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Coronavirus Pandemic

Prevalence of intestinal parasites during pre- and post-COVID-19 pandemic at a tertiary care center in Lebanon

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Abstract

Introduction: Intestinal parasitic infections (IPIs) are a major medical and public health problem, especially in developing countries. This study aimed at comparing the prevalence and types of IPI during pre- and post-COVID-19 pandemics, and with data reported in Lebanon a decade ago.

Methodology: Stool specimen results from a total of 4,451 and 4,158 patients were examined using the concentration method during the pre-covid (2017-2018) and post-covid (2020-2021) pandemic periods, respectively. Demographic information related to patient's age and gender was recorded.

Results: The overall positive detected parasites among the total tested in these two periods were 589 (13.2%) and 310 (7.5%), respectively. The protozoa accounted for most parasites (e.g., *Blastocystis hominis*, *Entamoeba coli (E. coli)*, *Entamoeba histolytica,* and *Giardia lamblia*). Only *B. hominis* and *E. coli* showed significant differences; *B. hominis* was more prevalent in the post-covid period (33.5%) whereas *E. coli* in the pre-covid phase (44.5%). Among gender, *E. histolytica* was higher in males during the post-covid period (13.3% vs. 6.3%). Regarding age, adults (between 26 and 55 years) had the highest prevalence, with a noticeable decrease among the elderly in the post-covid time. Compared to the previous decade, the prevalence of *B. hominis* and *E. coli* remained higher, and that of *E. histolytica* and *G. lamblia* was almost the same.

Conclusions: These findings indicate an overall reduction in the prevalence of IPI during the post-covid period, though IPIs persistence remains high. This highlights the need for enhancing public health awareness efforts to improve hygiene and sanitation to reduce parasitic prevalence in Lebanon.

Key words: intestinal parasitic infections; COVID-19; age; gender; Lebanon.

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Introduction

Intestinal parasitic infections (IPIs) are considered among the most common infections globally, with approximately 3.5 billion people affected, and more than 200,000 deaths reported annually [1]. In low-income countries, the risk of these infections increases due to different causes such as poor sanitation, economic crisis, insufficient access to clean water, poor education, overpopulation, malnutrition, and inadequate infrastructure [2].

In 2019, the Coronavirus disease (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) appeared and was transmitted rapidly worldwide [3]. In Lebanon, the pandemic was accompanied by a huge economic crisis and infrastructure collapse at many levels imposing a shortage in all medical resources, which represented a burden to the Lebanese healthcare system [4]. Therefore, the Lebanese government decreased all non-urgent medical cases services, and imposed prolonged lockdowns and strict restrictions on borders, which in turn might have affected the overall healthcare and control measures hence the management of intestinal infections in the country.

In Lebanon and earlier, a couple of studies from our institution addressed the prevalence of parasitic infection among patients and healthcare workers [5,6]. The most common parasites found in these studies were *Ascaris lumbricoides, Endolimax nana, Entamoeba histolytica, Entamoeba coli, Giardia lamblia, Iodamoeba butschlii, Taenia spp.,* and *Blastocystis hominis* [5].

To our knowledge, no studies revealed the prevalence of IPI in Lebanon during the COVID-19 pandemic. Thus, this current study was warranted to reveal the prevalence and types of IPIs during the pre- and post-covid periods as well as to compare the findings with what was reported earlier by our institution a decade ago [5].

Methodology

Study Population

This is a retrospective study that examined stool specimens results for intestinal parasitic infections from patient samples submitted for ova and parasite analysis to the parasitology section at the American University of Beirut Medical Center (AUBMC), a tertiary care center in Lebanon, during 2017-2018 (pre-covid) and 2020-2021 (post-covid) pandemic periods. A total of 4,451 and 4,158 patient's stool samples were examined during the two study periods pre-covid and post covid pandemic, respectively. The results of the stool examination were abstracted electronically as the data about the parasites, gender and age of the patients were collected from AUBMC electronic health records (EPIC system) through a request to our IT team who submitted coded data without any possible identifier.

Stool Analysis

The collection of fresh stool samples was examined according to standard operating procedure done previously [5]. All data including sample date, participants' names, age, and gender were recorded for each participant at the time of collection. The examination took place in the parasitology section at the Department of Pathology and Laboratory Medicine (PLM)-AUBMC, accredited by the College of American Pathologists (CAP) since 2004.

First, a visual inspection for the presence of whole or partial parts of parasites in the freshly collected samples was done. Then, a microscopic examination was done after undergoing a concentration technique (Fecal Parasite concentrator tor, FPC, Evergreen Scientific, Los Angeles, Ca, USA), based on the manufacturer's instructions and similar to the one reported by our lab earlier [5]. Coccidian parasites e.g., *Cryptosporidium* sp. and *Isospora* sp. were looked for using a modified Acid-Fast Stain (Cold Kinyoun Stain Kit, Atom Scientific UK). The staff responsible of the examination of parasites was the same during the two study periods, and each person had a minimum of 15 years of experience in this discipline.

Quality control

Quality control measures consisted of proficiency challenges on regular basis by the CAP through the examination of unknown specimens. Additionally, each new lot of reagent is checked with a known stock of positive stool specimens for intestinal parasites.

Statistical analysis

The Statistical analysis was done using the Statistical Package for the Social Sciences (SPSS IBM statistics, United Kingdom) version 27 software. The descriptive data was represented in mean ± standard deviation (SD). Data description was done using the calculation of frequencies (%) and 95% confidence intervals (CI). A p value of < 0.05 was considered to be statistically significant.

Results

A total of 4,451 and 4,158 patients were examined during the two study periods: pre-covid and post covid pandemic, respectively. The species of detected parasites during the two periods are shown in Table 1. The overall positive detected parasite findings in these two periods totaled 589 (13.2%) and 310 (7.5%), respectively. The protozoa accounted for most of the

Table 1. Overall findings of parasites among tested individuals.

Parasites	Number (%) of detected parasites at years: Pre-covid (2017-2018 [a]) (N = 589 (13.2%))	Post-covid (2020-2021[b]) (N = 310 (7.5%))	*p* value*
PROTOZOA			
***B. hominis*†**	129 (21.9%)	104 (33.5%)	**< 0.001**
Chilomastix mesnelli	3 (0.5%)	2 (0.6%)	NA
E. nana	93 (15.7%)	50 (16%)	0.924
E. coli	262 (44.5%)	97 (31.2%)	**< 0.001**
E. histolytica†	42 (7%)	31 (10%)	0.157
G. lamblia†	32 (5.4%)	17 (5.5%)	0.981
Iodamoeba butschlii	14 (2.3%)	2 (0.6%)	NA
NEMATODES			
Ascaris lumbricoides†	1 (0.1%)	0 (0%)	NA
Strongyloides stercoralis†	3 (0.5%)	3 (1%)	0.42
Enterobius vermicularis†	0 (0%)	1 (0.3%)	NA
CESTODES			
Hymenolepis nana†	1 (0.1%)	0 (0%)	NA
Taenia species†	8 (1.3%)	1 (0.3%)	0.176
TREMATODES			
Dicrocoelium dendriticum	1 (0.1%)	2 (0.6%)	0.274

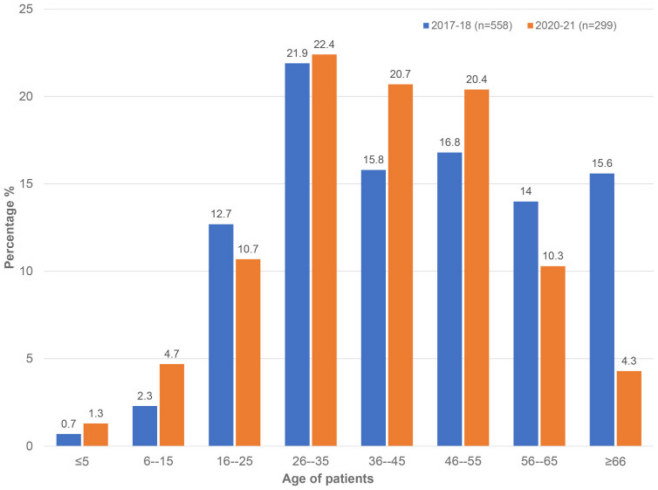
*(*p* value) was assessed based on the number of parasitic species showing 8 parasites and above; Numbers in bold means statistically significant values. † Indicates the pathogenic considered parasites. a= Total examined species = 4451b= Total examined species= 4158.

detected parasites in the two study periods, followed by very low numbers in the other parasitic groups (nematodes, cestodes, and trematodes). The significant difference *p* value (P) among the detected parasites was assessed based on the number of parasitic species showing 8 parasites and above. Only *B. hominis* and *E. coli* showed significant differences with a $p < 0.001$; *B. hominis* was more prevalent in the post-covid period whereas *E. coli* was higher in the pre-covid phase.

Regarding gender (Table 2), no significant differences were noted among males and females for the five most common recovered species except for *E. histolytica* ($p < 0.05$) which was more detected in males than in females during the post-covid period.

Concerning age (Figure 1), adults aged above 25 on average, and in both periods, had a higher prevalence of parasites than children. Interestingly, the prevalence of parasites was nearly the same in adults during both periods with a noticeable decrease in percentage among the elderly (age above 66) in the post covid time.

Figure 1. Distribution of number of protozoa detected based on ages for the two study periods 2017-18 (pre-covid) and 2020-21 (post-covid).



Discussion

In this pre- and post- covid pandemic study of parasites in Lebanon, the findings revealed almost the same number of detected species in both periods (a total of 13, belonging to Protozoa, 7 species, Nematodes 3 species, Cestodes 2 species, and Trematodes 1 species), with higher prevalence noted in the pre-covid (13.2%) vs the post-covid (7.5%) period (Table 1). Regarding the prevalence differences among species, only *B. hominis* showed higher significant difference in the post-covid period (21.9 % vs 33.55%) whereas *E. coli* showed significant difference in the pre-covid era (44.5% vs 31.2%). No difference in prevalence was detected for *E. nana* (15.7% vs 16%), *E. histolytica* (7% vs 10%), and *G. lamblia* (5.4% vs 5.5%).

Findings from the current study are compared with the only two studies published from our region covering a similar study period; one from Saudi Arabia and the other one from Iran [7,8] In both studies, a reduction in the overall prevalence of parasite was noted in the post-covid period, similar to our findings. The data from Saudi Arabia showed an estimated overall prevalence reduction from 26.6% in the pre-covid to 16.5% in the post-covid period, also noting decreases in the types of parasites as follows: *B. hominis* (6.9% vs. 3.6%), *E. coli* (5.8% vs. 0.2%), *E. histolytica* (3.2% vs. 1.8%), and *G. lamblia* (5.7% vs. 3.2%) [7]. In Iran, the pre vs post covid prevalence was 5.8% vs 2.8% [8]. Worth noting that in both studies, the prevalence of parasites was lower compared to ours. The rationale for the decrease of parasitic infection in the post-covid period was attributed mainly to strict regulations imposed by the governments, including lockdown measures taken during covid pandemic period along with health education, improved personal hygiene and proper sanitation [7,8].

In addition, we compared the parasite species detected in this current study for the period 2017-2018 with the previously reported one, a decade ago (2007 – 2008), from the same institution in Lebanon [9]. Although in the earlier study, the most prevalent parasites were the nematodes (*Ascaris lumbricoides*, 30.8%) and cestodes (*Taenia spp*. 4.8%), these were not detected in the current study. Moreover, in the current vs previous study higher prevalence was observed for *B. hominis* (21.9 % vs 17%), and *E. coli* (44.5% vs

Table 2. Comparison of commonly recovered parasites based on gender during pre- and post-covid period.

Parasites	Number (%) of findings based on gender during years					
	2017-2018 [a]			2020-2021 [b]		
	Males (N = 291)	Females (N = 267)	*p* value	Males (N = 173)	Females (N = 126)	*p* value
B. hominis	75 (25.7%)	54 (20.2%)	0.21	58 (33.5%)	46 (36.5%)	0.67
E. nana	44 (15.1%)	49(18.4%)	0.2	24 (13.9%)	26 (20.6%)	0.14
E. coli	130 (44.7%)	132 (49.4%)	0.1	55 (31.8%)	42 (33.3%)	0.86
E. histolytica	22 (7.5%)	20 (7.5%)	0.89	23 (13.3%)	8 (6.3%)	**0.04**
G. lamblia	20 (6.9%)	12 (4.5%)	0.28	13 (7.5%)	4 (3.1%)	0.1

Numbers in bold means statistically significant values. a = pre-covid; b = post-covid.

12%) while almost similar prevalence was detected for *G. lamblia* (5.4% vs 6%).

The higher parasitic prevalence in Lebanon can be attributed to different factors. Both *B. hominis* and *E. coli* are usually transmitted via fecal-oral contact and can be ingested from contaminated water and food [10]. Lebanon in this period particularly was and still is suffering from water crisis and inadequate sanitation due to many factors such as climate change, government mismanagement of water resources, and the high number of refugees in the country of whom only 68% use improved sanitation facilities [11]. This contamination consequently leads to a high prevalence of these parasites. Moreover, the sewage-contaminated water was well reflected in the identification of unusual extraintestinal non- cholerae *Vibrio spp.* and *Aeromonas spp.* infections among different patients in the country [12–14]. Add to this the huge financial and economic collapse that the country is facing which led to the devaluation of its currency and undermined its ability to face the COVID-19 pandemic [4].

Additionally, we compared our findings to those from other regional countries without COVID-19 data inclusion. For example, a cross-sectional study in Egypt conducted between October 2020 and January 2021, reported a higher prevalence of *G. lamblia* (8.5%) and of *E. histolytica* (12.3%) in school children selected in primary and secondary schools. Researchers in Egypt explained this high prevalence of bad environmental sanitary conditions and decreased levels of personal hygiene and awareness in their country [15]. In Yemen, a study also in children showed a very high prevalence for both *E. histolytica* (61.7%) and *G. lamblia* (23.94%). These high numbers were also attributed mainly to low hygienic practices, environmental and water contamination with feces, and a high level of poverty leading to decreased awareness [16].

On the other hand, in the Arab Gulf countries, a high parasitic prevalence was reported for *E. histolytica* (31.3%) and *G. lamblia* (36.3%), and this is mainly due to foreign workers from endemic areas working in United Arab Emirates and coming from endemic regions of intestinal parasites such as India, Bangladesh, and Pakistan [17]. On the other hand, a study done on national Kuwaiti population showed a very low prevalence of *E. histolytica* (< 1%) and *G. lamblia* (< 1%), mainly attributed to enhanced healthcare system and better living conditions in the country. Similar findings of low prevalence levels among these parasite species have been reported from Greece and Turkiye [18,19].

Also, the prevalence of *E. histolytica* in our study was higher among males than females in the period after COVID-19 (2020-2021). These results are in accordance with a study in Iran conducted in the same period which revealed a higher incidence of intestinal parasite infections in males than in females [8]. This, however, is opposed to data reported from Saudi Arabia which revealed a high incidence of *E. histolytica* in females, post COVID-19 [7]. Various studies conducted in Lebanon, Iran, Qatar, Nepal, and Brazil before the pandemic also showed parasite predominance in males than females [5,8,20–22]. This male gender-based increase in parasitic association was explained by various factors such as lifestyle and work situation, etc. Further studies are needed to explain the exact underlying reasons responsible for these differences.

Furthermore, our study showed that in both periods, adults aged between 26 and 35 had a higher prevalence of parasites than children. These results are in accordance with a previous study in Iran revealing a high prevalence of infections among adults aged between 30-39 years old [8], and in UAE where the 26-34 year age group represented the common age for exposure to parasitic infections [17]. In Saudi Arabia, however, young ages (< 24 years) had the highest prevalence of protozoal infections, while older ages (> 45 years) had the highest percent distribution of helminths [7]. The exposure to parasites among adults aged between 26 - 35 was attributed to poor sanitation, polluted food or water, unsafe waste disposal, and poor hygiene.

Intriguingly, a noticeable decrease in infection prevalence among the elderly (age above 66) in the post-covid time was observed in our study. This reduction might be due to imposed strict restrictions on movement that led to the decreased spread of the COVID-19 infection [11] as well as to altered patterns of behavior (improved hygienic measures) among the elderly to protect them against any infection.

Strengths and Limitations

This study is a novel one, being the first to examine the prevalence of intestinal parasitical infections among patients admitted to AUBMC during the pre- and post-COVID-19 pandemic in Lebanon. Also, it is considered among the rare studies in the region addressing this aspect. On the other hand, being a retrospective study from one center, though being a major one, in Lebanon, the findings couldn't be generalized to the entire population.

Conclusions

Intestinal parasitic infections continue to cause public health problems globally, including Lebanon, especially due to hard economic crisis and shortage in medical resources. In our study, addressing and comparing the changing trends of these parasites in the pre-and post- covid periods revealed an overall decrease in the prevalence of IPI with no remarkable changes in parasite types. The predominance of protozoa in the two periods reflects the need for improved sanitation, personal hygiene, and health education to the public in order to reduce their high prevalence especially in developing countries.

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Authors' contributions

GA and HE: Design, data editing, review literature, manuscript drafting, revision. SF and LG: contributed to data collection, interpretation, analysis and final approval of manuscript.

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