Seroepidemiology of selected zoonotic infections in Basra region of Iraq

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الوبائيات السيرولوجية لبعض العداوى الحيوانية المنشأ في مدينة البصرة العراقية

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الخلاصة: أُجريت دراسة وبائية سيرولوجية مجتمعيَّة المُرْتَكَز لأربع من حالات العدوى الشائعة الحيوانية المنشأ (وهي: داء البروسيلات، والداء العُداري، وداء المقوَّسات، وداء الليشمانيات الحشوي)، وذلك في ثلاث مناطق (ريفية وحضرية وفي ضاحية نصف ريفية) في محافظة البصرة جنوبي العراق. وأظهرت الدراسة أن معدَّل انتشار داء البروسيلات في منطقة الضاحية نصف الريفية (29.3٪) كان أكثر ارتفاعاً منه في المنطقتين الريفية والحضرية. أما معدَّل انتشار داء العُداريات وداء المقوّسات فقد كان مرتفعاً نسبياً في المناطق الثلاث (إذ تراوح بين 19٪ – 35.5٪ لداء العُداريات، وبين 41.1٪ – 52.1٪ لداء المقوّسات). أما داء الليشمانيات الحشوي، فكانت معدلات العدوى به منخفضة (0.2٪ – 1.9٪). وقد أظهرت الدراسة بشكل عام أن منطقة الضاحية نصف الريفية معرَّضة بشدة لمخاطر العدوى الحيوانية المنشأ، بالمقارنة مع المنطقتَيْن الأخريَيْن. ومن الممكن لهذه الدراسة أن تكون بمثابة قاعدة رشيدة لتخطيط أسلوب شامل ومتكامل لمكافحة العداوى الحيوانية المنشأ في المناطق المدروسة.

ABSTRACT A community-based seroepidemiological study was made of 4 common zoonotic infections (brucellosis, hydatidosis, toxoplasmosis and visceral leishmaniasis) in 3 areas (rural, urban and suburban semirural) in Basra governorate, southern Iraq. The prevalence of brucellosis was higher in the suburban semirural area (29.3%) than the rural and urban areas. The prevalence of hydatidosis (19.0%–35.5%) and toxoplasmosis (41.1%–52.1%) were relatively high in all 3 areas. With respect to visceral leishmaniasis, low rates of infection were reported (0.2%–1.9%). The study shows in general that the suburban semirural area is at highest risk of zoonotic infections compared with other areas. The results could form a rational basis for the planning of an integrated comprehensive approach for control of zoonotic infections in the areas surveyed.

Séroépidémiologie de certaines infections zoonosiques dans la région de Bassora en Iraq

RÉSUMÉ Une étude séroépidémiologique communautaire a été réalisée sur quatre infections zoonosiques courantes (brucellose, hydatidose, toxoplasmose et leishmaniose viscérale) dans trois zones (rurale, urbaine et semi-rurale suburbaine) du gouvernorat de Bassora (Sud Iraq). La prévalence de la brucellose était plus élevée dans la zone semi-rurale suburbaine (29,3 %) que dans les zones urbaine et rurale. La prévalence de l'hydatidose (19,0 % - 35,5 %) et de la toxoplasmose (41,1 % - 52,1 %) était relativement forte dans l'ensemble des trois zones. En ce qui concerne la leishmaniose viscérale, on a signalé de faibles taux d'infection (0,2 % - 1,9 %). De manière générale, l'étude montre que la zone semi-rurale suburbaine a le plus fort risque d'infections zoonosiques par rapport aux autres zones. Ces résultats pourraient servir de base rationnelle pour planifier une approche complète intégrée en matière de lutte contre les infections zoonosiques dans les zones enquêtées.

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Introduction

Zoonoses are defined as infections that are naturally transmitted between vertebrate animals and humans [*1*]. They are responsible for widespread illness and death among humans. They are also known to affect animal health and productivity [*2*]. The social and economic burden of zoonotic infections is considerable, especially in developing countries [*3*]. The World Health Organization, in collaboration with other international and regional organizations, has called for strengthening comprehensive national control strategies and programmes for the control of major zoonotic infections [*3*]. Such programmes include intersectoral collaboration between public health and veterinary authorities in addition to other public and private agencies. It would be more feasible and cost-effective if an integrated approach were planned and administered to control a group of zoonotic infections that share common ecological and epidemiological characteristics in terms of source of infection and modes of transmission.

One of the essential prerequisites for the success of such an integrated approach is the acquisition of knowledge about the extent of the problem (in terms of frequency and distribution) in the targeted geographical areas. The development of serological tests for the diagnosis of many zoonotic infections has made it possible to assess the extent of exposure to these infectious diseases by taking a single blood sample from each person in the population at risk [*4–6*].

Reports based on routine statistics from health authorities in Basra have indicated that zoonotic infections in Basra constitute a public health problem [*7*]. The lack of an appropriate surveillance system, however, does not allow estimation of the exact burden of these infections among the population.

In this study we report the results of a community-based study carried out in Basra, southern Iraq, to assess the epidemiological pattern of four selected major zoonotic infections: brucellosis, toxoplasmosis, hydatidosis and visceral leishmaniasis using serological tests. As far as we know, no previous population-based study has been carried out in this part of the world.

Methods

Three areas in Basra were selected for the study: Bab Al-Twail, a rural village situated south of Basra city; Al-Qibla, an urban slum area situated in the centre of Basra city; and Al-Hartha, a semirural suburban area situated to the north of Basra city.

The households in each area were selected randomly using a cluster sampling technique described elsewhere [*8*]. The minimum sample size required was calculated in each area so that the proportion of each infection was determined with type I error of 5%, with 20% degree of precision of the expected proportion. According to these parameters, the minimum sample size required was 400 inhabitants in each area.

Households included in the study were visited by the team of investigators, and information about demographic, social and economic characteristics was obtained using specially designed interview forms. A blood sample was taken from every member of the household by venepuncture. The samples were sent the same day to the laboratory at the Department of Microbiology at Basra Medical College for serological testing as described below.

Serology testing

A latex test was used for the serodiagnosis of toxoplasmosis (Toxocell, Biokit SA,

Barcelona, Spain). This is a one-step rapid latex particle agglutination test on a slide for the qualitative and semi-quantitative determination of toxoplasmosis antibodies in serum.

Antibodies to *Brucella* species in serum were screened using a rose Bengal test (Micropath, Omega Diagnostics Ltd, Alloa, United Kingdom). The test depends on the ability of antibodies in the patient's serum to agglutinate the stained bacterial antigen.

An enzyme immunoassay method was used to screen for IgG antibodies to human *Echinococcus granulosus* in active cysts in serum (Al-Razi Centre, Baghdad, Iraq). The sample is considered positive if the absorbance value of the sample is equal to or greater than the cut-off value.

For the diagnosis of visceral leishmaniasis, antibodies to the parasite in serum were selected by direct agglutination test as described by Harith et al. [*9*]. This procedure gives good agreement with indirect fluorescent antibody testing (IFAT) which is usually used for the clinical diagnosis of leishmaniasis, yet it also allows estimation of antibody titre and thus level of exposure to infection.

The results were analysed using *SPPS* version 7.5 and the Z-test.

Results

The sample size of the population studied in the 3 areas was 439 in Bab Al-Twail (178 males and 261 females), 435 in Al-Qibla (215 males and 220 females) and 465 in Al-Hartha (255 males and 210 females).

The proportions of those below 15 years were as follows: Bab Al-Twail 45.8% Al-Qibla 36.1%; Al-Hartha 46.5%. The percentages of those 65 years and above were 2.1%, 3.7% and 1.7% in the 3 areas respectively.

Table 1 shows the overall prevalence rates (as expressed by percentage of positive cases) and 95% confidence intervals of the 4 infections. With respect to brucellosis the prevalence was significantly different among the 3 areas (as reflected by 95% confidence intervals). It was highest in the semirural suburban area of Al-Hartha (29.3%). With respect to hydatidosis the prevalence ranged from 19.0% in Al-Qibla (a slum area in Basra city) to 35.5% in Al-Hartha. There were no significant differences in hydatidosis between the 3 areas as reflected by the overlapping 95% confidence intervals. Relatively high rates of toxoplasmosis seropositives were reported in all areas (ranging from 41.1% to 52.1%). With respect to visceral leishmaniasis the rates ranged from 0.2% in Al-Qibla to 1.9% in Al-Hartha.

Tables 2–4 show the prevalence rates for brucellosis, hydatidosis and toxoplasmosis in the 3 areas by age and sex. Although lower prevalence rates were reported among children below 5 years of age with respect to brucellosis in Bab Al-Twail and Al-Qibla, hydatidosis in Bab Al-Twail, and toxoplasmosis in Al-Hartha, no significant age-specific trend could be ascertained except for the significance increase in prevalence rates of toxoplasmosis with increasing age in Al-Hartha. With respect to visceral leishmaniasis there were 16 cases in the 3 areas: 3 aged < 5 years, 12 cases aged 5–15 years and 1 case aged 15+ years.

There were no significant differences in the rate of any of the infections between males and females in any area except for a significantly higher prevalence of hydatidosis among males compared with females in Al-Qibla (24.0% among males compared with 15.2% among females) and higher prevalence rates of toxoplasmosis among females compared with males in Al-Hartha

Table 1 **Overall prevalence of brucellosis, hydatidosis, toxoplasmosis and visceral leishmaniasis in the study areas**

Disease	Bab Al-Twail (rural)				Al-Qibla (city centre)				Al-Hartha (semirural)			
	Total tested	Positive cases			Total tested	Positive cases			Total tested	Positive cases		
	No.	No.	%	(95% CI)	No.	No.	%	(95% CI)	No.	No.	%	(95% CI)
Brucellosis	439	25	5.7	(3.5–7.8)	435	53	12.2	(9.1–15.3)	465	136	29.3	(25.1–33.3)
Hydatidosis	61	14	23.0	(19.1–26.9)	58	11	35.5	(15.3–22.7)	62	22	35.5	(31.0–39.6)
Toxoplasmosis	138	62	44.9	(42.0–48.0)	141	58	41.1	(36.5–45.7)	140	73	52.1	(47.6–56.6)
Visceral leishmaniasis	429	6	1.4	(0.3–2.4)	435	1	0.2	(0.7–3.3)	465	9	1.9	(0.6–3.1)

CI = confidence intervals.

(60.0% among females compared with 32.5% among males).

Discussion

The results of the present study demonstrate how seroepidemiological community-based surveys are useful in assessing the level of exposure to selected zoonotic infections, as expressed by prevalence of seropositivity. Such rates reflect both clinical and subclinical (asymptomatic) infections. They also reflect the cumulative lifetime exposure of the population to such infections [*9*]. The study showed that there were no significant variations in the level of infections with toxoplasmosis, hydatidosis or visceral leishmaniasis between the 3 study areas (brucellosis did show variations). However, in general, the prevalence rates were highest in Al-Hartha, a semirural area. It seems that in spite of the difference in level of urbanization of the studied areas, they were not distinct ecologically or culturally to the extent that significant levels of transmission would result. The relatively high levels of infection with *Toxoplasma gondii* and *Echinococcus granulosus* (the causative agents of toxoplasmosis and hydatidosis respectively) indicates intimate contact with cats and dogs. It is known that stray dogs and guard dogs are common in the 3 studied areas. The significantly higher level of brucellosis in Al-Hartha compared to Al-Qibla and Bab Al-Twail might be because the transmission of infection is acquired though consumption of unpasturized milk or its products, rather than due to direct contact with infected animals [*10*].

The rates of infection with toxoplasmosis reported in this study in the 3 areas are higher than those reported in neighbouring countries such as Saudi Arabia [*11,12*] or the United Arab Emirates [*13*]. In Saudi

Table 2 **Distribution of brucellosis infection with respect to age and sex in the study areas**

Age and sex	Bab-al-Twail			Al-Qibla			Al-Hartha		
	Total tested	Positive cases		Total tested	Positive cases		Total tested	Positive cases	
	No.	No.	%	No.	No.	%	No.	No.	%
Age (years)									
< 5	38	1	2.6	46	4	8.7	52	15	28.9
5–14	163	8	4.9	111	14	12.6	164	39	23.8
15–44	184	15	8.2	197	27	13.7	211	65	30.8
45+	48	1	2.1	81	8	9.9	34	15	44.1
Unknown	6	0	0	0	–	–	4	2	50.0
Sex									
Male	178	5	2.8	215	22	10.2	255	74	29.0
Female	261	20	7.7	220	31	14.1	210	62	29.5

Arabia prevalences of 32.7% and 25.0% were reported. Wide variations in the level of infection with toxoplasmosis among different nationality groups were reported in the United Arab Emirates. The significant increase in the level of toxoplasmosis infection with increasing age reported in this study was also confirmed in the above studies.

With respect to brucellosis, prevalences of 13% and 23% were reported in western Sudan and Saudi Arabia respectively [*14,15*]. Their figures are comparable to those reported in Al-Qibla and Al-Hartha. However neither study was community-based as they included either only those at risk (the Sudan study) or were hospital-based (the Saudi Arabian study).

With respect to visceral leishmaniasis, low rates were detected in our study. However, such rates are important since they indicate that such infection is endemic

Table 3 **Distribution of hydatidosis infection with respect to age and sex in the study areas**

Age and sex	Bab-al-Twail			Al-Qibla			Al-Hartha		
	Total tested	Positive cases		Total tested	Positive cases		Total tested	Positive cases	
	No.	No.	%	No.	No.	%	No.	No.	%
Age (years)									
< 5	3	0	0	5	1	20.0	5	2	40.0
5–14	22	5	22.7	14	2	14.3	17	3	17.7
15–44	29	7	24.1	29	5	17.2	32	13	40.6
45+	7	2	28.6	11	3	27.3	6	3	50.0
Unknown	0	–	–	0	–	–	1	1	100.0
Sex									
Male	18	4	22.2	25	6	24.0	30	9	30.0
Female	43	10	23.3	33	5	15.2	32	13	40.6

Table 4 **Distribution of toxoplasmosis infection with respect to age and sex in the study areas**

Age and sex	Bab-al-Twail			Al-Qibla			Al-Hartha		
	Total tested	Positive cases		Total tested	Positive cases		Total tested	Positive cases	
	No.	No.	%	No.	No.	%	No.	No.	%
Age (years)									
< 5	9	3	33.3	7	4	57.1	11	1	9.1
5–14	24	9	37.5	20	6	30.0	29	12	41.4
15–44	82	38	46.3	89	41	46.1	90	54	60.0
45+	23	12	52.2	25	7	28.0	10	6	60.0
Unknown	0	–	–	0	–	–	0	–	–
Sex									
Male	24	7	29.2	32	14	43.8	40	13	32.5
Female	114	55	48.3	109	44	40.4	100	60	60.0

and that flare-ups could occur whenever circumstances are appropriate for breeding of sandflies. In fact outbreaks of visceral leishmaniasis have been reported in the northern region of Basra governorate.

In conclusion, the present study has demonstrated the feasibility of conducting an integrated study of several zoonotic infections. Such an approach is also cost- effective since it makes use of a single survey and single blood specimen to screen for such infections. Health authorities, in collaboration with other sectors, could plan a comprehensive package for control of these infections through appropriate intervention measures such as control of animals, control of vectors and through early detection and treatment of human cases. Health education programmes directed towards the public and to those at risk should form an important component of such a package.

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Emerging zoonoses

The WHO/FAO/OIE joint consultation on emerging zoonotic diseases held in Geneva in May 2004 defined an emerging zoonosis as "a zoonosis that is newly recognized or newly evolved, or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range". Emerging zoonotic diseases have potentially serious human health and economic impacts and their current upwards trends are likely to continue. Examples are avian influenza, bovine spongiform encephalitis (BSE) and the Nipah virus. Some of the "lingering" zoonoses are re-emerging in some regions, such as brucellosis and dog rabies and parasitic diseases such as cysticercosis/taeniasis and echinococcosis/hydatidosis.

Many factors lead to the emergence of zoonotic diseases. Environmental changes, human and animal demography, pathogen changes and changes in farming practice are a few of them. Social and cultural factors such as food habits and religious beliefs play a role too.

Further information about zoonoses and the work of WHO in this area can be found at: http://www.who.int/zoonoses/emerging_zoonoses/en/