

Socioeconomic Impacts of Human Trypanosomiasis : a Review



Veterinary

KEYWORDS : Chagas disease, Burden of disease, socioeconomic, sleeping sickness; cost benefit analysis

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ABSTRACT

Zoonoses are important constraint to human development; Human Trypanosomiasis is one of the most important and most neglected tropical zoonosis. Combating Trypanosomiasis needs collaborative efforts from both health and agricultural sectors in order to set the priorities for disease control. The socioeconomic impact of the diseases play an important role in the decision making process. The objective of this paper is to review what had been written in literature on the socio-economic aspects of Human Trypanosomiasis. Over 20 papers on the subject were reviewed, and the findings were categorized to qualitative and quantitative monetary and non-monetary assessments. Moreover, the socio-economic impacts of the disease were compared between the different geographical locations. The result showed that worldwide the disease has serious socio-economic impacts on the affected communities, on national, regional and international levels. The development of drug resistance against trypanocidal drugs aggravates even more the problem. These results were critically discussed and conclusions were drawn and accordingly some recommendations were set.

1. Introduction

Human Trypanosomiasis is one of the most important and most neglected tropical diseases. Human African Trypanosomiasis (HAT) also known as sleeping sickness is caused by *Trypanosoma brucei*, and is transmitted by a tsetse fly of *Glossina* spp. [1]. Two types of the parasites are found: *T. b. gambiense* which causes the disease in central and western Africa, while *T. b. rodensense* causes the disease in eastern and southern Africa [2]. Two stages of HAT are defined: the first stage characterizes by fever, headache, joint pain and itching, whereas the clinical signs of the second stage, characterize by neurological and endocrinal disorders [3,4]. For the diagnosis of the disease, the Card Agglutination Test was the most appropriate screening test. Confirmation of HAT depends on microscopy and molecular tools but the latter are not applicable in field [5]. For the treatment of the disease four drugs are available for these are; Suramin, pentamidine, melarsoprol and eflornithine [6]. Human Trypanosomiasis in the new world is known as Chagas disease. The disease is caused by *Trypanosoma cruzi* which is transmitted to humans mainly by triatomine bugs [7]. Two phases of Chagas disease were recognized: The acute phase characterizes by mild symptoms include fever, headache, enlarged lymph glands, pallor, muscle pain, difficulty in breathing, swelling and abdominal or chest pain. Sometimes signs can be a skin lesion or a purplish swelling of the lids of one eye. In the chronic phase characterize by cardiac, digestive and neurological disorders the infection can lead to sudden death or heart failure [8]. The diagnosis of Chagas disease can be made by microscopic examination [9] beside the clinical findings, chronic cases are diagnosed by testing with at least two different serologic tests, three tests are commonly used: the Ortho *T. cruzi* ELISA, Chagas STAT-PAK, Chembio), and the PATH-Lemos rapid test [10]. Molecular techniques are high in the acute phase of Chagas disease, while in the chronic phase the immunological techniques are more effective [11]. Two drugs, benznidazole and nifurtimox are used for the treatment [12]. The treatment of cardiac and gastrointestinal signs and symptoms is similar to that for similar problems caused by other etiologies [13]. In Asia, animal *Trypanosoma* parasites *T. lewisi* and *T. evansi* resulted in human illnesses in three different geographical regions of India [14].

The socio-economic of Trypanosomiasis received similar importance as the other area of Trypanosomiasis research. The current work attempted to review the literature written on the socio-economic aspect of the disease

2. Methodology

More than 15 source including journals, books, Annual Reports, conferences proceedings and periodicals during 1979 -2013 were consulted. Accordingly the socio economic impacts of Human Trypanosomiasis were classified into economic and social impacts; further classification of the economic impacts into

qualitative and quantitative assessments was done. The quantitative assessment covered monetary and non- monetary assessment mainly the Disability Adjusted Life years (DALYS). The social impacts were reviewed at individual and community levels.

3. Results and Discussion

3.1 The Economic Impacts of Human Trypanosomiasis

3.1.1 Qualitative assessment.

Beside the negative impacts on the productivity of the infected people, Trypanosomiasis also affects the productivity of caregivers and at risk population. Studies in East Africa, the Democratic Republic of Congo [15] [16] [17] [18] demonstrated these negative impacts. The disease was proved to be an impediment to development process in war-torn zones such as Angola, Sudan, the Democratic Republic of Congo and Côte d'Ivoire [17, 19, 20]. In such resource deficit countries the available funds are usually directed to the defense and peace building, under such circumstances, combating diseases receive little interest and funds which negatively impacted human health and the development process. The latter also results from the abandonment of fertile lands as the case of Kenya and the Democratic Republic of Congo [21,17,22]. Considering the impact on at risk population, it was reported that in some affected countries the agricultural workers always afraid of contracting the disease, consequently decreasing the labour force especially bearing in mind the fact that the disease mainly strikes the active adult population. Other studies in Kenya and Democratic Republic of Congo dealt with the negative impact of the disease on the family's resources time and money wise. The time spent in care giving and money spent directly in the diagnosis and treatment of the infected person [21, 22, 23].

3.1.2 Quantitative assessment

According to [24] 1.7 million Disability Adjusted Live Years (DALYS) were lost per year during 1999- 2008 due to the disease. Africa lost US\$ 1.5 million in revenues from agriculture annually due to combined human and zoonotic forms of sleeping sickness.

[25] evaluated the DALY burdens for *T. b. rhodesiense* across Africa at 753,828 and that in South-East Uganda at 488 and 4,379 DALY for 0% underreporting and 50% under-reporting of sleeping sickness.

[18] estimated the cost of HAT case per household in Buma (DRC) at US \$163.98 about 43% of the family annual income. In this area the disability caused by HAT is evaluated without intervention at 2,145 DALYs (27 per case). The intervention enabled 1,408 DALYs to be averted at a savings of US \$17 per DALY. In the Republic of Congo, a case of HAT who was correctly diagnosed and treated was found to cost his or her household the equivalent of 2.6–5 months of household income from agriculture [26]. They also estimated the household cost in Niari

(Brazzaville, Republic of Congo) to be 58,000 CFA francs ($\approx$ US\$100).

[27] Estimated the DALY for HAT in Urambo District, Tanzania at 215.7. The costs of treating 143 patients were estimated at US\$ 15,514 of which patients themselves paid US\$ 3,673 and the health services US\$ 11,841.

Unlike the case of Africa, great efforts were done to control the disease in South America. These countries recognized the importance of the vector control in preventing humans from the infection. According to [28], the countries of the Southern America Cone Initiative have spent more than US\$ 345 million to finance the vector control activities during the period 1975 to 1995. The benefits of this programme were subjected to cost benefit comparison. As the programme prevented loss of 11, 486, 000 DALY's, 1 DALY was gained for each US\$39 spent on the program. The estimated benefits of the program were US\$ 7, 5 million, accordingly US\$17 were saved for each dollar spent on prevention.

Based on retrospective (1993-2004) records [29] compared between three control strategies fully horizontal, vertical or a mixed vector control strategy. The total direct costs (in 2004 US\$) of the horizontal and mixed strategies were, respectively, 3.3 and 1.7 times lower than the costs of the vertical strategy. The estimated CE ratios for the vertical, mixed and horizontal strategies were US\$132, US\$82 and US\$45 per averted human case, respectively. This indicates that although the horizontal strategy cost less, the mixed one was most cost effective.

[30] estimated the cost of entomological survey per house in Colombia at \$4.4 (in US\$ of 2004), the mean cost of spraying a house with insecticide was \$27 and the cost of treatment of a chronic Chagas disease patient between \$46.4 and \$7,981 per year.

3.2 The social impacts of Human Trypanosomiasis

3.2.1 The social impacts at community level

(HAT) affects more than half a million people per year, especially in war-torn zones [15] [19] [20]. The report of [17] showed that (HAT) has been a major cause of depopulation of large tracts of Africa. The disease has direct impacts on human settlement - migration, in parts of sub-Saharan Africa including Nigeria [31] and Kenya [32] resulting in negative impact on agriculture [33] and livestock [34]. As a result of the frequent outbreaks of Trypanosomiasis, changes in settlement patterns and increase population density [15][34]. Poor marginalized rural populations particularly the productive age group (15 to 45 years) are the main groups affected by (HAT). Though the disease represents a major threat to the socio-economic development of the affected countries.

3.2.2 The social impacts at individual and family levels.

From their studies [21] [22][35] and [18] concluded that individuals affected by HAT suffering from biological damage and functional incapacities. For them if untreated, the disease causes death. In Democratic Republic of Congo, Angola, and Southern Sudan, sleeping sickness was considered the first or second greatest cause of mortality in those communities [36]. The community and individuals in Kenya, Democratic Republic of Congo develop behavioural changes as a result of central nervous system involvement [21] [37] [22] [35]. divorce and break-up of families were the main consequences of these behavioural changes.

The study of [16] and the report of [15] revealed that the disease causes abortions, sterility and gynecological disorders which lead to stigmatization and reduced productivity. Infected women may give birth to a congenitally infected child [38].

Studies in Uganda demonstrated that HAT increased the poverty and decreased the agricultural activities, often leading to famine or lack of basic food security [21], [22].

In children, HAT has been reported by [37] to have a negative in-

fluence on their physical growth, intellectual development and attainment of sexual maturity. The disease disrupt of children's education [21], [22].

According to [37] the treatment problems especially in case of long-term hospitalization, lead to severe social consequences as a result of negative attitudes towards hospital treatment and incomplete treatment that contribute to the risk of death from sleeping sickness.

4. Conclusion

It was concluded that socio economic studies of trypanosomiasis receives not less interest among researchers. The economic analysis covered different aspects, some studies dealt with the losses due to the disease regarding mortality, morbidity and treatment cost. Others were interested in cost - benefit comparisons the control programmes in which cost benefit analysis as well as their cost effectiveness were done.

All the results demonstrated that the disease negatively impacts human population and that any development objectives cannot be achieved without controlling the disease, hence the importance of implementing such programmes.

Latin America far exceeded Africa in the control in the disease and achieved fruitful results. Despite the effort of PATTC, Africa still needs more collaboration in combating the disease. Joint Human - Animal programmes will have a pronounced effect. Social studies on the risk factors associated with the disease will help the decision makers in formulating effective control programmes.

REFERENCE

- [1] Dumas M, Bouteille B, Buguet A, editors (1999). Progress in human African trypanosomiasis, sleeping sickness. Paris: Springer-Verlag; [2] Fevre, EM; Coleman, PG; Welburn, SC; Maudlin, I; (2004) Reanalyzing the 1900-1920 sleeping sickness epidemic in Uganda. *Emerging infectious diseases*, 10 (4). p. 567. ISSN 1080-6040 | [3] Kuzoe FA: 1993; Current situation of African trypanosomiasis. *Acta Trop* 54:153-162 PubMed Abstract | [4] World Health Organization, 2006 World Health Organization: African trypanosomiasis (sleeping sickness). World Health Organ Fact Sheet 2006, 259 [http://www.who.int/mediacentre/factsheets/fs259/en/] website | [5] Mitashi, P; Hasker, E; Ngoyi, D.; Pyana, P.; Lejon, V.; Van der Veken, W.; Lutumba, P.; Buscher, P.; Boelaert, M.; And Deborggraeve, S. (2013). Diagnostic accuracy of Loopamp Trypanosoma brucei detection kit for diagnosis of human African trypanosomiasis in clinical samples. *PLoS Neglected Tropical Diseases* 7, (10): 1935-2727. | [6] Steverding, 2010. The development of drugs for treatment of sleeping sickness: a historical review *Parasites & Vectors* 2010, 3:15 doi:10.1186/1756-3305-3-15 | [7] Lent H, Wygodzinsky P. 1979 Revision of the Triatominae (Hemiptera, Reduviidae), and their significance as vectors of Chagas' disease *Bull Am Museum Natural History*; 163:123-520. | [8] WHO (2014). Chagas disease (American trypanosomiasis) Fact sheet N°340. | [9] CDC Centers for Disease Control and Prevention (2013). 1600 Clifton Rd. Atlanta, GA 30333, USA 800-CDC-INFO (800-232-4636) TTY: (888) 232-6348. | [10] Barfield, C.A.; Barney, R.S.; Crudder, C.H.; Wilmoth, J.L.; Stevens, D.S.; Mora-Garcia, S.; Yanovsky, M.J.; Weigl, B.H.; Yanovsky, J., (2011) "A Highly Sensitive Rapid Diagnostic Test for Chagas Disease That Utilizes a Recombinant Trypanosoma cruzi Antigen," *Biomedical Engineering, IEEE Transactions on*, vol.58, no.3, pp.814,817 | doi: 10.1109/TBME.2010.2087334 | [11] Fevre E1, Lares M, Vietri M, Medina M. (2013). Comparison between immunological and molecular techniques for the diagnosis of Chagas disease. *Enferm Infect Microbiol Clin*. 31(5):277-82. doi: 10.1016/j.eimc.2012.09.007. | [12] Bern C, Montgomery SP, Herwaldt BL, (2007). Evaluation and treatment of chagas disease in the United States: a systematic review. *JAMA*. 298(18):2171-81. [Medline]. | [13] Louis V Kirchhoff, MD, MPH Professor, (2011) Departments of Internal Medicine (Infectious Diseases) and Epidemiology, Carver College of Medicine and College of Public Health, University of Iowa; Staff Physician, Medical Service, Iowa City Veterans Affairs Medical Center | http://emedicine.medscape.com/article/214581-treatment | [14] Doke, P and Kar, A. (2011). A fatal case of Trypanosoma lewesi in Maharashtra India. *Annals of Tropical Medicine and Public Health*: 4 (2): 91-95 | [15] WHO (World Health Organization), (1998). African trypanosomiasis; Control and Surveillance. Report of a WHO expert committee, WHO technical report series no. 881. WHO, Geneva. | [16] Hide, G. (1999). History of Sleeping Sickness in East Africa. *Clinical Microbiological Reviews*, 12 (1): 112-125. | [17] WHO (World Health Organization), (2001). Report of the Scientific Working Group on African trypanosomiasis, 2001 TDR/SWG/01 | [18] Lutumba, P.; Makieya, E.; Shaw, A.; Meheus, F.; and Boelaert, M. (2007). Human African trypanosomiasis in a rural community, Democratic Republic of Congo. *Emerg Infect Dis* [serial on the Internet]. Available from http://wwwnc.cdc.gov/eid/article/13/2/06-0075.htm | [19] Kabayo, J. P. (2002). Aiming to eliminate tsetse from Africa. *Trends Parasitol*. 18: 473-475. | [20] Courtin D, Berthier D, Thevenon S, Dayo GK, Garcia A, Bucheton B (2008). "Host genetics in African trypanosomiasis". *Infect. Genet. Evol* 8 (3): 229-38. doi:10.1016/j.meegid.2008.02.007. PMID 18394971. | [21] Kyomuhendo, B.G. (1998). The Effects of Human Trypanosomiasis on the Functioning of Households. Unpublished Report, 1998. TDR Project ID: 960028. | [22] Bukachi, S.A. (2007). Socio-economic and Cultural impacts of Human African trypanosomiasis and the Coping Strategies of Households in the Busoga Focus. PhD Thesis, the University of Nairobi. | [23] J. Robays Raguenaud, M.E.; Josenando, T. and Boelaert, M. (2008). Eflornithine is a cost-effective alternative to melarsoprol for the treatment of second-stage human West African trypanosomiasis in Caxito, Angola. *Tropical Medicine and International Health*, v.13, no.2, p.265(7) (ISSN: 1360-2276) | [24] WHO "WHO report on neglected tropical diseases Working to overcome the global impact of neglected tropical diseases" World Health Organization, 2010 | First WHO report on Neglected Tropical Diseases | Ref: ISBN 978 92 4 156409 0 or WHO/HTM/NTD/2010.1 | [25] M. Odiit, P. Coleman, E. Fèvre, J. McDermott, (2000). "Incorporating the burden of human sleeping sickness in an economic impact assessment of trypanosomiasis". In: Proceedings of the ninth international symposium on veterinary epidemiology and economics, 7-11 August 2000. Breckenridge CO, USA. | [26] J. Gouteux, P. Bansimba, F. Noireau, and J. Frénil, "Cost of the individual treatment of Trypanosoma brucei gambiense trypanosomiasis in a focus of infection in Niari (Congo)". *Med Trop (Mars)*; 47:61-3. 1987. [PubMed]. | [27] L. Matamba, E. Fèvre, S. Kibona, K. Picozzi, S. Cleaveland, A. Shaw, and S. Welburn, (2010). "Quantifying the burden of rhodesiense sleeping sickness in Urambo District, Tanzania," *PLoS Negl Trop Dis*. 2; 4(11):e868. doi: 10.1371/journal.pntd.0000868. 2010. | [28] A. Moncayo, "Chagas disease: current epidemiological trends after the interruption of vectorial and transfusional transmission in the Southern Cone countries". *Mem. Inst. Oswal-do Cruz* vol.98 (5), 2003. Rio de Janeiro. | [29] G. Vazquez-Prokopec, C. Spillmann, M. Zai-denbergh, U. Kitron, and R. Gürtler, "Cost-effectiveness of chagas disease vector control strategies in Northwestern Argentina". *PLoS Negl Trop Dis*; 3(1):e363. 2009doi: 10.1371/journal.pntd.0000363. Epub 2009 Jan 20. http://dx.doi.org/10.1590/S0074-02762003000500001 | [30] M. Castillo-Riquelme, F. Gühl, B. Turriago, N. Pinto, F. Rosas, M. Martínez, J. Fox-Rushby, C. Davies, and D. Campbell-Lendrum, D. "The costs of preventing and treating chagas disease in Colombia". *PLoS Negl Trop Dis*; 2(11):e336. doi: 10.1371/journal.pntd.0000336. Epub 2008 Nov | [31] A. Takele, and G. Abebe, "A survey of trypanosomiasis in GamuGofa region, (Ethiopia)," *Rev. Elev. Med. Vet. Pays. Trop.*, 41(3): 271-276, 1988. | [32] J. Abenga, F. Enwezor, F. Lawani, H. Osue and E. Ikemereh. "Trypanosome prevalence in cattle in Lere Area in Kaduna State, North central Nigeria," *Rev. Elev. Med. Vet. Pays. Trop.*, 57(1-2): 45-48, 2004. | [33] B. Swallow "Impacts of Trypanosomiasis on African Agriculture." *PAAT Technical and Scientific Series* nr 2, Rome, 52pp. 2000. | [34] B. Swallow, (2000b). "Multiple impacts of trypanosomiasis in crop/livestock systems in Africa: In Socio-economic consequences for poor livestock farmers of animal diseases and VPH problems livestock, the poor and the vulnerable Improved Animal Health for Poverty Reduction and Sustainable Livelihoods". FAO, animal production and health paper 153 Food and Agriculture Organization of the United Nations Rome, 2002. | [35] J. Robays, P. Lefevre, S. Lutumba, V. Luban-za, Ku Mesu, P. Van der Stuyt and M. Boelaert "Drug Toxicity and Cost as Barriers to Community Participation in HAT Control in the Democratic Republic of Congo." *Tropical Medicine and International Health*, 12(2):290-298, 2007. | [36] R. Odero, K. Cleveland, K. Kiminyo, D. Lucey, "African Trypanosomiasis (Sleeping Sickness)" http://emedicine.medscape.com/article/228613-overview#a0101(2012). [Accessed: March 12, 2014]. | [37] F. Kuzoe, (2001). "A position paper on African Trypanosomiasis" The Scientific Working Group meeting on African Trypanosomiasis, 4-8 June, Ouagadougou, Burkina Faso. | [38] A. H Aroke, T. Asonganyi, and E. Mbonda, "Influence of Past History of Gambian Sleeping Sickness on Physical Growth, Sexual Maturity and Academic Performance of Children in Fontem, Cameroon," *Annals of Tropical Medicine and Parasitology* 92 (8): 829-35. 1998. |