	13	53	64	24
NGO	20	8	89	0	14	89	100	31	93	86	100	83	2
Region													
Tigray	34	22	79	0	66	76	89	62	96	95	99	100	7
Afar	24	5	10	11	71	15	94	31	84	42	94	83	1
Amhara	41	87	20	8	37	37	77	29	71	64	76	87	35
Oromia	21	116	51	1	41	69	87	39	99	88	94	94	24
Somali	13	8	69	0	49	47	92	41	66	75	75	95	1
Benish. Gumuz	19	4	66	0	100	58	100	83	100	100	100	100	1
SNNP	19	80	34	4	34	46	90	29	59	65	76	96	15
Gambella	7	6	44	0	0	56	100	35	100	100	56	78	0
Harari	29	2	50	10	90	70	60	50	90	80	90	90	1
Addis Ababa	28	31	41	12	61	42	73	27	53	42	80	61	9
Dire Dawa	66	3	33	9	61	52	82	36	70	82	94	85	2
Urban/rural													
Urban	33	149	46	8	44	52	81	44	64	60	81	88	49
Rural	22	214	29	2	42	49	85	25	91	83	85	89	47
Total	27	363	37	5	43	50	83	35	77	71	83	89	96

General hospitals (86%) and NGOs (96%) more likely to provide preventive treatment for TB. Whereas, lower clinics, private for-profit, and other governmental (military, prison, federal police) less likely offer preventive treatment for TB with 26%, 30%, and 30% respectively. Seventy- six percent of health facilities that offer care and support services for HIV/AIDS clients provide micronutrient supplement. All other governmental organizations (military, prison, federal police) offer fully while NGO (mission/faith-based, nonprofit) provide the least (45%) micronutrient supplement (Table 3).

Advanced services for HIV/AIDS: According to table 4, all health facilities that provide service of ART for HIV/AIDS patients assessed. Overall, 17% of all health facilities offer ART for HIV/AIDS patients and/or provide ART medical treatment follow-up services including community-based service. These ART services are more likely offered in referral

hospitals (94%), general hospitals (87%), and primary hospitals (83%), and it is less likely offered in clinics and private for-profit (less than 1%) than other facility types. At the regional level, among the facilities assessed; Somali (8%), SNNP (9%), and Gambella region (10%) are less likely to offer the service than facilities in other regions. Antiretroviral therapy guidelines are available in 86% of the facilities that prescribe ART for HIV/AIDS patients and/or provide ART medical treatment follow-up services including community-based service. In all medium clinics and NGO ART guidelines fully available whereas, less likely in other governmental organizations (49%). Fifty- three percent of health facilities that have ART service; have at least one interviewed provider who received in-service training in some aspect of ART during the 24 months preceding the survey. Medium and lower clinic staff received in-service training (100%) and less likely other governmental organization (less than 1%).

Table 3: HIV care and support services offered, 2014

Background characteristic	Percentage of facilities offering specific Care and Support services (CSS)												Number of facilities offering HIV/AIDS care and support services
	Opportunistic infections Rx	Systemic IV Rx for fungal disease	Rx for Kaposi's sarcoma	Palliative care	Nutritional rehabilitation	Fortified protein supplementation	Pediatric HIV client care	Preventive Rx for TB	CPT ²	Micro nutrient supplementation	FP counseling or services	Condoms for preventing further transmission of HIV	
Facility type													
Referral Hospital	100	90	79	86	90	97	86	79	100	86	100	100	2
General Hospital	100	79	65	95	81	67	85	86	97	88	95	89	6
Primary Hospital	100	64	50	91	100	89	100	82	98	93	100	98	2
Health Center	100	47	33	74	75	62	93	73	84	79	100	97	63
Higher Clinic	83	28	45	94	67	17	92	53	92	87	80	53	2
Medium Clinic	91	20	13	45	59	17	49	27	48	67	98	59	9
Lower Clinic	90	38	11	64	56	2	54	26	62	59	84	65	12
Managing authority													
Government/ public	100	50	36	76	77	65	93	74	85	80	100	98	70
Other governmental	100	100	15	30	30	30	15	30	30	100	100	100	0
Private for profit	90	34	16	61	57	7	56	30	65	68	88	65	24
NGO	100	35	86	100	96	91	100	96	41	45	93	28	2
Region													
Tigray	100	46	45	79	82	79	90	66	96	100	100	100	7
Afar	100	83	15	47	70	54	59	59	70	84	100	83	1
Amhara	97	45	17	65	64	43	82	55	76	70	97	86	35
Oromia	100	51	49	87	69	57	99	76	82	68	99	94	24
Somali	100	89	38	75	69	27	95	75	100	75	100	95	1
Benishan. Gumuz	83	66	58	100	100	83	83	83	83	83	100	100	1
SNNP	100	34	29	72	90	53	73	65	73	80	99	91	15
Gambella	100	13	35	56	87	56	100	56	100	100	100	78	0
Harari	100	40	50	70	90	60	80	80	90	90	100	90	1
Addis Ababa	86	49	34	61	64	37	65	55	82	90	85	68	9
Dire Dawa	97	39	36	76	91	52	67	70	70	88	94	88	2
Urban/rural													
Urban	97	50	32	69	72	52	76	62	81	77	96	89	49
Rural	98	42	31	76	72	49	91	65	77	75	98	87	47
Total	97	46	32	73	72	51	83	63	79	76	97	88	96

As indicated in table 4, 31% of all health facilities which offer ART services have laboratory capacity for complete blood count. Medium clinic (less than 1%) and governmental managing health facilities (28%) are less likely to offer CBC laboratory service than other managing authority and facilities. Amhara and Gambella regions (9% for both) facilities are less likely to offer complete blood count service than other regions facilities. Similarly, 17% of ART services have diagnostic capacity for CD4 cell count. All medium clinics and other governmental managing authority have CD4 cell count. Health centers (8%) and higher clinic (less than 1%) less likely have CD4 cell count. Particularly in Gambella region, there is no diagnostic capacity for CD4 cell count. None of the assessed facilities offering ART service have a capacity for RNA viral load. Seventeen percent of all health facilities assessed have renal or liver function test. All higher clinic and medium clinics have renal

or liver function test. Health center have the lowest (7%) in having renal or liver function test.

The availability of the test were greatly vary across the regions, none of the facilities in Gambella and six percent of facilities in Oromia and Benishangul Gumuz regions have laboratory diagnostic capacity for renal or liver function than facilities in other regions. In Dire Dawa, Addis Ababa, and Harari the availability of this test is 85%, 66%, and 56% respectively. The survey assessed only the availability of first line adult ART regimens in facilities for ARV prophylaxis for adult treatment as a single dose, double or triple or fixed drug combination that offering antiretroviral viral prophylaxis. Among all health facilities assessed that offer ART service, 98% of them have first-line adult ART regimen. Reasonably, the drug is available in all facility types except in lower clinics (not available).

Table 4: Guidelines, trained staff, and laboratory diagnostic capacity for antiretroviral therapy services, 2014

Background characteristics	% of facilities offering ART services ¹	Number of facilities	% of facilities offering ART services		Laboratory diagnostic capacity for				First-line adult ART regimen available ⁴	Number of facilities offering ART services
			ART guidelines	Trained staff ²	Complete blood count ³	CD4 cell count	RNA viral load	Renal or liver function test		
Facility type										
Referral Hospital	94	2	93	63	100	83	0	93	100	2
General Hospital	87	7	90	69	72	54	4	68	98	6
Primary Hospital	83	3	95	63	65	53	0	44	100	2
Health Center	28	182	85	49	21	8	0	7	98	50
Higher Clinic	1	13	70	100	70	0	0	100	100	0
Medium Clinic	0	37	100	100	0	100	0	100	100	0
Lower Clinic	0	119	-	-	-	-	-	-	-	0
Managing authority										
Government	31	190	86	52	28	16	0	14	98	58
Other governmental	6	2	49	0	100	100	0	100	100	0
Private for profit	1	163	90	73	83	19	5	95	100	2
NGO	7	8	100	21	72	41	0	72	90	1
Region										
Tigray	28	22	99	78	39	18	2	18	99	6
Afar	25	5	78	89	47	20	0	20	100	1
Amhara	17	87	74	60	9	19	0	15	94	15
Oromia	19	116	87	38	34	15	0	6	100	22
Somali	8	8	91	51	34	43	0	26	100	1
Benishangul Gumuz	25	4	100	87	31	12	0	6	100	1
SNNP	9	80	98	36	25	11	0	14	100	7
Gambella	10	6	70	15	9	0	0	0	100	1
Harari	26	2	89	89	44	33	0	56	100	1
Addis Ababa	17	31	86	71	66	18	1	66	100	5
Dire Dawa	26	3	100	69	85	23	0	85	100	1
Urban/rural										
Urban	26	149	88	56	30	21	1	26	100	39
Rural	10	214	83	47	32	9	0	3	95	22
Total	17	363	86	53	31	17	0	17	98	61

Discussion

The availability of HIV testing system helps the people to know their HIV status. This enables people to make informed decisions about HIV prevention options, including services to prevent children from becoming infected with HIV, male and female condoms, harm reduction services for people who inject drugs, voluntary medical male circumcision and pre-exposure and post-exposure prophylaxis (Sidibé 2018). More than half of all facilities have HIV testing system in the facility or else agreed external testing site (or in affiliated laboratory). Among that more likely referral hospital (100%) and less likely lower clinic (6%) have HIV testing system in the facility.

This result shows lower than the service provision assessment survey at 2004 and 2010 in Kenya. Almost three fourth of facilities respectively offering the VCT testing services at least one day a week services by type of facility, managing authority and province. Among that more likely Stand-alone VCT (100%) have VCT testing system in the facility (NCAPD, MoH, CBS, and ORC Macro 2005; NCAPD, MMS, MPHS, KNBS, and ICF Macro 2011). Facilities in Gambella region (22%) were the lowest to have HIV testing systems than facilities in other regions. However, Gambella region were the highest

prevalence rate of HIV/AIDS. In 2005 regionally, Gambella, Addis Ababa, and Harari had the highest prevalence at 6.0, 4.7 and 3.5%, respectively. While in the 2016 survey the highest prevalence (4.8%) was observed in Gambella regional state (Getiye Dejen Kibret 2019). One of the factor might be, there were not male circumcision practice in Gambella Regional State. Therefore, Voluntary Medical Male Circumcision (VMMC) is considered to be one of HIV prevention intervention strategies and has been implemented since 2008, targeting adult males (15+ years) first and gradually adolescent boys (10-14 years). The cumulative number of VMMC up to 30 September 2017 is 76,649 (Federal HIV/AIDS Prevention and Control Office 2018).

Among all assessed health facilities, 27% of facilities offer HIV/AIDS care and support services. Among the facilities, referral hospitals more likely (91%) and lower clinics less likely (10%) to offer HIV/AIDS care and support services. This result is much lower than SPA survey at 2010 in Kenya. Sixty four percent of facilities offering HIV/AIDS care and support services (NCAPD, MMS, MPHS, KNBS, and ICF Macro 2011). This needs great attention since dissatisfaction with healthcare services were risk factors for ART discontinuation (Adal 2019).

People living with HIV/AIDS are at higher risk of developing opportunistic infections. Care and support services include treatment for opportunistic infections and for symptoms related to HIV/AIDS. This study shows that the health facilities were providing systemic IV treatment for fungal diseases, treatment for Kaposi's sarcoma, palliative care, nutritional rehabilitation with 46%, 32%, 73%, and 72% respectively. These results were much higher than SPA survey at 2010 in Kenya. They were providing systemic IV treatment for fungal diseases, treatment for Kaposi's sarcoma, palliative care, nutritional rehabilitation with 17%, 10%, 22%, and 50% respectively (NCAPD, MMS, MPHS, KNBS; ICF Macro 2011).

Antiretroviral therapy helps people with HIV live longer, healthier lives and reduces the risk of HIV transmission. People with AIDS should start ART immediately (US. Department of Health and Human Services 2019). Overall, 17% of all health facilities excluding health posts offer ART for HIV/AIDS patients. The facilities provide ART medical treatment follow-up services including community-based service. These ART services are more likely offered in referral hospitals (94%) and less likely offered in clinics (less than 1%). At the regional level, among the facilities assessed; Somali (8%), SNNP (9%), and Gambella region (10%) are less likely to offer the service than facilities in other regions. Antiretroviral therapy guidelines are available in 86% of the facilities that prescribe ART for HIV/AIDS patients and/or provide ART medical treatment follow-up services including community-based service. This result goes in line with SPA survey at 2010 in Kenya. Fifteen percent of facilities prescribe ART and provide medical follow-up services (NCAPD, MMS, MPHS, KNBS, and ICF Macro 2011). Although there are a need to improve HIV/AIDS service provision facilities as a whole, there are some parts which require more attention. Facilities of HIV testing system, and HIV/AIDS care and support services, particularly at lower clinic need progress. On the other side, Ethiopia SPA+ 2014 is the first national coverage survey and still not done again. This is one of the strength of this study. However, we could not get enough variables for further analysis, since this study is secondary analysis.

Conclusion

Less than half of HIV testing service provider received in-service training. About one third of health facilities workers not have access for PEP. More than one third of the facilities not having an HIV testing system in the facility or else agreed external testing site (or in affiliated laboratory). Generally, HIV testing system in Ethiopia was low.

Conflict of interest: The authors declared that they do not have conflict of interest

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Original article

Knowledge, attitude and practice towards breast cancer and its early detection measures among female students of Rift Valley University, Gullele campus, Addis Ababa, Ethiopia

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Abstract

Introduction: Globally cancer is among the top leading causes of death. Breast cancer is the most common cancer in women worldwide. Health education and communication have been found to promote health-seeking behavioral change with sufficient utilization and compliance to breast cancer prevention and screening strategies.

Objective: This study was designed to assess knowledge, attitude and practice regarding breast cancer and its early detection measures among female students of Rift Valley University.

Method: A cross-sectional study design was used to select 310 study participants randomly. Self-administered questionnaires were used to collect information. The collected data were entered into SPSS version 20. Simple statistics such as frequencies, means, and standard deviations, binary and logistic regression were done as appropriate.

Result: A total of 310 study participants participated in the study, of these, only 2.8% of them had good knowledge about risk factors, signs and symptoms and early detection measures of breast cancer and 59.2% had a positive attitude towards breast cancer early detection measures. About 29.4% of the study participants had done breast self-examinations, from these only 6.8% of them practiced monthly. Level of education of the participant, parents' occupation and program of enrolment were statistically significant association knowledge. Students whose parents' occupation is health-related are more likely to practice breast self-examination than others with Adjusted odds ratio 7.654 (1.92, 16.12) (95% CI).

Conclusion: The finding of this study revealed that study participants have poor knowledge of risk factors, early detection measures and early warning signs of breast cancer. Improving women's awareness and practice mainly through health education should be given emphasis.

Keywords: Breast cancer, Cancer prevention, Knowledge about breast cancer, breast cancer early detection

Introduction

Breast cancer is the most common cancer in women worldwide. The incidence of breast cancer is on the rise with report of 1.7 million new cases in the year 2012. The incidence varies across continent and countries with the highest being in the United States and Canada and the lowest rate recorded in Asia. The GLOBACAN registry revealed breast cancer as the most frequent diagnosed cancer in women in 140 countries worldwide. Even if the incidence rate remains highest in more developed regions, the mortality is relatively much higher in less developed countries due to lack of early detection and access to treatment facilities (Parkin et al. 2001; WHO 2014; Seif and Aziz 2000). Reports from South Africa, Uganda and Nigeria showed that breast cancer is among the leading cancer in women. This is also true in Ethiopia where breast cancer is the leading cancer in women followed by cervical cancer.

It is estimated that around 10,000 Ethiopian women and men have breast cancer with thousands of more cases unreported as women living in rural areas often seek treatment from traditional healers before seeking help from the government health system (Seif and

Aziz 2000; ECA 2008; Parkin 1994, Karayurt et al. 2008).

The key strategy in reducing breast cancer-related mortality, improving breast cancer outcome and survival is screening to early detect and manage breast cancer. This is very important because an excellent prognosis is directly associated with the stage at which the tumor is initially detected and how localized the lesion is. Early diagnosis usually results in successful treatment before metastasis and signifies a better outcome (Parkin 1994). Recommended preventive techniques to reduce breast cancer morbidity and mortality include breast self-examination (BSE), clinical breast examination (CBE), and mammography. CBE and mammography require a hospital visit and specialized equipment and expertise whereas BSE is an inexpensive tool that can be carried out by women themselves (Karayurt et al. 2008).

Even though BSE is a simple, quick, and cost-free procedure, the practice of BSE is low and varies in different countries. Several reasons like lack of time, lack of self-confidence in their ability to perform the technique correctly, fear of possible discovery of a

lump, and embarrassment associated with manipulation of the breast have been cited as reasons for not practicing BSE (Karayurt et al. 2008).

There is evidence that women who correctly practice BSE monthly are more likely to detect a lump in the early stage of its development, and early diagnosis has been reported to influence early treatment to yield a better survival rate (Petro-Nustas and Mikhail 2002).

Health education and communication have been found to promote health-seeking behavioral change with sufficient utilization and compliance to breast cancer prevention and screening strategies. However, adequate research was not done in the study area and awareness about breast cancer among Ethiopian women is not well documented. This paper, therefore, attempts to assess the level of knowledge and attitude towards breast cancer and practice of self-breast examination among female students of Rift Valley University, Gullele Campus.

Materials and Methods

The study was conducted at Rift Valley University College (Gullele campus) which is one of the private teaching institutions in Ethiopia. Previously its official name was Rift valley University College and was renamed "Rift Valley University" in 2014. Gullele campus has five undergraduate programs or departments, two postgraduate programs and a total of 5125 undergraduate students, out of which 1650 were females.

The study design is an institution based cross-sectional study concerning KAP of breast cancer and its early detection measures among female undergraduate students of Rift Valley University. The study was conducted from January 8 to March 15, 2017. The study population was regular year 1-4 undergraduate female students who were randomly selected from the department of computer science, Marketing, Business administration, Accounting and Management. The study campus (Gullele campus) is stratified into five departments and the sample was distributed to each department using the probability proportional to their size or number of female students. Finally, the study participants were selected randomly from those departments. Data were collected using self-administered questionnaires and then checked for completeness, accuracy, and consistency by investigators, after collecting the data every day. The collected data entered into SPSS version 20 for analysis. Simple descriptive statistics such as

frequency and mean were done. Knowledge, attitude and practice of students towards breast cancer are the dependent variables of this study. It is said Poor knowledge for those who answered $\leq 50.0\%$ of knowledge question; Satisfactory knowledge for those who answered $51.0\% - 70.0\%$ of knowledge questions; Good knowledge for those who answered $(>70.0\%)$ of knowledge questions; Positive attitude for a score above the mean and Negative attitude for a score below the mean. In this study, practice refers to the actual application of breast self-examination in early detection of breast cancer.

Bivariate analysis was done to determine the relationship between independent and outcome variables. The variables included in the multivariate logistic regression were variables with $p\text{-value} \leq 0.2$ on the bivariate analysis. Multivariate logistic regression was used to assess the relationship between independent variables with outcome variables and to control confounding effect. The result of the final model expressed in terms of Odds Ratio (OR) and 95% confidence intervals (CI) and statistical significance will be declared, if the $P\text{-value}$ is ≤ 0.05 .

The ethical approval and clearance letter of permission was obtained from St. Paul's Hospital Millennium Medical College (SPHMMC) IRB before data collection; informed consent was obtained from all study participants before collecting data.

Results

A total of 310 of study participants involved in this research making a response rate of 94%. Nearly half (48.8%) of the participants were aged (20-25). More than half (65.6%) of them were single and Orthodox Christian (52.3%) in religion. Only a few of them had parents with health-related occupation; only 3.5% of them had a family history of breast cancer and 4.1% of them had a personal history of breast mass (Table).

Regarding the study participants' knowledge, about risk factors for breast cancer (58.4%) of them mentioned smoking as a risk factor, followed by a high-fat diet (47.2%). Overall, 1.1%, 6% and 92.8% of the study participants have good, satisfactory and poor knowledge about risk factors for breast cancer. About 67.5% of the study participants mentioned breast lump as a sign of breast cancer followed by pain in the breast (65%). Overall, 19.1%, 21% and 59.9% of the study participants have good, satisfactory and poor knowledge about signs and symptoms of breast cancer.

Table 1: Socio-demographic characteristics of under graduate regular female students of Rift Valley University

Variable	Description	Frequency	%
Age	<20	75	23.4
	20-25	157	48.8
	26-30	62	19.4
	>30	16	5.0
Educational status	Year 1	98	30.6
	Year 2	74	23.1
	Year 3	73	22.8
	Year 4	65	20.0
Marital status	Single	210	65.6
	Engaged	67	20.9
	Married	26	8.1
	Divorced	7	2.2
Mother's occupation	Health related	38	11.9
	Non health related	272	88.1
Father's occupation	Health related	15	4.7
	Non health related	295	95.3
History of breast mass	Yes	13	4.1
	No	297	95.9
Family history of breast cancer	Yes	11	3.5
	No	299	96.5
Religion	Orthodox	162	52.3
	Muslim	45	14.5
	Protestant	100	32.3

In terms of means of diagnosis, CBE was the most common means of detecting breast cancer, mentioned by 250 (78.1%) of the participants, followed by ultrasound and SBE. Regarding their practice, 103(32.2%) of the participants reported that they know

how to perform self-breast examination. Similarly, the/a small number of the participants correctly identified the recommended frequency and age to start SBE. Overall 3.1%, 12.6%% and 84.4% of the study participants have good, satisfactory and poor knowledge about early detection measures of breast cancer (Table 2).

Concerning to the knowledge score, 1.1%, 19.1% and 3.1% of the participants were classified as having Good knowledge (>70.0%) on the risk factors, early warning signs of breast cancer and early detection measures respectively.

Forty-five percent of the study participants had a positive attitude toward breast cancer and its early detection measures. Nearly half of the 51.2% of study participants agree that any young woman can acquire breast carcinoma. 243 (76%) agreed on self-breast examination doesn't cause harm and 36% of them agreed upon undergoing mastectomy if necessary.

Less than one third (29.4%) of the study participants have done BSE before and 70.6% of them have not ever done BSE at all. The largest proportion (78%) of the study participants did BSE occasionally and 6(6.38%) monthly. Of the participants who practiced SBE37 (39%) started practicing SBE at the age of 20-25Years. The most common reason for not practicing SBE mentioned by the study participants was not having breastproblem1 91 (28.4%) followed by not knowing how to do SBE 51 (23.6%).

Table 2: Attitude towards breast cancer among under graduate regular female students of Rift Valley University

Variables	Agree n(%)	Strongly Agree n(%)	Neither Agree Nor Disagree n(%)	Disagree n(%)	Strongly Disagree n(%)
Breast cancer is a curable disease	33(10)	101(31.6)	58(18.1)	79(24.7)	39(12.2)
Long time Survival (> 5 year) after breast cancer is rare	48(15)	68(21.3)	66(20.6)	102(31.9)	26(8.1)
Breast cancer is highly prevalent and is a leading cause of deaths amongst all malignancies (cancers) in Ethiopia	32(10)	159(49.7)	70(21.9)	45(14.1)	4(1.3)
Any young woman including you can develop breast cancer	17(5.3)	147(45.9)	105(32.8)	36(11.3)	5(1.6)
Breast cancer cannot be transmitted from person to person	46(14.4)	82(25.6)	123(38.4)	42(13.1)	17(5.3)
Screening/self-breast examination helps in prevention of breast cancer	37(11.6)	160 (50)	79(24.7)	33(10.3)	1(0.3)
Self-breast examination causes no harm	101(31.4)	142(44.4)	42(13.5)	21(6.6)	4(1.3)
One should undergo mastectomy(surgical removal of breast) if necessary	16(5)	100(31.3)	110(34.4)	66(20.6)	18(5.6)

In this study significant association found between educational status, parents' occupation, history of breast mass, family history of breast cancer and overall study participants of the respondents. Regarding breast examination practice statistically significant association found between educational status, parents' occupation, knowledge level of breast cancer, the

attitude of study participants and their practice of early detection measures. As the students' year of study increases their practice of BSE also increased. Students whose parents' occupation is health-related are more likely to practice BSE than others with AOR (95%CI) 7.654 (1.92, 16.12).

Table 3: Practice of early detection measures of under graduate regular female students of Rift Valley University

Variables		Frequency	Percent (%)
Do you practice BSE (Breast Self-Examination)	No	216	70.6
	Yes	94	29.4
If yes, then how often you practice Breast self-Examination?	Weekly	3	3.19
	Monthly	6	6.38
	Once in 3 month	12	12.77
	Occasionally	73	77.66
At what age you started practicing BSE (Breast Self-Examination)	At <20	15	15.96
	At 20-25	37	39.36
	At 26-30	30	31.9
	At 31-35	12	12.7
	At >35 of age	0	0.00
If you don't practice SBE regularly (monthly) then what are the reasons? One can answer more than one. (Skip those who practice regularly, once in a month)	I don't have breast problem	91	28.4
	I don't think It's necessary	43	19.9
	I don't feel comfortable doing this	3	0.9
	I don't know how to do that	51	23.6
	I haven't just decided	27	12.5
	Too frequent to practice	3	0.9
	It may be painful	2	0.6
	I'm afraid that it may reveal breast cancer	3	0.9
What would motivate you to practice BSE?	Health education about BSE by mass media	84	29.6
	Having history of breast mass	70	21.9
	knowing someone with breast cancer	20	6.3
	Having family history of breast cancer	41	12.8
Have you ever done your breast examination by any Doctor? (Clinical Breast Examination)	No	264	82.5
	Yes	46	14.4
(If not,)Why are you reluctant to participate in CBE (Clinical Breast Examination)?	I am Concerned about extra money	18	6.8
	I am Concerned about extra time	16	6.1
	Fear of outcome	14	5.3
	I am too young to participate	13	4.9
	I have no symptom of breast cancer	121	46.0
	No one recommended	54	20.5
	I am not sure about its benefit	27	10.3

Table 4: Factors affecting knowledge and BSE of Rift Valley University students

Characteristics		Knowledge		Odds Ratio	
		Satisfactory-Good	poor	COR(95%CI)	AOR(95%CI)
Year of study	1 st year	3(4.05)	71(95.95)	1	1
	2 nd year	14(14.14)	85(85.86)	3.34(1.56, 8.29)	3.73 (1.69, 8.37)
	3 rd year	7(10.8)	58(89.2)	8.57(3.66,25.78)	9.45(2.64, 21.76)
	4 th year	40(62.5)	24(37.5)	10.63(4.22, 26.07)	10.6(3.01, 23.29)
Family history of breast cancer	No	47(16.2)	243(83.3)	1	1
	Yes	14(70.0)	6(30.0)	12.06(4.22, 26.07)	11.08(1.86, 65.84)
Attitude of study participants	Negative	35(26.5)	97(73.5)	1	1
	Positive	74(41.6)	104(58.4)	3.97(0.92, 6.68)	1.839(0.21, 2.78)
Parents' occupation	Non-Health related	49(18.01)	223(81.99)	1	1
	Health related	16(42.10)	22(57.90)	9.01(3.98, 25.99)	5.16(1.02, 11.98)
Personal history of breast mass	No	55(18.5)	242(81.5)	1	1
	Yes	10(77.0)	3(23.0)	14.67(8.33, 31.77)	2.04 (0.46, 10.39)
Practice BSE					
Year of study	No		Yes		
	1 st year	62(83.78)	12(16.22)	1	1
	2 nd year	79(79.79)	20(20.21)	1.31(0.42,4.76)	0.88(0.01, 4.12)
	3 rd year	52(71.23)	21(28.77)	1.46(0.48,4.98)	1.01 (0.15, 7.12)
Knowledge Score	4 th year	23(35.93)	41(64.70)	6.46(1.98,22.13)	5.04 (0.80, 10.20)
	Poor	195(79.59)	50(20.41)	1	1
	Satisfactory	19(39.58)	29(60.42)	5.95(1.77, 20.99)	3.70 (0.68, 19.67)
	Good	2(11.76)	15(88.24)	29.25(4.99,170.11)	28.63 (4.87, 168.37)
Attitude toward breast cancer	Negative	130(95.5)	6(4.5)	1	1
	Positive	129(74.14)	45(25.86)	7.55(2.52, 24.67)	2.75(0.59, 12.87)
Parents occupation	Non Health related	208(76.47)	64(23.53)	1	1
	Health related	8(21.05)	30(78.95)	12.18(4.88, 29.59)	7.654(1.92,16.12)
Personal history of breast mass	No	214(72.05)	83(27.95)	1	1
	Yes	2(15.38)	11(84.62)	14.18(6.98, 32.11)	12.11(2.99, 28.79)

Those study participants who have good knowledge about risk factors, signs and symptoms and early detection measures are more likely to practice BSE than those with satisfactory and poor knowledge. Study participants who had a positive attitude toward breast cancer and its early detection measures were more likely to BSE than who has a negative attitude (Table 4).

Discussion

The finding of this study showed that study participants with good knowledge score for risk factors, early detections measures and warning signs of breast cancer was low. This is lower than other similar studies conducted among female university students in Malaysia, Iraq, and Nigeria (Hadi et al. 2010; Alwan et al. 2012; Isara and Ojedokun 2011) It is also lower than a study conducted among female students of Adama Science and Technology University, School of Health Science, Assela town, Ethiopia (Segni et al. 2016). This could be due to the effect of the study population which involved health science students having better knowledge than the students on which this study is performed. But it was similar with the findings of a study done among female students at Mekelle University, which showed that study participants with good knowledge score for risk factors, early detection measures and warning signs of breast cancer was 1.4%, 3.6% and 22.1% respectively (Hailu et al. 2014). This overwhelmingly poor knowledge score of female students may be explained by the notion that though this disease poses a serious burden to the public, the healthcare system didn't give enough emphasis on the prevention and early detection of the disease.

Regarding the knowledge of participant about early warning signs of breast cancer, this study showed that pain and lump in the breast were the most common warning signs of breast cancer mentioned whereas dimpling of the breast and lump under armpit were mentioned by few unlike to the findings from Malaysia and Jeddah (Hadi et al. 2010; Milaat 2000). The finding of this study indicated that study participants had better awareness of CBE than SBE; which is higher than evidence from Ibadan, Nigeria (Oluwatosin and Oladepo 2006). It reveals a potential pitfall in educating women about breast cancer screening. It is necessary to educate them on the differences as well as the respective role of breast cancer screening procedures/ modalities and the associated guidelines. It is foreseeable that if women perceive BSE to be equivalent to CBE, they may decide not to visit a medical provider under the assumption that the BSE alone is adequate screening. However, a higher proportion of respondents of this study failed to recognize SBE as a means for early

detection of breast cancer. In contrary to the finding from Nigeria (Oluwatosin and Oladepo 2006). This study reported that 46.3% of the study participants did not know self-breast examination as an early detection method of breast cancer. However, this finding was higher than evidence from Nigeria in which only 6.4% of the study participants identified BSE as a/the detection mechanism (Kayode et al. 2005). Despite slight variations among studies, the knowledge of study participants about BSE is poor. This implies that information, education and communication works are very limited. This finding also showed that the recommended breast self-examination once a month is not popular in an environment where there is no active national screening program.

This study reported that among those who know breast self-examination only 12.5% and 11.9% of the participants know the recommended age when SBE should start and the frequency of SBE respectively. This is by far lower than report from Nigeria, and Angola (Alwan et al. 2012; Oluwatosin and Oladepo 2006; Sambanje 2012). The finding of this study also showed that a significant proportion of 70.6% of the study participants reported that they have never practiced self-breast examination. This was almost in line with evidence from Malaysia, Iraq, Abuja and Ibadan Nigeria (Hadi et al. 2010; Alwan, Al-Attar and Tawfeeq 2012; Isara and Ojedokun 2011; Gwarzo et al. 2009). But it is higher than a study done in Enugu, Nigeria (Virginia 2012). This low level of Breast self-examination practice may be attributed to the notion that chronic diseases like breast cancer are not getting due attention at all levels of the health care system. In line with study from Nigeria and Malaysian (Virginia 2012; Redhwan and Al-Naggar 2011). The finding of this study showed that the major reason participants mentioned as a barrier to practicing breast self-examination was lack of knowledge on how to perform.

Conclusions

The finding of this study revealed that study participants has poor knowledge of risk factors, early detection measures and early warning signs of breast cancer. Nearly half of the participants have a positive attitude towards breast cancer early detection measures. Moreover, less than one-third of the study participants have practiced self and clinical breast examination. Not having breast problems and lack of knowledge of how to perform were the main reasons mentioned by the majority of the participants for not practicing breast self-examination. The country's public health sector and other concerned body should give attention to this issue and improve women's awareness and practice mainly through health education using mass media and other possible means.

Conflict of interest: The authors declared that they do not have conflict of interest

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Original article

Effect of maternal employment on the nutritional status of infants and children 6 to 23 months of age in Kolfe-Keraniyo Sub-city, Addis Ababa, Ethiopia

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Abstract

Introduction: As in many developing countries, malnutrition is one of the most important health problems among infants and young children in Ethiopia. Inadequate and/or inappropriate dietary intake and infectious diseases are the immediate/direct causes. This is in turn related to several socio-economic, demographic, child-care, and environmental factors.

Objectives: To determine the effect of maternal employment on the nutritional status of infants and children 6-23 months-old age in Kolfe-keraniyo sub-city, Addis Ababa, Ethiopia, 2019.

Methods: Facility-based cross-sectional study was conducted from July 1 to 30 in Kolfe-keraniyo sub-city selected four health centers. A simple random sampling technique was used to select 207 employed and 210 unemployed mothers. A structured questionnaire was used to gather quantitative data from the participants. Anthropometric measurements were taken from infants and young children. A 24-hours recall was used to collect dietary information on what the children had eaten for the 24-hours preceding the interview. Data were entered and analyzed using SPSS software version 24. Variables that had P-value of 0.2 or less on binary logistic regression were entered into multiple logistic regression to assess the association between dependent and independent variables and to control the effect of cofounders. P-value of ≤ 0.05 was taken as statistically significant.

Result: In this study, the prevalence of stunting, under-weight, and low weight for height in children of employed mothers were 6.8%, 7.2%, and 5.8% whereas in the children of unemployed mothers were 12.9%, 13.8%, and 8.1%, respectively. There was no statistically significant association between the maternal employment and nutritional status of their children. However, children from family size of four and above [AOR 3.45, 95%CI: (1.58, 7.52)] and, children who were not met minimum dietary diversity score [AOR 16.84, 95%CI: (5, 56.75)] were more likely to be stunted.

Conclusion: Family size, dietary diversity scores and vaccination status of children were prominent factors related to child malnutrition. Therefore, improve dietary diversity score of children by promoting good child feeding practices during postnatal follow up, educating mothers about family planning and importance of children vaccination are the best options to reduce malnutrition.

Keywords: Maternal employment, nutritional status, complementary feeding, minimum dietary diversity

Introduction

Child malnutrition and ill health are of utmost concern since deprivation in early childhood often causes irreversible damage to physical and mental health, reduces learning at school, and leads to lower incomes on adults (Habtamu 2014). Child malnutrition is the underlying cause of death in an estimated 45% of all deaths among children under-five years old (EDHS 2011). The magnitudes of stunting, underweight, and wasting in children under five years of age worldwide were 24.7%, 15.1 %, and 7.8%, respectively (WHO 2014). More than 150 million (39.9%) children under the age of five years in African countries are malnourished (Michael 2012). Ethiopia is one of the countries in sub-Saharan Africa with the highest rate of malnutrition. According to the 2016 Ethiopian Demographic Health Survey report, 38% of children

under age 5 are stunted or too short for their age, and 18% severely stunted. Ten percent are wasted or too thin for their height, including 3% who are severely wasted. Twenty-four percent of children under age 5 are underweight or too thin for their age, with 7% severely underweight (EDHS 2016).

Even though its patterns and prevalence vary significantly, malnutrition is a global issue (Hailu and Ababa 2015). Currently, 195 million under-five children are affected by malnutrition. Of this 90% of them live in sub-Saharan Africa and South Asia (Black et al. 2008). Ethiopia is among the nations with the highest under-five mortality rates in the world and at least 53% of mortality can be attributed directly or indirectly to malnutrition (Caulfield et al. 2004). Several factors that are associated with malnutrition

have been identified including poor breastfeeding and child feeding practices, lack of access to enough nutritious food, low levels of parental education and belonging to the low-income group (Ma'alin et al. 2016).

Women play multiple roles in the family that affect the health and wellbeing of all family members. In almost all societies around the world, they are assigned by custom to be the primary caregivers to infants and children. Activities carried out by women such as breastfeeding, preparing food, collecting water and fuel, and seeking preventative and curative medical care are crucial for children's healthy development. Women also play important roles as generators of family income, whether in household farms or businesses or as wage employees. In developing countries especially, such work is likely to be essential to family survival (UNDP 1995).

Maternal employment refers to mothers who are part of the workforce and earn wages or salaries (Mulu 2014). There have been remarkable changes in employment patterns globally, with a significant increase in employment rates among women (Dunifon et al. 2013).

Currently, women represent 39.8 % of the global labor force (Mulu 2014). Mothers' employment has increased rapidly due to increased household income demand as a result of increased prices of food. Thus apart from household responsibilities, many women are now employed outside the home to earn income for their families (Dunifon et al. 2013). In Ethiopia, the proportion of women currently employed rises from 27% in 2005 to 38% in 2010 (EDHS 2011; Gebreselassie 2005). Woman's entering the work field has both negative and positive effects, the one is that it increases the family income and it may give the women some economic independence and status in society. It however also increases her workload and cuts into the time that she has to spend with her children (Pandey 2007; Yeleswarapu 2012). Employed mothers may have insufficient time to satisfactorily breastfeed and prepare nutritive meals for their children considering their increased burden of work. They believe that, although there may be market substitutes such as; infant formula, ready foods, employed house help, the added expense may be too expensive for most mothers (Al-Binali 2012).

On the other hand, maternal employment could be beneficial to the child's nutritional status and health care if mothers earn enough income and show a strong preference for spending the income on the welfare of their children. Although income is the major resource required to pay for medical care, food, water, and housing that a child's health depends on, time spent in

child care including that by the mother and other household members, hours spent in breastfeeding, supervision of the child, preparation of bottles feed and complementary foods, taking them to health clinics and so on are also of great importance to the optimal health of the child (Smith 2002). Therefore, this study aims to assess the effect of maternal employment on the nutritional status of their children.

Materials and Methods

Facility-based cross-sectional study was conducted from July 1- 30, 2019 in Kolfe-keraniyo Sub-city Addis Ababa Ethiopia. Kolfe-keraniyo Sub-city is one of the 10 sub-cities of Addis Ababa the capital city of Ethiopia. As of 2011, its population was 546,219 of which 220,859 male and 235,360 female. The area of the sub-city is 61.25sq. km, with a population density of 7,448.5 per/sq.m There are 15 woredas and 11 health centers in the sub-city (AACAILIC 2006/2014). This sub-city was selected since there is limited study conducted before related to this topic.

All mothers with children age 6 to 23 months old in Kolfe-Keraniyo sub-city and visiting the health center during the data collection period were source population and all mothers with a child of 6-23 months old, who visited the selected health centers were the study population. Children who visited health centers only for vaccination and growth monitoring purposes and children from working and non-working mothers were included in the study. Children with chronic diseases and children whose mother died or a child and mother live separately were excluded. A mother is considered to be "non-working mother" if she reports she is not working at least for the last six months whereas a mother is considered to be a "working mother" if she reports earning income at least for the last six months by working either in government, NGO, public, private sector, or earnings based on self-managed income-generating work. To determine the sample size, single population proportion formula was used. With the prevalence statistical parameters formula, a total of 420 sample size was recruited by taking Confidence level of 95%; Power of 80%; P, prevalence of stunting in children of the unemployed mothers 46% (obtained from the previous study (Wondafrash et al. 2017) which has similar aims and sound finding reports related to the outcome variable); d-the permissible margin of error (the required precision=5%), and none response rate 10%. Four of the 11 health centers of the sub-city were selected by the lottery method. Study participants were drawn proportionally from the selected health centers. Finally, study subjects were selected by using a simple random sampling method. Nutritional status of the children (stunting, wasting and under-weight) was taken as the dependent variable of the study.

Referenced Z-scores while nutritional status of children was assessed from the median of WHO reference population:

Stunting

Moderate: Height-for-age between -2 SD to -3 SD,

Severe: Height-for-age <-3 SD

Wasting

Moderate: Weight-for-height between -2SD to -3 SD

Severe: Weight-for-height <-3 SD

Underweight

Moderate: Weight-for-age between -2SD to -3 SD

Severe: Weight-for-age <-3 SD

The questionnaire was administered to the mothers in face-to-face interview, then anthropometric measurements (weight and length) were taken from their children. Mothers were asked to recall foods and drinks that children had eaten for the past 24-hour preceding the interview. The anthropometric measurements of children were entered to ENA-SMART software for nutritional analysis and then transferred to SPSS version 24 for further statistical analysis. The collected data were entered and analysed by using SPSS software. Frequencies of descriptive statistics were presented using graphs and table.

Variables that had P-value of 0.2 or less on binary logistic regression were entered into multiple logistic regression to assess the association between dependent and independent variables and to control the effect of cofounders. P-value of ≤ 0.05 was taken as statistically significant. Ethical clearance was obtained from Santé medical college, Addis Ababa City Administrative Health Bureau, and communication was made with the officials of Kolfe-keraniyo sub city and selected health centers. The confidentiality of each study participants in sampled client information was assured. All participated individuals had informed about their right to refuse participation and data collectors were instructed not to attempt to force any one to participate.

Result

Socio-demographic characteristics of the study participants:

From a total of 420 mother-child pairs, 417 mothers were included in the study and the response rate was 99%. Of those 207(49.6%) were employed and 210(50.4%) were unemployed. Regarding maternal age, 102(49.3%) of employed and 91(43.3%) of unemployed mothers were found within the age range of 25-29 years (Table 1).

Table 1: Socio-demographic characteristics in study participants Kolfe-Keraniyo Sub-city, Addis Ababa, Ethiopia, 2019

Variable	Employed N (%)	Unemployed N (%)	Total N (%)
Age of mother			
18-24	65(31.4)	51(24.3)	116(27.9)
25-29	102(49.3)	91(43.3)	193(46.3)
>30	40(19.3)	68(32.4)	108(25.85)
Religion			
Orthodox	93(44.9)	87(41.4)	180(43.15)
Muslim	82(39.6)	100(47.6)	182(43.6)
Protestant	32(15.5)	23(11.0)	55(13.25)
Marital status			
Married	194(93.7)	205(97.6)	399(95.67)
Divorced	13(6.3)	5(2.4)	18(4.35)
Educational status			
College and above	99(47.8)	52(24.8)	151(36.3)
High school	51(24.6)	47(22.4)	98(23.5)
Elementary school	30(14.5)	66(31.4)	96(22.95)
Read and write only	18(8.7)	25(11.9)	43(10.3)
Unable to read and write	9(4.3)	20(9.5)	29(6.9)
Monthly income of husband			
Less than Birr 500	8(3.9)	2(1.0)	10(2.45)
Birr 500 - Birr 2000	12(5.8)	36(17.1)	48(11.45)
Birr 2001- Birr 4500	46(22.3)	44(21.0)	90(21.65)
More than Birr 4500	78(37.9)	66(31.4)	144(34.65)
Don't Know	62(30.1)	62(29.5)	124(29.8)
House hold size			
2-3	85(41)	80(38.1)	165(39.6)
4	100(48.3)	81(38.6)	181(43.45)
5 or more	22(10.6)	49(23.4)	71(17)
Head of the household			
Male	77(37.2)	204(97.1)	286(67.15)
Female	38(18.4)	5(2.4)	43(10.4)
Both	92(44.4)	1(0.5)	93(22.45)

About 180(43.15%), 182(43.6%), and 55(13.25%) of the study participants were orthodox, Muslim, and protestant followers, respectively. Majority of employed (93.7%) and unemployed (97.6%) mothers

were married. Pertaining to the educational status of mother, 99(47.8%) of employed and 52(24.8%) of unemployed mothers were attended college and above, 9(4.3%) of employed and 20(9.5%) of unemployed

mothers were unable read and write. When employed mothers were asked about the type of work they did, 64(31%) of mother were government employee, 47(23%) were self-employee, 46(22%) private sector employee, vender (13%), and daily laborer (9%).

Participants child characteristics: Ninty seven (46.9%) of employed and 106(50.5%) of unemployed mothers had children within the age range of 12-17 months. One hundred twenty two (58.9%) and

111(52.9%) of females and 85(41.1%) and 99(47.1%) of males were from employed and unemployed mothers, respectively. Regarding child birth weight, majority 174(84.1%) of employed and 177(84.3%) of unemployed were normal. All 207(100%) of employed and 210(100%) of unemployed mothers children were vaccinated according to their age and 231(55.4%) of the children were fully immunized from both employed and unemployed mothers.

Table 2: Participants' child characteristics by employment status in Kolfe-Keraniyo Sub-city, Addis Ababa, Ethiopia, 2019

Variable	Employed N (%)	Unemployed N (%)	Total N (%)
Age of child			
6-11	66(31.9)	34(16.2)	100(24.05)
12-17	97(46.9)	106(50.5)	203(48.7)
18-23	44(21.3)	70(33.3)	114(27.3)
Sex of child			
Female	122(58.9)	111(52.9)	233(55.9)
Male	85(41.1)	99(47.1)	184(44.1)
Birth weight			
LBW	14(6.8)	16(7.7)	30(7.75)
NBW	174(84.1)	177(84.3)	351(84.2)
HBW	19(9.2)	17(8.1)	36(8.65)
Child fever(last 2 weeks)			
Yes	41(19.8)	58(27.6)	99(23.7)
No	166(80.2)	152(72.4)	318(76.55)
Child cough(last 2 weeks)			
Yes	31(15)	46(21.9)	77(18.45)
No	175(84.5)	164(78.1)	339(81.3)
I don't know	1(0.5)	1(0.5)

Breastfeeding practice of mother: From the total study participants, 415(99.5%) had ever breastfed their children, of those 205(49.4%) of mothers were employed and the remaining 210(50.6%) were unemployed. Eighty-eight (42.5%) of employed and 67(31.9%) of unemployed mothers had given formula milk for their children before initiation of breastfeed. About 126 (60.9%) of employed and 127(60.5%) of unemployed mothers initiate breast-feeding during the first hour after delivery. The prevalence of exclusive breast feeding practice among employed and unemployed mothers was 74(35.7%) and 160(76.2%), respectively. One hundred sixtyseven (80.7%) of employed and 173(82.4%) of unemployed mothers were breastfed their children till the time of the survey, and 40(19.3%) of employed and 37(17.6%) of unemployed were not. Nearly nineteen (47.5%) of employed mothers were stop breastfeeding because of their working condition.

Complementary feeding practice and minimum dietary diversity of the child: Most of the study participants 200(96.6%) of employed and 207(98.6%) of unemployed mothers were started complementary feeding for their children, of which 123(61.5%) of employed and 39(18.8%) of unemployed were started before six months. Majority 343(82.2%) of both employed and unemployed mothers were feeding their children additional foods and fluids apart from breast

milk three or more times a day. Regarding the use of bottle feeding which has nipple, 129(63.3%) were employed and 78(37.7%) were unemployed. When mothers asked about child feeding practice apart from breast milk, from seven food groups which are listed in WHO indicators for assessing infant and young child feeding practice guideline 124(62%) of employed and 94(45.4%) of unemployed mothers were given four or more food groups for their children.

Mothers working characteristics: About 174(84.1%) of mothers were working for 5-6 days/week and 124 (59.9%) of employed mothers reported to work for 4-8hours/day, and 171(82.6%) of the mothers had no onsite child care at their workplace. During their working time, 11(5.3%), 26(12.6%), 170(82.1%) were used expressed breast milk, infant formula, and other liquids and foods, respectively.

Nutritional status of children: The result of Anthropometry demonstrates that the prevalence of wasting, stunting, underweight, and overweight among infant and young children of both employed and unemployed mother was 6.95%, 9.82%, 10.5%, 5.55%, respectively. The study result indicates that majority of employed mothers children (94.2%) and unemployed children (91.9%) had normal weight for age Z score and 29(6.95%) of both employed and unemployed mothers' children were wasted.

Table 3: Complementary feeding practice and Dietary diversity score of the child among employed and unemployed mothers in Kolfe-Keraniyo Sub-city, Addis Ababa, Ethiopia, 2019

Variable	Employed Number (%)	Unemployed Number (%)	Total Number (%)
Additional fluid/ food			
Yes	200(96.6)	207(98.6)	407(97.6)
No	7(3.4)	3(1.4)	10(2.4)
When did you start			
<6months	123(61.5)	39(18.8)	162(40.15)
>6 months	77(38.5)	168(81.2)	245(59.85)
How many times do you feed apart from breast milk			
1-2 times	37(17.9)	27(12.9)	64(15.4)
3 times	110(53.1)	84(40.0)	194(46.55)
>3 times	53(25.6)	96(45.7)	149(35.65)
Not yet	7(3.4)	3(1.4)	10(2.4)
Snack in b/n main meals			
Yes	164(79.2)	174(84.1)	338(81.65)
No	43(20.8)	33(15.9)	76(18.35)
Give infant formula			
Yes	52(25.1)	38(18.4)	90(21.75)
No	155(74.9)	169(81.6)	324(78.25)
Feeding bottle which has nipple			
Yes	129(62.3)	78(37.7)	207(50)
No	78(37.7)	129(62.3)	207(50)
Dietary diversity score			
Good (≥ 4 food groups)	124(62)	94(45.6)	218(53.8)
Poor (≤ 3 food groups)	76(38)	112(54.4)	188(46.2)

About 376(90.3%) of both employed and unemployed mothers children had the normal height for age Z score; 35(8.38%) and 6(1.44%) of children had moderate and severe stunting respectively. Regarding weight for height Z score 373(89.5%) of both

employed and unemployed mothers children had normal weight for their age, and 44(10.5%) of children were underweight. Pertaining to heavyweight for height Z score from the total 417 children 19(4.55%) and 2(1.0%) were overweight and obese, respectively.

Table 4: Nutritional status of children among employed and unemployed mother in Kolfe-Keraniyo Sub-city, Addis Ababa, Ethiopia, 2019

Variable	Employed N (%)	Unemployed N (%)	Total N (%)
Weight for height Z score			
Normal (+2 to -2SD)	195(94.2)	193(91.9)	388(93.05)
Moderate (<-2 SD to ≥ -3 SD)	12(5.8)	17(8.1)	29(6.95)
Height for age Z score			
Normal (+2 to -2 SD)	193(93.2)	183(87.4)	376(90.3)
Moderate (<-2 SD to ≥ -3 to)	13(6.3)	22(10.47)	35(8.38)
Severe (<-3 SD)	1(0.5)	5(2.38)	6(1.44)
Weight for age Z score			
Normal (+2 to -2 SD)	192(92.8)	181(86.2)	373(89.5)
Moderate (<-2 SD to ≥ -3 SD)	15(7.2)	29(13.8)	44(10.5)
(Heavy)Weight for height Z score(over weight)			
Normal (+2 to -2 SD)	194(93.7)	202(96.2)	396(94.9)
Over-weight (>2 SD)	13(6.3)	8(3.8)	21(5.05)

Factors influencing the nutritional status of children

Stunting: Stunting was to be influenced more by the size of family members and minimum dietary diversity score of children. Children from family size of four and above were more likely to be stunted as compared to children from family size of three or less [AOR 3.45, 95%CI: (1.58, 7.52)]. Also, children who were not met minimum dietary diversity score (MDDS) was

likely to be stunted compared to children who were met MDDS [AOR 16.84, 95%CI: (5, 56.75)].

Wasting: Wasting was found to be strongly associated with child vaccination status. The odds of not fully vaccinated children being wasted was [AOR 4.70, 95% CI (1.49, 14.87)] compared to fully-vaccinated children.

Table5: Association of child and maternal related variable with child stunting, under-weight and wasting in Kolfe-Keraniyo Sub-city Addis Ababa, Ethiopia, 2019

Variable	Wasting		Stunting		Nutritional status of children		Malnutrition	
Variable	COR(95%CI)	AOR(95%CI)	COR(95%CI)	AOR(95%CI)	Underweight COR(95%CI)	AOR(95%CI)	COR(95%CI)	AOR(95%CI)
Employment status								
Not employed/Empl	1.56(0.71, 3.42)	1.24(.46, 3.33)	2.02 (1.03,3.98)*	0.79 (0.34,1.82)	2.04 (1.06,3.93)*	1.20 (0.53,2.70)	1.93 (1.25,2.98)€	1.35 (0.79,2.32)
Family size								
≥ 4/<4	2.54(1.1, 5.88)*	1.76(.69, 4.48)	4.30 (2.17,8.54)§	3.45 (1.58,7.52)€	2.63 (1.31,5.28)€	1.75 (0.8,3.82)	4.05 (2.38,6.9)§	3.35 (1.83,6.13)§
4 th vaccination								
Not completed	3.25 (1.23, 8.64)*	4.7(1.49, 14.87)€	0.82 (0.24,2.79)	1.26 (0.31,5.05)	1.06 (0.36,3.16)	1.57 (0.45,5.44)	1.08 (0.51,2.27)	1.26 (0.53,2.99)
CF initiation time								
<6/≥6	1.10 (0.51, 2.40)	1.37 (.52,3.60)	0.38 (0.18,0.81)€	0.43 (0.18,1.06)	0.58 (0.29,1.15)	0.80 (0.35,1.84)	0.74 (0.48,1.15)	1.07 (0.61,1.87)
Food diversity								
Poor/good	18.33 (4.29,78.32)*	20.7 (4.67,91.94)§	19.21 (5.82,63.37)§	16.84 (5.56,75)§	32.88(7.8,137.89)§	30.01 (7.09,126.9)§	7.56 (4.62,12.39)§	7.02 (4.2,11.71)§

Significant level (*P*-value) for $\alpha = < 0.05$, < 0.01 and < 0.001 represented by *, € and §

Discussion

The present study was designed to determine the effect of maternal employment status on the nutritional status of 6 to 23 months old children in Kolfe-keranyo sub-city, Addis Ababa. In this study, the overall prevalence of stunting, under-weight, and wasting among children from both employed and unemployed mothers was 9.8%, 10.5%, and 6.95% respectively, which is lower than the stunting (37%) and underweight (21%) prevalence of the National Ethiopian Mini Demographic and Death Survey. This is could be due to the difference in sample size between the two studies, while the prevalence of wasting in this study was 6.95% which is consistent with EDHS report of 7 % (EDHS 2016).

The current study found that the prevalence of ever breastfeeding was 99.5%. The percentages in both groups were almost similar to EDHS 2016 reports of 97 % (EDHS 2016). In contrast, this study result is higher than the study done in Wolayta sodo town prevalence of ever breastfeeding was 90.8% and 82.6% among employed and unemployed mothers respectively (Eshete et al. 2017). The results of this study indicated that the prevalence of exclusive breast feeding among employed and unemployed mother was 35.7% and 76.2%, respectively. Recent studies on determinants of exclusive breastfeeding mention maternal employment as one factor that influences the practice (Mekuria and Edris 2015; Ogunba and Sciences 2015; Taddele et al. 2014).

The study conducted in Northwest Ethiopia, Injibara Town, showed the prevalence of exclusive breastfeeding practice was 44% and 65% among employed and unemployed mothers, respectively (Mekuanint 2014) which is comparable with this study finding. In Ghana, studies on maternal work and exclusive breastfeeding in parts of the country have looked into exclusive breastfeeding practice of formal sector working mothers, and have found that mothers in this sector are unable to practice exclusive breastfeeding as recommended by the WHO due to conditions prevalent at their work places. These studies found that exclusive breastfeeding rate among formal sector working mothers ranges from 10% to

50% depending on the type of work (Danso 2014; Gladzah 2013). The most startling finding was that, the prevalence of prelacteal feeding which was 42.5% and 31.9% among employed and unemployed mothers respectively, which is much higher than EDHS 2016 reports of 8%. It might be due to urbanization of the study area and the increasing number of cesarean section delivery 28.6%, which results delayed the contact hour of mothers with their child after delivery for different reason. According to EDHS 2016 report, infants in urban areas were more likely to receive prelacteal feeding (12%) than those in rural areas (7%). And children born to mothers with more than secondary education were more likely to receive a prelacteal feeding 17%, compared with children of mothers with secondary education or lower 7-8% (EDHS 2016). In contrast with this finding, the study done in Ghana revealed that employed mothers were less likely to practice prelacteal feeding compared to unemployed mothers. The negative association might have been as a result of more employed mothers having formal education than unemployed mothers (Akasise 2017).

As mentioned in the literature review, Mothers' employment status was strongly associated with complementary feeding (Solomon et al. 2017). The result of this study showed that, 61.5% of employed and 18.8% of unemployed mothers were started complementary feeding for their children before six months of age. The high percentage of employed women was started complementary feeding as early as the recommended age compared with their unemployed counterparts. Previous studies indicated that inadequate time for childcare by working mothers could influence the complementary feeding initiation and practices of mothers. A study in northern Ethiopia revealed that house-wives (unemployed mothers) were more likely to initiate timely complementary feeding compared to employed mothers (Shumey et al. 2013).

Dietary diversity is a proxy for adequate micronutrient density of foods. Minimum dietary diversity assesses food intake among children age 6 to 23 months from at least four food groups. The cut-off of four food groups is associated with better-quality diets for both

breastfed and non-breastfed children. Consumption of food from at least four food groups means that the child has a high likelihood of consuming at least one animal source of food and at least one fruit or vegetable in addition to a staple food (grains, roots, or tubers) (EDHS 2016). Inappropriate complementary feeding practices increase the risk of under nutrition, illness and mortality among children under the age of two years (WHO 2003, 2009). Despite have optimum breastfeeding, children who do not receive sufficient dietary diversity and meal frequently after 6 months of age could become stunted (Black et al. 2008).

In this study, 62% of employed and 45.4% of unemployed mothers were given four or more food groups for their children prior to the data collection day, surprisingly, it is much higher than the reported national (EDHS 2016). On the other hand, which was comparable with the study done in Addis Ababa 59.9% (95% CI: 54.7–65.3) of the children aged 6–23 months had fed on four or more food groups meeting the minimum requirement of diversified diet (Solomon et al. 2017). In fact, the study found that a strong association between dietary diversity scores of children and all forms of malnutrition (stunting, underweight and wasting). Another important finding was that maternal educational attainments of secondary and above were significantly associated with minimum dietary diversity compared to those mothers who had no formal education. This finding is consistent with another study done in Addis Ababa (Solomon et al. 2017).

Another important finding was that, 100% of both employed and unemployed mothers child were vaccinated according to their age, and 55.4% of the children were fully immunized from both employed and unemployed mothers. This was highest from national survey report of 89% (EDHS 2016).

The overall result showed that there was no statistically significant association between maternal employment status and nutritional status of their children. However, Family size, minimum dietary diversity score of children was strongly associated with stunting. Wasting was found to be influenced more by children vaccination status. All maternal and child characteristics except for family size, children vaccination status and dietary diversity score left insignificant for the association with child nutritional status. Although, these results differ from studies which were done in Adama town (Wondafrash et al. 2017), it was consistent with a study done in Wolayta sodo town, which reported the same insignificant association (Eshete et al. 2017). In general, in this study family size, vaccination status and dietary diversity score of children was the most important

factors which influenced children nutritional status positively or negatively. This study shares the common limitation of the cross-sectional study – difficult to make a causal association. As the study considered the 24-h recall method to assess the dietary diversity score of children, it might not accurately reflect participants past feeding dietary habit and there might be a recall bias.

Conclusions and Recommendations

In this study, that prevalence of stunting, underweight and wasting among children 6 to 23 months old of employed and unemployed mothers was lower compared to the national reports. There was no statistically significant association between maternal employment and child nutritional status. However, the family size and minimum dietary diversity score of children were strongly associated with stunting. Wasting was found to be influenced more by children vaccination status. Therefore, nutritional intervention initiatives should focus on promoting family planning, motheral education on the importance of child vaccination and good dietary diversity practice, especially during postnatal followup.

Competing interest: The authors declare that they do not have competing interest.

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Review article

Overview on the impacts of nutrition-sensitive intervention on dietary diversity and nutritional status of women and children in developing countries

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Abstract

Introduction: Globally, two billion people suffer from micronutrient deficiencies, 151 million children under five suffer from stunting, and millions more have impaired cognitive development related to poor nutrition. This is partly due to insufficient consumption of animal-sourced foods, which supply multiple bioavailable nutrients that are lacking in cereal-based diets.

Objective: To synthesize evidence on the impact of nutrition-sensitive intervention on dietary diversity and nutritional status of women and children focusing on developing countries

Methods: The review is based on a systematic search of the published and unpublished literature. No institutional review approval was required for this study as humans were not involved.

Results: It was analyzed to see what previous efforts related to enhancing the dietary diversity of women and children were in place. Based on this, six studies showed that children under 5 years of age suffer from stunting caused by diets of insufficient quality and quantity, improper care and feeding practices in early life. Besides, it was found that the knowledge about the linkages between agriculture and nutrition are still limited. The major gap observed in nutrition-sensitive agricultural interventions is found to be lack of multi-sector collaboration for tackling malnutrition. None of the studies assessed showed whether nutrition-specific interventions should be jointly or separately applied for tackling malnutrition.

Conclusion: It is found that the knowledge about the linkages between agriculture and nutrition are still limited. A multi-sectorial approach is mainly required to tackle nutrition security in general and dietary diversity in particular.

KeyWords: Women of reproductive age, dietary intake, nutrition education, healthy eating, diet diversity

Introduction

According to FAO, WFP, and UNICEF, 815 million people were suffering from hunger in 2016, a 38 million increase compared to the previous year (FAO et al. 2015). Around 155 million children have stunted growth due to poor nutrition. Levels of nutrient deficiencies are also alarmingly high: two billion people suffer from micronutrient deficiencies, also known as “hidden hunger.” Unless urgent and effective action is taken, more than half of the world’s population will suffer from at least one type of malnutrition by 2030 (Mozaffarian et al. 2018).

Worldwide, malnutrition accounts for 45% of child mortality (Black et al. 2013). Africa is the continent that has made the least progress in reducing the prevalence of undernutrition, and after a decline, undernutrition is on the rise again (Pedersen and C.S. 2018). Data indicates that 25% of the world’s under five years children are stunted, and this prevalence increases to 38% in Sub-Saharan Africa (UNICEF et al. 2017). Maternal short stature, a long-term consequence of stunting in girls, is further associated with fetal growth restriction, which can lead to

neonatal death and stunting in the next generation (Katz et al. 2013). Agricultural development aimed specifically at improving the diets of women of reproductive age is crucial, therefore, to ending the intergenerational cycle of hunger and malnutrition, and restoring the bridge between agriculture and health is at the highest importance.

Stunting is a consequence of chronic nutritional deprivation that can begin during and even prior to pregnancy due to maternal malnutrition and other in utero adversities. Child undernutrition is associated with high child mortality and morbidity (Black et al. 2013), poor motor and cognitive development, lower educational attainment, and economic productivity in adulthood (Black et al. 2013). Despite investments in agriculture and gains in productivity of food staples in Africa, the number of children who are stunted due to malnutrition is climbing (Stevens et al. 2012).

Achievements in food security have not been translated to improved nutrition and health at the household level (International Food Policy Research Institute 2015). The scale of malnutrition across the continent continues to be high, with 58 million under

five years of age children too short for their age (stunted), 13.9 million weighs too little for their height (wasted), and 10.3 million are overweight (Covic et al. 2016). An estimated 163.6 million children and women of reproductive age are anemic (Oyedele 2017), while more than 220 million people are estimated to be calorie deficient (FAO et al. 2015). Adult obesity is also on the rise in all 54 African countries, with about eight percent of adults over 20 are obese (Adeboye et al. 2012).

The ripple effects of malnutrition extend beyond the affected individuals to the society and economy. Agricultural development initiatives have the potential to improve the nutrition of those most vulnerable to malnutrition, viz. women of child-bearing age and children as well as the general population. However, the initiatives must be specifically designed to address nutritional goals (Ruel and Alderman 2013), with rigorous evaluation of the impact on nutritional outcomes. According to FAO et al. (2018), childhood overweight affected 38.3 million children; with Africa and Asia representing 25 percent and 46 percent of the global total respectively.

Research on the potential impact of interventions in agriculture on nutrition outcomes is of particular relevance in developing countries where agriculture-related activities are a major source of livelihoods for large sections of society and where the population suffers from one of the highest global burdens of malnutrition in all its forms. This literature review aims to assess the strength of the available evidence that agricultural interventions have an impact on intermediate and final nutrition outcomes, especially on the dietary diversity of women and young children.

Materials and Methods

A range of databases, journals and grey literature sources were searched, and papers were included if they explicitly addressed quality assurance within the paradigm. A meta-narrative approach was used to review and synthesise the literature.

Eligibility criteria

Inclusion criteria: Randomized control studies published from 2010 to 2019 designed to evaluate multi-strategy interventions. For the review, women of childbearing age were defined according to the World Health Organization definition of people aged 15–49 years, and developed countries were identified using the World Bank's definition (Vander and Wynn 2018).

Results and Discussion

Literature search: The review was based on a systematic search of peer-reviewed literatures. Two dominant narratives were interpreted from the literatures: the first focuses on demonstrating quality within research outputs; the second focuses on principles for quality practice throughout the research process. The second narrative appears to offer an approach to quality assurance that befits the values of the overview, emphasising the need to consider quality throughout the research process. The literature search conducted on five databases and reference lists of previous literature reviews to identify peer-reviewed studies published between 2010 and 2019, detailing *impacts of nutrition-sensitive agricultural interventions on nutritional outcomes in the form of dietary diversity on women and young children*. The search was broken down by interventions of the following types: *nutrition education interventions; home gardens; consumer behavior; poultry intervention; and animal source food promotion*.

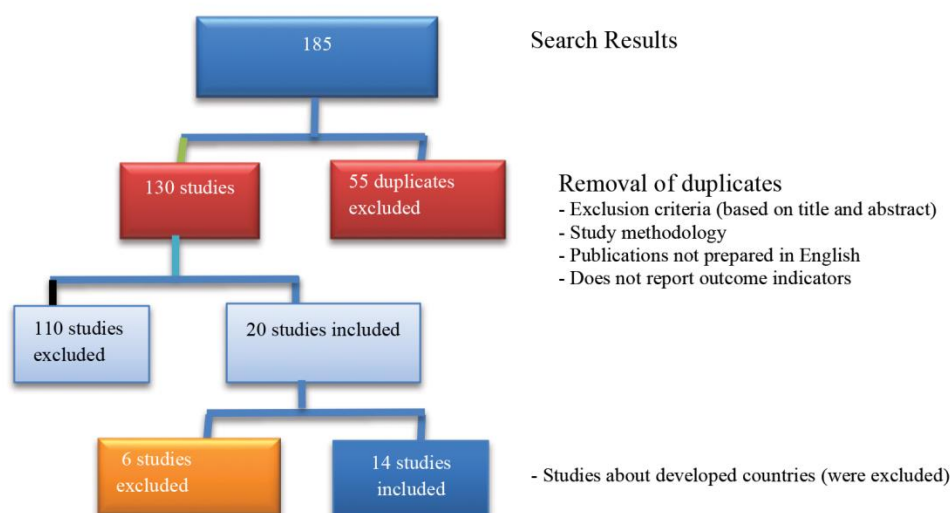


Figure 1: Stages of the screening process

During the search, more than 185 related published articles were found, but only 14 qualified based on set inclusion and exclusion criteria. A program theory of the interventions was outlined, and the efficacy of the interventions on the following four outcome indicators was assessed: nature of intervention; women dietary diversity; children dietary diversity; and children's nutritional status. No ethical approval was required for this study as humans were not involved.

Challenges in consumption and consumption behavior:

Popovic and Bossink (2019) pointed out that although consumers do value sustainable products in the sense of being, e.g. environment friendly or otherwise 'ethical', daily purchasing behavior is often not consistent with this. These results indicate that public policies need to use a mix of instruments from market-based instruments such as taxes and labeling to so-called command and control mechanisms (legislation and other regulation) over information instruments (e.g. educational campaigns). While consumption behavior is one of the determinant factors for malnutrition and still the world currently produces enough food to feed everyone, over a billion men, women and children go to bed hungry every night. As of 2010, a total of 925 million suffered from chronic hunger: 578 million people in the Asia Pacific region, 239 million in Sub-Saharan Africa, 53 million in Latin America, 37 million in North and North East Africa, and just a little over 19 million in the developed countries (Shah 2013).

Beckline and Kato (2014) analyzed data and concluded that there was a substantial modification in consumer food preferences within the past five years or after the 2008 food riots. These factors included but were not limited to cultural background, age and seasonal variation, gender, purchasing power, palatability, and nutrient content. Cultural background, seasonal changes, age, purchasing power, gender, and time frame are more potent factors than palatability and nutrient content (Beckline and Kato 2014). Consumers have been given an important role in pursuing sustainable development, but progress in terms of changing consumption patterns has been small. This is often ascribed to a lack of appropriate knowledge and information (Gjerris et al. 2016).

Past efforts on enhancing dietary diversity of women and children:

Children under five years of age suffer from stunting caused by diets of insufficient quality and quantity, improper care and feeding practices in early life, and high rates of infectious disease during infancy and childhood. One of the World Health Organization's recommendations to prevent chronic malnutrition is to promote the consumption of nutrient-dense, diverse, locally available foods.

However, this can be a challenge for families in poor communities who earn very little income, have limited access to fertile land and safe water for food production, and have many dependents to feed (Picchioni et al. 2017). Childhood undernutrition is associated with over a third of child mortality globally (Shetty 2018). Nutrition-sensitive, multisectoral programs have therefore received increasing attention. Nonetheless, the knowledge about the linkages between agriculture and nutrition is still limited (Picchioni et al. 2017).

Zaba et al (2014) argued that healthy diets are often less affordable than unhealthy diets, and high prices for nutritious foods (e.g. fruits, vegetables, and animal-source foods) are one of the main barriers that prevent vulnerable populations from adopting healthy food choices. An unhealthy diet is one of the most critical risk factors that need to be addressed to tackle the triple burden of malnutrition and diet-related diseases (Zeba et al. 2014). To meet the minimum requirement for a healthy diet, women should obtain more than or equal to five food groups (FAO et al. 2016). Jckes et.al (2017) undertaken a 10-week nutrition education and supplemental feeding program and concluded that the weekly education and supplementary feeding program benefited children in terms of dietary diversity and frequency of meals, and caregiver knowledge of feeding one to two months after program completion (Ickes et al. 2017).

Role of nutrition-sensitive agriculture in enhancing dietary diversity

Importance of nutrition education on dietary diversity: Nutrition education helps people to improve their diet through discussion, demonstration and practice. It usually targets the community to enhance caregiver feeding practices and children's dietary diversity and the frequency by which they are fed (Kulwa et al. 2014). Nutrition education as one form of nutrition-sensitive interventions addresses the underlying causes of maternal and child malnutrition; such as food security and access to health services and resources at the maternal, household, and community levels for caregiving and include specific nutrition goals and actions (Reinhardt and Fanzo 2014).

According to Ruel et al. (2013), examples of nutrition-sensitive interventions or programs include agriculture and food security programs; social safety nets; early child development; women's empowerment; schooling; water, hygiene, and sanitation; and health and family planning services (Ruel et al. 2013). Nutrition education programs are usually targeted at highly vulnerable segments, such as those who live in lower socioeconomic status, lower nutritional status and low educational level. During the past decade,

several educational intervention programs have been published and added new evidence for the effects of educational intervention on children's growth and nutritional status. Nutrition knowledge can enhance the impact of production and income in rural households, especially crucial for women and young children. It can increase the demand for nutritious foods in the general population (Ruel et al. 2013).

Increasingly recognized as an essential catalyst for the success of food security and nutrition interventions, effective nutrition education ensures that increased food production/income translates into improved diets and improved nutrition status. According to Uccello et.al (2017) attitudes and practices influenced by education can be causes of poor nutrition. The authors further elaborated that education can influence the attitude people have towards fruit and vegetable consumption. This can be improved if the attitude towards food taboos, long-established dietary and snacking habits, agricultural production decisions, food distribution in the family, ideas about child feeding, misleading food advertising, ignorance of food hygiene is improve.

As Murendo et.al (2018), promoting consumption of iron-rich foods, hygiene, preservation, and nutrition gardens which are the entry points for behavioral change communications improves household members' nutrition knowledge especially for women. The improved nutrition knowledge boosts women's decision making and household members' nutritional status (Murendo et al. 2018). Nutrition education as one package for behavioral change communications is considered as important for smoothing the dietary transition to cheap processed foods rich in sugar, fat, and salt.

Trends and practices in nutrition-sensitive agriculture interventions: Unlike nutrition-sensitive interventions, nutrition-specific interventions address the immediate determinants of undernutrition in the form of micronutrient deficiencies either through dietary supplementation or by fortifying the commonly consumed food items with micronutrients (Shetty 2018).

However, nutrition-specific interventions alone, even if implemented at scale, will not meet the global targets for improving nutrition unless it is jointly implanted with nutrition-sensitive interventions (Bhutta et al. 2013). Nutrition-sensitive agriculture is a concept that aims to narrow the gap between available and accessible food and the food needed for a healthy and balanced diet for all people. It explicitly incorporates nutrition objectives into agriculture and addresses the utilization dimension of food and nutrition security, including health, education,

economic, environmental, and social aspects. As stated by Hodge et al. (2015), nutrition-sensitive interventions that incorporate agriculture when properly aligned with nutrition-specific approaches can help to address nutrition security and minimize the impacts of undernutrition on women and children. Research findings showed that increasing either food production or income is not sufficient to improve nutrition status: education or behavior change communication (BCC) was cited as an important factor in encouraging dietary diversity.

One of the current practices of nutrition-sensitive intervention in Africa is the importance of women's empowerment pathways as a key to influencing children's nutritional status. This is because, gender is described as "a very important bridge" between agriculture and nutrition. Jaenicke and Virchow 2013(2013) indicated that the current global agro-food systems, which are predominantly based on grain production, will not be able to satisfy the increased demand for food quantity and quality in the decades to come unless more flexible, locally adapted systems are in place that provide food and nutrition security despite increased climate variability, social insecurity, land ownership shifts, and resource degradation. Nutrition-sensitive agriculture puts a specific "nutrition lens" on agriculture intending to sensitize the agricultural sector to the importance of nutrition and health aspects within the food security and to better connect agriculture, health and nutrition sectors within the agro-food system.

Major gaps in nutrition-sensitive agricultural interventions: Interventions in South Asia have to-date mainly targeted the improvement of dietary quality through enhancing dietary diversity and the consumption of animal-sourced foods (Bird et al. 2019). Bird et.al. (2019) further underscored that these days there has been a growing interest in tackling the micronutrient deficiencies by introducing micronutrient-biofortified crop varieties that, for example, have had success in improving micronutrient status in Africa (Bird et.al. 2019). Sustainable improvements in the nutritional status of women and their children will only be possible when their diets provide all the macro- and micronutrients they need. Narrowing the nutrition gap requires "nutrition-sensitive" food and agriculture systems that explicitly incorporate nutrition objectives (Thomas et al. 2012).

Webb and Kennedy (2014) stressed the importance of linking nutrition education properly to enable producer households acquire significant nutrition benefits in the form of food production and consumption. According to Maestre et al. (2017), even if many nutrition interventions minimize the impacts

of malnutrition, dietary diversification strategies applied separately from other strategies have not shown remarkable outcomes. They further outlined food should be safe to eat provided that it is nutrient-dense at the point of consumption (Maestre et al. 2017). As a result, diet diversification strategies of the kinds considered were classified as an “optional” intervention to be used in appropriate settings (when trying to improve nutrition), but without modeling the potential effects to be gained or specifying what settings are more “appropriate” than others.

Nutrition-specific interventions alone, even if implemented at scale, will not meet global targets for improving nutrition. Other sectors need to contribute as well, and agriculture has strong potential due to the many ways in which it can influence the underlying determinants of nutrition outcomes, including improving global food availability and access and through enhancing household food security, dietary quality, income, and women's empowerment. Making agriculture more nutrition-sensitive however, requires a new way of thinking, planning, implementing, and partnering, as well as the active engagement of a variety of stakeholders from multiple sectors. It also requires identifying critical entry points where nutrition goals can be incorporated into agro-food systems (McDermott et al. 2015). This author looks at different directions, choosing to narrow the focus to the role of animal-source protein in improving nutrition as generated by interventions promoting animal production.

This literature review generated 14 studies across a range of nutrition education interventions; home gardens; consumption behavior and behavior change communication activities. Most of the studies reported positive impacts on production associated with an intervention, but only four evaluated nutrition outcomes directly. Those four reported improvements in various nutritional indicators (night blindness, serum retinol and ferritin levels, hemoglobin levels, and linear growth). Still, they did not document statistical significance attributable to the intervention or concerning counterfactuals (Webb and Kennedy 2014).

Research, development, and policy to improve dietary diversity of women and children in rural areas: Interventions aimed at improving diets and raising levels of nutrition should combine public health, nutrition education, and dietary strategies. Agriculturalists need to work with nutritionists to identify deficits in local diets and micronutrient intakes. Food-based interventions will be more effective when accompanied by community health programs. Interventions should include a vigorous

program of nutrition education and behavior change, targeted principally towards women, to ensure that increases in food supply and income lead to improved household nutrition (Bello and Pillay 2019).

According to Bruins (2015), policy and program responses include food-based strategies such as dietary diversification and food fortification, as well as nutrition education, public health and food safety measures, and finally supplementation. These approaches should be regarded as complementary, with their relative importance depending on local conditions and the specific mix of local needs (Bruins et al. 2015). According to a baseline cross-sectional survey conducted in Ghana, the effect of increased agricultural biodiversity on dietary diversity was significantly higher in households of lower socioeconomic status. Therefore, improvement of agricultural biodiversity could be one of the best approaches for ensuring diverse diets, especially for households of lower socioeconomic status of the rural areas (Saaka et al. 2017). A cluster-randomized community-based prospective study in the rural area of Tanzania witnessed, integrated agriculture and nutrition intervention among rural farming households is a simple and innovative solution that may contribute to the reduction of undernutrition and disease burden among women and children in developing countries (Mosha et al. 2018). The 2013 Lancet Series on maternal and child nutrition highlighted a multi-sectoral nutrition strategy that improves nutrition to save lives, build resilience, increase economic productivity, and advance development. To define and measure the approach for meeting this goal, the strategic objective is to scale up effective, sensitive interventions, and integrated nutrition-specific, programs, and systems across humanitarian and development contexts (USAID 2014).

An observational study from 9 sub-Saharan African countries revealed that, in agriculture, interventions to enhance food security and increase crop yields include the promotion of subsidized fertilizers and improved seeds for the major staple crops. Efforts to improve nutrition include support for nutritious crops alongside home gardens, fish farming, livestock, and small animal rearing. Agricultural interventions are combined with field training by extension staff on best agronomic practices. Income-generating activities include the introduction of high-value crops, agro-processing initiatives, and microfinance programs to stimulate small-business development (Remans et al. 2011). The nutrition literature has demonstrated that diversity of foods and food groups is the foundation of a healthy diet that provides adequate calories, fats, proteins and micronutrients (Tapsell et al. 2016).

Conclusion and recommendations

This review assessed the impact of nutrition-sensitive intervention on dietary diversity and nutritional status of women and children on five outcome indicators: participation in the program; household income; diet composition; nutritional status of women; and nutritional status of children. Of all the studies we reviewed, 14 met our criteria for establishing a credible counterfactual. These 14 studies broke down into the following intervention types: nutrition education interventions; home gardens; crop production; market access; consumer behavior; poultry intervention; and animal source food promotion. No study reported participation rates in the program. Only one study tested for impact on household income and found a positive effect. Twelve studies attempted to assess the impact of the interventions on diet diversity. Two of these studies undertook no statistical test on diet change, four found no statistically significant impact, and six found a significant and positive impact on the consumption of food targeted by the intervention. The major gap observed in nutrition-sensitive agricultural interventions is found to be lack of multi-sector collaboration for tackling malnutrition. None of the studies assessed whether nutrition-specific interventions should be jointly or separately applied for tackling malnutrition.

We recommend researchers, development partners and policymakers to improve dietary diversity of women and children in rural areas after systematically analyzing different articles in two areas; agriculturalists need to work with nutritionists to identify deficits in local diets and micronutrient intakes, and food-based interventions which accompanied by community health programs to be effective. For nutrition security in general and dietary diversity in particular, we recommend, multi-sectorial approach for tackling malnutrition. Applying nutrition-sensitive intervention together with nutrition-specific intervention is the other way of minimizing macro and micronutrient deficiencies.

Competing interest: The authors declare that they do not have competing interest.

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Bangoura ML, Nsor-Atindana J, Zhu K, Tolno MB, Zhou H & Wei P (2013). Potential hypoglycaemic effects of insoluble fibers isolated from foxtail millets [*Setaria italica* (L.) *International Journal of Food Science & Technology*, 48:496–502.

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