Journal of Public Health and Epidemiology

Volume 9 Number 3 March, 2017

ISSN 2141-2316

Academic Journals

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Vol. 9(3), pp. 31-40, March 2017
DOI: 10.5897/JPHE2016.0901
Article Number: E2BAFF662806
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

A study on the fungi isolated from the carpeting, walls and prayer beads from the "New Mosque and Nuruosmaniye Mosque" situated in the province of Istanbul

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Received 6 December 2016; Accepted 2 Februrary 2017

Mosques which are visited by many people every day, for both worship and touristic purposes, play an important role in the spread of infections in society. It is for this reason that research into the fungal concentrations found on the carpets, walls and prayer beads in mosques may prove instrumental in determining potential risks and in protecting the health of visitors. The sampling of fungus content from the carpeting, walls and prayer beads of two different mosques in the province of Istanbul was undertaken with the aim of determining fungi content and levels at two chosen stations in 2015 in the months of January, April, July and October. Samples were taken using dry sterile swabs. The samples brought to the laboratory were cultivated in Peptone-Dextrose Agar in appropriate conditions. The isolated fungi were spot cultivated in Malt Extract Agar (MEA) medium and pure colonies were detected. The preparations extracted from the pure culture of the fungi were examined using a microscope. In the sampling carried out for a duration of four months, 190 colonies were detected. As a result of the study undertaken, 18 different species from 8 genera were isolated. The genera identified were as follows; Alternaria, Aspergillus, Chaetomium, Cladosporium, Penicillium, Scopulariopsis, Trichoderma and Ulocladium. Amongst the genera, the 3 most commonly detected ones were; Aspergillus, 53.2% Penicillium 24.2% and Cladosporium, 14.2%. As a result of the study, the species most isolated, in order, are as follows: Aspergillus fumigatus at 25.8% Aspergillus flavus at 12.7%, Aspergillus parasiticus at 10%, Cladosporium sphaerospermum and Penicillium palitans at 8.4% respectively, Penicillium citreonigrum at 7.4%, Cladosporium cladosporioides at 6.3%, Penicillium citrinum at 5.8%, Chaetomium globosum at 4.2%, Aspergillus niger at 3.2%, Penicillium solitum and Trichoderma longibrachiatum at 1.6% respectively, Alternaria citri, Emericella nidulans and Penicillium chrysogenum at 1.05% respectively and Aspergillus sydowii, Scopulariopsis brevicaulis and Ulocladium alternariae at 0.5% respectively.

Key Words: Aspergillus, Penicillium, Fungus, Carpeting, Mosque, Indoor, Biology, Microbiology, Epidemiology, Istanbul

INTRODUCTION

Due to the characteristic of being able to develop in different habitats, fungi are widely dispersed across earth (Bavbek et al., 2006; Inal et al., 2008). Some of the fungi lead a symbiotic existence whilst others can be

saprophytic or parasitic (Öner, 2009). Due to the fact that fungi can be found in soil, air and water, they can be considered to be invaluable organisms of the natural environment (Lukaszuk et al., 2007). Despite the fact that up until today 120,000 species of fungi have been identified, it is known that in the region of 1.5 million fungi ensure their existence (Webster and Weber, 2007). It is known that the most common genera of the fungal community are *Cladosporium, Penicillium* and *Aspergillus* (Shelton et al., 2002).

The majority of fungus spores can ensure their existence for long periods. This can be considered to be very important from the perspective of the reproduction of fungi, allergic reaction and pathogenesis (Bavbek et al., 2006; Inal et al., 2008). Spores generally speaking enter the body through the respiratory system and on occasion rarely through the digestive tract or skin. Fungal spores also contribute to the cause of allergic diseases along with pollen, house dust, animal hair, medication, artificial colours, viruses, bacteria and parasites (Gelincik 2004). Fungi which possess the characteristic of wide dispersion can have a pathogenic and allergen effect on humans, animals and plants (Çeter and Pınar, 2009). The effect of fungal spores present in inhaled air on human health is dependent on the concentration, composition (genera and species) and quantity of the spores. Spores that are greater than 10 microns attach to the upper respiratory tract pathway (nose, pharynx) and can cause symptoms of high temperature (Hargreaves et al., 2003). The importance of fungi that are known to cause various diseases increase day by day (Çolakoğlu, 1983; Tümbay, 1983).

The concentration of fungal spores in the atmosphere differs from region to region. Concentration can vary depending on factors such as geographical regional characteristics, seasonal changes, altitude and vegetation type and biotic-abiotic factors. The meteorological factors that affect the quality and quantity of fungi in a particular region are climatic conditions such as sunlight, temperature, moisture, wind speed, precipitation and snowfall (Boyacioglu et al., 2007; Aríngoli et al., 2008; Aydogdu and Asan, 2008; Kilic et al., 2010; Morris et al., 2011).

Fungus studies carried out on mosques are considerably few. The aim of this study is to determine the concentration and distribution of fungus that originate from the carpets, walls and prayer beads in mosques, which are utilised for both worship and touristic related visits by people. Upon designation of species of fungi, changes in concentration and distribution which have an effect on community health according to seasons (summer-winter), would be determined. Therefore, this study will ensure that the effect on the human health of isolated fungi from material in mosques will be more easily determined. Social establishments play an important role in the transmission of fungal infections. The role of carpets, walls and prayer beads in mosques, which are institutions of vital importance from a societal perspective, in the transmission of fungal infections can be explained as follows: Closed footwear, synthetic socks and washed feet not drying sufficiently are factors in the spread of dermatophytosis of the feet. With regard to prayer beads, the fact that they are used repeatedly by more than one person is instrumental in the spread of fungal infections. The dermatophytes of infected individuals pass to the floor surface and are passed to non-infected individuals again through the floor surface. The moistness of the floor surface, worship performed in the mosque with damp feet, synthetic socks and the use of closed footwear, are effective in the spread of fungal infections. In this situation the following precautionary measures can be taken; the cleaning of the mosque carpets at regular intervals would ensure that the quantity of fungus in the carpets of mosques is reduced. The ideal frequency for the cleaning of the carpets should be determined.

The frequent washing of areas where ablution is performed would result in a positive result in terms of the reduction of fungus quantity. Also, ablution areas should be designed in a way that allows for the feet to dry sufficiently. It is also of importance that carpet producers add anti-fungal to the carpets to ensure that fungus quantities decrease (Raboobee et al., 1998). The cleaning and replacement of prayer beads at certain intervals using methods deemed appropriate would also go a long way to reducing fungus concentration. The wiping of mosque walls frequently and at regular intervals being washed with pressurised water would ensure that fungus intensity would be reduced.

MATERIALS AND METHODS

Sampling was undertaken from two different mosques in the province of Istanbul in 2015 during the months of January, April, July and October (Table 1). Samples were taken from the carpets, walls and prayer beads twice a month.

The samples taken were brought to the laboratory and cultivation in peptone-dextrose agar was undertaken. This agar medium was used for the first isolation of the fungi. In order to inhibit the excessive growth of the fungi in the culture medium prepared and to ensure limited growth, 30 mg/l of Rose-Bengal stain was added and sterilised at 120°C for 15 min. Following this, after being cooled to approximately 45 to 50°C to inhibit the reproduction of bacteria, 30 mg/l of streptomycin antibiotic was added (Sarıca et al., 2002).

Subsequent to the sterilisation process, distribution of 15 to 20 ml

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Table 1. Mosques in Istanbul chosen for sampling.

1	New Mosque
2	Nuruosmaniye Mosque

was undertaken into standard Petri dishes (Pitt, 1979; Klich, 2002). The samples under study were first cultivated into these mediums. Following an incubation period of approximately 7 to 10 days, and the monitoring of the reproduction of the isolated fungi, the fungi were spot cultivated in malt extract agar (MEA) medium and the Petri dishes were left to incubate at room temperature (22 to 26ºC) for an incubation period of 7 to 14 days at which point pure colonies were detected. The colonies detected were prepared in lactophenol solution (Çolakoğlu, 1996).

The identification of fungus colonies was carried out based on macroscopic (colony dimension, texture, shape, colouring from above and underneath, sporulation, zonation, exudation, pigmentation and existence of various macroscopic reproductive structures) and microscopic (examination of colony texture with stereo microscope, shape of conidia upon budding and measurement of various sections with light microscope, perimeter characteristics and such characteristics as colour (Tikveşli, 2013).

In order for the microscopic structures of the fungi to be examined under a microscope, lactophenol solution dyed in picric acid was used for the preparatory environment (Bilgehan, 2002). The use of this solution was important because it allowed the fungi structures to be more easily observed. A few drops of the lactophenol solution dyed in picric acid were added to the microscopic slide and the fungi drawn by the sterile pipette were added to the lactophenol solution and then sealed by lamella. After a while, the lamellae corners were sealed with the aid of a clear nail polish and the prepared slides were then incubated in the storage boxes (Çolakoğlu, 1983).

The slides prepared from the pure fungi cultures were examined using an Olympus Cx22 make microscope. An ocular disc was used to measure the fungi and photographs taken were added to the research. The identification of these fungi was based on both national and international literature (Çolakoğlu, 1983).

For the identification of general species, “Fungi and Indoor Fungi”, “Identification of common *Aspergillus* Species” and the publications of CBS-KNAW’ were utilised (Samson et al, 2010). In addition to this, “The Genus *Aspergillus*” was used for the identification of *Aspergillus* species (Raper and Fennell, 1965), “*Dematiaceous Hyphomycetes*” was utilised for the identification of the *Alternaria* and *Cladosporium* species (Ellis, 1971) and “A Manual of the *Penicillia*” was enlisted for the identification of the *Penicillium* species (Raper et al., 1949).

RESULTS

As a result of samples being taken and isolated from the carpets, wall and prayer beads of two different mosques in the province of Istanbul, 190 colonies detected from 8 genera and 18 different species were examined (Table 2).

An examination of the overall total reveals that the most isolated fungus was the *Aspergillus* genus at 53.2%. The following genus followed the above genus in terms of being the most isolated genus of fungus; *Penicillium* at 24.2%, *Cladosporium* at 14.2%, *Chaetomium* at 4.2%, *Trichoderma* at 1.6%, *Alternaria*, at 1.05%, *Scopulariopsis* and *Ulocladium* at 0.5% (Table 2).

Throughout the duration of the study the most isolated species was *Aspergillus fumigatus at 25.8%* and this was followed by *Aspergillus flavus at 12.7*%, *Aspergillus parasiticus* at 10%, *Cladosporium sphaerospermum* and *Penicillium palitans* at 8.4% , *Penicillium citreonigrum* at 7.4%, *Cladosporium cladosporioides* at 6.3%, *Penicillium citrinum* at *5.8%, Chaetomium globosum* at *4.2%, Aspergillus niger* at 3.2%, *Penicillium solitum* and *Trichoderma longibrachiatum*, at 1.6%, *Alternaria citri*, *Emericella nidulans* and *Penicillium chrysogenum* at 1.05% and *Aspergillus sydowii*, *Scopulariopsis brevicaulis* and *Ulocladium alternariae* at 0.5% (Table 2 and Figure 1).

According to the results of the research conducted, walls were the material that fungus were most isolated from, at a value of 39.5%. This was followed by carpets at 38.9% and prayer beads at 21.6% (Table 2).

Throughout the study the fungus most isolated from the New Mosque was at a rate of 52.1%. An evaluation of the fungus isolated from the New Mosque’s materials in terms of walls, carpets and prayer beads, reveals that its walls had the highest value of fungi isolated at 19.5%. This was followed by carpets at 18.4% and prayer beads at 14.2% (Table 2).

The species of fungus most isolated from the carpet of the New Mosque were *A. fumigatus* and *P. palitans* at 20%, whereas *A. flavus* was the species most isolated from the carpets of the mosque at 24.4% and *A. parasiticus* was the species most isolated at 18.6% (Table 3).

At the New Mosque in the month of January, *Cladosporium sphaerospermum* was the most isolated species from the carpets with 3 colonies, whereas in contrast, the species most isolated from the walls with 4 colonies was *A. flavus* and *P. citrinum* and *U. alternariae* from the prayer beads with 1 colony In the month of April, the most isolated species of fungus from the carpets was *P. palitans* with 4 colonies and for the walls this was *A. flavus* with 4 colonies. In contrast, the most isolated species from the prayer beads were *A. fumigatus* and *P. palitans* with 3 colonies. In the month of July, *A. fumigatus* was the most isolated species from the carpets with 4 colonies. This was followed by *A.* parasiticus being the most isolated species from the walls with 3 colonies and *A. fumigatus* was the most isolated species from the prayer beads with 6 colonies. However, in the month of October, the most isolated species of fungus from the carpets was *A. fumigatus* and *C. sphaerospermum* with 2 colonies, and for the walls this was *C. sphaerospermum* with 2 colonies and the most isolated species of fungus from the prayer beads was *A. parasiticus* (Table 3).

April was the month that witnessed the highest rate of fungi isolated from the carpets of the New Mosque at 34.2%. April was also the month that witnessed the highest rate of fungi isolated from the walls of the New Mosque at 35.1%. However, July was the month that witnessed the highest rate of fungus reproduction in

Table 2. The percentage distribution and occurrences of fungi genera and species isolated from the carpets, walls and prayer beads of the New and Nuruosmaniye Mosques.

Genera and species name	New mosque			Nuruosmaniye mosque			Colony quantity in total	%
	C	W	P	C	W	P		
Alternaria	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**1.05**
Alternaria citri	-	2	-	-	-	**-**	2	1.05
Aspergillus	**15**	**22**	**18**	**20**	**15**	**11**	**101**	**53.25**
Aspergillus flavus	3	9	3	3	3	3	24	12.7
Aspergillus fumigatus	7	4	10	13	8	7	49	25.8
Emericella nidulans	1	-	-	1	-	-	2	1.05
Aspergillus niger	1	4	-	1	-	-	6	3.2
Aspergillus parasiticus	3	5	5	1	4	1	19	10
Aspergillus sydowii	**-**	-	-	1	-	-	1	0.5
Chaetomium	**2**	**2**	-	**2**	**2**	-	**8**	**4.2**
Chaetomium globosum	2	2	**-**	2	2	-	8	4.2
Cladosporium	**6**	**4**	**-**	**9**	**9**	**-**	**28**	**14.7**
Cladosporium cladosporioides	1	-	-	6	5	-	12	6.3
Cladosporium sphaerospermum	5	4	-	3	4	-	16	8.4
Penicillium	**11**	**7**	**8**	**6**	**11**	**3**	**46**	**24.2**
Penicillium chrysogenum	1	-	-	1	-	-	2	1.05
Penicillium citreonigrum	-	1	3	1	7	2	14	7.4
Penicillium citrinum	2	3	1	2	3	-	11	5.8
Penicillium palitans	7	3	4	1	-	1	16	8.4
Penicillium solitum	1	-	-	1	1	-	3	1.6
Scopulariopsis	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**0.5**
Scopulariopsis brevicaulis	1	-	-	-	**-**	-	1	0.5
Trichoderma	**-**	-	-	**2**	**1**	**-**	**3**	**1.6**
Trichoderma longibrachiatum	-	**-**	**-**	2	1	-	3	1.6
Ulocladium	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**0.5**
Ulocladium alternariae	-	-	1	-	-	-	1	0.5
Total	**35**	**37**	**27**	**39**	**38**	**14**	**190**	
%	**18.4**	**19.5**	**14.2**	**20.5**	**20**	**7.4**		**100**
Total %		**52.1**			**47.9**			**100**

***H,** Carpet; ***D,** wall; ***T,** prayer beads.

terms of the prayer beads at the New Mosque at 44.4% (Table 3).

The concentration of the fungus isolated at the Nuruosmaniye Mosque was 47.9%. Among the materials sampled, the carpets revealed the highest rate of fungus isolation at 20.5%, followed by the walls at 20% and the prayer beads at 7.4% (Table 2).

The species most isolated from the Nuruosmaniye Mosque's carpets was *A. fumigatus,* at a rate of 33.3%, 21% from the walls and the highest concentration of isolated species at 50% from the prayer beads (Table 4).

During the month of January at the Nuruosmaniye Mosque, while *C. cladosporioides* was the most isolated species from the carpets with 3 colonies, *A. flavus* and *A. parasiticus,* were the most isolated species from the walls with 3 colonies and the species most isolated from the prayer beads was *A. flavus* with 3 colonies. During the month of April, *A. fumigatus*, was the most isolated species from the carpets with 4 colonies whereas for the walls, this was again *A. fumigatus*, but with 3 colonies. The species most isolated from the prayer beads was also *A. fumigatus* with 2 colonies. For the month of July, the following species were isolated from the carpets with 1 colony: *A. flavus*, *A. fumigatus*, *A. sydowii*, *C. cladosporioides*, *C. sphaerospermum* and *T. longibrachiatum.* Whereas *Penicillium citreonigrum* was the species most isolated from the walls with 3 colonies and *A. fumigatus* and *P. citreonigrum* were the species

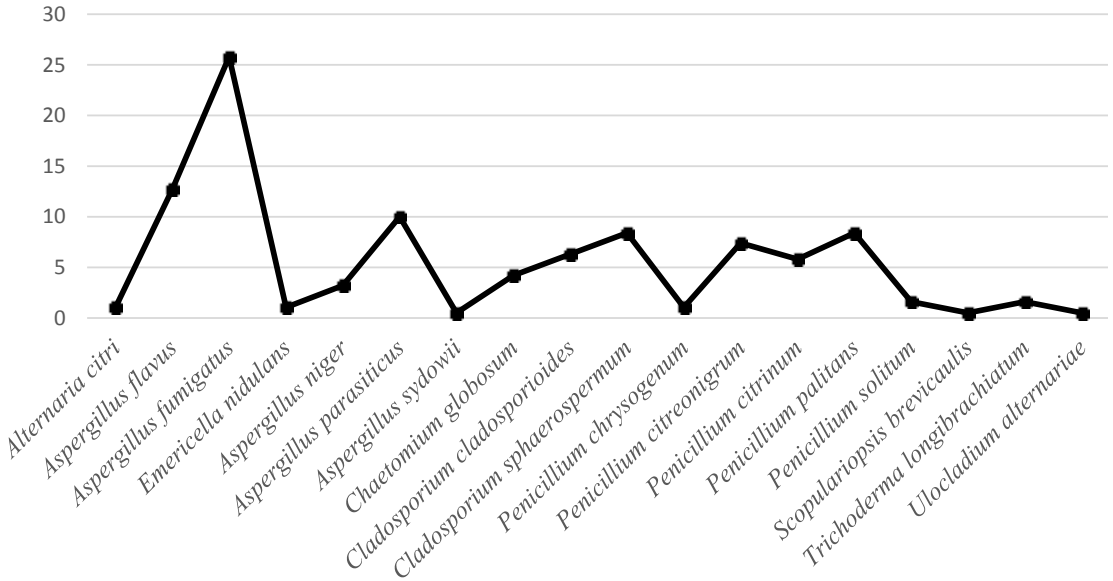

Figure 1. The percentage distribution and occurrences of fungus species isolated from the New and Nuruosmaniye mosques throughout the Study.

most isolated from the prayer beads with 2 colonies. For the month of October, *A. fumigatus* was the species most isolated from the carpets with 8 colonies and the again the species most isolated from the walls and prayer beads with 3 colonies and 2 colonies respectively (Table 4).

January was the month that witnessed the highest concentration of fungi isolated from the carpets of the Nuruosmaniye Mosque at a rate of 38.5%. The highest concentration of fungi isolated from the walls of the Nuruosmaniye Mosque at a rate of 36.9% and was also in January. Again, January was the month that witnessed the most fungus isolation from the prayer beads at a rate of 42.8% (Table 4).

As a result of the research carried out in the months of January, April, July and October in the year of 2015, a total of 57 colonies were detected during the month of January in the winter season. Whereas in contrast, 53 colonies were detected during the spring season in April, 43 colonies were detected in summer during July and 37 colonies were detected during autumn (Table 5).

The isolation of fungi according to season throughout the study in terms of percentages is as follows; January in winter came first with 30%, April in spring came second with 27.9%, July in summer is in third place with 22.6% and October in autumn is last with 19.5% (Figure 2).

Isolation of fungal species

A total of 18 fungal species namely

(indexfungorum)
Alternaria citri (Penz.) Mussat 1901
Aspergillus flavus Link 1809
Aspergillus fumigatus Fresen. 1863
Emericella nidulans (Eidam) Vuill. 1927
Aspergillus niger Tiegh. 1867
Aspergillus parasiticus Speare 1912
Aspergillus sydowii (Bainier & Sartory) Thom & Church 1926
Chaetomium globosum Kunze 1817
Cladosporium cladosporioides (Fresen.) G.A. de Vries 1952
Cladosporium sphaerospermum Penz. 1882
Penicillium chrysogenum Thom 1910
Penicillium citreonigrum Dierckx 1901
Penicillium citrinum Thom 1910
Penicillium palitans Westling 1911
Penicillium solitum Westling 1911
Scopulariopsis brevicaulis Bain. 1907
Trichoderma longibrachiatum Rifai 1969
Ulocladium alternariae (Cooke) E.G. Simmons 1967

DISCUSSION

Fungi are commonly found in the environment. The probability of airborne saprophytic fungi causing invasive disease in individuals who otherwise have a healthy immune system is low (Asan et al., 2004). However, for those with pre-existing conditions, the potential for a disease to arise is high (Asan et al., 2004; Latgé, 1999).

Almost all of the fungi that cause allergic disorders are saprophytic. The majority of such fungi fall within the Ascomycetes and Deuteromycetes category (Kurup et al., 2000; Li and Yang, 2004). It is known that the fungi that cause infections in humans are *Alternaria*,

Table 3. The percentage distribution and occurrences of fungi genera and species isolated from the carpets, walls and prayer beads of the New mosque according to month.

Genera and species name	Carpet						Wall						Prayer beads					
	Jan	Apr	Jul	Oct	Colony quantity	%	Jan	Apr	Jul	Oct	Colony quantity	%	Jan	Apr	Jul	Oct	Colony quantity	%
Alternaria	**-**	**-**	**-**	**-**	**-**	**-**	**2**	-	-	-	**2**	**5.4**	**-**	**-**	**-**	**-**	**-**	**-**
A. citri	-	-	-	-	-	-	2	-	-	-	2	5.4	**-**	**-**	-	-	-	**-**
Aspergillus	**1**	**5**	**6**	**3**	**15**	**42.8**	**7**	**8**	**5**	**2**	**22**	**59.5**	-	**5**	**9**	**4**	**18**	**66.7**
A. flavus	-	3	-	-	3	8.6	4	4	-	1	9	24.4	**-**	2	-	1	3	11.1
A. fumigatus	-	1	4	2	7	20	-	1	2	1	4	10.8	**-**	3	6	1	10	37
E. niduans	-	-	-	1	1	2.8	-	-	-	-	-	-	**-**	-	-	-	-	-
A. niger	-	1	-	-	1	2.8	1	3	-	-	4	10.8	**-**	-	-	-	-	-
A. parasiticus	1	-	2	-	3	8.6	2	-	3	-	5	13.5	**-**	-	3	2	5	18.6
Chaetomium	-	**2**	-	-	**2**	**5.8**	-	**2**	-	-	**2**	**5.4**	-	-	-	-	-	-
C. globosum	**-**	2	**-**	**-**	2	5.8	**-**	2	**-**	**-**	2	5.4	**-**	**-**	**-**	**-**	**-**	-
Cladosporium	**3**	**-**	**-**	**3**	**6**	**17.2**	**1**	**1**	**-**	**2**	**4**	**10.8**	**-**	**-**	**-**	**-**	**-**	-
C. cladosporioides	-	-	-	1	1	2.8	-	-	-	-	-	-	-	-	-	-	-	-
C. sphaerospermum	3	-	-	2	5	14.4	1	1	-	2	4	10.8	-	-	-	-	-	-
Penicillium	**3**	**5**	**1**	**2**	**11**	**31.4**	**2**	**2**	**2**	**1**	**7**	**18.9**	**1**	**4**	**3**	**-**	**8**	**29.6**
P. chrysogenum	1	-	-	-	1	2.8	-	-	-	-	-	-	-	-	-	-	-	-
P. citreonigrum	-	-	-	-	-	-		-	1	-	1	2.7		1	2	-	3	11.1
P. citrinum	1	-	-	1	2	5.8	1	1	-	1	3	8.1	1	-	-	-	1	3.7
P. palitans	1	4	1	1	7	20	1	1	1	-	3	8.1	-	3	1	-	4	14.8
P. solitum	-	1	-	-	1	2.8	-	-	-	-	-	-	-	-	-	-	-	**-**
Scopulariopsis	**1**	**-**	**-**	**-**	**1**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
S. brevicaulis	1	-	-	-	1	2.8	-	-	-	-	-	-	-	-	-	-	-	**-**
Ulocladium	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3.7**
U. alternariae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	3.7
Total	**8**	**12**	**7**	**8**	**35**		**12**	**13**	**7**	**5**	**37**		**2**	**9**	**12**	**4**	**27**	
%	**22.9**	**34.2**	**20**	**22.9**		**100**	**32.5**	**35.1**	**18.9**	**13.5**		**100**	**7.5**	**33.3**	**44.4**	**14.8**		**100**

*Jan, January; *Apr, April; *Jul, July; *Oct, October; *C, Carpet; *W, Wall; *P, Prayer beads.

Cladosporium, *Aspergillus* and *Penicillium* (Srikanth et al., 2008; Adhikari et al., 2004; Ustaçelebi, 1999). In addition to this, the most commonly encountered fungi are *Alternaria*, *Aspergillus*, *Aureobasidium*, *Botrytis*, *Cephalosporium*, *Cladosporium*, *Curvularia*, *Drechslera*, *Epicoccum*, *Fusarium*, *Gliocladium*, *Helminthosporium*, *Paecilomyces*, *Penicillium*, *Phoma*, *Saccharomyces*, *Scopulariopsis*, *Starchybotrys*, *Stemphylium*, *Trichoderma*, *Trichophyton*, *Trichothecium* and *Ulocladium* (Kurup et al., 2000; Li and Yang, 2004). The majority of the above mentioned fungi were isolated as part of this study. The mould fungi that give rise to negative effects on health show variability. Mould fungi affect human health through both immune and non-immune mechanisms. The allergens that are produced by

Table 4. The percentage distribution and occurrences of fungi genera and species isolated from the carpets, walls and prayer beads of the Nuruosmaniye mosque according to month.

Genera and species name	Carpet						Wall						Prayer beads					
	Jan	Apr	Jul	Oct	Colony quantity	%	Jan	Apr	Jul	Oct	Colony quantity	%	Jan	Apr	Jul	Oct	Colony quantity	%
Aspergillus	**3**	**4**	**3**	**10**	**20**	**51.4**	**7**	**3**	**1**	**4**	**15**	**39,5**	**5**	**2**	**2**	**2**	**11**	**78.6**
A. flavus	1	-	1	1	3	7.7	3	-	-	-	3	7,9	3	-	-	-	3	21.4
A. fumigatus	-	4	1	8	13	33.3	1	3	1	3	8	21	1	2	2	2	7	50
E. nidulans	1	-	-	-	1	2.6	-	-	-	-	-	-	-	-	-	-	-	-
A. niger	1	-	-	-	1	2.6	-	-	-	-	-	-	-	-	-	-	-	-
A. parasiticus	-	-	-	1	1	2.6	3	-	-	1	4	10,6	1	-	-	-	1	7.1
A. sydowii	-	-	1	-	1	2.6	-	-	-	-	-	-	-	-	-	-	-	-
Chaetomium	**2**	-	-	**-**	**2**	**5.1**	-	**2**	-	-	**2**	**5,3**	-	-	-	-	-	-
C. globosum	2	-	-	-	2	5.1	-	2	-	-	2	5,3	-	-	-	-	-	-
Cladosporium	**4**	**3**	**2**	**-**	**9**	**23**	**3**	**2**	**3**	**1**	**9**	**23,7**	-	-	-	-	**-**	**-**
C. cladosporioides	3	2	1	-	6	15.3	1	2	2	-	5	13,1	-	-	-	-	-	-
C. sphaerospermum	1	1	1	-	3	7.7	2	-	1	1	4	10,6	-	-	-	-	-	-
Penicillium	**5**	**-**	**-**	**1**	**6**	**15.4**	**3**	**3**	**3**	**2**	**11**	**28,9**	**1**	**-**	**2**	-	**3**	**21.4**
P. chrysogenum	1	-	-	-	1	2.6	-	-	-	-	-	-	-	-	-	-	-	-
P. citreonigrum	1	-	-	-	1	2.6	1	2	3	1	7	18,4	-	-	2	-	2	14.3
P. citrinum	1	-	-	1	2	5.1	1	1	-	1	3	7,9	-	-	-	-	-	-
P. palitans	1	-	-	-	1	2.6	-	-	-	-	-	-	1	-	-	-	1	7.1
P. solitum	1	-	-	-	1	2.6	1	-	-	-	1	2,6	-	-	-	-	-	**-**
Trichoderma	**1**	-	**1**	**-**	**2**	**5.1**	**1**	-	**-**	**-**	**1**	**2,6**	-	-	-	-	**-**	**-**
Trichoderma longibrachiatum	1	-	1	-	2	5.1	1	**-**	-	-	1	2,6	**-**	**-**	**-**	**-**	-	-
Total	**15**	**7**	**6**	**11**	**39**		**14**	**10**	**7**	**7**	**38**		**6**	**2**	**4**	**2**	**14**	
%	**38.5**	**18**	**15.3**	**28.2**		**100**	**36.9**	**26.3**	**18.4**	**18.4**		**100**	**42.8**	**14.3**	**28.6**	**14.3**		**100**

*Jan, January; *Apr, April; *Jul, July; *Oct, October; *C, Carpet; *W, Wall; *P, Prayer beads.

moulds can cause IgE dependant responses such as allergic rhinitis immunologically and allergic asthma. Less commonly they can give rise to immune dependant disorders such as Allergic Bronchopulmonary Aspergillosis (ABPA), allergic fungal sinusitis and hypersensitivity pneumonitis. Non-immune effects are those as infection, inhalation temperature, mucous membrane irritation and effects linked to mycotoxins (Mazur and Kim, 2006). Exposure to mould indoors has been reported to have the following effects; on the respiratory system such as asthma, 'wheezing' and sinusitis; haematological effects such as pulmonary haemorrhage and pulmonary haemosiderosis; on the central nervous system such as chronic fatigue, weakness, memory loss, irritability, anxiety, depression, tremors, tinnitus and on the reproductive system such as abortus and ovary endometriosis. Particularly in those who have a weak immune system, exposure to mould has been reported to cause systemic infections that can be life threatening (Curtis et al., 2004).

Two studies similar to the study in hand have been carried out in Turkey. One of these studies researched the micobiota in the carpets and air in three different mosques in Edirne (Tikveşli, 2013). Whilst the other study researched the fungi

Table 5. Colony quantity of isolated fungi according to season**.**

Seasons	Colony quantity
Winter	57
Spring	53
Summer	43
Autumn	37
Total	**190**

present in the air both indoors and outdoors of the Edirne Selimiye Mosque Library (Kızılyaprak et al., 2007).

The genera of fungus most isolated in the current study are, in order, as follows; *Aspergillus*, *Penicillium*, *Cladosporium*, *Chaetomium*, *Trichoderma*, *Alternaria*, *Scopulariopsis* and *Ulocladium* (Table 2). According to results of the similar studies carried out in Turkey, the genera of fungus most identified were *Cladosporium*, *Penicillium*, *Alternaria* and *Aspergillus* respectively (Tikveşli 2013). In another study, *Alternaria*, *Cladosporium*, *Penicillium* and *Aspergillus* were the genera detected in an indoor environment (Kızılyaprak et al., 2007). In a study carried out by Gómez de Ana et al (2006) the genera most detected were *Cladosporium*, *Penicillium*, *Alternaria* and *Aspergillus*. In another study carried out by Li and Kuo (1992) in line with the findings of the current study, the genera of *Aspergillus*, *Penicillium* and *Cladosporium* revealed the highest concentrations. Although, the above mentioned genera were identified in the study at hand also, a difference was ascertained in the order of concentrations levels. However, similarly, the types most detected remained the same (Sarıca et al., 2002; Dassonville et al., 2008; Suerdem and Yildirim, 2009).

Throughout the study, the first of the three species most isolated was *A. fumigatus* at 25.8%, *A. flavus at 12.7%* and followed by *A. parasiticus* at 10% (Table 2 and Figure 1). *A. fumigatus* can give rise to the invasive pulmonary disorder called aspergillosis. It is for this reason that the last few years has witnessed an increase in the studies that focus on the effect on the human health of fungi at home and in the workplace (Aríngoli et al., 2008; Kilic et al., 2010).

In a study carried out on random individuals who suffered allergies with fungus spores, it was generally determined that particle size was above 5 µm whereas in delayed type allergies, the diameter of the spore was much smaller and that the conidia had descended to the depths of the lung. The *A. fumigatus* conidia clusters accumulate on the upper respiratory pathways and the diameter of the conidia is 2 and 3.5 µm. Fungi such as *A. glaucus* and *A. niger* that possess thorny conidia and fungi such as *A. terreus* and *A. fumigatus* that have conidia with a partially scabrous surface get stuck and accumulate in the respiratory system more easily. Of these conidia, those with a diameter of around 5 µm can reach the bronchus, those with a diameter of up to 1 µm can reach the entrance to the alveoli and those of 0.5 µm diameter can reach the alveolus. The fact that the conidia can travel so far is the reason for the significance of the extreme susceptibility in the delayed type (Kurup et al., 2000; Özyaral et al., 2006). Due to the fact that fungus structures reach the bronchi and even the alveolus, and accumulate in the tissues and survive for an unlimited period of time in humans due to the environment they live in, ensures that hypersensitivity ensues. Either the term “delayed type hypersensitivity pneumonitis” or “extrinsic allergic alveolitis” is used for this disorder (Eduard, 2006).

It is known that carpets accrue more dust than wooden floors. Studies show that carpets contain more allergens (Beguin and Nolard, 1999). A carpet is an important allergen reservoir (Tranter et al., 2009). Old and worn-out carpets can be a breeding ground for fungi (Roberts et al., 1999). Studies have proven the strong link between dust and disorder symptoms (Niemeier et al., 2006).

The species of fungus most isolated from the carpet of the New Mosque were *A. fumigatus and P. palitans* at 20%, the species most isolated from the walls of the New Mosque was *A. flavus* at 24.4% and the species most isolated from the prayer beads of the New Mosque was *A. parasiticus* at 18.6% (Table 3). The species most isolated from the Nuruosmaniye Mosque’s carpets was *A. fumigatus*, at a rate of 33.3%, *A. fumigatus*, at a rate of 21% from the walls and the highest concentration of isolated species at 50% of *A. fumigatus*, from the prayer beads (Table 4). In their study carried out in 2005, Hicks et al identified the *Aspergillus* and *Penicillium* genera to be the most commonly detected in carpet dust (Hicks et al., 2005). In another study carried out by Celtik et al. (2011) *Cladosporium*, *Penicillium*, *Alternaria* and *Aspergillus* were the genera most isolated in floor dust. The results of these studies are in line with the results of the current study.

Throughout the study, the New Mosque was the mosque that had the highest rate of isolated fungi at 52.1%. An evaluation of the fungus isolated from the New Mosque’s materials; walls, carpets and prayer beads, reveal that its walls had the highest value of fungi isolated at 19.5%. This was followed by its carpets at 18.4% and prayer beads at 14.2% (Table 2). The concentration of fungus isolated at the Nuruosmaniye Mosque was 47.9%. Among the materials sampled, the carpets revealed the highest rate of fungus isolation at 20.5%, followed by the walls at 20% and the prayer beads at 7.4% (Table 2).

The difference in fungus concentration at both stations may be attributed to the following factors: The presence of various plants and trees that might be a source of fungus, the limited number of windows which ensures insufficient ventilation and variations in the floor area of buildings (Tikveşli, 2013). On the other hand, the fact that visitor numbers were made up of from different cultures and concentrations, the hygiene awareness of those visiting and the cultural composition of the community surrounding the station can be thought to also be important factors.

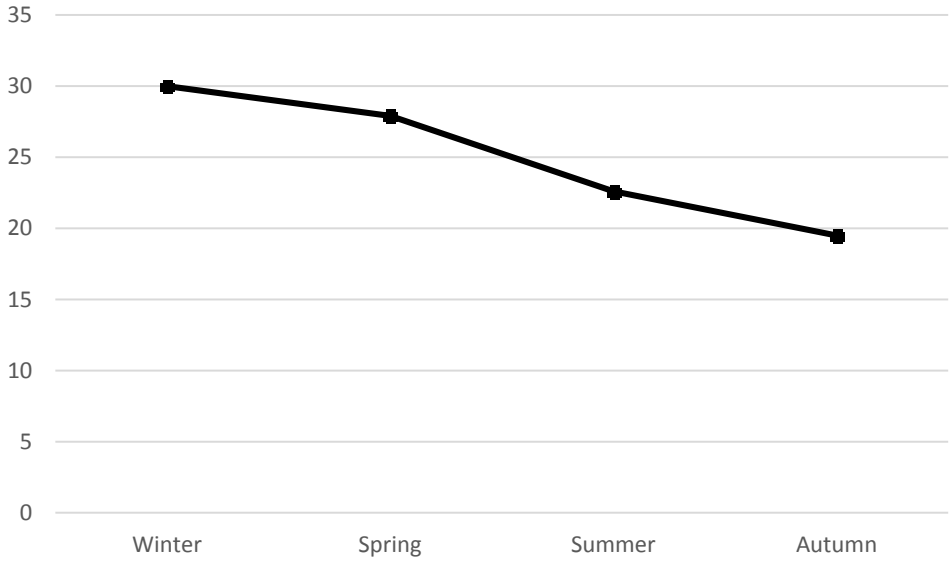

Figure 2. The percentage of fungi isolated from the New and Nuruosmaniye mosques throughout the study according to season.

Air-conditioning systems are an indoor source of fungi. Due to the fact that fungus spores can travel from an external to an internal environment ensures that there is a seasonal variation in spore concentrations. Throughout the study the highest level of fungus reproduction was observed in the winter season. Winter was followed in order by spring, summer and autumn (Figure 2).

The study observed that *Alternaria* and *Cladosporium* showed the highest level of isolation in January. In line with the current study the study carried out in Edirne (2013) detected that the concentration of the *Alternaria* genus was higher in an internal environment in the winter and summer. In addition to this, this study determined that the *Alternaria* genus was similar to the *Cladosporium* genus and that a positive moderate relationship was established between the two genera (Fang et al., 2005). In the above study the *Aspergillus* genus was most isolated in the month of April and the *Penicillium* genus witnessed the highest level of isolation in January. In line with the study at hand, a similar study carried out in Istanbul (2006) detected high levels of *Aspergillus* in the spring season and the Edirne (2013) and Istanbul (2006) studies detected very high concentrations of *Penicillium* during the winter season, particularly January (Çeter and Pınar, 2009; Fang et al., 2005). This indicates that climatic characteristics have an instrumental effect on fungi. Research carried out by Mota et al. (2008) determined that climatic and vegetation variations affected fungus concentrations.

As far as is known, a study either nationally or internationally that has researched the carpets, walls and prayer beads in terms of fungus species and concentration of two different mosques has yet to be encountered. All of the above factors being part of this study ensure that it is one of a kind. Despite the fact that such studies are few and far between in Turkey, they have nonetheless gained momentum in terms of becoming more varied over the last few years.

CONFLICT OF INTERESTS

No conflict of interest declared.

ACKNOWLEDGMENTS

This study was supported by the Marmara University Scientific Research Projects Commission (BAPKO), Project No.: FEN-C-YLP-121214-0386. The authors would like to sincerely thank Marmara University for supporting.

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Vol. 9(3), pp. 41-45, March 2017
DOI: 10.5897/JPHE2015.0743
Article Number: C1902D562808
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Retrospective study on rabies at selected districts of Tigray Region, Northern Ethiopia

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Received 13 May, 2015; Accepted 3 June, 2015

A retrospective study was conducted on the prevalence of rabies at selected districts of Tigray (Gantafeshum, Enderta, Mekelle, and Adigrat) from 2008 to April 2009 for human and animals. In addition to the retrospective study, a questionnaire was also prepared and circulated to 420 study participants. As per the information collected, 267 animals and humans died of rabies and the highest percentage of cases was in dogs (70.8%) followed by bovine (9.80%), human (7.10%), equine (6.75%), hyena (3.75%) and ovine (1.87%). On comparing the rabies cases in the areas, it was noticed that maximum cases occurred in Gantafeshm (32.58%), followed by Enderta (27.34%), Mekelle (25.1%), and Adigrat (14.98%). Year wise data collected indicated that the maximum cases of rabies in animals occurred in the year 2006 (25.0%) followed by 2007 and 2008 (19.44), 2004 (13.9%), 2003, and 2005 (11.1%). From the post bite treatment, it is indicated that in Mekelle out of a total of 2798 cases, 59.4% (n=1662) belong to male and 40.6% (n=1136) to females indicating that cases were more in males than females and maximum cases coming to hospitals were in the year 2007 (21.94%) followed by 2006 (20.8%), 2008 (19.2%), 2005 (17.9%), 2004 (11.4%) and 2003 (8.60%). In Adigrat, out of a total of 864 cases, 60.3% (n=521) were in males and 39.69% (n=343) in females and maximum number of cases coming to hospitals were in the year 2006 (21.8%) followed by 2007 (17.5%), 2004 (17.1%), 2008 (16.4%), 2005 (14.7%) and 2003 (12.5%). The study revealed that rabies was prevalent in the districts. Rabies cases in human being were observed to be more in people living in villages than those living in urban areas. Thus, awareness creation about the disease should be recommended in order to design effective prevention and control methods.

Key words: Animal, human, rabies, retrospective, Tigray, Ethiopia.

INTRODUCTION

Rabies, hydrophobia, mad dog, lyssa, and tollwut are different terms usually applied interchangeably to coin, the highly feared zoonotic, infectious, and highly fatal disease caused by virus that belongs to the genus lyssavirus, which is transmitted mainly by the bite of rabid animal to human and other susceptible hosts. The disease affects humans and all other warm-blooded vertebrates and the agent is present in saliva of infected

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animals, most commonly dogs and other wild carnivores (Buxton and Fraster, 1997). It is one of the main zoonotic diseases caused by viruses.

The clinical disease is manifested by excitability, furious behavior, inability to swallow, salivation, convulsions, paralysis, comma and death. Rabid patients often exhibit fear of water and this has given rise to the alternative name of hydrophobia for the disease. Humans acquire rabies when bitten by wild and domesticated carnivores. These animals also transmit the disease to cattle, horses and sheep, which however, seldom spread the disease to human and other warm-blooded animals (Ayele et al., 2001). World wide, it is estimated that approximately 55 thousand people die of rabies each year. This figure, however, suggested that only 3% of human rabies deaths are recorded by central health authorities. Although, 99% of all human deaths from rabies occur in the developing world, the disease still remains neglected in most of these countries (knobel et al., 2005). In addition, millions of persons, primarily in developing countries of the subtropical and tropical regions undergo costly post exposure treatment (PET). The disease constitutes a significant economic burden, especially, in developing countries of Africa and Asia, which is estimated to millions of dollars per annum (Meslin et al., 1994).

In Ethiopia, the first and only recorded rabies epidemic was made in 1903 in Addis Ababa (Pankhurt, 1990). The early 19th century travelers including Edward Ruppel and Sir Samuel Baker have reported either seeing a rabid dog or people bitten by apparently rabid dogs in various parts of Ethiopia and mentioned that rabies was enzootic throughout the country (WHO, 1999). Rabies is of significant economic importance in areas where it is endemic. It was included in the list of transmissible diseases considered to be of socio-economic and economic and/or public health importance within countries (Hemachudha et al., 2002). The discovery of unique strain of rabies virus in the saliva of healthy looking dogs, the isolation of two rabies related viruses (Mokola and Lagos bat viruses) and the possibility of human to human transmission recorded for the first time in Ethiopia indicates the high risk of acquiring the disease (Yimer et al., 2002). There is no well organized information about rabies in Ethiopia, therefore, this study was conducted to depict the prevalence of rabies in the selected districts of Tigray Region, Northern Ethiopia and to assess community's knowledge about rabies and its prevention and control methods.

MATERIALS AND METHODS

Study area

The study was carried out in selected districts of Tigray from November 2008 to April 2009.

Mekelle city is located in 785 km far from the capital city of Ethiopia, Addis Ababa, to North. Geographically, it is located between 33° 24' 13" to 13° 36' 52" North altitude and 39° 25' 30" to 39° 38' 39" east longitude. It lies in an altitude range of 2150 to 2270 m above sea level. The average temperature per year is between10 and 24°C. The weather condition is hot and humidity conditions share among the Ethiopia "Woynadega" areas with total annual rainfall of 5 79 mm.

Enderta is one of the nearest districts to Mekelle city. It encircles the Mekelle city in all directions. It is located 39° 30' 30" to 47° 30" east longitude and with altitude of 13° 00' to 13° 30" North with a total 88055 hectares. The agro climates of the areas are 1% Degas, 96% Woynadega and 3% Kola and with a land formation of 35% plain and the remaining 65% are mountain and valleys. The mean annual rainfall lies between 450 and 500 mm and the average temperature per year is 10 to 24°C.

Adigrat is located on the northern Ethiopia in Tigray. It is in the north east of Tigray. It is about 120 km from the state capital (Mekelle). The area is at an altitude of 2332 m above sea level with a temperature range of 10 to 26°C. The total surface area of the town is about 896.95 hectare and the average annual rainfall is 583 mm.

Gantafeshum is one of the districts in the eastern Tigray and it is located 110 km away from Mekelle city, which encircles the Adigrat town, and the area is at an altitude of 2008 to 2520 m above sea levels with a temperature range of 16 to 23°C and the average annual rainfall is 410 to 515 mm.

Study animals

Animal study was carried out based on the cases recorded in the governmental veterinary clinics in Adigrat, Mekelle, Enderta and Gantafeshum and a questionnaire was prepared concerning the disease information in Animals. Moreover, information about human cases was carried out based on the recorded cases obtained from governmental hospitals established at Adigrat and Mekelle cities.

Retrospective study

The study in humans was carried out based on the recorded cases in medical hospitals of Adigrat and Mekelle and a questionnaire was prepared concerning the disease information in humans.

Study design

The study design was a retrospective type of study and the information concerning the disease was collected from a six year (2003-2008) retrospect data about occurrence of rabies in animals and humans in these areas (Adigrat, Gantafeshum, Enderta and Mekelle). Questionnaire was also used to collect information concerning the various risk factors for the occurrences of the rabies disease. The peoples of these different areas were also asked about the disease.

Data analysis

The data collected from questionnaire survey was entered into Microsoft Excel 2010 Version spread sheet. The data was cleaned and then analyzed using STAT version 11. Descriptive statistics like percentage was used to summarize the data.

RESULTS

The present work was conducted to find out rabies cases in four different parts (Mekelle, Adigrat, and Enderta and

Table 1. Death due to rabies in different species of livestock and human beings at different districts of the region (2003-2008).

Species	Adigrat	Mekelle	Gantafeshum	Enderta	Total	%
Canine	30	49	60	50	189	70.78
Bovine	3	8	10	5	26	9.8
Equine	6	5	2	5	18	6.74
Ovine	-	3	-	2	5	1.87
Hyena	-	2	-	8	10	3.75
Human	1	-	15	3	19	7.1
Total	40	67	87	73	*267*	-
%	14.98	25.09	32.58	37.34	-	-

Table 2. Sex and age wise rabies cases in human being at different districts of the region (2003-2008).

Age	Males		Females		Total	%
	No	%	No	%		
0-14	0	0	1	100	1	5.26
15-44	2	33.333	4	66.666	6	31.58
>44	9	75	3	25	12	63.15
Total	11	57.89	8	42.105	19	-

Table 3. Post bite treatment of human in Mekelle hospital.

Year	Male				Female					%
	Up to 14	15-44	>44	Total	Up to 14	15-44	>44	Total	Grand total	
2003	31	30	40	101	25	75	40	140	241	8.6
2004	93	69	34	196	63	42	20	125	321	11.47
2005	199	131	38	368	72	44	18	134	502	17.94
2006	189	121	13	326	106	125	126	256	582	20.8
2007	194	112	33	339	114	126	35	275	614	21.94
2008	138	162	32	339	90	83	33	206	538	19.22
Total	844	625	193	1662	470	495	171	1136	2798	-
%	30.16	22.33	6.89	59.4	16.76	17.96	6.1	40.6	-	-

Gantafeshum) of Ethiopia. For this, the survey was conducted and a questionnaire was prepared. On the basis of these, the results are as follows:

The rabies cases in the aforementioned four places in different species of livestock and human beings are presented in Table 1.

From the table, it is clear that the highest percentage of case occurred in dogs (70.78%) followed by bovines (9.8%), humans (7.1%), equines (6.745%), hyena (3.745%) and ovine (1.87%). On comparing rabies cases in these different parts, it was noticed that maximum cases occurred in Gantafeshum (32.58%), followed by Enderta (27.4%), Mekelle (25.09%) and Adigrat (14.98%).

Further, the aforementioned data of human cases was analyzed age and sexes-wise which is presented in Table 2.

From Table 2, it is clear that among the reported human rabies cases, 63.15% were in age of >44 years followed by 15 to 44 years (31.6%) and up to 14 years (5.26%). It is also evident from the table that rabies cases were more in males (57.9%) than females (42.10%).

It is clear from Table 3 that in Mekelle out of a total of 2798 cases, 1662 (59.4%) belonged to male and 1136 (40.6%) belonged to females indicating that these cases were more in males than females It is also very clear from the table that maximum cases coming to hospitals were in the year 2007 (21.94%) followed by 2006

Table 4. Retrospective data on post bite treatment of human being in Adigrat hospital.

Year	Male				Female					%
	Up to 14	15-44	>44	Total	Up to 14	15-44	>44	Total	Grand Total	
2003	32	25	11	68	12	21	7	40	108	12.5
2004	24	52	19	95	25	20	8	53	148	17.12
2005	34	28	12	74	22	19	12	53	127	14.69
2006	72	33	8	113	41	26	8	75	188	21.75
2007	28	31	18	87	16	29	19	64	151	17.48
2008	31	43	10	84	22	27	9	58	142	16.44
Total	221	222	18	521	138	142	63	343	864	-
%	25.57	25.57	9.02	60.30	15.97	16.43	7.3	39.7	-	-

(20.8%), 2008 (19.22%), 2005 (17.94), 2004 (11.47%) and 2003 (8.6%).

Table 4 clearly indicates that in Adigrat out of a total of 864 cases, 60.3% (521) were in males and 39.699% (343) were in females. It is also very clear that maximum number of cases coming to hospitals were in the year 2006 (21.75%) followed by 2007 (17.476%), 2004 (17.129%), 2008 (16.435%), 2005 (14.69%) and 2003 (12.5%).

When comparing the results of both Mekelle and Adigrat, it is interesting to find out that the incidences was the lowest in the year 2003 whereas maximum in the years 2006 and 2007.

DISCUSSION

The present work was conducted in four different parts of Ethiopia by carrying out survey regarding rabies. For this, a questionnaire relating to rabies was prepared and circulated to 420 persons.

On the basis of these studies, it was observed that maximum rabies cases was in dogs indicating that this might have acted as the major source of infection to humans by their bite. This is also substantiated by our results that in humans, most cases were due to bite of dogs. More or less similar are the findings reported by Rodostits et al. (1994).

The current study showed that Mekelle and Adigrat towns had lower rabies occurrence. This may be due to the facts that since Gantafeshum and Enderta are the rural areas where people are not aware of the problem of the disease. The people of these areas also do not have education for prevention and treatment of the diseases compared to urban (Mekelle and Adigrat) areas. In the urban areas as our result indicate that some persons used vaccination against rabies, but not in rural areas.

The death due to rabies in human beings is higher in >44 aged persons followed by 15 to 44 and 0 to 14 years old. This may be because in old aged, less number of people goes for post bite treatment as compared to young ones is evident from our data in Table 4. From this, it is clear that the highest death and the lowest post bite treatment is in people of age >44 years which may be due to the traditional thinking in these old peoples.

As indicated from the questionnaire also, the community of these areas believed mostly in traditional medicine and holy water as they consider that these are helpful in treatment after bite of rabid dog; this is also indicated by Ayele et al. (2001).

The domestic livestock animals that are affected by this disease are bovine and equine, but rare ovine and caprine. This may be because of bovine and equine remain in contact with dogs, whereas ovine and caprine fear from dogs and remain away from dog, therefore, are less affected by rabies as compared to bovine and equine.

As per the information gathered from the people using a questionnaire that the carcass of rabid animals is thrown into free land, which act as a source of infection. When rabid animals bite persons, most of them go for holy water treatment (spiritual mechanism of treatment) and traditional medication instead of allopathic treatment. Therefore, these aggravate the distribution of the disease and death of the persons without having any post bite treatment.

Population of bats in these areas are high and contact to humans especially at the night, therefore bats can be a source of infection to animals and humans as indicated by Davis et al. (1990), that vampire bats and insectivorous bats are important reservoirs of rabies, because the virus remains latent in them for long periods of time, so that they disseminate the virus in their nasal secretions and saliva being apparently healthy. It was also observed that many stray dogs were collected from different areas due to improper disposals of animals' bones which led to easy collection of carnivorous.

Conclusion

The present work was conducted in four different parts of Ethiopia (Adigrat, Enderta, Gantafeshum and Mekelle) to find out rabies cases. Study revealed that rabies is

prevalent in all the four area, which may be because of large number of stray dogs that are not vaccinated. Secondly owned pets are also not vaccinated properly so dog population should be properly controlled, registered and vaccinated, and the community should be aware of the disease through community education.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

The authors would like to acknowledge those households participated in the study and Mekelle University, College of Veterinary Medicine for financial and material support.

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academicJournals

Vol. 9(3), pp. 46-50, March 2017
DOI: 10.5897/JPHE2016.0891
Article Number: 394E9DC62810
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Prevalence of precancerous cervical lesion and associated factors among women in North Ethiopia

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Received 17 November, 2016; Accepted 16 December, 2016

Literature shows that cervical cancer is very prevalent among women living in low resource settings. Once it progresses to invasive cervical cancer, its cost is very high. Thus, screening cervical cancer is highly recommended in poor settings including Ethiopia, where the disease burden is very high. However, little is documented on the prevalence and determinants of precancerous cervical lesion among healthy women. Thus, this study aimed to assess the prevalence and factors associated with precancerous cervical lesion among women working in Almeda textile factory, Adwa, North Ethiopia. An institution-based cross-sectional study was conducted from February 20 to 25, 2016 among women working in Almeda textile factory in North Ethiopia. Three hundred forty-two women were included in this study. Data were collected using a structured checklist. SPSS version 20 was used for data entry and analysis. Logistic regression was used to identify factors associated with the precancerous cervical lesion. Statistical significance was set at p-value < 0.05. The mean (± SD) age of the respondents included in this study was 32.95 (± 6.94). In this study, the overall prevalence of precancerous cervical lesion was 6.7% (95% CI: 4.4, 9.6). Being infected with sexually transmitted infections [AOR=49.88, 95% CI: (16.59, 149.91)] was significantly associated with the precancerous cervical lesion. In conclusion, the prevalence of precancerous cervical lesion was high among women working in Almeda textile factory in North Ethiopia. Therefore, cervical cancer screening and treatment services should be initiated and expanded to reduce morbidity from cervical cancer and its adverse effects.

Key words: Precancerous cervical lesion, screening, Ethiopia.

INTRODUCTION

Cervical cancer is caused by certain types of the human papillomavirus (HPV), the most common sexually transmitted infection (STI). Almost all sexually active individuals become infected with HPV at some point in their lives; the peak time for infection is shortly after starting to have sex. Fortunately, most women's immune systems will eliminate HPV naturally, but if an infection with specific types of HPV associated with cervical cancer persists, it may lead to precancerous lesions. If left untreated, these lesions may progress to cervical cancer (WHO, 2008; Ferlay et al., 2010; Bray et al., 2001; Munoz et al., 2004).

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Cancer is the leading cause of death in economically developed countries and the second leading cause of death in developing countries (WHO, 2008; WHO, 2013). Cervical cancer is the second most common cancer in women. Globally, more than half million (530,000) new cases of cervical cancer occur each year. More than eighty-five percent of the cases occur in low-resource countries like Africa, Latin America and Southeast Asia (Ferlay et al., 2010). Sub-Saharan Africa is one of the most affected regions. The incidence of cervical cancer is 52.8 per 100,000 women in sub-Saharan Africa, whereas the incidence is only 6.8 per 100,000 women in Western countries (Ferlay et al., 2010). The disproportionately high burden of cervical cancer in developing countries and elsewhere in medically underserved populations is largely due to a lack of screening that allows detection of precancerous and early stage cervical cancer (Parkin et al., 2008; Mathew and George, 2009; Vizcaino et al., 2000). The most simple, efficient and cost-effective screening technique in low-resource countries is visual inspection using acetic acid (VIA) (Sherris et al., 2009; Mvundura and Tsu, 2014), which performs well in identifying precancerous lesions (Sherris et al., 2009; Sauvaget et al., 2011). Different studies have demonstrated that using VIA, trained physicians and other health service providers can correctly identify between 45 and 79% of women at high risk of developing cervical cancer (Sherris et al., 2009). In addition to screening, VIA is the lowest-cost option for treating precancerous cervical lesion which significantly decreases cervical cancer deaths (Mvundura and Tsu, 2014).

Ethiopia is one of the sub-Saharan Africa countries most affected by cervical cancer. According to World Health Organization (WHO) report, the age-adjusted incidence rate of cervical cancer in Ethiopia is 35.9 per 100,000 patients with 7619 annual number of new cases and 6081 deaths every year (WHO/ICO, 2009). Moreover, facility-based studies show that cervical cancer is the leading cause of cancer in Ethiopia (Aseffa et al., 1986; Ruland et al., 2006) and other studies show that cervical cancer account for 25.8 to 32% of all female malignancies (Loutfi and Pickering, 1992; Ashine and Lemma, 1999). Despite this fact, very few women receive screening services in Ethiopia (Waktola et al., 2005). Information on the prevalence and associated factors of precancerous cervical lesion among healthy women are urgently needed to convince concerned bodies for prioritizing, designing and initiating cervical cancer screening programs aimed at improving maternal health. However, there is no study that documented the prevalence and associated factors of precancerous cervical lesion among healthy women in the study area.

Therefore, it is believed that this study will help health planners to plan appropriate screening and treatment strategies, to prevent cervical cancer mortality and morbidity.

MATERIALS AND METHODS

Study setting, population, and sampling

An institution-based cross-sectional study was conducted from February 20 to 25, 2016 among women employee of Almeda textile factory, Adwa town. Adwa town is located in the northern part of Ethiopia between 14012' North Latitude and 38056' East Longitude at a distance of 977 km away from Addis Ababa. According to the census 2007 report of Central Statistical Agency of Ethiopia, the total population of Adwa town is 40,500, of whom 18,307 are men and 22,193 are women (CSA [Ethiopia], 2008). Almeda textile factory is one of the biggest factories found in Adwa town, central zone of Tigray regional state. In Almeda textile factory currently, there are 4,400 women employees. Women employees who were screened for precancerous cervical lesion from September 12 to 20, 2015 as part of the screening campaign made by Family Guidance Association (FGA) in Almeda textile factory was the source population for this study. The precancerous cervical lesion screening campaign was done by trained nurses using VIA. The inclusion criteria for this study were being a female employee of Almeda textile factory, 25 to 64 years old and being screened for the precancerous cervical lesion in the screening campaign conducted from September 12 to 20, 2015. Since the total women included in the screening were 342, all the 342 women were eligible and included in this study.

Data collection tool and procedure

A structured checklist, adapted from the available national medical registers used for similar purpose, was used to collect the data. The checklist included selected socio-demographic and reproductive characteristics. The data were collected by two diploma nurses and the data collection was entirely supervised by one senior public health professional. Furthermore, the data collection process was closely monitored by the principal investigators. Both data collectors and supervisors were trained for two days on the objectives of the study, sampling technique, ethical consideration, data collection tool and techniques of collecting data to maintain precaution throughout the study. The collected data were checked daily by the supervisors and feedback was provided to data collectors when necessary.

Data processing and analysis

Data were entered, cleaned and analyzed by SPSS version 20 statistical package for a window. Descriptive summaries using frequencies and proportions were used to present the study results. Multivariable logistic regression was used to identify factors associated with the pre-cancerous cervical lesion. Adjusted odds ratio at 95% confidence interval and p-value were used to measure the strength of association and identify statistical significant result. P-value < 0.05 was considered as a statistically significant association. Model goodness-of-fit was checked by Hosmer-Lemeshow test (P=0.56). Multicollinearity was checked by VIF.

Ethical considerations

Ethical clearance and official letter were obtained from Aksum University College of Health Sciences and Tigray Regional Health Bureau. Permission letter was then received from Family Guidance Association (FGA). As this study used secondary data, informed consent from individual women was not relevant and feasible. Names and code numbers were not included in the study so as to ensure confidentiality.

Table 1. Selected socio-demographic and reproductive characteristics of women working in Almeda textile factory, Adwa, North Ethiopia, 2015.

Variables	Number (n)	Percent (%)
Age		
<35	218	63.7
≥35	124	36.3
Marital status		
Married	233	68.1
Single	109	31.9
Educational status		
Primary	83	24.3
Secondary and above	259	75.7
Parity		
< 4	299	87.4
≥4	43	12.6
History of STI		
Yes	82	24.0
No	260	76.0
Current STI status		
Positive	36	10.5
Negative	306	89.5
PITC (provider-initiated HIV testing and counselling) test result		
Positive	16	4.7
Negative	326	95.3

RESULTS

Characteristics of the study participants

The mean (±SD) age of the respondents included in this study was 32.95 (±6.94). The minimum and maximum ages were 24 and 56 years, respectively. The majority (68.1%) of the study participants were married. More than three fourth of the study participants were secondary and above by educational level. Regarding the reproductive characteristics, the median parity was 2 and the range of parity was 7 with minimum and maximum parities of 0 and 7, respectively.

The majority of the study participants had a total parity of less than four. Of the total study participants, 82 (24%) had history of STI and 36 (10.5%) had a STI during the date of data collection. Sixteen (4.7%) of the study participants were living with human immune deficiency virus/acquired immune deficiency syndrome (HIV/AIDS) (Table 1).

Prevalence of precancerous cervical lesion and associated factors

Out of 342 screened women, 23 (6.7%) [95% CI: 4.4, 9.6] were found to be positive for a precancerous cervical lesion. In the determination of factors associated with the prevalence of precancerous cervical lesion, a multivariable logistic regression model was fitted using enter method and STI status was the only variable found to have a significant association with the outcome variable. That is, study participants who were infected with STIs during the cervical cancer screening campaign were nearly 50 times more likely to have precancerous cervical lesion as compared to their counterparts [AOR=49.88 (95% CI: 16.59, 149.91)] (Table 2).

DISCUSSION

This study assessed the prevalence of precancerous cervical lesion among women employee of Almeda

Table 2. Logistic regression analysis of factors associated with precancerous cervical lesion among women working in Almeda textile factory, North Ethiopia, 2015.

Characteristics	Precancerous cervical lesion screening result		COR (95% CI)	AOR (95% CI)
	Positive	Negative		
	N (%)	N (%)		
Age				
<35	17 (73.9)	201 (63.0)	1.66 (0.64,4.34)	1.63 (0.43, 6.22)
≥35	6 (26.1)	118 (37.0)	1	1
Marital status				
Married	19 (82.6)	214 (67.1)	2.33 (0.77,7.02)	2.63 (0.68, 10.15)
Single	4 (17.4)	105 (32.9)	1	1
Educational status				
Primary	5 (21.7)	78 (24.5)	0.86 (0.31,2.39)	1.21 (0.29, 5.10)
Secondary and above	18 (78.3)	241 (75.5)	1	1
Parity				
< 4	20 (87.0)	279 (87.5)	0.96 (0.27,3.36)	0.86 (0.13, 5.59)
≥4	3 (13.0)	40 (12.5)	1	1
History of STI				
Yes	8 (34.8)	74 (23.2)	1.77 (0.72,4.33)	1.16 (0.34, 3.97)
No	15(65.2)	245 (76.8)	1	1
Current STI status				
Positive	17 (73.9)	19 (6.0)	44.74 (15.82,126.55)	49.88 (16.59,149.91)
Negative	6 (26.1)	300 (94.0)	1	1
PITC test				
Positive	1 (4.3)	15 (4.7)	0.92 (0.12,7.30)	0.29 (0.02, 3.61)
Negative	22 (95.7)	304 (95.3)	1	1

Textile factory, North Ethiopia. Results of this study showed that the prevalence of precancerous cervical lesion was 6.7% [95% CI: 4.4, 9.6]. This finding is in line with the study conducted in Rwanda (Makuza et al., 2015), in which the prevalence was 5.9%. However, the finding of the current study is lower than the study done among HIV-infected women in Southern Ethiopia by Gedefaw et al. (2013) , in which the prevalence was 22.1%. Similarly, it is lower than the study done among HIV-infected women in Kenya by Memiah et al. (2012), in which the prevalence was 26.7%. This discrepancy may be due to the difference in the study population. In the present study, the participants were not in HIV infected population, whereas the two studies were carried out in HIV infected population who are at a higher risk of developing cervical cancer (Frisch et al., 2000; De Vuyst et al., 2008). This finding suggests the need to access community-based precancerous cervical lesion screening service integrated with health system by referral which could significantly avert the progress of precancerous cervical lesion to invasive cervical cancer among women. However, none of the study participants were ever screened for precancerous cervical lesion before this study conducted. This would let the precancerous lesion progress to invasive cancer which is very costly. This results in high cost due to the progress of precancerous lesion to invasive cancer (Mvundura and Tsu, 2014).

This study also assessed factors associated with precancerous cervical lesion among the study participants and the findings revealed that women who were infected with sexually transmitted diseases were more likely to develop precancerous cervical lesion than their counterparts. This finding is consistent with the finding of a similar study done in Southern Ethiopia (Gedefaw et al., 2013), in which women who had a history of STIs were more likely to develop precancerous as well as invasive cervical cancer lesion than their counterparts. This finding implies that cervical cancer screening service should

primarily target women infected with STIs in general including those who are infected with HIV/AIDS.

Finally, one of the limitations of this study is worth mentioning. Since secondary data was used for this study, it was impossible to include some key sexual and reproductive characteristics such as age at menarche, age at first sexual intercourse, lifetime number of sexual partners and so on that need to be included in this study.

Conclusion

The prevalence of precancerous cervical lesion was very high. Of the variables included in the analysis, STI was significantly associated with developing precancerous cervical lesion. Cervical cancer screening and treatment service should be available and accessible with emphasis to those that have STIs. Alongside accessing the service, appropriate community sensitizing programs need to be implemented to create awareness at the grass root level.

Conflict of interests

The authors have not declared any conflict of interest.

Abbreviations

AIDs, Acquired immune deficiency syndrome; **AOR,** adjusted odds ratio; **CI,** confidence interval; **COR,** crude odds ratio; **FGA,** Family Guidance Association; **HIV,** human immune deficiency virus; **HPV,** human papilloma virus; **PITC,** provider-initiated HIV testing and counseling; **SD,** standard deviation; **STI,** sexually transmitted infection; **VIA,** visual inspection using acetic acid.

ACKNOWLEDGEMENTS

The authors acknowledge Family Guidance Association (FGA), Aksum branch, North Ethiopia for funding the study. Their special thanks also go to the data collectors and supervisors.

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