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# The prevalence of intestinal parasitic protozoan among patients in Ad-Dawadimi General Hospital, Saudi Arabia

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**Abstract.** Intestinal parasitic protozoan diseases in Saudi Arabia are a significant public health problem with prevalence ranging from 4.1% to 42%. This study was carried out to determine the risk factors associated with the prevalence of intestinal parasitic protozoan infections among patients in Ad-Dawadimi General Hospital, Saudi Arabia. This study was conducted from the 1st of January to the end of December 2015. Faecal specimens from 4,000 patients who were admitted to Ad-Dawadimi General Hospital during the study period were analyzed by the formal-ether concentration technique to detect trophozoites and cysts of *Giardia lamblia* and *Entamoeba histolytica*. Ziehl-Neelsen staining was used to detect *Cryptosporidium* oocysts. Overall, intestinal parasitic protozoans were found in 470 patients (11.75%). The infection rate of *Giardia lamblia*, *Cryptosporidium* spp. and *Entamoeba histolytica/dispar* was 5%, 4.3% and 2.5%, respectively. Infection among males was (8.4%), while among females it was (3.4%). Age, gender and season were highly significant factors on the prevalence of parasites infection at $P < 0.005$. However, the present study indicated that intestinal parasitic protozoan infections are still a public health problem in Saudi Arabia.

## INTRODUCTION

*Giardia lamblia*, *Entamoeba histolytica* and *Cryptosporidium* spp. are considered as the most prevalent intestinal protozoa worldwide especially in developing countries (Savioli *et al.*, 1992; Mehraj *et al.*, 2008). The majority of infections are associated with subacute or chronic diarrhoea, abdominal pain and intestinal irritation particularly in children (Hashmey *et al.*, 1997; Kaur *et al.*, 2002). These parasites are transmitted by the faecal-oral route and most cases are associated with contaminated drinking water (Ford, 2005; Savioli *et al.*, 2006).

Most of the previous studies conducted in Saudi Arabia were focused on several regions such as Riyadh, Jeddah, Mekkah, Al-Madina Al-Munawara, Asir, Hail and Al-Ahsa providing updated data concerning the prevalence of intestinal parasitic protozoan infection among different populations. There are no available data regarding the prevalence of human intestinal parasitic protozoan in Ad-Dawadimi district, Saudi Arabia. The objective of this study was to determine the prevalence of *Giardia lamblia*, *Entamoeba histolytica* and *Cryptosporidium* spp. infections in humans in Ad-Dawadimi district of Saudi Arabia.

## MATERIALS AND METHODS

### *Study site*

The Ad-Dawadimi district is located on the top of Najd Hill in central Saudi Arabia. It is approximately 280 km west of Riyadh, the capital city of Saudi Arabia, and geographically situated at latitude 24.5° north and longitude 44.4° east. The population is approximately 245,000 people. Ad-Dawadimi is a major area for animal husbandry and

agriculture, which are important sources of income for the community. Moreover, the district depends entirely on groundwater and rainwater as water sources (Fig. 1).

***Ethical Consideration***

All patients were informed of the reason for this study and signed consent forms authorizing their voluntary participation. The university ethics committee approved the data and sample collection.

***Faecal Samples Collection***

Four thousand faecal samples were collected (one sample from each participant) between January 1 and December 31, 2015. Fresh samples were obtained in clean screw-capped cups. Faecal samples were transported to the Parasitological Laboratory at the Faculty of Science and Humanities, Shaqra University, within 1-2 hours after collection. Samples were coded and immediately examined for parasitic protozoa or were stored at 4°C until parasitological examination was performed.

***Parasitological examination***

The data from the patients were collected from the Ad-Dawadimi General Hospital. Fecal specimens of 4,000 patients who attended Ad-Dawadimi General Hospital during the study period were analyzed individually using a wet mount preparation after formal-ether concentration and were microscopically examined systematically using low (x10) and high (x40) power microscope forcysts or trophozoites of *Giardia lamblia* and *Entamoeba histolytica/ Entamoeba dispar*, as previously described by McHardy *et al.* (2014). Modified Ziehl-Neelsen stain was used for identification of *Cryptosporidium* spp. oocysts according to Garcia (2009).

***Climatological data***

The seasons were defined as follows: summer: June, July and August; autumn: September; October and November; winter: December, January and February; spring: March, April and May. The mean monthly minimum and maximum temperatures, mean

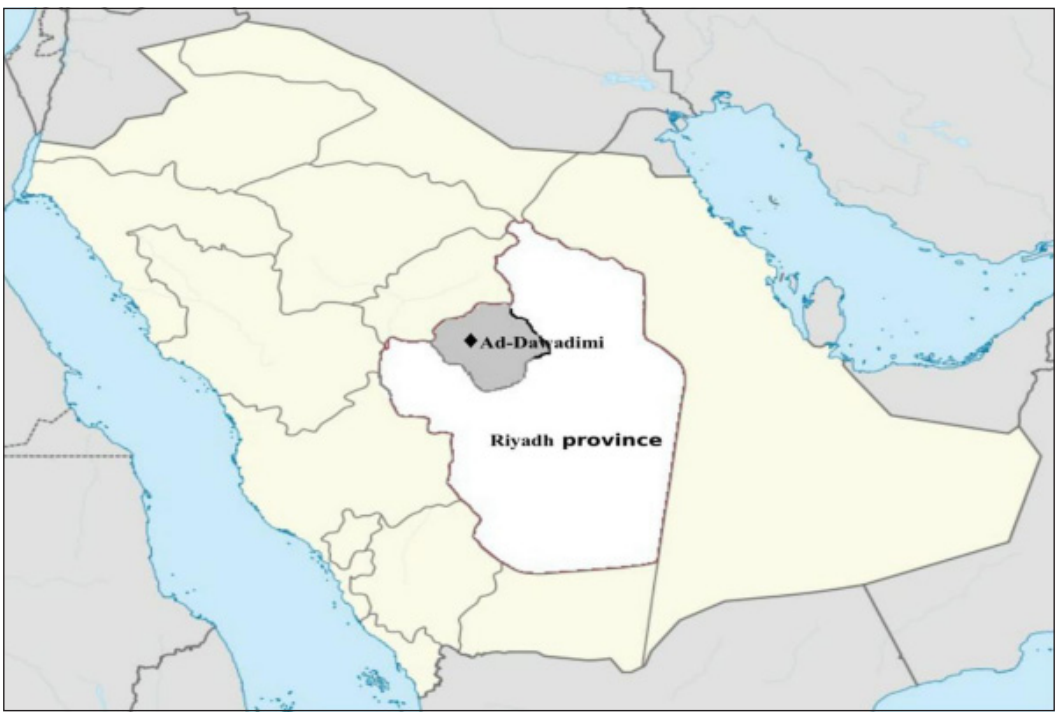


Figure 1. Ad-Dawadimi district location in Riyadh Province, Saudi Arabia.

rainfall and relative humidity for the Ad-Dawadimi district were obtained from the Presidency of Meteorology and Environment (PME), Saudi Arabian Government website (http://www.pme.gov.sa). The Ad-Dawadimi district has very hot summers with an average temperature of 40.7°C. Winter is very cold with an average temperature of 13°C with windy nights. The overall climate is arid, receiving very little rainfall (152 mm), with a relative humidity ranging from 12% to 55% throughout the year.

***Statistical analysis***

Data analyses were performed using the Statistical Package for Social Sciences (SPSS) (v20.0, IBM SPSS Statics 20, USA) for windows software. The Chi square test was applied to compare the rate of parasites infection between age, sex and season. In this study statistical significance was defined as $p<0.05$.

## RESULTS

Among the 4,000 stool samples, 2811 (70.3%) and 1189 (29.7%) were collected from males and females respectively. Overall, 470 (11.75%) stool samples were positive for intestinal parasitic protozoan On the basis of microscopic examination, 5% (200) were positive for *G. lamblia* 4.275% (171) for *Cryptosporidium* spp. and *E. histolytica/ E. dispar* 2.475 % (99) and no mixed infection was detected (Table 1). Parasitic protozoan infections among males was 8.357%, while among females was 3.375% and infections among children was 6.95%, while among adults was 4.8% (Tables 2 and 3). The seasonal distribution of intestinal protozoan infections was highest during summer (5.975%) and was lowest during winter (0.8%). (Table 4).

## DISCUSSION

In this study, the prevalence of *G. lamblia* was 5% lower than that in previous studies conducted in Saudi Arabia. The prevalence of *G. lamblia* has been reported as 22.6% in Al-Qassim region (Al-Faleh, 1982); 10.9% in Asir province (Omar *et al.*, 1991); 9.5% in Jeddah (Al-Braiken *et al.*, 2003); 37.7% prevalence in Riyadh (Al-Shammari *et al.*, 2001); 33.8% among food handlers in Riyadh city (Kalantan *et al.*, 2001); 29.3% among non-diarrhoeal schoolchildren in Hail (Fareid *et al.*, 2011); and 9% among patients of Afif Hospital (Cruz *et al.*, 2015). Our results were similar to those of Abahussain (2005) who reported *G. lamblia* prevalence of 4% among expatriate workers in Al-Khobar, and Al-Mohammed *et al.* (2010) who reported a prevalence of 6.5% among patients in Al-Ahsa. In the present study, the prevalence of *G. lamblia* (5%) was higher than recorded by Al-Harthi (2004) 2.9% among schoolchildren in Makkah,1.3% among patients of Al-Noor Specialist Hospital in Makkah by Zaglool *et al.* (2011) and 1.9% among diarrhoeic children in Almadinah Almunawarh (Abbas *et al.*, 2011).

Compared with other neighbouring countries, the infection rate of *G. lamblia* in this study was lower than among patients from Yemen (17.7%) (Alyousefi *et al.*, 2011), the United Arab Emirates (17.5%) (Dash *et al.*, 2010), Oman (18%) (Prakash, 2008), Iraq

Table 1. Prevalence of intestinal parasitic protozoan infections according to species (N=4000) in Ad-Dawadimi General Hospital, Saudi Arabia (January to December 2015)

| Parasite species | n | % (n/4000) | Chi-Square | |
|---|---|---|---|---|
| | | | $\chi^2$ | Sig. |
| *Giardia lamblia* | 200 | 5 | | |
| *Entamoeba histolytica/E. dispar* | 99 | 2.475 | 34.5 | 0.000*** |
| *Cryptosporidium* spp. | 171 | 4.275 | | |
| Total | 470 | 11.75 | | |

Table 2. Prevalence of intestinal parasitic protozoan according to the gender in Ad-Dawadimi General Hospital, Saudi Arabia (January to December 2015)

| Parasite species | Gender | | | | Chi-Square | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | | | | |
| | n | % (n/4000) | n | % (n/4000) | $\chi^2$ | Sig. | n | % (n/4000) |
| *Giardia lamblia* | 143 | 3.575 | 57 | 1.425 | | | 200 | 5 |
| *Entamoeba histolytica/ E. dispar* | 79 | 1.975 | 20 | 0.5 | 5.77 | 0.056 | 99 | 2.475 |
| *Cryptosporidium* spp. | 113 | 2.825 | 58 | 1.45 | | | 171 | 4.275 |
| Total | 335 | 8.357 | 135 | 3.375 | 85.11 | 0.000*** | 470 | 11.75 |

Table 3. Prevalence of intestinal parasitic protozoan according to age in Ad-Dawadimi General Hospital, Saudi Arabia (January to December 2015)

| Parasite species | Age | | | | Chi-Square | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Children | | Adults | | | | | |
| | n | % (n/4000) | n | % (n/4000) | $\chi^2$ | Sig. | n | % (n/4000) |
| *Giardia lamblia* | 117 | 2.925 | 83 | 2.075 | | | 200 | 5 |
| *Entamoeba histolytica/ E. dispar* | 69 | 1.725 | 30 | 0.75 | 6.617 | 0.037* | 99 | 2.475 |
| *Cryptosporidium* spp. | 92 | 2.3 | 79 | 1.975 | | | 171 | 4.275 |
| Total | 278 | 6.95 | 192 | 4.8 | 15.74 | 0.000*** | 470 | 11.75 |

Children were those less than 14 years old and adults were those ≥ 14 years old.

Table 4. Seasonal patterns of intestinal parasitic protozoan during the study period in in Ad-Dawadimi General Hospital, Saudi Arabia

| Parasite species | Seasons | | | | | | | | Chi-Square | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Summer | | Autumn | | Winter | | Spring | | | | | |
| | n | % n/4000 | n | % n/4000 | n | % n/4000 | n | % n/4000 | $\chi^2$ | Sig. | n | % n/4000 |
| *Giardia lamblia* | 101 | 2.525 | 63 | 1.575 | 11 | 0.275 | 25 | 0.625 | | | 200 | 5 |
| *Entamoeba histolytica/ E. dispar* | 41 | 1.025 | 23 | 0.575 | 9 | 0.225 | 26 | 0.65 | 18.504 | 0.005** | 99 | 2.475 |
| *Cryptosporidium* spp. | 97 | 2.425 | 45 | 1.125 | 12 | 0.3 | 17 | 0.425 | | | 171 | 4.275 |
| Total | 239 | 5.975 | 131 | 3.275 | 32 | 0.8 | 68 | 1.7 | 210.26 | 0.000*** | 470 | 11.75 |

(38.5%) (Al-Saeed and Issa, 2006), Iran (9%) (Sayyari *et al.*, 2005) and Kuwait (11.4%) (Al-Nakkas *et al.*, 2004), but higher than that reported from Qatar (2.9%) (Abu Madi *et al.*, 2011). These differences may be attributable to differences in sample size, personal hygiene practices and behaviour, study design, study areas and the technique used. Moreover, it is common for the rural communities in the Ad-Dawadimi district to keep animals such as camels, goats and sheep on the ground floor of an inhabited house or farm, resulting in a bigger chance for the zoonotic transmission of certain intestinal protozoa, particularly *Giardia* and *Cryptosporidium* (Curtis *et al.*, 2000; Mahdy *et al.*, 2008). Additionally, *Giardia* infection is closely associated with the contamination of untreated drinking water. In the Ad-Dawadimi district, groundwater is the primary source of drinking water because the majority of houses lack a proper sanitary system; thus, the possibility for faecal contamination is high via ground seepage (Omar *et al.*, 1995; Wright *et al.*, 2004).

In the present study, *E. histolytica/E. dispar* was detected among 2.5% of patients, a prevalence lower than that reported in previous studies from different regions of Saudi Arabia. For example, *E. histolytica* infection was detected in 31.0% of people in Riyadh City (Al-Shammari *et al.*, 2001); 30.0% among diarrhoeal schoolchildren in Hail and 14.6% in non-diarrhoeic samples (Fareid *et al.*, 2011); 8.2% among male primary schoolchildren in Al-Ahsa (Al-Mohammed *et al.*, 2010); 30.6% among patients of Afif Hospital (Cruz *et al.*, 2015); 4.7% among patients of Al-Noor Specialist Hospital in Makkah (Zaglool *et al.*, 2011); 4.1% in Asir province (Omar *et al.*, 1991). In the current study, the results were higher than those reported in Jeddah (2.2%) and Makkah (1.0%) (Al-Braiken *et al.*, 2003; Al-Harthi, 2004). Additionally, the prevalence of *Cryptosporidium* spp. in the present study was 4.3%, which is lower than that reported by Al-Braiken (2008) Al-Megrin (2010) and Amer *et al.* (2016) in Jeddah, Riyadh and Hail, respectively. These differences may be attributable to differences in sample size, study area and diagnostic methods used.

In the current study, the prevalence of parasitic protozoan infections among males (8.4%) was higher than that among females (3.4%), which is in agreement with previous studies (Zafar *et al.*, 1991;Al-Tukhi *et al.*, 1996; Shenoy *et al.*, 1998; Zaglool *et al.*, 2011; Abbas *et al.*, 2011). This may be attributable to the male lifestyle characterized by greater contact with the environment and livestock compared with females. In the present study, the prevalence of parasitic protozoan infections among children was 7.0%, while that among adults was 4.8%. The higher prevalence in children indicates a certain degree of acquired resistance to infection in adults (Al-Tukhi *et al.*, 1996; de la Guardia *et al.*, 2011). This increase may be explained by the lack of personal hygiene behaviours in children versus adults and the increased activities of children at home, at school and on playgrounds. These findings are in agreement with previous studies reporting the highest risks in children, with decreased risks in older children and adults (Webbe & El-huka, 1990; Al-Tukhi *et al.*, 1996; Karl & Yvonne, 2005; Zaglool *et al.*, 2011; Abbas *et al.*, 2011).

The seasonal distribution of parasitic protozoan infections was highest during the summer (5.97%) and lowest during the winter (0.8%) in accordance with previous studies reporting that the highest risks were observed in the summer season (Imam *et al.*, 2012; Lal *et al.*, 2012). This finding may be attributable to outbreaks of cryptosporidiosis, giardiasis, and *amoebiasis* associated with drinking water and recreational water use in summer months (Joce *et al.*, 1991; Barwick *et al.*, 2000; Lee *et al.*, 2002). Indeed, hot weather leads to higher water consumption (Gofti-Laroche *et al.*, 2001) and promotes outdoor swimming and many outdoor activities (Imam *et al.*, 2012).

## SUMMARY

Intestinal parasitic protozoan infections such as *Giardia lamblia*, *Entamoeba histolytica* and *Cryptosporidium* spp. constitute an important public health problem in the Ad-Dawadimi district, Saudi Arabia. Poor

personal hygiene habits are the primary correlate affecting the prevalence of these infections. Different preventative programs, including health education, good personal hygiene practices and awareness, are required to mitigate the risk of infection and should be implemented to reduce infection rates.

**CONFLICT OF INTEREST STATEMENT**
I declare that I have no conflict of interest.

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