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Research Article

Prevalence of Amoebiasis and Giardiasis Among Patients of Security Forces Hospital, Makkah, Saudi Arabia

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Abstract

Background: The intestinal protozoa, *Entamoeba histolytica* and *Giardia lamblia* among the most important parasitic etiology of acute diarrhea. The current research carried out to determine the *E. histolytica* and *G. lamblia* prevalence among suspected in- and outpatients visiting Security Forces Hospital in Makkah city, Makkah province, Saudi Arabia.

Materials and Methods: Totally 922 suspected in- and outpatients visiting Security Forces Hospital. The patients were investigated for *E. histolytica* and *G. lamblia* infection using microscopic examination of patient stools and radiological examination during the period between March 2021 and February 2022.

Results: The current research revealed that the amoebiasis and giardiasis prevalence among suspected in- and outpatients visiting Security Forces Hospital, Makkah city (2.3%), (0.3%) respectively. The majority of amoebiasis within 0-10 years age followed by 31-40 years age patients as well as among Saudi suspected patients 17/922 (1.8%) followed by Indian (3/922; 0.3), Egyptian and Jordanian (1/922; 0.1). Furthermore, *G. lamblia* was diagnosed in Indian cases followed by Saudi, in addition, number of giardiasis cases revealed among age group of 21–30 years, followed by 71–80 years. In addition, prevalence of amoebiasis and giardiasis among suspected male patients was higher than females.

Conclusion: The present study revealed that amoebiasis and giardiasis are still detected among in- and outpatients visiting Security Forces Hospital, Makkah city. Regular epidemiological surveys about intestinal parasitic infections are required to develop effective prevention and control strategies.

Keywords: Microscopic Examination; *Entamoeba histolytica*; *Giardia lamblia*; Makkah; Saudi Arabia

Abbreviations

KSA: Kingdom of Saudi Arabia; WHO: World Health Organization; *E*: *Entamoeba*; *G*: *Giardia*; ALA: Amoebic Liver Abscess; ELISA: Enzyme Linked Immunosorbent Assay; GE: Gastroenteritis; IHA: Indirect Hemagglutination Assay; PCR: Polymerase Chain Reaction; ICT: Immunochromatographic Assay; IRB: Institutional Review Board; CDC: Center of Disease Control.

Introduction

Intestinal parasitic infections are considered as major causes of public health problems [1] and associated with wide spread of mortality and malnutrition worldwide [2]. *E. histolytica* and *G. lamblia* are the most frequently isolated protozoa from diarrheal patients are and the most prevalent intestinal protozoan in food-borne disease outbreaks with unsafe food handling practice [3,4]. In addition, amoebiasis and giardiasis is more common in children population, because of the lack of proper hygiene and inadequate nutrition [5,6]. Poor practice of cleaning utensils, untrimmed fingernail status and eating unwashed fruits or vegetables were identified as significantly associated risk factors of suspected patients being infected by intestinal parasites [4].

According to the World Health Organization, 3.5 billion people are affected with intestinal parasites in the world, and 450 million are ill [1]. Among intestinal parasites, *E. histolytica* affects about 500 million people worldwide, causing 50 million persons suffering from symptomatic illness and about 110,000 deaths particularly in developing countries [7]. Furthermore, giardiasis is a form of infectious diarrhoea caused by the flagellated protozoan *G. lamblia*. It is common globally and estimated to cause 280 million infections every year causing diarrhea particularly in children leading to malnutrition and stunted growth of the affected child [8].

Saudi Arabia is encountered as one of the biggest countries that receive many expatriate workers from different endemic regions for many diseases, including those caused by intestinal parasites [9]. In Saudi Arabia, intestinal parasitic infection is one of significant public health problem mostly among children [2].

Transmission of amoebiasis occurs mainly via the fecal-oral route or drinking contaminated water containing *Entamoeba* cyst [9]. The trophozoites excyst in the terminal ileum of the large intestine [10], with each emerging trophozoite invades the colonic mucosa causing clinical symptoms, including amebic colitis, watery diarrhea and dysentery, abdominal cramps and tenderness, weight loss and rarely the formation of a tumor like granulation mass (ameboma) [1,10]. Trophozoites migrate through the bloodstream affecting the liver causing amoebic liver abscess (ALA) and other organs [11].

The majority of ALA manifestations present with fever, right upper quadrant pain, respiratory disease with a cough [12].

Pleuropulmonary amoebiasis is the second most common extraintestinal amoebiasis. It occurs by direct expansion of ALA or through blood stream from intestinal lesions or via Lymphatic system [13]. However, about 90% of amebic infections are asymptomatic and self-limiting [14,15].

The gold standard method for diagnosing intestinal amebiasis is microscopic examination of stool sample. Detecting *E. histolytica* cysts and trophozoites using normal saline and iodine techniques [16,17]. In the acute stage, the most common finding in stool samples are Charcot-Leyden crystals and blood [12,17]. During microscopic examination of intestinal tissues, biopsies may reveal broad based (flask shaped ulcer) [16]. Additional diagnostic methods include culture, isoenzyme analysis, antigen and antibody detection tests and molecular identification [13].

Diagnosis of non-intestinal amoebiasis can be achieved by abdominal ultrasound or computed tomography (CT) scan [12]. Therefore, extraintestinal amoebiasis is confirmed by positive serological tests [12,13,17].

Giardiasis is a diarrheal disease caused by the flagellated protozoan *Giardia* that may inhabit the upper small intestine of mammals [18]. Transmission occurs when *Giardia* cysts spread from feces to water, food, surfaces, or skin and are then ingested. The most common form of giardiasis is asymptomatic carrier state. Most symptomatic *Giardia* infections are self-limited in duration; however, some persons might experience a reoccurrence of symptoms or develop long-term complications [19]. Giardiasis causing acute gastrointestinal symptoms. However, chronic giardiasis may cause prolonged steatorrhea with malodorous and greasy stools, abdominal cramping, weight loss and vitamin deficiencies resembling other diseases associated with malabsorption. bloating or gas, nausea, vomiting, weight loss, and dehydration. It has also been described as an infrequent cause of exocrine pancreatic insufficiency (EPI) which is a major cause of maldigestion/malabsorption syndromes [17].

Some of the extraintestinal complications include iridocyclitis, choroiditis, retinal hemorrhages, arthritis, myopathy, failure to thrive, growth stunting, impaired cognition and chronic fatigue syndrome. Giardiasis may be reactivated in immunocompromised hosts, thus indicating the effectiveness of normal host defence mechanisms against the parasite. Patients with giardiasis might

be infectious for several weeks, and ingestion of as few as 10 cysts can cause disease, making good hygiene a critical component of preventing further disease spread [20].

The gold standard technique for the detection of *G. lamblia* cysts and/or trophozoite is microscopic method of fecal samples [17,21]. Immunologically based methods *G. lamblia* antigen detection in stool by ELISA and Immune-chromatographic assay (ICT) has been reported [22].

E. histolytica and *G. lamblia* among the common identified intestinal protozoan parasites among in- and outpatients visiting of various hospitals in Saudi Arabia such as King Fahd Hospital in Jeddah [23], Al-Noor Specialist Hospital, Makkah [7], King Fahd Medical City, Riyadh [16], Ibn Sina College Hospital and Al-Jedaani Hospital, South Jeddah [2] and in local public hospitals of Hail [24]. There is a scarcity of information about the frequency and distribution of amebiasis and giardiasis in- and outpatients of Security Forces Hospital, Makkah region. In that research, a cross-sectional study was conducted for estimating the prevalence of amebiasis and giardiasis for in- and outpatients of Security Forces Hospital, Makkah during the period from 2021 to 2022.

Materials and Methods

Study region and population

The present hospital-based cross-sectional study was carried out by investigation of 922 Saudi and non-Saudi suspected patients (0–90 years old; 538 male and 384 female) who were subjected to healthcare check-up and clinical monitoring for infectious diseases at Security Forces Hospital, Makkah, between March 2021 and February 2022.

Security Forces Hospital, Makkah (SFHM) services started in the last Quarter 2013 and the hospital is upgrading gradually toward the excellence with capacity around 200 beds located in Makkah, Al-Awali. Region around 10 Km from The Holy Mosque toward east. The establishment of SFHM is considered one of the most important Ministry of Interior Health projects that the western region has had in the past few years.

Makkah is a city and administrative center of the Makkah province of Saudi Arabia with an area of 1,200 km^2. The current population of Makkah was 2,115,000 in 2022. Makkah features a hot desert climate [25] (Figure 1).

Figure 1: Location of Makkah (Quoted from: https://www.researchgate.net/figure/Map-of-Saudi-Arabia-showing-the-regions) (accessed on 15 September 2023).

Subjects

Study populations were recruited from all suspected in- and outpatients visiting Security Forces Hospital in Makkah city between March 2021 and February 2022. Inclusion criteria comprised any patient suffering from fever, abdominal pain, diarrhea, dysentery, steatorrhea with malodorous and greasy stools, vomiting, right upper quadrant pain, chest pain and cough. But exclusion criteria included those diagnosed with measles, chickenpox, infected wounds. Suspected patients were examined by physicians of the SFHM. Selected demo-graphic population data were obtained including age, gender and nationality using structured questionnaire.

Selection of population

Initially a total of 2020 suspected in- and outpatients visiting the Security Forces Hospital were investigated in the current study. After the clinical examination of suspected patients by the physicians of Security Forces Hospital and the application of adopted inclusion and exclusion criteria, 922 patients fulfilled the inclusion criteria.

Stool specimen collection and microscopic examination

Totally 922 stool samples were obtained from suspected patients with enteric infection including diarrhea, vomiting and fever suspected for amoebiasis or giardiasis. Collect a small amount of fresh stool sample (3–5 g or 4 ml if diarrhea) with a clean and tight-lid sample container. Microscopic examination of fecal preparations was done to examine the presence of trophozoites or cysts. Fecal preparations were immediately performed by emulsifying uniformly about a matchstick size of stool (2 mg) in a drop of normal saline. An iodine wet mount was mainly used to stain the nucleus of the protozoa cysts. The sedimentation technique was performed using the readily modified formalin-ether sedimentation technique [17].

Radiological examination

Radiological examination using X-ray was used to detect pathological abnormalities especially in extraintestinal complications [17].

Ethical considerations

Institutional Review Board (IRB # 0480-180422) was obtained from the General Administration for Medical Service, Security Forces Hospital Program, Makkah, Ministry of Interior, KSA.

Data analysis

Data analyses were done using SPSS software version 26.0 (SPSS Inc. Chicago, Illinois, USA) and Microsoft Excel 2010. The Chi-square ($\chi 2$) test and Student "*t*" test were used for the categorical data and continuous variables as appropriate. A P-value of <0.05 was expressed statistically significant.

Results and Discussions

Results

Intestinal infection causative agent according to species

Belong to the species causing intestinal infection in suspected in- and outpatients visiting the Security Forces Hospital, *E. histolytica* cases 22/922 (2.3%), while *G. lamblia* cases represents 3/922 (0.3%) (Table 1, 2, 3).

Nationality	Results			
	E. histolytica (%)		*G. lamblia* (%)	
	Positive	Negative	Positive	Negative
Saudis	17/922 (1.8) *	710/922 (77.0)	1/922 (0.1)	726/922(78.7)
Egyptian	1/922 (0.1)	22/922 (2.3)	0/922 (0.0)	23/922(2.5)
Bangladeshi	0/922 (0.0)	32/922 (3.4)	0/922 (0.0)	32/922(3.4)
Indian	3/922 (0.3)	101/922 (11.0)	2/922 (0.2)	102/922(11.0)
Nepalese	0/922 (0.0)	8/922 (0.9)	0/922 (0.0)	8/922(8.7)
Filipino	0/922 (0.0)	20/922 (2.1)	0/922 (0.0)	20/922(2.2)
Jordanian	1/922 (0.1)	1/922 (0.1)	0/922 (0.0)	2/922(0.2)
Yemenis	0/922 (0.0)	1/922 (0.1)	0/922 (0.0)	1/922 (0.1)
Syrian	0/922 (0.0)	1/922 (0.1)	0/922 (0.0)	1/922 (0.1)
Malaysian	0/922 (0.0)	1/922 (0.1)	0/922 (0.0)	1/922 (0.1)
Pakistanis	0/922 (0.0)	1/922 (0.1)	0/922 (0.0)	1/922 (0.1)
Sudanese	0/922 (0.0)	1/922 (0.1)	0/922 (0.0)	1/922 (0.1)
Sri Lankan	0/922 (0.0)	1/922 (0.1)	0/922 (0.0)	1/922 (0.1)
Total	22/922 (2.3)	900/922 (97.6)	3/922 (0.3)	919/922 (99.7)

Table 1: Distribution of amoebiasis and giardiasis among patients of different nationalities in Security Forces hospital in Makkah, KSA.

*P < 0.05 vs other nationality sets.

Nationality	Results			
	E. histolytica (%)		*G. lamblia* (%)	
	Positive	Negative	Positive	Negative
Male	12/922 (1.3)	526/922 (57.0)	2/922 (0.2)	536/922(58.1)
Female	10/922 (1.0)	374/922 (40.6)	1/922 (0.1)	383/922(41.5)
Total	22/922 (2.3)	900/922 (97.6)	3/922 (0.3)	919/922 (99.7)

Table 2: Gender of amoebiasis and giardiasis cases among patients in Security Forces hospital in Makkah, KSA.

Age groups	Results			
	E. histolytica (%)		*G. lamblia* (%)	
	Positive	Negative	Positive	Negative
0-10 Y	6/922 (0.7) *	164/922 (17.8)	0/922 (0.0)	170/922(18.4)
11-20 Y	3/922 (0.3)	52/922 (5.6)	0/922 (0.0)	55/922(6.0)
21-30 Y	2/922 (0.2)	161/922 (17.7)	2/922 (0.2)	161/922 (17.5)
31-40 Y	5/922 (0.5)	219/922 (23.8)	0/922 (0.0)	224/922 (24.3)
41-50 Y	2/922 (0.2)	110/922 (11.9)	0/922 (0.0)	112/922 (12.1)
51-60 Y	0/922 (0.0)	98/922 (10.6)	0/922 (0.0)	98/922 (10.6)
61-70 Y	2/922 (0.2)	62/922 (6.7)	1/922 (0.1)	63/922 (6.8)
71-80 Y	1/922 (0.1)	21/922 (2.3)	0/922 (0.0)	22/922 (2.4)
81-90 Y	1/922 (0.1)	13/922 (1.4)	0/922 (0.0)	14/922 (1.5)
Total	22/922 (2.3)	900/922 (97.6)	3/922 (0.3)	919/922 (99.7)

Table 3: Age group distribution pattern of amoebiasis and giardiasis cases among patients in Security Forces hospital in Makkah, KSA.

*P < 0.05 vs other age group sets.

Sociodemographic characteristics of examined *E. histolytica* and *G. lamblia* infection cases

The 922 suspected in- and outpatients visiting the Security Forces Hospital in Makkah city was defined and classified according to sociodemographic characteristics (gender, age, and nationality as shown in Table 1, 2, 3.

E. histolytica was diagnosed in 17/922 (1.8%) Saudi cases. They were followed by Indian (3/922; 0.3), Egyptian and Jordanian (1/922; 0.1) while no record in other nationalities while *G. lamblia* was diagnosed in 2/922 (0.2%) Indian cases followed by Saudi (1/922; 0.1%) (Table 1).

According to gender, 12/922 (1.1%) *E. histolytica* infection were detected in male while 10/922 (1.0%) in female while 2/922 (0.2%) *G. lamblia* infection were detected in male and 1/922 (0.1%) in female (Table 2).

Number of *E. histolytica* infected cases revealed (6/922; 0.7%) among age group of 0–10 years, followed by 31–40 years (5/922; 0.5%), 11–20 years (3/922; 0.3%), 21-30 years, 41-50, 61-70 years (2/922; 0.2%), 71-80, 81-90 years (1/922; 0.1%). Furthermore, number of *G. lamblia* infected cases revealed (2/922; 0.2%) among age group of 21–30 years, followed by 71–80 years (1/922; 0.1%) (Table 3).

Radiological examination

A case of pleuropulmonary amoebiasis of 87-year-old Saudi women (Positive *E. histolytica* using microscopic examination for stool sample), with generalized fatigability, dysarthria associated with intermittent fever, diarrhea wasting and anorexia 2 months before the ward admittance, with dry cough. X-ray revealed a bilateral perihilar and basal reticular densities with underlying air-filled cystic spaces (bronchiectasis changes) and associated with blunted both CPAS (Costophrenic Angles). Increased cardiothoracic ratio and dilated hilar vascular shadows. In addition. Bilateral accentuated bronchovesicular markings and dilated unfolded aorta with curvilinear calcified atheromatous plaque seen at aortic knuckle wall. Right apical minimal pleural thickening (Figure 2).

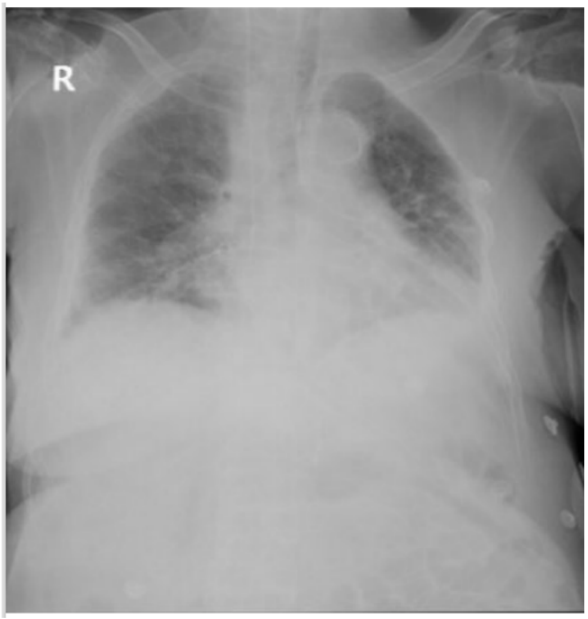

Figure 2: Pleuropulmonary amoebiasis: Image from Chest X- ray acquisition.

Discussions

E. histolytica and *G. lamblia* are often the most prevalent pathogenic protozoan parasites in the intestine and still a major community health concern in the Middle East, particularly in the Arab countries such as Yemen [26], Sudan [27], Qatar [28], Palestine [29], Jordan [30], Iraq [31], United Arab Emirates [32].

The findings of the present study revealed that out of 922 stool samples examined for *E. histolytica,* 22 (2.3%) were found to be positive for the infection among patients of Security Forces hospital, Makkah city. This percentage is similar to other community-based studies in Saudi Arabia such as School Children in Taif (2%) [33], food handlers in Belgarn (2.7%) [34], food handlers in Jeddah (2.97%) [35], patient of Heraa General Hospital, Makkah (3.99%) [36], schoolchildren of Abha (Asir) (4.1%) [37], patients in Al-Noor Specialist Hospital, Makkah 4.7% [7], among Patients of King Fahd Medical City in Riyadh Region 5.5% [9], among symptomatic children in Jeddah (6%) [38], in Riyadh 8.8% [39]. On the other hand, the prevalence of *E. histolytica* among patient of Security Forces hospital, Makkah, in the current study is higher than those reported among patients the King Fahd Medical City in Riyadh Region 0.27% [16], among patients of Maternity and Children Hospital (0.4%) and patients of King Abdul-Aziz Hospital (0.7%) [36]. Furthermore, a relatively high frequency of *E. histolytica* infection (20%) among infants and children among Ibn Sina College Hospital and Al-Jedaani Hospital in Jeddah for gastroenteritis (GE) enteropathogens [2], among food handlers in Al-Medinah (23%) [40], (83%) among adult diarrheic patients visiting King Fahd hospital in Jeddah [23].

Compared to other countries, the prevalence of intestinal infections with *E. histolytica* in Mozambique (2.0%) [41], Iran (3.7%) [42], Turkey (25.1%-69.9%) [43,44], Ethiopia (12.8%-70.8%) [4,46,47].

This further agrees with the results in the present study; that occurrence of amoebiasis is higher among children (0-10 years) and adults (31 to 40 years) than other age groups which agreed with reported research in Saudi Arabia whereas the majority of these studies are interested in children [2,7,33,48] as well as in Turkey [44,49].

The high prevalence among 31–40-year age group could be attributed to the close contact with the contaminated environment through their tendency to spend most of their times outside their houses and to eat the fast foods.

In the present study, the rate of amoebiasis and giardiasis among male was higher than that among females. This result was in agreement with previous studies [7,23,50]. This may be explained by male lifestyle characterized by greater contact with the environment and livestock compared to females.

We found in the current study, the intestinal amoebiasis and giardiasis among Saudis followed by expatriates from India, Egyptian and Jordan where optimal conditions of temperature and humidity are most favourable for the survival, development and transmission of the parasites. In addition, this may be contributed to the lifestyle, nature of work, the socio-economic status of these workers, and their direct contact with contaminated sources. This result was in agreement with previous studies conducted in various parts in Saudi Arabia including Taif [33], Riyadh [9], Jeddah [23] and in other part of the world especially Iran [42], On the other hand, Yemeni children had consistently the highest prevalence of

infection with protozoa and helminths [26]. Furthermore, many studies concluded that *E. histolytica* and *G. lamblia* were found in almost all the nationalities [40,51].

In the current study, prevalence of amoebiasis and giardiasis among males' patients of Security and Forced Hospital, Makkah was higher than females. This result was in agreement with previous studies [7,23,44,50].

Pleuropulmonary amoebiasis is an infrequent presentation of the extraintestinal amoebiasis [52]. In the current research, a pleuropulmonary amoebiasis of 87-year-old Saudi women. X-ray revealed bronchiectasis changes (Figure 2).

Giardiasis is a diarrheal disease caused by the parasite *G. lamlia*, the most common cause of intestinal parasite infections globally especially in United States [18]. In the current study, out of 922 fecal samples examined in the present research, *G. lamblia* was identified in 0.3% of samples.

It was obvious that the prevalence was generally higher than what was reported for *Giardia* in Saudi Arabia such as among patients of the King Fahd Medical City in Riyadh Region (0.07%) [16]. On the other hand, it was obvious lower than what was reported for *Giardia* in Saudi Arabia among patients of Ibn Sina College Hospital and Al-Jedaani Hospital, south Jeddah (1.4%) [2], among patients of Al-Noor Specialist Hospital, Makkah (1.3%) [7], among patients of in schoolchildren of Abha (Asir) (10.9%) [37], among food handlers in Al-Medinah (23%) [40], in Riyadh (6.3%) [39], among the food handlers in Belgarn (8.1%) [34].

In addition, the currently recorded prevalence rate of *Giardia* infection (0.3%) was significantly lower than the prevalence of infection outside Saudi Arabia such as Iran (4.5%) [42], Bolivia (9.7%) [53], Ethiopia. (7.0 - 29.9%) [4,45,46], Turkey (24.6%) [43], USA (37.7%) [18] and Mozambique (50%) [41], Australia (33.6%) [54].

The result of the current study remains controversial between several studies in different population. These differences could be attributed mainly to behavior (type of work), ecological and physiological reasons or hormonal reasons, sociodemographic differences as well as the diagnostic techniques used. Al-Eissa., *et al.* [49] stated that the rate of infection by *E. histolytica* varied among countries, socio-economic and sanitary conditions, and populations.

Prevention messaging to patients and their household members should include prompt diagnosis, maintaining good hand hygiene especially before preparing food or eating and after using the bathroom or changing diapers, cleaning and disinfecting home environments and childcare facilities, and monitoring water quality in private wells [18]. Also, it may be time to need a vaccine against *E. histolytica* and *G. lamblia* to guard against these serious infections.

Study limitations of the present study includes (i) Many hospitals in various regions of Makkah city need to be included as a multicentre study (ii) Other variables such as season, occupational hazardous and rural or urban residences, and feeding habits need to be included in the future study (iii) A pleuropulmonary amoebiasis need confirmatory method such as serology and PCR, (iv) A study of the immunological factors and genetic analysis of the isolated *E. histolytica* and *G. lamblia* would have been of value to explain the possible underlying mechanisms of severity of infection among adults and children.

Conclusions

Findings of the present study revealed that the *E. histolytica* and *G. lamblia* prevalence (2.2%) and (0.3%) among suspected cases in Security Forces hospital, Makkah, Saudi Arabia between March 2021 and February 2022. These findings can in turn raise a dire need to increase the screening implements and improve the preventative programs against *E. histolytica* and *G. lamblia* infection cases infection in the Kingdom of Saudi Arabia.

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Conflict of Interest

The author declares that there is no conflict of interests.

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