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Economic losses due to cystic echinococcosis in India: Need for urgent action to control the disease

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ABSTRACT

Cystic ehinococcosis (CE) caused by *Echinococcus granulosus* remains a neglected zoonotic disease despite its considerable human and animal health concerns. This is the first systematic analysis of the livestock and human related economic losses due to cystic echinococcosis in India.

Data about human cases were obtained from a tertiary hospital. Human hydatidosis cases with and without surgical interventions were extrapolated to be 5647 and 17 075 per year assuming a total human population of 1 210 193 422 in India. Data about prevalence of hydatid cysts in important food producing animals were obtained from previously published abattoir based epidemiological surveys that reported a prevalence of 5.39% in cattle, 4.36% in buffaloes, 3.09% in pigs, 2.23% in sheep and 0.41% in goats. Animal population data were sourced from the latest census conducted by the Department of Animal Husbandry, Dairying and Fisheries, India. Other input parameters were obtained from published scientific literature. Probability distributions were included for many input values to account for variability and uncertainty. Sensitivity analyses were conducted to evaluate the effect of important parameters on the estimated economic losses.

The analysis revealed a total annual median loss of Rs. 11.47 billion (approx. US $ 212.35 million). Cattle and buffalo industry accounted for most of the losses: 93.05% and 88.88% of the animal and total losses, respectively. Human hydatidosis related losses were estimated to be Rs. 472.72 million (approx. US $ 8.75 million) but are likely to be an under-estimate due to under-reporting of the disease in the country. The human losses more than quadrupled to Rs. 1953 million i.e. approx. US $ 36.17 million, when the prevalence of human undiagnosed cases was increased to 0.2% in the sensitivity analyses. The social loss and psychological distress were not taken into account for calculating human loss. The results highlight an urgent need for a science based policy to control and manage the disease in the country.

1. Introduction

Cystic echinococcosis (CE) is an important zoonosis caused by *Echinococcus granulosus* affecting both the livestock and human populations, particularly in developing countries such as India (Singh et al., 2010). Dogs act as a definitive host of *E. granulosus*; humans and food

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producing animals acquire the infection by ingestion of eggs shed by the definitive host (Thompson, 1995). Cysts of *E. granulosus* have been found in a variety of intermediate and aberrant hosts such as cattle, buffalo, sheep, goat, pigs, horses, camel and man (Rausch, 1986, 1995; Thompson and Allsopp, 1988; WHO, 1984).

In livestock, CE may lead to reduced yield and quality of meat, milk and wool; reduced birth rate; delayed performance and growth; and condemnation of organs, especially of liver and lung (Benner et al., 2010; Budke et al., 2005; Torgerson et al., 2000; Polydorou, 1981). Economic losses also occur due to destruction of infected viscera and dead animals or due to ban on export of animals and their products if these are required to be free of CE.

Human echinococcosis continues to be a significant public health problem in several regions of the world. Human losses primarily occur due to the need for surgical interventions, hospital care and productivity losses in asymptomatic cases. A recent Spanish study reported high economic losses at €148 964 534 with human disease constituting most (89.1%) of the total losses (Benner et al., 2010). In Chile, human hydatidosis was associated with the average mortality rate of 0.2 deaths per 100 000 inhabitants per annum and a loss of 3349 years of life due to the premature death of 235 people (Martinez, 2011).

The rural population of India is dependent on livestock for their livelihood (Singh et al., 2011) where cattle and buffalo production systems constitute the backbone of the livestock industry. Hydatid cysts have been found in most of the food producing animals in India such as cattle, buffalo, sheep, goat and pigs. Presence of stray animals such as dogs and cattle, unorganised slaughtering, free access of dogs to slaughter waste, decline in vulture population, sewage irrigation, and improper garbage disposal methods increase the chances of disease transmission to humans (Singh et al., 2002).

Despite being a significant zoonotic problem, not many studies have been conducted in India to understand disease epidemiology or to estimate economic losses due to the disease. As a result, virtually no programs have been developed or implemented at the national level to control or eradicate the disease. This is the first systematic analysis of the economic losses due to CE in India. Such studies are required to help develop disease prevention and control strategies for India and other developing countries.

2. Methods

2.1. Livestock related losses

The important food producing animals that make a substantial contribution to the meat and dairy industry in the country—sheep, goat, cattle, buffalo and pigs—were included in the analysis. The prevalence of CE in livestock was based on a recent abattoir based epidemiological survey conducted in India (Singh, 2011). The official data for animal populations (Table 1) were obtained from the latest census carried out by the Department of Animal Husbandry, Dairying and Fisheries, India (DAHD & F, 2010). The annual wool output per sheep was taken from published scientific literature (Banerjee, 1991) while the average milk yield and carcass weight were sourced from the official data (DAHD & F, 2010). The drought power production equivalence was taken from previous studies (Banerjee, 1991). The price of energy (kW h) charged by Punjab State Electricity Regulatory Commission (2010) Punjab (India) was used to calculate losses in draught power.

Table 1
Cost parameters used to estimate the economic losses associated with cystic echinococcosis in livestock, India.

Parameter	Average cost, in Rs. per kg	Reference
Sheep		
Sheep carcass	131.26	Ranjan and Rawat (2011)
Sheep liver	131.26	Ranjan and Rawat (2011)
Sheep lung	40	Market value
Sheep wool	38	NABARD (2010)
Goats		
Goat carcass	131.26	Ranjan and Rawat (2011)
Goat liver	131.26	Ranjan and Rawat (2011)
Goat lung	40	Market value
Goat's milk at farm gate	20	Market value
Cattle		
Beef carcass	112.18	Ranjan and Rawat (2011)
Cow liver	60	Market value
Cow lung	35	Market value
Cow's milk	26	Market value
Buffalo		
Buffalo carcass	112.18	Ranjan and Rawat (2011)
Buffalo liver	60	Market value
Buffalo lung	35	Market value
Buffalo's milk	30	Market value
Pigs		
Pig carcass	95	Wright et al. (2010)
Pig liver	50	Market value
Pig lungs	30	Market value
Energy (kW h)	2.82	Punjab State Electricity Regulatory Commission (2010) Punjab (India)

The other related input parameters such as organ weight, animal produce, productivity losses (decrease in fecundity, carcass weight, milk production, draught power and wool output), life expectancy and reproductive rates were obtained from the published scientific literature (Table 2). The prices of animal carcasses, milk, liver and lungs were sourced through market surveillance or from published scientific literature (Table 1).

Both direct and indirect economic losses for all the species were calculated separately. While direct losses included those occurring due to offal condemnation of infected animals, the indirect losses included those occurring due to reduction in growth and production and decrease in fecundity. All the analyses were conducted using R-statistical program (R-statistical package version 2.12.0, R Development Core Team, http://www.r-project.org).