
Effect of hand washing measures in preventing COVID-19 on diarrhoeal and intestinal parasites in Rwanda: A retrospective cohort study

Pierre Dukuziyaturemye^{1*}, Jean Habanabakize²

¹Department of Environmental Health, College of Medicine and Health Sciences,
University of Rwanda, P.O. Box 3286, Kigali

²Rwanda Biomedical Centre, P.O. Box 7162, Kigali, Rwanda

*Corresponding Author: dukuzegift@gmail.com

ABSTRACT

Background: Diarrhoeal and intestinal parasites are of global public health concern. Diarrhoea disease accounts for 1.8 million deaths per year among children aged under five years, while intestinal parasites affect more than 2 billion people mostly in low-income countries. One of the measures to contain COVID-19 was reduced the incidence of diarrhoeal and intestinal parasites. This study aimed to identify the effects of hand washing measures in preventing COVID-19 on diarrhoeal and intestinal parasites in Rwanda.

Methods: This retrospective cohort study used secondary data analysis from the Rwanda Health Management Information System, a data set from the Ministry of Health. Data were analyzed using Stata version 15. The difference in difference model was designed to compare variability incidence of diarrhoeal and intestinal parasites before and during COVID-19.

Results: The results show that COVID-19 decreased significantly the incidence of diarrhoeal diseases. A one- percentage increase of COVID-19 results in 0.064 percentage point reduction of the incidence of diarrhoeal diseases. A one- percentage point additional of COVID-19 results in 0.04 percentage point reduction of the overall incidence of intestinal parasites.

Conclusion: The measures to combat COVID-19 had positive and significant effect on incidence of diarrhoeal and intestinal parasites in Rwanda.

Keywords: COVID-19, Hand hygiene, Intestinal parasites, Pandemic

INTRODUCTION

The index case of the novel corona virus (2019-nCoV) was declared in late December 2019 in the city of Wuhan, Hubei Province in the People's Republic of China^[1]. Phylogenetic analysis of the data of the entire genome sequence also showed that 2019-nCoV is classified among the genus Beta corona virus which comprises the severe acute respiratory syndrome corona virus (SARS-CoV), the Middle East respiratory syndrome corona virus (MERS-CoV), and many bat-derived SARS-like corona viruses. On 12 February 2020, the World Health Organization (WHO) officially renamed the novel corona virus SARS-CoV-2, the COVID-19 as a disease caused by the corona virus SARS-CoV-2^[2]. In early March 2020, WHO declared COVID-19 a global pandemic with more than 100,000 cases and 4000 deaths in over 100 countries^[3]. As COVID-19 spread across the globe, causing the deaths of thousands of people, it has not been reported in much of African countries, despite the predictions of misery across the continent due to COVID-19 pandemic^[4]. As of 23rd May, 2021 there were 4,793,149 million confirmed cases of SARS-CoV-2 infection on the African continent (128,576 total deaths) compared to the 46,186,387 million cases in Europe (1,060,944 total deaths) and 39,464,719 million cases in North America (884,759 total deaths)^[4].

In Rwanda, the first case of COVID-19 was reported on 14th March 2020, and a nation-wide lockdown was instituted from 22 March to 3rd May 2020^[5]. In the same month, the government introduced other preventive measures to limit the spread of this infectious disease. On December 2020, Rwanda conducted more than 730,000 tests and recorded 8,383 positive cases, 6,542 recoveries, and 92 deaths^[6]. Impressively, all decision makers and policy makers have joined efforts for the implementation of COVID-19 preventive measures including hand washing with water or hand rub with alcohol-based hand sanitizer, wearing masks, physical and social distancing, and staying home to reduce the risk of exposure at the community level. The current COVID-19 pandemic has not only posed a challenge, but also an opportunity to observe the several pandemic control measures implemented to bring down the transmission of diarrhoeal and intestinal parasites diseases.

Diarhoeal diseases and intestinal parasites are a serious global public health concern that affect child survival particularly in the developing countries. In 2016, diarrhoeal diseases were among top ten leading causes of mortality, causing more than 1.6 million deaths worldwide^[5]. Annually global diarrhoeal burden of disease accounts for 72.8 million disability adjusted life years (DALYs) lost through incapacitation and premature deaths, especially in low- income countries^[7]. Intestinal parasites are microorganisms that live and grow in the gastrointestinal tract of humans and animals responsible for morbidity and mortality^[8]. Intestinal parasites are transmitted when someone comes in contact with infected faeces for example, through contaminated soil, food, or water. Globally, intestinal parasites affect more than 2 billion people with high prevalence rates in low- and middle-income countries^[9]. In the horn of Africa, the prevalence of intestinal parasites is reported to be as high as 84%, 90% in Central Sudan, and 84.7% in Burkina Faso^[8-10].

The preventive measures to contain COVID-19, especially hand washing with water and soap or hand rub with alcohol-based hand sanitizer reduced the incidence of diarrhoeal and intestinal parasites. The study conducted in Ethiopia revealed that diarrhoeal is due to inadequate hygiene, COVID-19 prevention precautions such as hand hygiene practices have undoubtedly added to a reduction in the incidence of the diarrhoeal in the community^[11]. However, two out of every five people lack access to basic hand-washing facilities, mostly in developing countries^[9,11]. This makes it difficult for people to fully adhere to COVID-19 preventative measures like hand washing. A review of 30 studies shows that hand washing with soap stops nearly a half of diarrhoeal incidence^[12]. Measures to prevent diarrhoeal include improving of water supply at the household or community level as well as hygiene promotion interventions^[13].

To date, there is no study conducted in Rwanda to identify the effects of measures to contain COVID-19 on incidence of diarrhoeal and intestinal parasites. This study aims to identify the effect of COVID-19 preventive measures on incidence of diarrhoeal and intestinal parasites.

METHODS

Study design

A retrospective cohort study was conducted using secondary data to identify the effect of COVID-19 on diarrhoeal and intestinal parasites. This study used the data from Rwanda Health Management Information System collected from July 2019 to January 2020; equivalent to 9 months pre-COVID-19 and 9 months during COVID-19 pandemic.

Population

The current study, used administrative data from Health Management Information System Data Base (RH MIS) of the Ministry of Health, it covered 563 public health facilities from 30 districts of Rwanda. All patients who consulted district hospitals, provincial hospitals and health centers for diarrhoeal diseases, intestinal parasites and respiratory infections during the study period were considered in the study population.

Data collection tool

This study used data extracted from the Rwanda Management Information System (R-HMIS), which is the main tool for data collection, validation, analysis and presentation of aggregated statistical data for the health sector in Rwanda^[14]. These data are collected from patient consultation sheets and entered into HMIS by qualified data managers based at the health center level and later sent it at central level where they are kept in R-HMIS as aggregated data for further analysis and presentation. Extracted data entered in predesigned excel sheet to facilitate the analysis.

Data Analysis

The data extracted from R-HMIS in excel sheet was imported into Stata version 15 for cleaning, coding and analysis. To achieve our research objective, based on the fact that COVID-19 did not spread in the country at the same time, we designed the Difference in

Difference Model. Difference-in-differences (DiD) allows the comparison of differences in outcomes, before and after an intervention, between groups by controlling for bias from unobserved variables that remain fixed over time^[15]. Using DiD design, we assumed that the shock caused by COVID-18 timely varies by district and health centres. To derive the impact of COVID-19 on hand hygiene-related diseases by estimating the following baseline model:

$$y_{hdt} = \alpha + \beta Covid_t + \varepsilon_{hst} \quad (1)$$

Where are the outcome variables at health facility (provincial hospital, district hospital and health centres) in the district d, collected at given time t. The term is the variable of interest of our study which is the dummy variable being zero or one for the period before and after COVID-19 first case detected in Rwanda, respectively. Furthermore, in order to capture the unobserved heterogeneity across the patients, we include other attributes in the model, including the gender of the patients and express this in the following equation:

$$y_{hd} = \alpha + \beta Covid_t + \psi X + \eta_h + \sigma_d + \varepsilon_{hd} \quad (2)$$

To deal with the time invariant differences in our estimates, we also include being the health facility (provincial hospital, district hospital and health centre) fixed effect and being the district fixed effect. Finally, we estimated the impact of COVID-19 on hand hygiene-related diseases by including the interaction with gender, this is very important to allow us to understand whether the female and male patient could respond differently on hand hygiene-related diseases during the COVID-19 event. Therefore, we estimated DID setup using equation 3 while include interaction term $Covid_t * gender$.

$$y_{hd} = \alpha + \beta Covid_t + \omega Covid_t * gender + \psi X + \eta_h + \sigma_d + \varepsilon_{hd} \quad (3)$$

Using a Difference in Difference (DID) approach to estimate the impact of COVID-19 implies that variations are derived from the following two sources. First, cohorts of patients

consulted with health facility after COVID-19 occurrence might have lower incidence of the hand hygiene-related diseases compared to those consulted before the onset of COVID-10 pandemic in the same region. Second, the reduction the intensity in hand hygiene-related diseases intensity that resulted from intensive hand washing during the COVID-19 pandemic varied between districts.

Ethical Considerations

The ethical clearance was obtained from The Institutional Review Board (IRB) of the College of Medicine and Health Sciences, University of Rwanda (365/CMHS IRB/2020). The authorization to obtain data was given by the Rwanda Ministry of Health (20/1506/DPMEHF/2021). Confidentiality was ensured during data collection and no patients' names were used.

RESULTS

1. Descriptive statistics of key outcome variables

Before performing the analysis, the descriptive statistics of diarrhoeal diseases and intestinal parasites by gender and age groups were presented as shown in table 1.

Table 1: Summary statistics of the key outcome variables

Key outcome variables	Observations	Mean	Sd	Min	Max
Diarrhoeal diseases of under5 for female	121608	0.01	1.16	0	393
Diarrhoeal diseases of under5 for male	121608	0.01	0.28	0	45
Diarrhoeal diseases of above 5 for female	121608	1.02	5.80	0	522
Diarrhoeal diseases of above 5 for male	121608	0.69	5.42	0	697
Intestinal parasites of under 5 for female	121608	0.01	0.46	0	82
Intestinal parasites of under 5 for male	121608	0.01	0.34	0	54
Intestinal parasites of above 5 for female	121608	6.27	28.61	0	1000
Intestinal parasites of above 5 for male	121608	3.67	26.69	0	7048

Source: Computed by author based on Rwanda HMIS dataset (July 2019-dec 2020)

2. Monthly Trends of diarrhoeal diseases

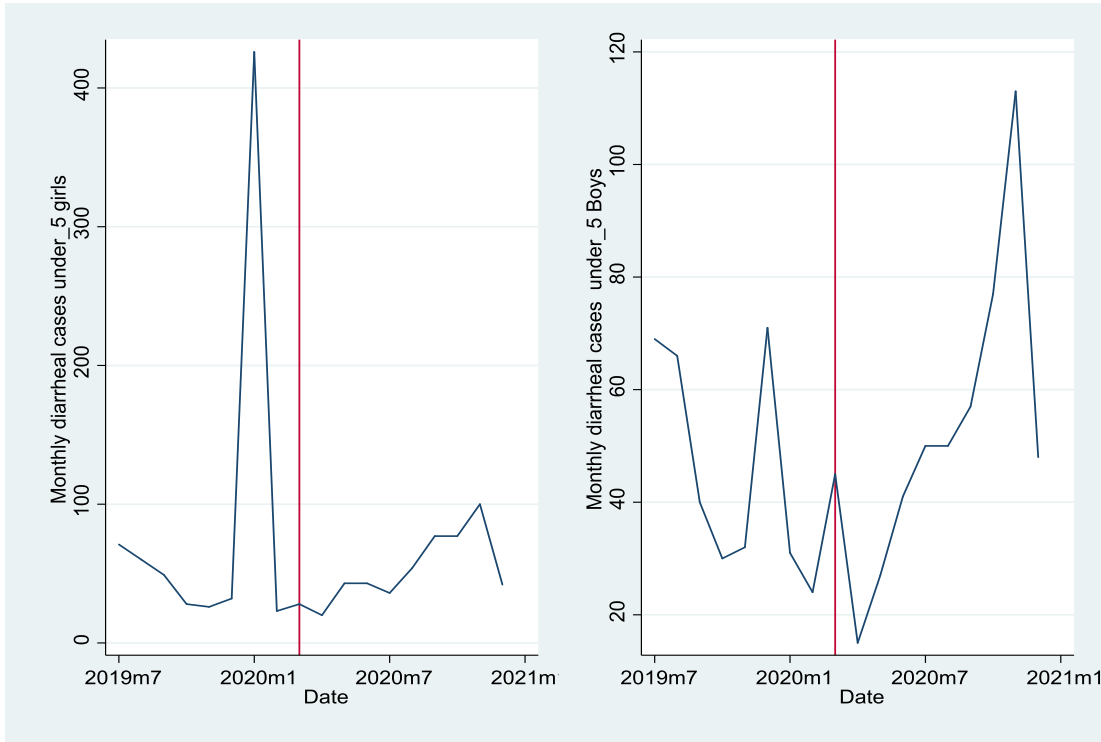


Figure 1. Monthly trends of diarrhoeal diseases under five years

Note: The middle vertical line indicates the beginning of lockdown following the index case of COVID-19 in Rwanda. M7: July, M1: January.

Figure 1 reports a decrease in diarrhoeal incidence since March 2020 and an upward shift since July 2020 for both men and women of above five years. This decrease in diarrhoeal incidence can be associated to positive effects of COVID-19 on diarrhoeal diseases as a result of intensive hand washing with soap, hand rub with alcohol base hand sanitizer and other preventive measures during lockdown.

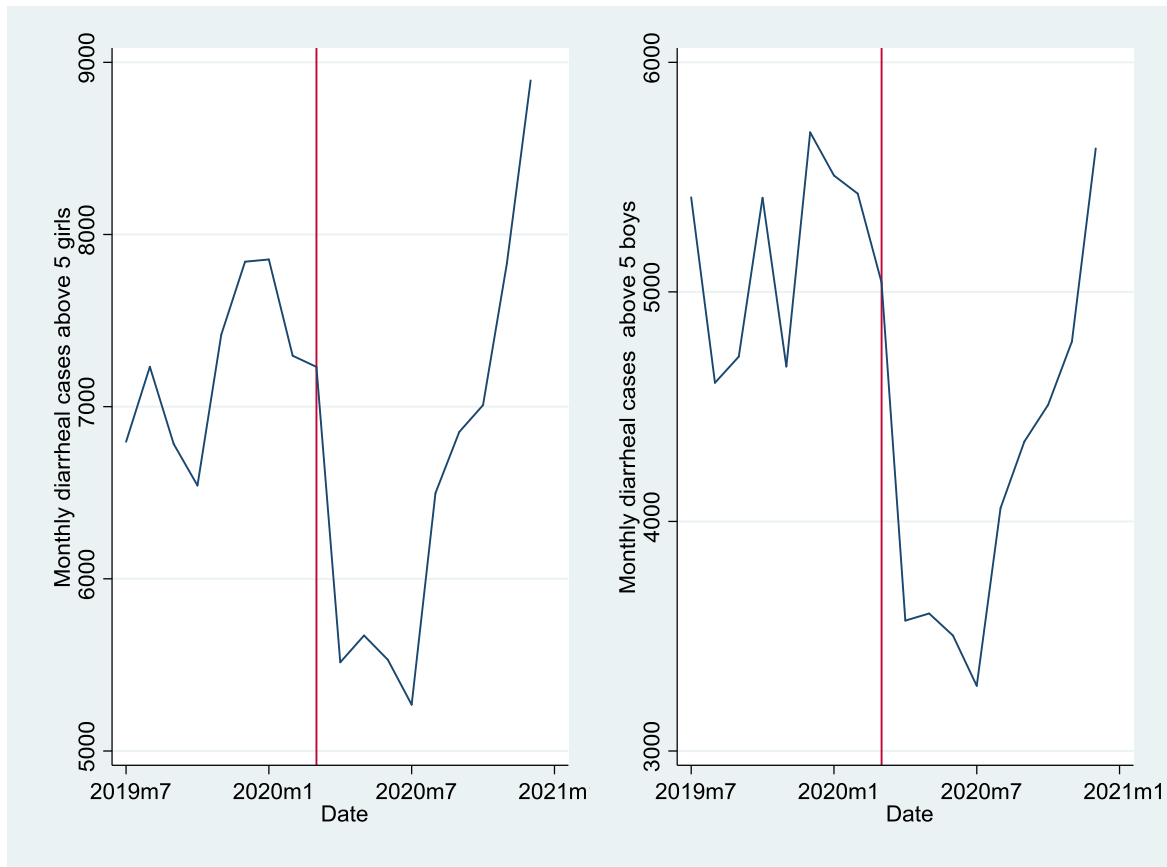


Figure 2. Monthly trends of diarrhoeal diseases above five years' old

Notes: The middle vertical line indicates the beginning of lockdown following the index case of COVID-19 in Rwanda. M7: July, M1: January

Figure 2 shows fluctuations of diarrhoeal incidence for both sides (before and after COVID-19 occurrence) reflecting no big impact of COVID-19 on diarrhoeal diseases in above five years for both sexes.

3. Monthly Trends of intestinal parasites

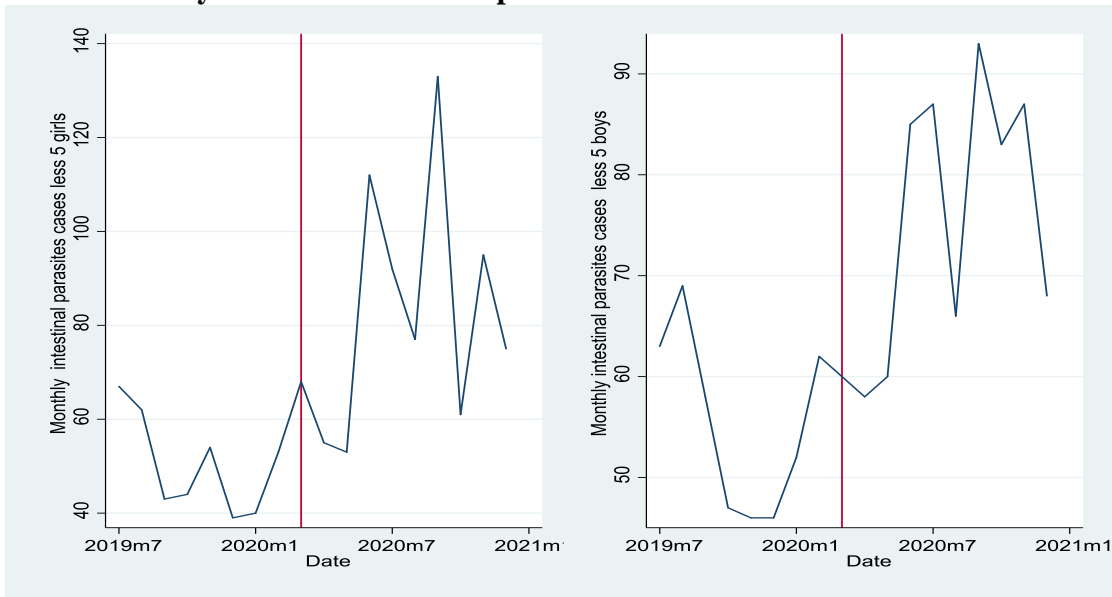


Figure 3. Monthly Trends of intestinal parasites under Five years

Note: The middle vertical line indicates the beginning of lockdown following the index case of COVID-19 in Rwanda. M7: July, M1: January. The figure shows fluctuations in incidence of intestinal parasites before and after the occurrence of COVID-19. These data do not show an effect of COVID-19 on the intestinal parasite.

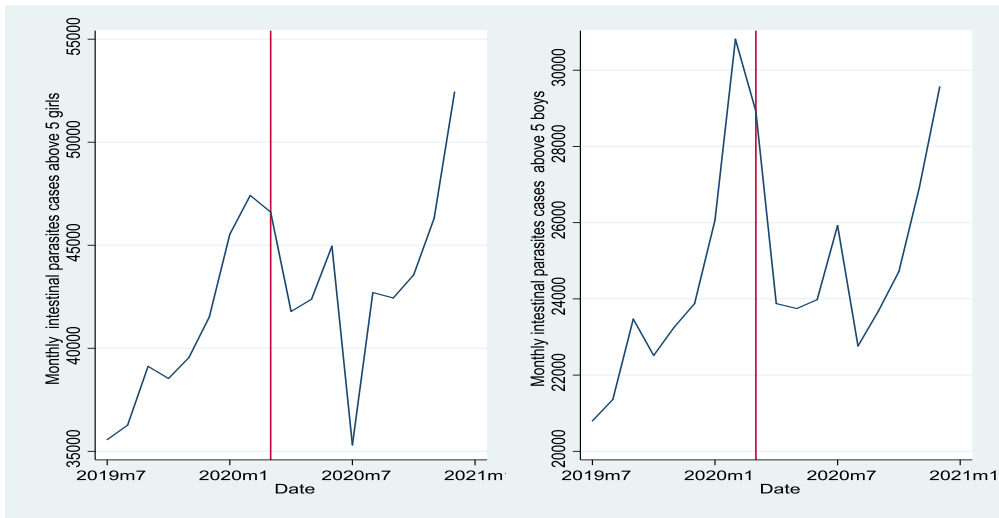


Figure 4. Monthly trends of intestinal parasites above five years' old

Notes: The middle vertical line indicates the beginning of lockdown following the index case of COVID-19 in Rwanda. M7: July, M1: January

4. The estimates of COVID-19 and hand hygiene-related diseases (diarhoeal and intestinal parasites)

For estimates of COVID-19 and hand hygiene related diseases, we presented the results of the DiD specification analysis. In these estimations, we controlled other individual characteristics like district, hospital, health centre fixed effect and dummy variables.

Table 2. Effects of hand washing measures to contain COVID-19 on monthly average diarrhoeal disease cases

	(1)	(2)	(3)	(4)	(5)
Variables	Females <5 years	Male <5 years	Females >5 years	Male >5 years	Log total cases
COVID-19	-0.004 (0.005)	0.001 (0.002)	-0.096*** (0.031)	-0.150*** (0.034)	-0.064*** (0.004)
Covid*Female					0.079*** (0.003)
Constant	0.012*** (0.002)	0.007*** (0.001)	1.069*** (0.015)	0.765*** (0.017)	0.408*** (0.002)
Observations	121,608	121,608	121,608	121,608	121,608
R-squared	0.010	0.030	0.023	0.024	0.026
District FE	YES	YES	YES	YES	YES
Hospital FE	YES	YES	YES	YES	YES
Health center FE	YES	YES	YES	YES	YES

Notes: The data used in this study was extracted from the HMIS of the Rwanda Ministry of Health, spanning from July, 2019 to December 2020. Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 1 reports the results of using the difference in incidence of diarrhoeal diseases before and after the onset of the COVID-19 pandemic, indicating that the coefficients of interest are negative and statistically significant in men and female above five and in overall patients.

Based on these estimates of Table 1, a one-month increase of COVID-19 pandemic has increased the probability of having low incidence of diarrhoeal diseases by 0.096 percentage points in female over five of age, 0.15 percentage points in men over five years of age and 0.064 percentage points for the overall patients.

Table 2. Effects of hand washing measures to contain COVID -19on monthly average of intestinal disease cases

	(1)	(2)	(3)	(4)	(5)
Variables	Females	Males<5 years	Females	Males	Log Total
	<5 years		>5 years	>5 years	Cases
COVID-19	0.005 (0.006)	0.003 (0.004)	0.358*** (0.109)	0.067 (0.138)	-0.04*** (0.004)
Covid*Female					0.093*** (0.003)
Constant	0.008*** (0.003)	0.008*** (0.002)	6.087*** (0.055)	3.636*** (0.069)	0.703*** (0.002)
Observations	121,608	121,608	121,608	121,608	121,608
R-squared	0.037	0.041	0.026	0.013	0.012
District FE	YES	YES	YES	YES	YES
Hospital FE	YES	YES	YES	YES	YES
Health center FE	YES	YES	YES	YES	YES

Notes: The data used in this study was extracted from the HMIS of the Rwanda Ministry of Health spanning from July, 2019 to December 2020. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1

Table 2 reports the results of using difference in incidence of intestinal parasites before and during the occurrence of the COVID-19 pandemic, and shows that, a one month increase in COVID-19 pandemic has increased the probability of having a high incidence of intestinal parasites by 0.358 percentage points in above five years female, and the probability of having a low incidence by 0.040 percentage points for the overall patients.

Discussion

This study describes the impact of COVID-19 on hand-hygiene related diseases in Rwanda based on the monthly incidence reported by RHIMS, for a period of 18 months combining nine months pre-COVID-19 counted from July 2019 to March 2020 and 9 months during COVID-19, counted from April 2020 to December 2020.

The results revealed that among 121,608 observations across health facilities during the 18 months, female and male more than 5 had higher incidence of diarrhoeal diseases and intestinal parasites. This study also found that COVID-19 had positive and significant effect on the probability of reduction reducing the incidence of diarrhoeal and parasitic diseases for men and female of all ages. The results show that a one-month increase of the COVID-19 pandemic has increased the probability of having a low incidence of diarrhoeal diseases in women older than five years, in men older than five years and the overall patients. This marked decline in gastrointestinal diseases was also observed in China and attributed to the intensive application of non-pharmaceutical interventions to contain COVID-19^[16]. For intestinal parasites, the results show that a one-month increase of COVID-19 pandemic has increased the probability of having a high incidence of intestinal parasites in women older than five years, and the probability of having low incidence for the overall patients. The positive and significant effect of COVID-19 on diarrhoeal diseases and intestinal parasites can be attributed to the fact that since Rwanda reported the first case of COVID-19, hand washing stations and alcohol-based hand sanitizers were found where people are gathered. Research has shown that hand washing together with other enforced preventive measures contributed a lot to the reduction of diarrhoeal diseases during COVID-19 pandemic^[17]. Poor hand hygiene and inadequate sanitation were found to be the main contributors of intestinal parasites. The high prevalence of intestinal parasitic infections in under-five children warrants strict control measures for microbial reduction through the improved hygiene and sanitation^[18].

A recent study conducted in Ethiopia on the effect of the hand washing campaign during COVID-19 on diarrhoea and respiratory diseases reported a reduction of incidence of diarrhoea below five years of age by 11.5%^[7-11]. Many hypotheses have been stated and tested to highlight this decline of intestinal and diarrhoeal diseases in relation to these non-pharmaceutical interventions to contain corona virus disease. First of all, COVID-19 have the same mode of transmission as these hand hygiene related diseases by direct or indirect contact. Secondary, imposed preventive measures like lockdown limited populated to sick healthcare during corona virus pandemic. Lastly, hand washing with water and soap and use of hand sanitizer have been improved during COVID-19^[19].

Conclusion

This study explores the impact of COVID-19 on hand hygiene related diseases in Rwanda during the period of 18 months, including 9 months before COVID-19 pandemic and 9 months during COVID-19 pandemic (July 2019- December 2020). Diarrhoeal diseases and intestinal parasites are among top ten causes of morbidity in under five year's children and above in all health facility in Rwanda. The results showed that there were positive and significant impact of COVID-19 on hand hygiene related diseases in Rwanda. Therefore, healthy policy makers targeting infectious diseases should consider the results of this study.

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Authors' contributions

All authors played a significant role in the conception, design, data analysis and interpretation, and writing of the manuscript.

Conflict of interest

All authors declare no actual or potential conflict of interest and no competing financial interest regarding this work

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