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Analysis of economic burden for patients with cystic echinococcosis in five hospitals in northwest China

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ABSTRACT

The direct and indirect economic burden of human cystic echinococcosis (CE) was investigated in the five specialist hydatid hospitals in Xinjiang, PR China, to provide information for health policy in the future. A total of 2018 CE patients (age range 2–88 years) attending the hospitals were studied between 2004 and 2008. The per-person direct medical cost was US$1493.12 (95% CI 1438.43–1547.80) and the per-person direct non-medical cost was US$19.67. The indirect economic cost was US$1435.96 per person, and the disability-adjusted life-years (DALY) lost was approximately 1.03 DALY/person. This study is the first to combine the human capital method with DALYs to analyse the indirect CE economic burden in northwest China. Factors such as age, occupation and hospital level should be considered when developing polices to reduce the economic burden of CE.

1. Introduction

Cystic echinococcosis (CE) caused by infection with the larval stage of the dog tapeworm *Echinococcus granulosus* is a public health problem in many parts of the world.[1–5] By 2006, China was one of the most important endemic regions for CE;[6] 28 of its 34 provinces had reported cases of CE, covering 44.6% of the total land area in China, with nearly 98% of cases in Xinjiang, Qinghai, Gansu, Ningxia, Tibet, Inner Mongolia, Shanxi and Sichuan.[7,8] CE is transmitted primarily in a domestic cycle in which dogs are the definitive host for *E. granulosus* and other animals or humans are the intermediate hosts.[7] In China, the free-ranging behaviour of dogs, preying on rodents and lagomorphs, and their close associations with humans[9] leads to the risk of humans being exposed to *E. granulosus* eggs excreted by dogs.

Expenses and loss of health and vitality associated with *Echinococcus* infection may become a significant burden for the affected individual, their family and their community. Evidence-based health policy[10,11] can lead to a more effective distribution and use of limited resources. The economic burden of disease is defined as the economic expenses and loss of income as a result of infection with the disease and the use of health resources to prevent or control the disease. It is an 'opportunity cost', reflecting that if people can reduce the risk of infection with, or avoid a disease, economic losses will be reduced for the individual and for society. Study of the composition, causation and impact factors of a disease can be used to develop efficient and pertinent measures for control and prevention.[12] Disability-adjusted life-years (DALY) are often used to quantify the overall burden of disease. They are a multiple index of the number of years of life lost to disability, poor health or premature mortality.[13]

The main treatment for CE in China is surgery[14] which can be complemented by treatment with albendazole. According to data from some hospitals in Xinjiang, northwest China, nearly 2000 echinococcosis patients had

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surgery at a total cost of US$ 769 220.91 per year,[15] However, the total number of patients and the cost of surgery are likely to be higher.[16,17]

The aim of this study was to evaluate the direct and indirect economic burden of echinococcosis disease on patients admitted to five specialist hydatid hospitals in Xinjiang, PR China. This information could help to determine the impact of the disease and to develop possible control strategies aimed at those most at risk of being infected.

2. Materials and methods

2.1. Study population

During the period 2004–2008, 2018 patients with CE were admitted to five specialist hydatid hospitals in Xinjiang, PR China. The patients were diagnosed according to the international classification of diseases (ICD-10).[18] Their details were extracted from the Case History Management System used in the five hospitals. The items investigated were sex, age, ethnic group, location (rural or city), occupation, medical insurance, days in hospital, therapeutic efficacy, cost of hospitalization, cost of medication, cost of check-up, cost of surgery and cost of bed. The privacy of patients was not affected by the investigation of these details.

2.2. Direct economic burden

The direct economic burden was the cost of seeking treatment. Both direct medical cost and direct non-medical cost constituted direct economic burden. Since the outpatient cost of a specific disease could not be obtained directly from the hospitals, direct medical costs are comprised of the cost of hospitalization. As it was difficult to obtain data on direct non-medical cost, we evaluated the food expenditure of patients, which was calculated on the basis of per capita consumption expenditure and the Engel coefficient between 2004 and 2008.[19]

2.3. Indirect economic burden

The indirect economic burden was analysed by the human capital method combined with DALYs. The formula was indirect economic burden = per capita GNP × DALY × productivity weight.

The DALY was synthetically a measurement of both life quality and life quantity and the formula for DALYs lost by an individual was:[13]

$$-\frac{DCe^{-\beta\alpha}}{\left(\beta+\gamma\right)^2}\left\{e^{-(\beta+\gamma)L}\left[1+\left(\beta+\gamma\right)(L+\alpha)\right]-\left[1+\left(\beta+\gamma\right)\alpha\right]\right\}$$

Where D was a disability weight (value range 0–1 where death was 1), γ was a discount rate (valued 0.03 Global Burden of Disease [GBD]), C was an age-weighting correction constant (valued 0.1658 by GBD), β was an age-weighting parameter (valued 0.04 by GBD), α was the age of the individual at diagnosis, e is the base of natural logarithms (approximately 2.7183) and L was the time lost to disability or premature mortality.[20]

As the GBD had not given a disability weight value to echinococcosis and the disease results in similar clinical symptoms to liver cancer the disability weights used were based on the values for liver cancer, which were obtained from the GBD and the Dutch Disability Weight Group.[21,22] Budke et al.[22] gave disability weights five values according to therapeutic efficacy (cured, improved, stable, worse, death), of 0, 0.2, 0.239, 0.809 and 1.

The indirect economic burden formula also considered that the disability weight value was different as a result of the different productivity of age groups. The age group of 0–14 years had not taken part in wealth creation so were assigned a value of 0.15; the age groups of 15–44 years and 45–59 years are working age and thus taking part in wealth creation so were assigned values of 0.75 and 0.80, respectively; the age group of ≥60 years was given a value of 0.1.[23]

2.4. Statistical analyses

Stochastic analysis was undertaken, continuous variables tended to have skewed distributions and therefore median values and mean values were quoted, and ANOVA and multiple stepwise regression analysis were used. SPSS V.15.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis and $p<0.05$ was considered statistically significant.

3. Results

Of the 2018 study patients, 51.54% were male and 48.46% were female. The highest number of patients by age group was in those aged 30–45 years (n=863, 42.77%) followed by those aged 15–30 years (n=505, 25.02%). The Han group were the ethnic group most affected by CE (n=1021, 50.59%) followed by the Karzak group (n=377, 18.68). Only 828 (25.97%) patients had medical insurance and farming was the most common occupation (n=1190, 58.97%).

3.1. Direct economic burden

3.1.1. Direct medical costs

The number of patients admitted each year ranged from 355 to 512 (Table 1). The overall median hospitalization cost was US$1231.65 per patient and US$79.80 per day. The median number of days in hospital was 15 (Table 1).

Of the 2018 patients, most (863, 42.77%) were in the 30–45 years age group (females, 420; males, 443) followed by 505 (25.02%) in the 15–30 years age group (females, 241; males, 264), 100 in the <15 years age group and 52 in the ≥70 years age group. The patients aged 45–60 years cost the maximum US$, which was an average of US$1653.83 per person (Figure 1).

The majority of patients were cured (n=1654) and very few patients died (n=8) (Table 2). Medication was the highest cost component. All costs were much higher per patient for the eight who died (Table 2).

When the costs of hospitalization were analysed by occupation 57.07% of the total hospitalization cost was for farmers (Table 3). Retired people had the highest mean cost per person (US$1942.44) followed by government officials