Human brucellosis in the Gaza Strip, Palestine

R. Awad [1]

داء البروسيلات البشرية في قطاع غزة ، فلسطين

رياض عبد الكريم عواد

خلاصة : تم استقصاء حجم مشكلة البروسيلات في قطاع غزة ومدى تعرض الحالات لعوامل الخطر . فوجد أن معدل وقوع داء البروسيلات كان ثمانية في كل مئة ألف نسمة في عام 1996 . وتبين أن معدلات الوقوع النوعية العمر تكاد تكون متساوية في سائر الفئات العمرية ، بعمر وسطي عند وقوع العدوى يبلغ 20 سنة . لقد كانت البلاغات عن الحالات ترد من جميع المناطق ، بمعدل مرتفع بصورة خاصة في المنطقة الوسطى ومدينة غزة . وفي معظم الحالات كان المرض يبدأ خلال فصلي الربيع والصيف . وكانت عوامل الخطر الرئيسية المبلغة هي تناول الألبان ومنتجاتها ولاسيما الجبن المصنوع منزلياً (70.4%) . ولقد وقعت 22.2% من الحالات بين مربي الحيوانات . ولوحظ أن نسبة الحالات المزمنة أو الراجعة كانت عالية جداً (17%) .

ABSTRACT The magnitude of the brucellosis problem in the Gaza Strip and the exposure to risk factors among cases were investigated. The incidence of brucellosis in 1996 was 8/100 000. The age-specific incidence rate was approximately equal in all age groups, with a mean age of infection of 20 years. Cases were reported from all districts, with a particularly high incidence in the Mid-zone district and Gaza City, and most cases had onset of illness in spring and summer. The main reported risk factor was consumption of milk and milk products, especially home-made cheese (70.4%), and 22.2% of cases were among animal breeders. The proportion of chronic and relapsing cases was very high (17%).

La brucellose humaine dans la Bande de Gaza (Palestine)
RESUME L'ampleur du problème posé par la brucellose dans la Bande de Gaza et l'exposition aux facteurs de risque parmi les cas ont été examinées. L'incidence de la brucellose en 1996 était de 8 pour 100 000. Le taux spécifique d'incidence par âge était approximativement le même dans tous les groupes d'âge, l'âge moyen auquel l'infection se produit étant de 20 ans. Des cas ont été signalés dans tous les districts avec une incidence particulièrement élevée dans le district du Centre et à Gaza-ville; dans la plupart des cas, le début de la maladie avait lieu au printemps et en été. Le principal facteur de risque signalé était la consommation de lait et de produits laitiers, en particulier les fromages fermiers (70,4%), et 22,2% des cas se trouvaient chez des éleveurs d'animaux. La proportion de cas chroniques et de rechutes était très forte (17%).

[1] *Zoonotic Unit, Rimal Clinic, Ministry of Health, Gaza, Palestine.*
Received: 02/09/97; accepted: 04/12/97

Introduction

Zoonoses are a significant health problem in many industrialized and developing countries and continued effort is needed to control them in developing countries [*1–3*]. As the trade in animals and animal products and movement of people increase, the risk of introduction and re-introduction of certain infectious zoonotic diseases is growing [*4*].

Globally, despite the remarkable results achieved by the majority of industrialized countries, where bovine brucellosis has been eradicated or controlled, ovine–caprine brucellosis remains a problem in all developing countries and is prevalent where goats and sheep are kept [*5*]. Brucellosis is the most important zoonotic disease in Palestine.

The main species causing brucellosis in the Eastern Mediterranean Region (EMR) are *Brucella melitensis* and *B. abortus*, and the main reservoirs of infection in most countries are sheep and goats, and to a lesser extent cattle, buffaloes and camels [*6*]. Research suggests that *B. melitensis* biotypes 1 and 3 are responsible for most cases in animals in Palestine [*7*].

The Gaza Strip is located at the south-east corner of the Mediterranean Sea, between Israel and Egypt. It is approximately 45 km long and 8 km to 12 km wide covering an area of approximately 365 km^2. It is divided into four districts with three different environmental areas; urban, rural and refugee camps. In 1996, the recorded population was 860 000, although the true population is estimated to be 1 000 000. Approximately 50% of the population is below the age of 15 years. More than 65% are refugees living in eight refugee camps, and approximately 40% of the population live in Gaza City [*8*].

This study had three main aims: first, to describe the magnitude of the brucellosis problem in the Gaza Strip using historical notification data; second, to describe the characteristics and exposure to risk factors for brucellosis among cases notified in 1996; third, to use the data to improve control programmes.

Subjects and methods

Annual notification data for brucellosis were available from Ministry of Health records for the years 1985 to 1996 [*9*]. These were analysed by year and district.

A descriptive study was conducted of all cases reported in 1996. The subjects were interviewed using a standard questionnaire which asked about demographic data and main risk factors. Exposure to risk factors was ascertained for the 3-month period before the onset of symptoms. Animal contact with sheep and goats (breeding animals) indicated the disease as an occupational hazard.

Acute brucellosis is an illness characterised by acute or insidious onset of fever, night sweats, undue fatigue, anorexia, weight loss, headache and arthralgia, with a positive rose bengal test. Chronic cases were defined as a duration of illness longer than 1 year and may manifest in four ways: insidious onset of disease, acute disease followed by recurrent relapses, localized disease due to *Brucella* spp. in certain organs, or persistent illness usually unresponsive to antimicrobial therapy [*10*]. Relapsing disease was defined in this study as recurrent episodes of illness of less than 1 year duration following treatment.

Informed consent was obtained from all participants following explanation of the aims and importance of the survey. All family contacts of subjects were screened and

Table 1 **Reported human brucellosis incidence from 1986 to 1996 in the Gaza Strip by district**

Area	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
North	2	34	73	13	18	20	30	30	10	3	4
Gaza City	3	17	17	13	48	32	52	70	61	22	33
Mid-zone	–	–	–	5	2	–	–	–	1	2	17
South	–	–	20	12	60	53	17	6	7	6	15
Total	5	51	110	43	128	105	99	106	79	33	69

included as cases if they fulfilled the criteria for case definition. Interviews were conducted by three staff members of the Epidemiology and Zoonotic Unit at the time the subject first presented and the questionnaires were completed before any health education was provided.

Results

Annual incidence 1986–1996

The annual incidence of reported cases is shown in Table 1. The mean annual incidence was 75 cases. The overall annual incidence rate in the Gaza Strip in 1996 was 8/100 000.

Descriptive data

A total of 69 cases of brucellosis were reported in 1996. The addresses of 54 of the people affected (78.3%) were available; they were visited and all 54 (100%) agreed to participate in the study.

The age range was from 4 years to 90 years, with a mean age of 20 years. They were distributed by age as follows: 0–9 years (36%), 10–14 years (13%), 15–39 years (40%) and ≥ 40 years (11%). The age-specific incidence rate of brucellosis was similar for all age groups (Table 2). Age was not recorded in seven cases.

There were slightly more male cases (55.6%) than female. Among children aged 0–14 years, 14 (60%) were males, and among those 15 years and over, 12 (50%) were males.

The incidence rate of brucellosis by district was 2.5/100 000 in the North district, 6.2/100 000 in Gaza City, 11.3/100 000 in the Mid-zone district and 3.1/100 000 in the South district. The distribution of cases by environmental area was 46% from urban areas, 30% from rural areas and 24% from the camps.

The incidence had a seasonal pattern. Onset of symptoms occurred in spring in 25 cases (46%), in summer in 19 cases (35%), in autumn in 5 cases (9%) and in winter in 1 case (2%). The date of onset was unknown in 4 cases.

Table 2 **Age-specific frequency of brucellosis cases, Gaza Strip, 1996**

Age (years)	Frequency	Population
0–9	17	314 142
10–14	6	113 147
15–39	19	326 349
≥ 40	5	106 722
Total	47	860 369

Age was missing for seven cases

Risk factors for infection

Consumption of milk and milk products (cheese and sour milk) was reported by 70.4% of cases and contact with animals by 22.2%. The risk factor was unknown in 7.4% of the cases. In 38 cases (71%), the only reported risk factor was consumption of milk and milk products, in 7 cases (13%) the only risk factor was animal contact, in 5 cases (9%) both risk factors were present and in 1 case neither risk factor was present. Of those who reported eating home-made cheese, the majority (95%) did not boil it before consumption. None of the people affected reported eating raw meat. There were no cases among veterinarians, veterinary assistants or slaughterhouse workers.

There was no significant overall difference in risk factors between males and females. However, among children under 15 years of age, animal contact was reported by five males and one female and among adults was reported by two males and four females. The main reported risk factors differed depending on whether the person lived in an urban area, a rural area or a camp. Among those who lived in an urban area, cheese consumption was reported by 78.2%, but consumption of sour milk and animal contact were not reported by any urban residents. Among camp residents, consumption of sour milk was reported by 60.2%, cheese consumption by 6.6% and animal contact by 13.3%. In those living in rural areas, animal contact was reported by 83.4%, but cheese consumption was not reported at all.

There were seasonal differences in reported risk factors. Of the 25 cases with an onset in spring, 12 (48%) reported eating cheese, and 10 (40%) reported animal contact. In cases with onset in summer, 9 (47%) reported consumption of sour milk. Of the 6 cases with onset in autumn and winter, all reported consumption of milk and milk products (Figure 1).

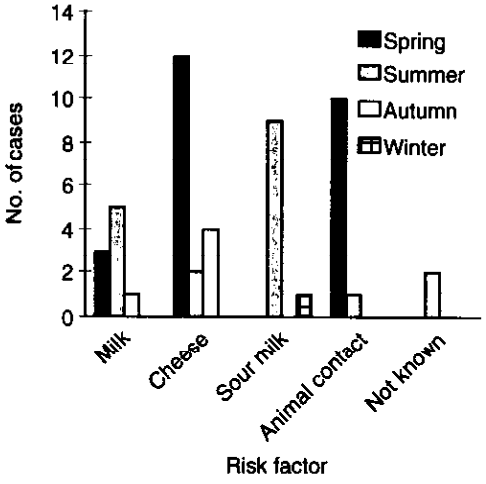

Figure 1 Distribution of risk factors for brucellosis by season, Gaza Strip, 1996

Chronic brucellosis was found in 3 cases (6%), and relapsing disease in 6 cases (11%), with a combined total of 17%. Of these 9 cases, 4 were males and 5 females, and 2 of the cases were children under the age of 15 years. Chronic and relapsing disease were not found in cases under 9 years of age. All the adults with brucellosis were aged between 20 years and 40 years. Symptoms of fever, bone pain, sweating and headache were reported by 4 people with the disease (44%).

Discussion

This study is the first to describe the incidence of brucellosis and the various risk factors among cases in the Gaza Strip. The recent establishment of the Palestinian Authority has increased movement both into and out of the Gaza Strip. This demographic change will have a direct and indirect ef-

fect on the infectious disease problem and on programmes to control and prevent infectious and zoonotic diseases.

In the Gaza Strip, a mean of 75 cases of human brucellosis have been reported annually since 1987, with a peak in 1990. Cases of human brucellosis have been notified to the Epidemiology and Zoonotic Unit since 1986. Treatment of brucellosis is provided free of charge by the Ministry of Health; therefore the cost of treatment does not discourage presentation of cases. However, underdiagnosis and underreporting of cases is a recognized problem, and it is estimated that for each reported case there are at least two additional cases that are not reported or not diagnosed. Therefore, the actual number of cases may be approximately three times as many as the reported number. Irrespective of how one enumerates cases, it is clear that brucellosis has become endemic in the human population in Palestine. Evidence suggests it is also enzootic in animals, especially sheep and goats, with a prevalence of approximately 5% to 6% in some Palestinian territories [*11*]. Serosurvey studies are therefore needed to estimate the actual prevalence of human and animal brucellosis.

The rose bengal test is the only laboratory test available in laboratories in the Gaza Strip. The test has a high sensitivity and specificity but its disadvantage is that it remains positive for a long period after treatment.

In western Europe and the United States of America (USA), the incidence of brucellosis is low; for example, fewer than 120 cases were reported in the USA in 1995 [*12*]. In comparison, in the EMR, the reported incidence increased rapidly between 1985 and 1990, due to improvements in the surveillance systems and laboratory facilities and increased awareness of the disease among physicians and the community. Six EMR countries (Egypt, Islamic Republic of Iran, Jordan, Oman, Saudi Arabia and Syrian Arab Republic) reported a combined annual total of more than 90 000 cases of human brucellosis in 1990 [*6*].

Despite a favourable environment for the spread of brucellosis in the Gaza Strip, the incidence was less than expected for many reasons. Underreporting has already been referred to. Intensive animal breeding is limited, and poor economic circumstances result in low consumption of milk, milk products and meat. In addition, frequent closure of the border by the Israeli authorities results in poor communication with the West Bank and neighbouring countries where the incidence of animal brucellosis is very high (5%–6% in the West Bank and 42% in some flocks, particularly in the Hebron area [*7*]). A recent study in Jordan estimated the reported diagnosed cases of human brucellosis to be 898 in 1986 and 1273 in 1987 (A.E. Abdou, unpublished data, 1988). This implies that, in the near future, the brucellosis problem in the Gaza Strip could be aggravated as a result of economic development and improved direct communication with the West Bank and neighbouring countries.

The incidence rate of brucellosis in the Mid-zone district (11.3/100 000) was over four times higher and in Gaza City (6.2/100 000) over twice as high as that in the North district (2.5/100 000). The distribution of cases by environmental area was 46% from urban areas, 30% from rural areas and 24% from the camps. Improved epidemiological surveys are needed to estimate the magnitude of the brucellosis problem in relation to different districts and environmental areas.

The incidence rate of brucellosis was approximately equal in all age groups, suggesting that all age groups are at risk. The mean age of infection was 20 years; there-

fore, brucellosis is not only a serious health problem but also a serious economic one. There was a slight male predominance among cases. However, in contrast to other countries, this is not due to occupational exposure of males. Among adults reporting contact with animals, there were significantly more females. This may be because in the Gaza Strip animals live in close contact with humans in small flocks inside the home, where women look after them. In the USA, brucellosis is seen primarily in males between the ages of 20 years and 60 years because of occupational exposure among abattoir workers and livestock handlers; the sex distribution tends to be the same in both the elderly and the very young [*13,14*]. Some studies suggest that the age distribution in EMR countries indicates that children are particularly at risk, and the sex distribution shows that males are significantly more affected [*6*].

The reported risk factors for transmission in urban areas were consumption of milk and milk products, especially home-made cheese (78.2%), but in the camps the main risk factor was the consumption of sour milk (60.2%). This difference can be explained by the economic situation in the camps. In the villages, animal contact was the main reported risk factor for transmission (83.4%). In the Gaza Strip, therefore, human brucellosis is mainly a consumer disease rather than an occupational one. Other risk factors for brucellosis (7.4%) not identified in this study may include eating uncooked vegetables contaminated with excreta of infected animals and inhalation of dust contaminated with excreta. Milk and milk products are mainly purchased from public markets. Most people who reported eating home-made cheese (95%) did not boil it before consumption. Cutting the cheese into slices and boiling it for 10 minutes may prevent the transmission of brucellosis. New milk treatment plants and health education programmes are needed to change people's habits from consuming home-produced cheese to that produced from pasteurized milk, especially during Ramadan.

A high proportion of cases occurred during the spring (47%), which is the first delivery season, when most of those infected reported consuming milk products (48%) or animal contact (40%). During summer there was also a high incidence (41%), mainly due to consuming home-made cheese and sour milk. There was a low incidence in the autumn, the second delivery season; in the Gaza Strip sheep and goats do not only deliver in the spring and autumn but all year round by synchronization. The pattern is similar to that seen elsewhere where seasonality in the incidence of human brucellosis is observed in temperate and cold countries, where parturition in small ruminants is seasonal and clustering of cases exhibits a strong connection with the lambing season, usually in early spring [*6*]. The highest incidence of human brucellosis occurs 1–2 months after this period [*5*]. In the USA, most cases occur in the spring and summer with the lowest incidence in the autumn [*13*]. Similarly, in EMR countries the incidence has a seasonal pattern, with the highest number of cases occurring during the spring and early summer period [*6*].

Meat of goats, sheep and cattle with brucellosis may also be a source of infection if eaten insufficiently cooked, particularly the meat, bone marrow, liver and spleen of small ruminants in the bacteraemic stage. Some particular food habits may be responsible for human brucellosis, such as drinking unpasteurized milk and eating raw meat. Crushing the umbilical cord of newborn lambs and kids with the teeth is another risky habit. Skinning stillborn

lambs and kids and aborted fetuses, which may be heavily contaminated with *Brucella* spp., also presents a high risk of brucellosis [5]. Although this study did not investigate these sources of infection, further investigation must be carried out to be certain that the meat of infected animals is cooked sufficiently before consumption.

Raw milk and milk products from milk of infected sheep, goats and cattle are the most important sources of *B. melitensis* infection [5]. Soft cheeses made from raw goat or sheep milk, using old traditional methods which do not ensure killing of *Brucella* spp. organisms are important sources of infection and may cause the extension of the epidemic to distant places, even to other countries where there is a great demand for such products. This problem is an important factor in Mediterranean areas because such cheeses lose their unique taste and aroma if made from pasteurized milk; thus, producers are reluctant to change traditional practices. Using the stomach contents of newly born lambs or kids as rennet in cheese-making increases the hazard posed by such products. Fermentation and ripening of such products, which may take some time, may reduce the viability of the *Brucella* spp. organisms, but practices vary widely between countries and therefore their safety is limited. Brucellosis may also be transmitted by processed foods and there have been reports of transmission by ice-cream made with a mixture of goats' and cows' milk [5].

This study found that keeping animals was an important risk factor and 13% of cases reported this as the only risk factor. Although veterinarians, veterinary assistants and slaughterhouse workers are considered high-risk groups, these occupations were not found among our cases. This may be because of underreporting or because these groups are aware of zoonotic diseases. Groups of professionals engaged in handling live infected goats and sheep or their products are continuously at risk of brucellosis. Such groups include shepherds, animal caretakers and handlers, veterinarians, slaughterhouse workers, sheep-shearers and laboratory workers handling materials infected with *Brucella* spp. Increased immunity to brucellosis is sometimes observed in populations where brucellosis has been endemic and a significant proportion of the population are serologically positive without showing any symptoms. It is believed that such people, being frequently exposed to brucellosis since childhood, acquire some kind of immunity, which is boosted on repeated contact. The rapid increase in tourism, bringing visitors from brucellosis-free countries into *Brucella*-infected areas, is a new factor in the epidemiology of brucellosis. Endemic countries are therefore forced to institute measures to eradicate caprine–ovine brucellosis, or at least to protect tourists by intensifying the control of milk and milk products in tourist areas [5].

We found three cases of chronic brucellosis (6%) and six cases of relapsing disease (11%). The proportion of chronic cases of brucellosis in industrialized countries is usually not more than 5% [1]. In this study, the proportion of chronic and relapsing cases was 17%, which is considered to be very high. Despite applying World Health Organization (WHO) medication protocols, the reasons for this may include lack of compliance with drug treatment, lack of awareness among doctors of WHO protocols and late presentation for treatment. Also, patients with fever and a history of brucellosis may be misdiagnosed as a new case because the rose bengal test remains positive for a long time. Therefore, diagnostic laboratory tests such as complement fixation tests or titration

must be available to investigate patients who present with fever and joint pain and who have a positive rose bengal test. Chronic and relapsing brucellosis is an area which needs further investigation. Patients must be treated according to WHO protocols and more health education is needed to improve patient compliance with medication in order to decrease the proportion of chronic and relapsing cases.

Recommendations

- Human and animal laboratory facilities need to be supplemented and upgraded to be capable of performing all serological and bacteriological tests related to brucellosis.
- An improved epidemiological survey is needed to determine the magnitude and distribution of the brucellosis problem both in humans and animals.
- A mass vaccination programme of young sheep and goats with Rev. 1 vaccine is needed. At the same time adult sheep and goats should be immunized with a reduced dose of Rev. 1 vaccine. Moreover, serious consideration should be given to the use of the *B. abortus* S19 attenuated vaccine to immunize cattle whenever feasible as recommended at the First National Zoonoses Workshop, Palestine, 1995. To avoid any risk of vaccine-induced abortion, the animals would have to be vaccinated during late pregnancy or, preferably, during the lactation period [*15*].
- Permanent marking of vaccinated animals with ear tags should be introduced.
- There should be obligatory slaughter of *Brucella*-positive animals under veterinary supervision and compensation for the owners.
- Quarantine and control measures should be established and blood samples collected from animals for serological tests.
- Control measures should be introduced in common animal markets and blood samples collected and examined by the rose bengal test.
- WHO protocols for the treatment of human brucellosis should be followed and more health education given to patients in order to decrease the misuse of drugs and noncompliance.
- A prospective study of chronic brucellosis cases should be conducted and cases followed up to decrease its occurrence.
- Milk and milk production plants should be established.
- Animals should be imported from brucellosis-free countries.
- Farmers, high-risk groups and the general population should be given health education about the nature of the disease and how to minimize the risk of transmission through animal contact and milk products produced from unpasteurized milk.
- Intersectoral cooperation with different ministries and nongovernmental organizations should be increased.
- Membership of national and international committees on zoonosis is recommended.

Acknowledgements

I am grateful for the guidance, tremendous support and valuable remarks of Dr Abed El-Jabar Tebbi, Director-General, Primary Health Care, Dr Yehia Abed, Director-General, Gaza Health Services Research, Plan-

ning and Development Centre, Ministry of Health, Dr Richard Roberts, Consultant, Communicable Diseases Control, North Wales Health Authority, and Denis Grancher, Veterinary School of Lyons, France. I would also like to express my thanks to the participants in this study and my colleagues in the Epidemiology and Zoonotic Unit and Veterinary Medical Department.

References

1. *Joint FAO/WHO Expert Committee on Brucellosis*, 6th report. Geneva, World Health Organization, 1986 (Technical Report Series, No. 740).
2. Meslin FX. *Emerging and re-emerging zoonotic diseases.* Paper presented at the Regional Conference on Emerging Infectious Diseases, Cairo, Egypt, 26–29 November 1995.
3. Awad R, Zubedy M, Shubeer M. *Strategy for brucellosis control.* Paper presented at the First National Zoonoses Workshop, Ramallah and Gaza, 20–30 November 1995.
4. Shimshony A. *Epidemiology of emerging zoonoses in Israel.* Beit Dagan, Israel, 1996.
5. Kolar J. Control of *Brucella melitensis* brucellosis in developing countries. *Annales de l'Institut Pasteur. Microbiologie.* 1987. 138:122–6.
6. Abdou AE. *Brucellosis in the Eastern Mediterranean Region.* Paper presented at the Regional Conference on Emerging Infectious Diseases, Cairo, Egypt, 26–29 November 1995.
7. Hassunah MA. *Animal health problems and needs in occupied Palestinian territories.* Palestine, General Directorate of Veterinary Services, 1993 (unpublished).
8. Research, Planning and Development Centre. *Annual report on health in the Gaza Strip.* Gaza, Ministry of Health, 1995.
9. Ministry of Health, Epidemiology and Zoonotic Units. *Disease statistics.* Gaza, Palestine, Ministry of Health, 1996.
10. Spink WW. Some biologic and clinical problems related to intracellular parasitism in brucellosis. *New England journal of medicine*, 1957, 247:603.
11. Tarazi W. *Epidemiology of brucellosis in the occupied Palestinian territories.* Palestine, American Near East Refugee Aid, 1990 (unpublished).
12. Abram S. *Control of communicable diseases in man.* Washington DC, American Public Health Association, 1995.
13. *Brucellosis surveillance. Annual survey 1978.* Atlanta, Georgia, Centers for Disease Control and Prevention,1979.
14. Brucellosis in the United States, 1965–1974. *Journal of infectious diseases*, 1977, 136:312–6.
15. Khaled S, Tschanen C, Durisch P. *Brucellosis control project in the West Bank.* Palestine, Vétérinaires sans Frontières, 1994.