ANIMAL AND HUMAN HEALTH AMONG SEMI-NOMADIC HERDERS OF CENTRAL MONGOLIA: BRUCELLOSIS AND THE BUBONIC PLAGUE IN OVÖRHANGAY AIMAG

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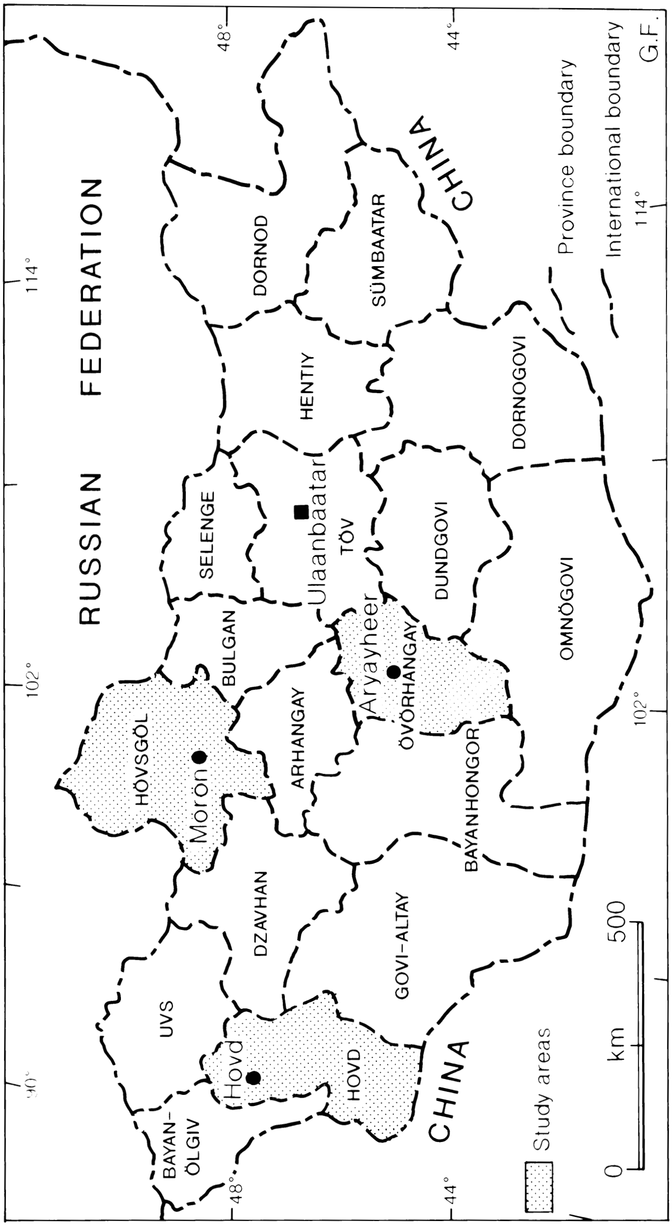
Introduction

Rapid changes are taking place in the lifestyle and environmental conditions of the semi-nomadic herders of Mongolia (Templer et al. 1993, Sneath 1993, Finke 1995) – indeed, life on the steppe is no longer what it once was (Jagchid and Hyer 1978, Bawden 1989). These changes no doubt have had an impact on the health levels of this population which still constitutes approximately twenty-five per cent of the national total (in 1992) of approximately 2.2 million people, and where the national rates of life expectancy and infant mortality were 61.3 years, and 59.8 per thousand respectively (Randall 1993, WHO and Ministry of Health 1993). Beginning with major political reforms in 1990, Mongolia has undergone rapid transition from a highly bureaucratic, centrally planned state to an open market economy and more pluralistic political system (Akiner 1991, Milne et al 1991). The dislocation that has accompanied these adjustments has handicapped attempts to expand, and even to maintain, modern health care as practised for several decades (WHO and Ministry of Health 1993). Furthermore, the move towards privatisation of the Mongolian economy also has had an impact on the practices of animal husbandry, particularly in the realm of disease control and government services, which basically are no longer available. Although referring to marketing trends, Müller's (1995) conclusions are also relevant to other services (e.g. veterinary care) that are (no longer) provided without charge by the state (Müller 1995). He has stated that, 'with the dissolution of co-operatives the old structures of sales and supplies have been dismantled and have not been replaced by any new structures . . . Private herdsmen are now almost free from any embed[ding] in formal institutional structures' (Müller 1995: 190). It is in this context of significant change that a health and socio-economic environmental survey was carried out in the first half of the last decade. This study was carried out in three of Mongolia's eighteen *aimag* or provinces (Ovörhangay, Hövsgol and Hovd), a sample of geographical areas which includes most of the characteristic natural and cultural conditions of this vast country of 1,566,000 square kilometres (Sodnam and Yanshin 1990) (Figure 1). The objective of this paper is to report on one aspect of this broader study, namely the relationships that exist between animal



Source: Adapted from World Bank report 1992.

Figure 1 *The Provinces of Mongolia* and human health among Mongolia's semi-nomadic herders for one of the three provinces: Ovörhangay.

The research is based on the premise that the health status of pastoral semi-nomadic communities, and indeed of populations throughout the world, is related directly to lifestyle (Hetzel and McMichael 1989), cultural factors (Gesler 1992), social and physical environments (Lee 1972, Cartledge 1994, Foggin et al. 1997, Gesler et al. 1997) and the provision and use of appropriate health care services (Kohn and White 1976, Smith 1982, Phillips 1990, Mohar 1998). This conceptual model reflects a series of related hypotheses that emerge from the relevant literature (Lalonde 1974, Meade 1977, Meade et al. 1988, Hancock 1992, 1996), namely that the health status of a community is seen as influenced by three 'enabling' or 'predictor' categories. The first relates to *lifestyle*; the second, to the *physical and socio-economic* characteristics of the environment (Martin et al. 1987); and the third to *perceptions of and interactions with the health care system* (Shannon and Dever 1974, Swift and Mearns 1993). The basic hypothesis of this research, therefore, is that the health status of a nomadic population varies as a function of lifestyle factors including, for example, diet, tobacco and alcohol consumption, geographic mobility and types of livelihood. The latter includes, by definition, health risk (of zoonosis) due to the proximity to different kinds of livestock. In addition, since health status is also a function of various social and physical environmental factors, there is need for a better understanding of the relationship between herding families and their animals.

We focus here on work conducted in Ovörhangay *aimag* (province) in the summer of 1993, and particularly on the potential prevalence of brucellosis, a zoonosis which occurs in Mongolia and other nomadic steppe economies (Khazanov 1984, Galaty and Johnston 1990). Situated in the geographic centre of Mongolia, Ovörhangay corresponds to an ecological microcosm of areas occupied throughout the country by semi-nomadic herdspeople. Its total population, almost entirely Halha Mongol, was approximately 100,400 in 1992. Ovörhangay includes eighteen districts (*sum*) and the four sample areas were chosen for their geographical representativeness of one of three natural environments typical of this province – wooded steppe (Jargalant and Bat-Oldzii), steppe (Bayan-Teeg), and arid *gobi* conditions (Baruun-Bayan-Ulaan) (Figure 2).

The approach we use deals primarily with *proximate* (or biomedical) and *intermediate* (or behavioural) causes but is not able to address in detail the more basic underlying questions of ultimate social and economic determinants of health status (Millard 1994, Mayer 1996, Gesler et al. 1997: 666). More specifically, the topic presented herein relates to a single component (i.e., the relationships between animal and human health) of the larger bio–socio–environmental system presented above, as observed through a survey whose specific goal was to examine the impact of animal diseases (particularly brucellosis) on human health. Of course, this is only a part (albeit an important one) of a necessarily holistic global

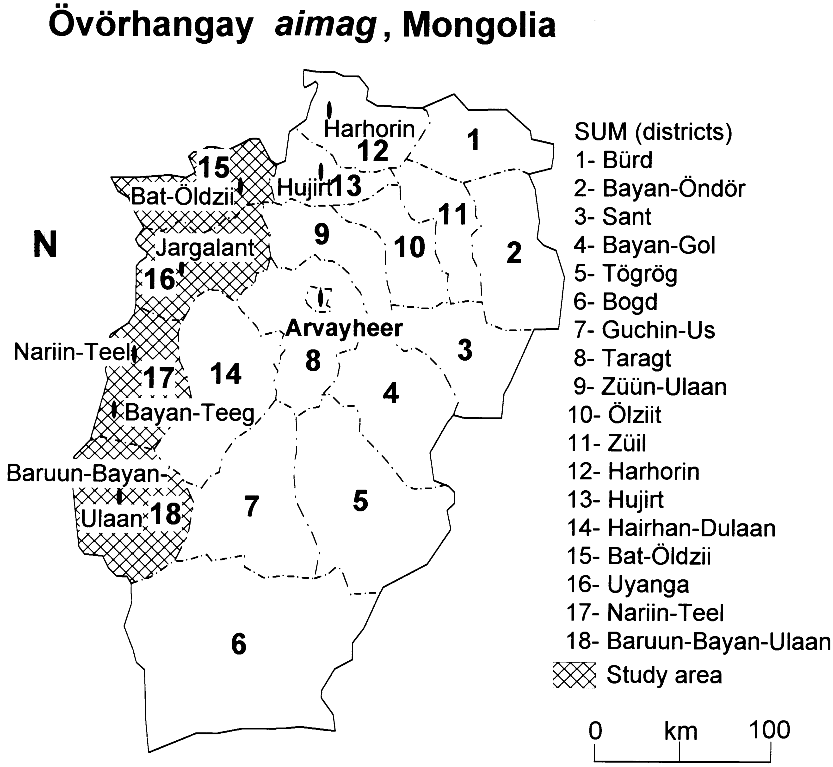


Figure 2 *The Study Area*
Source (for boundaries): Sodnom and Yanshin (1990: 95).

explanation of both spatial and socio-economic variations of health and disease among nomadic and semi-nomadic populations (Kearns 1993, Hertz et al. 1994).

For a variety of reasons there have been repeated attempts to alter the traditional lifestyle of semi-nomadic herders in Mongolia (Swift et al. 1990; Bazargur et al. 1990 and 1993). However, these attempts have generally not been successful. This is due in part to the failure of development planners to recognise that the nomadic way of life is usually an ecologically and economically sound adaptation to the natural conditions that exist in much of the country (Accolas et al. 1975, Humphrey 1978, Bazargur et al. 1993, Sheehy 1993, Bazargur 1996). Khazanov (1984: 69) points out that 'pastoral nomadism can be looked upon as an answer to conditions dictated by [the] environment and [that] it is a successful answer because out of all forms of the traditional food-producing economy it was pastoral nomadism which was able to master and exploit the potential resources of vast ecological zones'. This positive evaluation is also shared by Goldstein and

Beall (1984: 18) who state that 'nomadic pastoralism is one of the great advances in human cultural evolution'. Nevertheless, in spite of the beneficial aspects of their way of life (Templer et al. 1993), the fact remains that the constant contact between herders and livestock in Mongolia (Jagchid and Hyer 1978, Foggin and Farkas 1993, Minzhigdorj and Erdenebaatar 1993) likely fosters the presence of zoonoses, and therefore that zoonotic diseases are an important aspect to consider in a study of this population's health status (Acha and Szyfres 1987).

Brucellosis – also referred to as undulant fever, Malta fever and Gibraltar fever in animals, and Mediterranean fever in humans – has a worldwide distribution. *Brucellosis abortus* is most common in animals, followed by *B. melitensis* (Bell et al. 1988). Among humans, about half a million new cases worldwide are reported each year. Acha and Szyfres (1987: 24) note that 'the greatest prevalence in man is found in those countries with a high incidence of *B. melitensis* infection among goats, sheep or in both species [This] pattern holds true for [. . .] Russia and Mongolia [where] goat and sheep brucellosis constitute a significant problem'.

The most pathogenic variety for humans is *B. melitensis*. The disease manifests itself suddenly, with either continuous or intermittent fever. Weakness and fatigue are constant symptoms (Thimm 1982). The principal symptom in all animal species is the premature expulsion (abortion) of the foetus. In a previously uninfected herd, brucellosis spreads very rapidly. The symptom is similar among goats and sheep: abortion in the third or fourth month of pregnancy. With horses, however, abortion is rare and the disease usually spreads through contact with open lesions. The disease has also been observed in Bactrian camels. Humans are infected by animals through direct contact or indirectly by ingesting animal products. Since milk products are such an important part of the Mongolian diet, similar to virtually all nomadic and semi-nomadic societies (Accolas et al. 1975, Khazanov 1984: 53, Foggin and Farkas 1993), the Mongolian herding lifestyle places them at particular risk of contracting brucellosis.

Method

Interviews were conducted on the basis of the sample design of the overall health survey study carried out in Ovörhangay (as well as in Hövsgol and Hovd) between 1992 and 1994 (Foggin et al. 1997). The household (*ail* or *orh*) was the main unit of the overall study and of the 1993 zoonosis survey. A household consisted of all the people living in the same dwelling (in Ovörhangay almost always a *ger*, or *yurt*) at the time of data collection. The first stage in the sample selection process involved determining the total number of households in each of the four selected areas (Figure 2) at the precise time of the field work (Berry 1968, Lonner and Berry 1987). This required the help of local *sum* or *bag*[1] leaders (who have the merit of knowing everyone in their district because of frequent interaction). After listing the families residing in the district, their actual location was indicated on a map (scale: 1: 100,000) and numbered From this base, approximately sixty households were selected from each of the four sample *sum* in Ovörhangay in 1993 (N_{1993} = 224). In three of the four *sum*, the majority also had been part of the randomly selected family-households interviewed more broadly the previous year (N_{1992} = 195). This overlapping is part of a plan to integrate the additional information, gathered in 1993 and presented in this paper, with the overall health survey data bank. However, given the nomadic nature of the population, it was impossible to overlap completely. Thus each family that could not be located was replaced by another randomly selected household in the same *sum*. The fourth *sum*, Bat-Oldzii, had not been surveyed in 1992 and comprised an entirely new random sample of sixty households.

The questionnaire protocol was relatively brief but generally took about a half hour to administer (Creswell 1994). Sample households were interviewed through an exchange between one principal respondent and either a non-Mongolian interviewer with a translator or by a Mongolian fieldworker. The questionnaire covered topics relating to types and sizes of herds, symptoms in animals and humans typical of brucellosis, calf and sheep diphtheria, necrobacillosis (foot rot), the bubonic plague and environmental and lifestyle factors potentially related to the transmission of these diseases. The emphasis, however, was on brucellosis (Beveridge 1959, Rosen 1981, Acha and Szyfres 1987: 119). Brucellosis was explained by the interviewer in the following way:

> There is an animal (herd) disease (brucellosis) that can be observed by spontaneous abortions in cattle; also by [noting] infertility. In goats it shows in abortions and in mastitits (milk being clotted and discoloured). In sheep it is harder to detect, but as in goats there can be mastitis, lameness and cough. Horses do not show brucellosis by abortions but by joint lesions and fistulous withers or fistulous bursitis. With camels it shows through abortions and mastitis (Witter 1981; also see Stableforth 1959, Flores-Castro and Baer 1979).

After this long explanation, clearly translated into Mongolian, the herders were asked whether they observed these symptoms in their herds. Similarly, respondents were asked if there had been cases of brucellosis in the family, as well as if there were brucellosis-like symptoms among family members, whether or not brucellosis had been specifically identified. As can be seen from Table 1 (items 9 to 11) these symptoms were strongly associated with the reporting of the presence of brucellosis in humans. This information formed the basis for determining the potential existence of this disease in humans.

Results

First, it should be noted that sheep everywhere in this area constitute the dominant herd (Minzhigdorj and Erdenebaatar 1993), ranging from forty-five per cent of animals in both Baruun-Bayan-Ulan (BBU) and Jargalant (JLT) to just over fifty per cent in Bat-Oldzii (BTZ) and Bayan-Teeg (BTG). There is far more variation in the proportion of goats, ranging from six per cent in (BTZ) to nearly forty per cent in the Gobi desert area of BBU. Not surprisingly, it is also here (in BBU) that camels are an important component of the local herds: six per cent compared to less than one per cent everywhere else (Figure 3). The proportion of horses showed a variation from close to seven per cent in BBU to fourteen per cent in BTZ (see Figure 3). Regarding the incidence of brucellosis, it is considered a problem in 20 to 30 per cent of the household interviews conducted, depending on the district (*sum*).

The breakdown of brucellosis symptoms by types of herd animals is revealing (Figure 4). In BBU, forty-nine per cent of reported symptoms occur in goats and thirty-three per cent in sheep; in BTG, horses show almost forty per cent of the reported brucellosis symptoms, whereas almost very few symptoms were reported for horses in the three other *sum*. In the two northern *sum*, BTZ and JGL (see Figure 2), cattle dominate as the major 'problem' animal: eighty per cent and fifty-nine per cent of households reported brucellosis symptoms in cattle, respectively. These responses are all for the 1993 period. When questioned about the previous year, cattle were also severely affected by brucellosis in the two southern *sum* (BBU and BTG): nearly twenty-eight per cent and forty-one per cent in 1992, respectively, compared to fifteen per cent and eight per cent in 1993 (Figures 4 and 5).

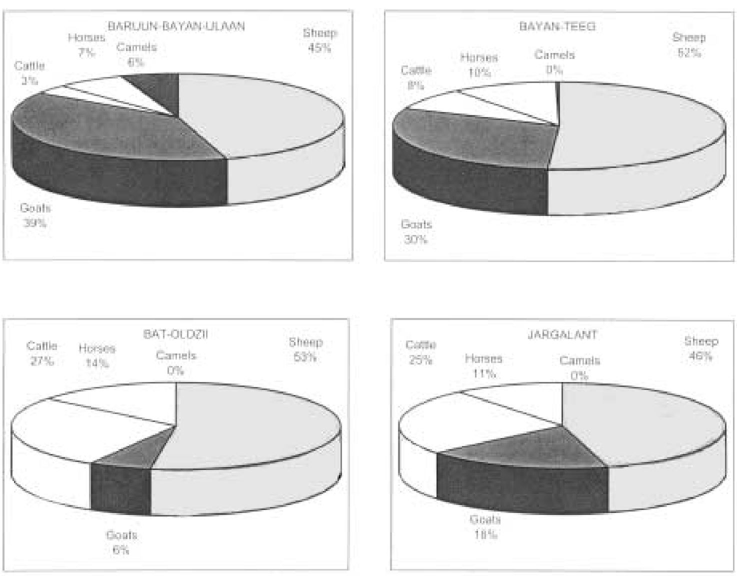


Figure 3 *Livestock Composition in Ovörhangay (1993)*

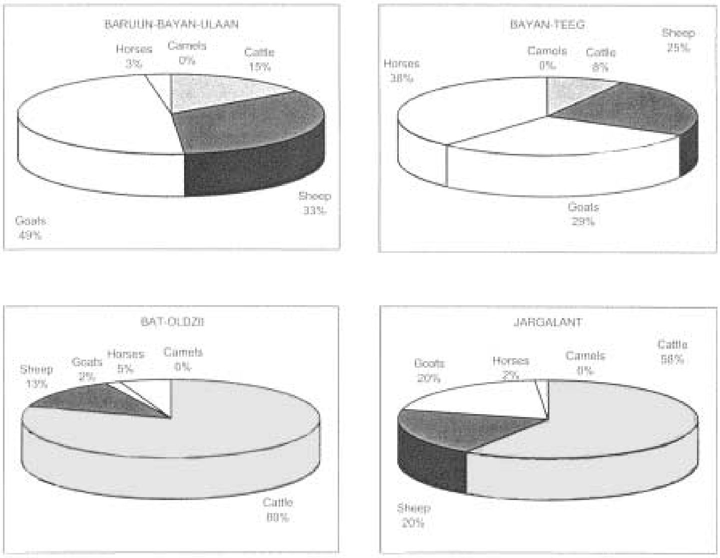


Figure 4 *Brucellosis Symptoms in Ovörhangay (1993)*

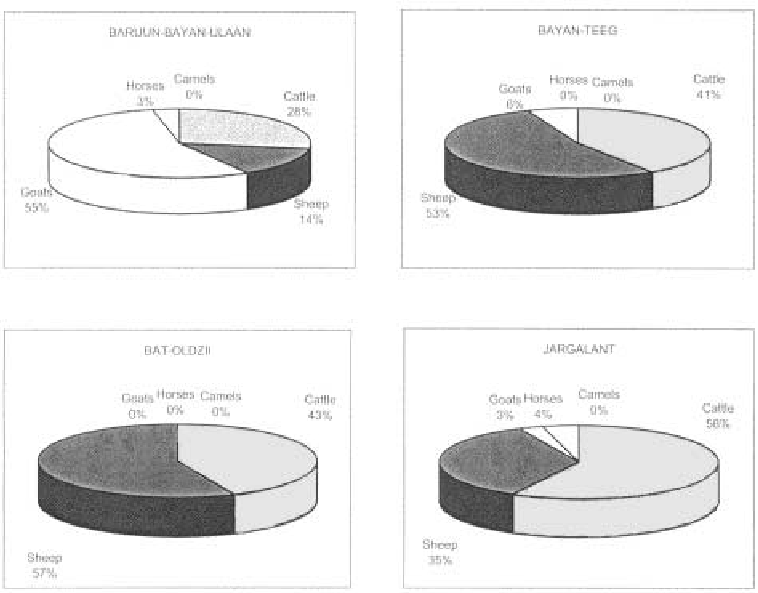


Figure 5 *Brucellosis Symptoms in Ovörhangay (1992)*

When respondents were asked which was the worst time or year for brucellosis that they could remember, only during 'the mid-1980s' were the levels to be anywhere comparable to the rates of brucellosis observed in 1992 and 1993. This, of course, will be biased by the memory problem of recalling events and conditions of the more distant past. However, those who could *not* remember (close to forty-five per cent) were not included in the percentage tabulations. Thus it appears that there may be an upward progression in recent years in the prevalence of this zoonotic disease in herd animals. This may be related to the recent economic changes that have taken place in Mongolia (Müller 1995), such as the privatisation of herds (i.e., less government involvement in disease control).

The epidemiology of brucellosis in humans is much harder to trace because this disease is notoriously underreported For example, Madkour and Gargani (1989: 11 and 12) reported that 'in the USA it is estimated that the actual incidence of human brucellosis is 26 times higher than has been reported [. . .] because of the disease being either unrecognised or unreported', and that '[t]his trend seems to be equally true in Europe, and there is no reason to suspect that the situation would be any better in the developing world.'

When questioned as to the appearance of brucellosis in humans, approximately fifty per cent of households in all four of the Ovörhangay *aimag* localities replied that brucellosis did not exist, whereas fewer than five per cent *definitely* recognised its presence in humans. The remainder did not know. This response by herding families is challenged by the increasing incidence of brucellosis in humans observed by the health personnel interviewed in Arvayheer, the *aimag* capital. It may be that new reported cases are coming from *sum* other than the four in this sample. However, the more likely hypothesis is that people simply do not recognise brucellosis symptoms in humans.

It is noted in the literature that higher than expected prevalence rates of certain types of heart disease are associated with the brucellosis-in-humans syndrome (Madkour 1989: 116, WHO and Ministry of Health 1993). Therefore, it may be significant to note that when questioned on general symptoms of human health and disease, one of the most often mentioned items was the generic expression 'heart attacks'. In fact, heart disease ('attacks') were reported in between ten per cent of households (Bayan-Teeg) to approximately forty-seven per cent of households (Jargalant) in the sample survey (Figure 6).

With regard to potential risk factors for the transmission of brucellosis from animals to humans, it already has been noted that various possibilities exist. Drinking raw milk (Colmenero et al. 1985, Madkour 1989: 24, 206) is a common occurrence that places people at risk for the transmission of brucellosis. As can be seen in Figure 7, even though the risk is well known, a large proportion of families allow their children to drink unboiled milk, particularly in some areas, such as Jargalant *sum* (approximately 50 per cent). Adults, on the other hand, generally do not drink milk as such, but use it as boiled milk in tea; they also consume various milk products, such as the sun-dried curd cheese called *aaruul*. It should be noted,

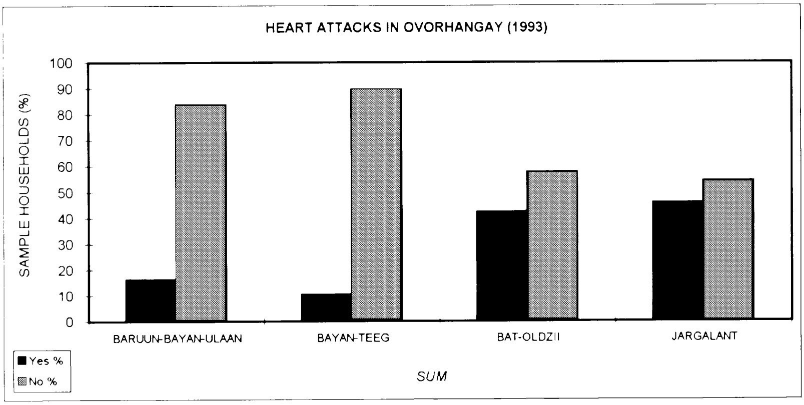


Figure 6 *Heart Attacks in Ovörhangay (1993)*

however, that between fifty and fifty-seven per cent of the sample families claim to always boil milk (Strickland 1993). This disparity is particularly important in light of the fact that brucellosis tends to be much more prevalent in children than in adults (Lulu et al. 1988). Madkour (1989: 205) states that

> brucellosis carries an important epidemiological significance when it affects children as it indicates that the disease is much more widespread and endemic in that area (Moussa et al. 1987). When the disease is found in a child, most probably other members of the family will be found to have the disease on family screening.[. . .] The mode of infection in children in endemic areas depends mainly on the tradition of animal husbandry and traditional food habits.

Also, the close contact that children have with animals is reflected by the substantial number of sample households (between sixty and seventy per cent) reporting that they keep young animals, usually lambs, inside their *ger* (yurts) during the lambing season (Figure 8).

In many ways it is impossible to analyse the potential effects of animal diseases (such as brucellosis) on human health without taking into account other sources of risk occurring at the same time. For example, another potential risk factor that has been reported is the consumption of fresh, raw liver and meat among some traditional farmers (Alausa 1979, Madkour 1989: 24). However, this is not likely to be a problem among Mongolians because meat and entrails are virtually always well cooked before eating. Alcohol consumption (particularly the home-made milk vodka called *shimiin arhi*) and smoking are also important factors to consider and have been reported on elsewhere (Foggin et al. 1997). At yet another level, the relative isolation and lack of on-site, health care facilities generate additional risk factors; for example, birth deliveries and medical emergencies that require

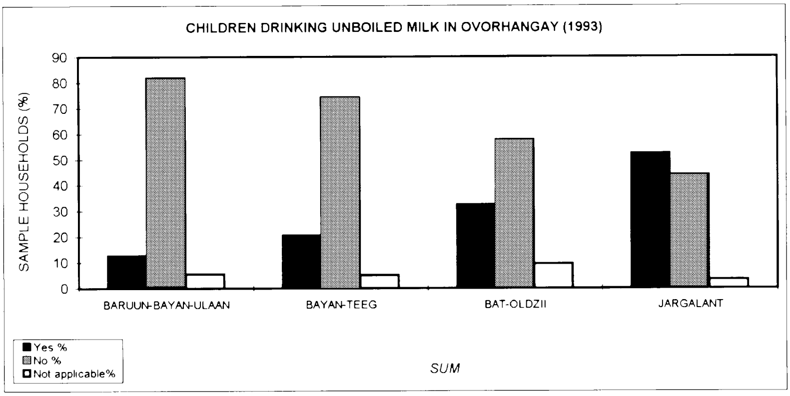


Figure 7 *Children Drinking Unboiled Milk in Ovörhangay (1993)*

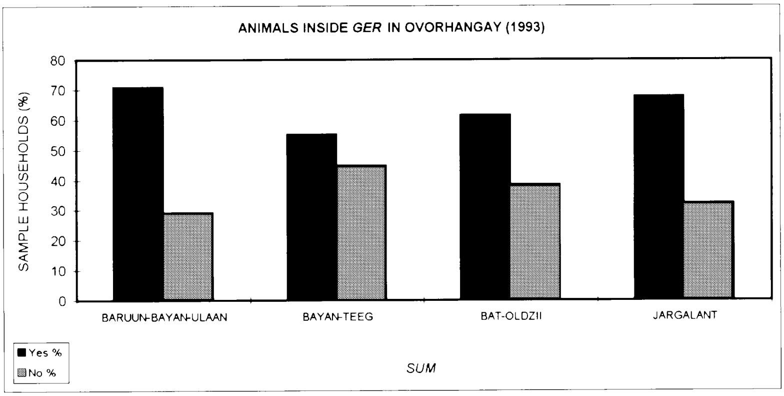


Figure 8 *Animals Inside ger in Ovörhangay (1993)*

immediate treatment (Germeraad and Enebisch 1996). It should be noted, however, that the geographical variation of risk levels is much more apparent at the level of *morbidity* (Foggin et al. 1997) than in terms of infant mortality rates (IMR) where there seems to be only a small variation from one *aimag* to another. In 1991, for example, IMRs ranged between sixty deaths per thousand births in Hovd and eighty per thousand in Hövsgol (see Figure 1). Surprisingly, Ovörhangay and Ulaanbaatar had very similar IMRs at that time, sixty-five and sixty-seven per thousand, respectively (Ministry of Health 1993, Randall 1993). Quite obviously the risk factors leading to equally high infant mortality rates in urban Mongolia must be substantively different, at least in part, from those in the rural areas where the semi-nomadic herders live and work. However, it should be remembered that a significant part of the 'urban' population of Ulaanbaatar still lives in a very traditional style (using the *ger* or *yurt* for housing, for example), resembling in some ways the lifestyle of their semi-nomadic relatives still in the countryside.

Having reviewed some of the general risk factors in this context, the fact remains that one of the major threats to the health of Mongolian semi-nomadic pastoralists stems from their principal occupation, that of herding and animal husbandry (Thimm 1982). The daily and seasonal requirements of the herder and his herds puts him in very close contact with animals, thus increasing the risk of contracting brucellosis. Assisting in the birthing process and providing veterinary care are probably the primary occupational hazards.

In addition to the above considerations regarding brucellosis, the bubonic plague had also been a recent problem in Ovörhangay at the time this fieldwork was conducted Mongolia is one of nine countries in the world where the plague is known to have occurred in 1992. The other countries were Madagascar, Zaire, China, Myanmar and Vietnam, and a proportionately smaller number of cases in the United States, Peru and Brazil (Tikhomirov 1994). Plague also occurs elsewhere, of course, depending on the year. At the time of the Ovörhangay survey in 1993, there had been an outbreak of the bubonic plague the previous summer, so it was a natural concern in virtually all discussions of potential risk factors, even though it is not a zoonotic disease per se. Plague spreads mainly from rodents to humans by flea-vectors first biting an infected rodent and then biting a human (Shulman et al. 1992: 452). In Mongolia marmots are the major vector carrying this highly infectious disease. Figures 9a through 9d show various aspects of this phenomenon: for example, the wide variation in the frequency of marmot hunting (Figure 9b), ranging from around ten per cent in the dry southern area to close to forty per cent in Jargalant. Perhaps, surprisingly, the proportion of households expressing concern, even fear of the bubonic plague (Figure 9a) is directly proportional to the number of people hunting and eating marmot meat (Figure 9c), with over eighty per cent in Jargalant. What is more surprising is the variation between the four *sum* in the percentages of households where vaccination had been given against the plague (Figure 9d). The high level of prophylactic treatment in Jargalant is understandable, but the lack of vaccinations in Bat-Oldzii is somewhat anachronistic. Such variation probably relates to a lack of sufficient health infrastructure and preventive health care opportunities, but we have no specific information on this. Since vaccinations are not indicated as a preferred approach to preventing the plague (the best approach is to avoid contact with potentially infected animals, but this is not realistic under the circumstances), it is clear that the relatively high number of households where one or more people were vaccinated is a specific response to epidemic conditions, conditioned more by fear of the disease than by any proven efficacy of vaccination. Levels of vaccination may also be related to the context of a rapidly changing economic

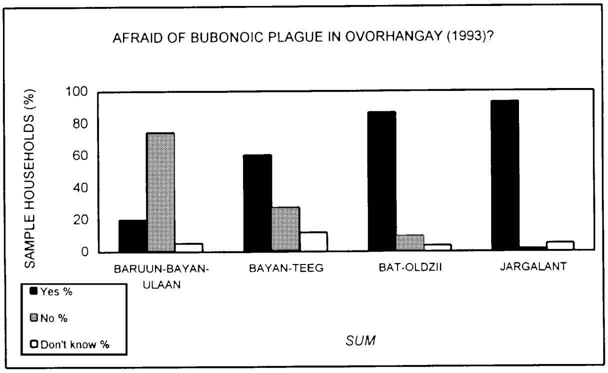


Figure 9a

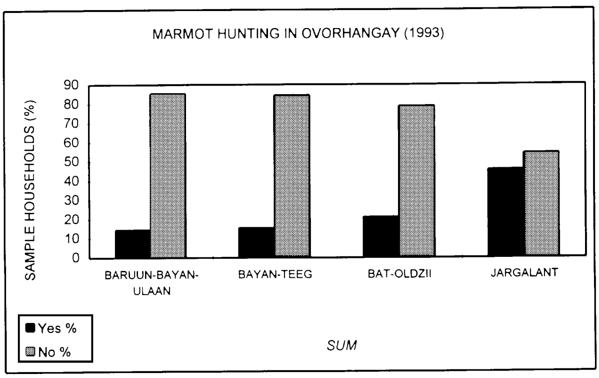


Figure 9b

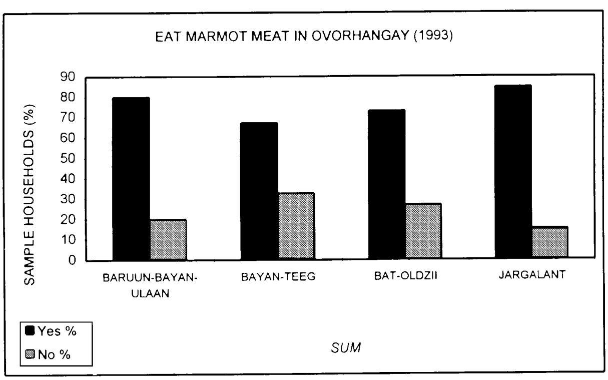


Figure 9c

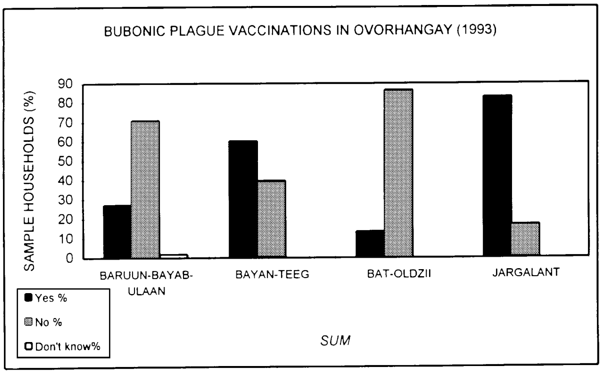


Figure 9d

system whereby people are more likely to be influenced by ideas and trends from outside the *aimag* than in the past (Potkanski 1993, Muller 1995).

Analysis

When total herd sizes, the number of cases of brucellosis infection reported in animals as well as numbers of households affected by human brucellosis are calculated by *sum*, it is possible to obtain the proportions of livestock with brucellosis as well as the proportions of households with at least one person possibly affected by this zoonotic disease. The proportion of households reporting either brucellosis or brucellosis-like symptoms varies from two per cent to five per cent between *sum*. Actual brucellosis rates are much lower among livestock, as indeed would also be the case with humans if individual case rates could have been calculated as opposed to numbers of affected households. When these proportions are plotted against each other by *sum* (Figure 10), there is a linear association between households with brucellosis and possibly infected livestock ($p = .028$). This confirms what has already been observed elsewhere with regard to the potential infectiousness of this disease (Acha and Szyfres 1987, Madkour 1989).

Proportions of sheep, goats, cattle and horses can also be related separately to proportions of households with reported human brucellosis symptoms. In this case, no significant relationships are noted, although the association between brucellosis in cattle and that in humans is considerably stronger than the others, but not statistically significant ($p = .093$). No cases of brucellosis are reported in camels, so this trial cannot be conducted. When an attempt is made to relate proportions of households reporting brucellosis in their herds to various

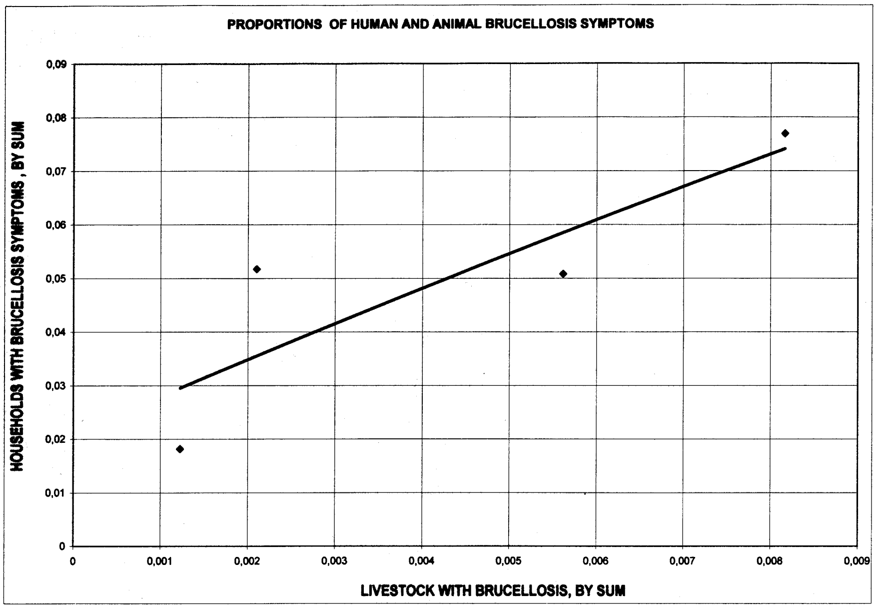


Figure 10 *Proportions of Human and Animal Brucellosis Symptoms (by* **sum***)*

(potentially) brucellosis-related symptoms in humans, the only strong relationship noted is that between livestock-related brucellosis and proportions of households that report 'heart attack' symptoms (p = 0.056).

When other associations among the study variables are analysed (using chi-square contingency tables, without grouping data by *sum*), other hypothesised relationships are also borne out (Table 1). For example, there is spatial differentiation of the different types of herds, of brucellosis symptoms in animals and of symptoms related to brucellosis in humans (Table 1, items 1 to 7). Also, and in keeping with the literature, a close association between heart disease (as measured here) and brucellosis in humans is borne out by this analysis (Table 1, item 8). Furthermore, it was confirmed that joint pains, night sweating and general weakness, as symptoms, are strongly associated with brucellosis in humans (Table 1, items 9 to 11). Not surprisingly, brucellosis symptoms in animals at the time of the survey are also associated with brucellosis as reported for cattle and sheep during the previous year (Table 1, items 12 and 13). Unfortunately, there is not sufficient precision in the data collected to establish clear links between some known lifestyle risk factors and brucellosis in humans (e.g., drinking unboiled milk).With regard to the other (non-zoonotic) disease examined in this study, the bubonic plague shows clear spatial variation (between *sum*), as well as associations with the practice of marmot hunting, with whether or not vaccinations had been given to at least one member of the families interviewed, and with

Table 1: *Significant Relationships: Brucellosis and Plague*

Chi-square contingency analysis of significant associations

Principal variable		**Comparative variable**	**P**
Herd total categories	by	district (*sum*)	.000
Cattle/yak categories	by	district (*sum*)	.000
Sheep categories	by	district (*sum*)	.037
Goat categories	by	district (*sum*)	.001
Brucellosis (animals)	by	district (*sum*)	.029
Heart disease (attacks)	by	district (*sum*)	.000
Ulcerative colitis	by	district (*sum*)	.026
Brucellosis (humans)	by	heart attacks	.000
Brucellosis (humans)	by	joint pains	.000
Brucellosis (humans)	by	night sweating	.000
Brucellosis (humans)	by	fever	.000
Brucellosis (animals)	by	brucellosis/cattle (1992)	.000
Brucellosis (animals)	by	brucellosis/sheep (1992)	.016
Bubonic plague/fear	by	district (*sum*)	.000
Bubonic plague/fear	by	marmot hunting	.015
Bubonic plague/fear	by	vaccinated	.000
Bubonic plague/fear	by	marmot eating	.019

whether or not household members regularly eat marmot meat (Table 1, items 14 through 17).

Conclusion

In the context of this study, two phenomena are of special interest to medical geographers (Kearns and Joseph 1993): one is the spatial variation of disease prevalence along with corresponding risk factors, and the other is the relationship between people's environment (social and physical) and their health status. These two areas of research – usually called *spatial analysis* in the first case, and *ecological* or *human-land relationships* in the second – are not, of course, entirely independent of each other. This can easily be seen when one speaks of the types and sizes of herds nomadic and semi-nomadic peoples are able to support in their respective ecological niches (in this case, ranging from the semi-arid *gobi* in the south to the relatively humid, wooded steppe in the northern parts of Ovörhangay *aimag*). In previous work, it has been noted that there is considerable geographic variation in specific indicators of health status and in culturally and environmentally related risk factors in Mongolia (Rubel 1967, Finke 1995, Foggin et al. 1997).

For this analysis we have changed the geographic scale from the inter-*aimag* to the intra-*aimag* (i.e., *sum*) level of data and observations. Even at this more local scale of spatial analysis it can be seen that there are considerable geographic variations in terms of the perceived prevalence of brucellosis as well as the bubonic plague. However, since the numbers are small, much caution is needed Nevertheless, there is a clearly observed relationship between certain lifestyle variables (such as marmot hunting) and perceptions of threat to health (e.g., fear of the bubonic plague). However, the impact of other lifestyle factors (such as geographic mobility) on the prevalence of brucellosis still needs to be confirmed.

What can be concluded with relative confidence is that in Mongolia: 1) the prevalence of human brucellosis is related to that of brucellosis in animals; 2) there is significant geographical variation (even at the intra-*aimag* level) of animal brucellosis; and 3) there are, in some cases, clear relationships between lifestyle factors and the prevalence of diseases such as brucellosis in humans and the bubonic plague. However, more analysis and basic research are still needed to further validate these conclusions and confirm or reject other suspected relationships.

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Note

1 Mongolia's provinces (*aimag*) are each comprised of between ten and twenty county-level administrative units (*sum*), which are in turn divided into districts (*bag*). Ovörhangay *aimag* has eighteen *sum* each of which is divided into three or four *bag*. Each one of these corresponds then to a spatial portion of a district (*sum*) and usually has a centrally located, village-like settlement (often the winter location of some of the semi-nomadic pastoralists) together with some infrastructure, such as a clinic, school, general store and communications centre.

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Résumé

La santé animale et la santé humaine parmi les pasteurs semi-nomades de la Mongolie centrale: brucellose et la peste bubonique dans le Aimag Ovörhangay
Partant de l'hypothèse que la santé de toute population est liée directement à son mode de vie, les auteurs examinent les rapports existant éventuellement entre la santé des pasteurs semi-nomades dans une des provinces de la Mongolie centrale et celle de leurs troupeaux.

Resumen

Salud animal y humana entre los pastores semi-nomádes de Mongolia Central: brucellosis y plaga bubónica en Ovörhangay Aimag
El trabajo analiza la relación entre salud animal y salud humana en un grupo de pastores semi-nómades de Mongolia central. Parte de la premisa que el estado de salud de una población está directamente ligado a su estilo de vida.

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