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Correlation between animal and human brucellosis in Italy during the period 1997–2002

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ABSTRACT

The aim of this study was to test the hypothesis that brucellosis in Italy is a food-borne, rather than an occupational disease. This hypothesis was tested using data for both human and animal populations from the period 1997–2002. The correlation between the distribution of the disease in the human, sheep and goat populations was analysed, as were the risk factors for the disease, with respect to gender, age, occupation and residence of the individuals involved. Notifications of human brucellosis, which are mandatory in Italy, reach a peak between April and June. However, considering the standard incubation period of 2–4 weeks, and the fact that lamb slaughter is traditionally at a peak during the Easter period, it might be expected that occupational exposure would result in a peak of human cases between March and May. The observed peak between April and June could be related to the production and consumption of fresh cheese, starting just after lamb slaughter. The age of patients showed a fairly uniform distribution, and analysis of incidence rates of human brucellosis between 1997 and 2002 showed that the incidence rates were consistent with an occupational exposure risk of about 25%.

Keywords Brucellosis, cheese, food consumption, incidence rates, lambs, occupational risk

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INTRODUCTION

Worldwide, brucellosis remains a major source of disease in man and farmed animals [1]. Consumption of contaminated foods and occupational contact remain the major sources of infection. Examples of human-to-human transmission following tissue transplantation or sexual contact are reported occasionally [2], but most human cases involving wild-type strains of *Brucella* spp. can be traced to food animals. In the past, cattle have been the major source of human infection in most countries, and programmes to eradicate the disease have been aimed largely at bovine brucellosis. Success has been achieved in northern and eastern European countries, Australia, New Zealand, Japan, Canada and the USA. Cattle remain the source of brucellosis in most African countries, where large numbers of cattle are maintained and drinking raw milk is a custom. In countries with near universal pasteurisation of milk, brucellosis has become an occupational disease. Brucellosis remains a serious zoonosis in areas of the world where *Brucella melitensis* is endemic in sheep and goats. These areas include the Mediterranean littoral, southwest Asia and parts of Latin America [3].

Prevention of human brucellosis depends on control of the disease in animals. Although success has been achieved in eradicating the bovine disease, *B. melitensis* infection in sheep and goats has proved more intractable, and success has been limited [1]. Previous studies in Italy regarding the impact of animal brucellosis on human disease have suggested an overlap between the distribution of disease in humans and that in the cattle and ovi-caprine populations [4], although it seems unlikely that the disease was transmitted to humans in the same proportion from cattle, sheep and goats. Caporale *et al.* [5] reported that *B. melitensis* was the pathogen isolated most frequently in human cases of brucellosis in Italy between 1970 and 1990,

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accounting for 99% of total cases. Therefore, the problem in Italy seems to focus on the ovi-caprine population, rather than the cattle population, and the correlation between the distribution of the disease in cattle and in human populations seems to be spurious, since there is a higher prevalence of bovine brucellosis in the same areas of southern Italy where ovi-caprine brucellosis is widespread.

Data on *Brucella* strains isolated from humans in Italy have not been updated since 1990, even though animal, mainly ovi-caprine, trends remained relatively high in the succeeding years [4]. The possible routes of infection have not been assessed formally in Italy, but there are consistent seasonal incidence peaks, which suggest that foodborne infection could be the main route of dissemination for the disease. The aim of the present study was to test the hypothesis that brucellosis in Italy is a food-borne, rather than an occupational disease. This hypothesis was tested using data for both human and animal populations during the period 1997–2002 for the whole of Italy, with particular reference to some regions where more detailed information was available. The correlation between the distribution of the disease in the human, sheep and goat populations was analysed, as were the risk-factors for the disease in human populations in Italy, with respect to gender, age, occupation and residence of the individuals involved.

MATERIALS AND METHODS

Data sources

National population data, subdivided by gender, age, occupation and residence, for the period 1997–2002 were provided by the Italian National Institute for Statistics [6]. National data regarding human cases of brucellosis, subdivided by gender, age, and month of occurrence, notified during the period 1997–2002 in Italian provinces and regions, were provided by the Italian Ministry of Health [7]. Regional data regarding the occupations of individuals involved in cases of brucellosis notified during the period 1997–2002 were provided by the University of Bari (Faculty of Medicine) for the Apulia region, by the Regional Epidemiological Centre for the Campania region, and by the Regional Health Unit for the Abruzzi region. National data on the number of flocks infected with brucellosis in Italian regions, as well as data regarding the ovi-caprine population density, were provided by the Italian Ministry of Health as part of national eradication campaigns for sheep and goat brucellosis. National data regarding the monthly number of lamb slaughters during 1997–2002 were provided by the Italian Institute of Services for Agricultural Food Market [8].

Statistical analysis

Regression model

The correlation between the incidence of human brucellosis in Italian regions and the number of brucellosis-infected flocks was investigated by least squares linear regression.

Mathematical model for occupational exposure

It was assumed that the number of expected cases of human brucellosis in a given age group, with respect to a given percentage of occupational exposure risk (Fig. 1), can be derived from the sum of: (1) the number of cases expected in that age group related to a given professional exposure risk, i.e., the number of observed cases multiplied by the percentage of occupational exposure risk and by the ratio between the population employed in the age group under consideration and the total population employed in all age groups; and (2) the number of cases expected in an age group that are related to non-professional exposure, i.e., the number of observed cases multiplied by 1 – the assumed percentage of occupational exposure risk and by the ratio between the total population in the age group considered and the total population in all age groups. The age groups considered were 0–14 years, 15–24 years, 25–64 years and ≥ 65 years. The percentages of occupational exposure risk were 0%, 25%, 59%, 75% and 100%. Validation of the mathematical model was based on surveillance data from the Abruzzi, Campania and Apulia regions, considering a north–south incidence gradient of human and animal brucellosis infection.

RESULTS

Incidence of brucellosis in humans and its relationship with animal brucellosis

The incidence of human brucellosis in Italy during 1990–2002 decreased from 2.7 cases/100 000 inhabitants in 1990 to 1.4 cases/100 000 inhabitants in 2002, with a peak of

$$\left(\begin{pmatrix}\text{Total}\\ \text{observed}\\ \text{cases}\end{pmatrix} * \begin{pmatrix}\text{Percentage}\\ \text{occupational}\\ \text{exposure}\end{pmatrix} * \begin{pmatrix}\text{Population}\\ \text{employed}\\ \text{in.age.class}\\ \hline \text{Total.}\\ \text{population.}\\ \text{employed}\end{pmatrix}\right) + \left(\begin{pmatrix}\text{Total}\\ \text{observed}\\ \text{cases}\end{pmatrix} * \left(1 - \begin{pmatrix}\text{Percentage}\\ \text{occupational}\\ \text{exposure}\end{pmatrix}\right) * \begin{pmatrix}\text{Total}\\ \text{population}\\ \text{in.age.class}\\ \hline \text{Total}\\ \text{population}\end{pmatrix}\right)$$

Fig. 1. Number of expected cases of human brucellosis in a given age group related to a given percentage of occupational exposure risk.