

## Occurrence of Kala-Azar in accordance with socio-economic conditions and associated disorders among the inhabitants of Trishal Thana, Mymensingh

<sup>1</sup>Md. Showket Hasan, <sup>1</sup>Hamida Khanum, <sup>2</sup>Mohammad Shafiul Alam and <sup>1</sup>Farzana Easmin

Parasitology Branch, Department of Zoology, University of Dhaka, Dhaka 1000

<sup>2</sup><sup>1</sup>International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B), Mohakhali, Dhaka-1212, Bangladesh

---

**Abstract:** The study was conducted in rural areas of Trishal Thana, Mymensingh District. Under 9 unions of Trishal thana, 51 villages were mostly affected by visceral leishmaniasis (Kala-Azar). The aim of the study was to determine the prevalence of Kala-Azar and to find out the relationship between infection of Kala-Azar and the socio-economic conditions of the affected areas and also the relationship between blood group and associated clinical disorders. The present study revealed that most of the people are poor, illiterate, leading unhygienic life and the housing patterns were not developed. Most of them live in mud and straw made house; cowsheds provide the suitable habitat for sandfly, causal agent of Kala-Azar. Among the 51 villages, 54.02% people were illiterate, 27% farmer. About 85.6% people live in mud made houses. Monthly expenditure of those peoples limited to below 4000 Taka. In the present study, out of 348 patients examined, 34 patients were belonging to the blood group A+ 78, B+ 36, AB+ 192, O+ 4, B- 2, and O- blood group and 2 were AB<sup>-</sup>. The highest prevalence (55%) of Kala-Azar found within O<sup>+</sup> blood group patients. On the other hand, 11.49% had single infection, 28.73% had double infection associated with jaundice, and the other 59.77% had multiple infection associated with jaundice, ascites, anemia, oedema. Kala-Azar patients usually have low immunity level due to deficiency of macrophage cell and dysfunction of liver. So, it shows the relationship between disease status, lack of immune response associated with clinical disorders.

---

**Keywords:** Kala-Azar, Population, Socio-economic condition

### Introduction

Leishmaniasis (Kala-Azar) is a protozoan disease caused by parasite of the genus *Leishmania*, transmitted to man by the bite of female phlebotomine sandfly. Three clinically distinct conditions of leishmaniasis are recognized namely visceral Leishmaniasis, cutaneous leishmaniasis and mucocutaneous leishmaniasis (Park and Park, 1987). *Leishmania donovani* is the causative agent for visceral leishmaniasis in the Indian subcontinent. It is an important public health problem in Bangladesh. It is a disease of reticulo-endothelial (R.E.) system characterized by chronic irregular fever with progressive enlargement of the spleen and to a lesser extent liver, wasting of the body, anaemia, progressive leukopenia, raised erythrocytic sedimentation rate (ESR) (IEDCR/WHO, 1993). In Bangladesh increasing trend of incidence of Kala-Azar is observed. Most prevalent areas are Sirajgonj, Pubna, Tangail and Mymensingh followed by Natore, Nowabganj, Rajshahi, Manikganj, Gazipur

and Jamalpur (Beximco Pharmaceuticals Newsletter, 1996). It has a high mortality rate. The inter-epidemic period used to be about every 15-20 years interval (IEDCR/WHO 1993, Islam 1992).

Kala-Azar is usually much prevalent in rural areas where the people are living in substandard hygienic condition. It is transmitted by the bite of sandfly, *Phlebotomus argentipes* (Park and Park, 1987). While infected female sandfly bites the susceptible host, the flagellates entering the circulation, change their shape as amastigote and undergo multiplication monocyte in the circulation and invade fresh cells. The cycle is repeated and the entire reticuloendothelial system becomes progressively infected. Sandfly may obtain the parasite directly from the infected skin or by ingesting the parasite from the circulating blood of the reservoir host. After an infective blood meal, the sandfly becomes infected in 6 to 4 days (extrinsic incubation period) (Park and Park, 1987) and the amastigotes transform into promastigotes.

\* Corresponding author: hamida\_khanum@yahoo.com

Infected persons commonly have diffuse lymphadenopathy (Beximco Pharmaceuticals Newsletter, 1996) and the skin over the entire body becomes dry, rough and harsh, and often pigmented (darkened). Death in Kala-Azar is always due to some complications, such as amoebic or bacillary dysentery, pneumonia, pulmonary tuberculosis and other septic infections (Chatterjee, 1995). In some incompletely or even completely treated patient of visceral leishmaniasis, parasites occur in the nodules on the face, forearms, inner aspect of the thighs and pubic regions. This condition is called Post Kala-Azar dermal leishmaniasis (PKDL). It develops in about 10%-20% patient of Kala-Azar, generally 1-2 years after completion of antimonial treatment when the visceral lesions disappear but the skin infection persists.

In Asia, zoonotic and anthroponotic cutaneous leishmaniasis and visceral leishmaniasis are also present. Recently, 200-300 cases have been reported per year. Endemic areas of Kala-Azar in India include Bihar, Bengal, Assam and Tamil Nadu. The period from 1960-'70 could be regarded as Kala-Azar free areas due to DDT spray under National Malaria Eradication Programme (NMEP). But from 1997 progressive rise in incidence reached 100,000 cases with 4500 deaths by 1970-80 (IEDCR/WHO-1993).

Increasing number of cases of post Kala-Azar dermal leishmaniasis and visceral leishmaniasis are being reported from various parts of Bangladesh (Khan, 1977; Islam, 1992; Rahman and Islam, 1983; Hussain and Rashid, 1987). Hossain and Rashid (1984) worked on suspected patients with splenomegaly and fever in Mitford Hospital. A study made by Masum *et al.* (1990). They reported that, in Thakurgaon District 53 patients were suffering from Kala-Azar with chronic fever. Masum and Chowdhury in 1996 studied Kala-Azar from various parts of rural Bangladesh and reported that out of 183 blood samples, 119 were seropositive for Kala-Azar.

## Materials and Methods

**Study Area:** This study was conducted in rural areas of Trishal Thana, Mymensingh District. Fifty one villages were selected under 9 unions of Trishal Thana were mostly affected by visceral

leishmaniasis (Kala-Azar) which includes Solimpur, Dhanikhola, Nouapara, Kustia, Taltala, Borma, Sharoshoti Kanda, Konabari, Porabari, Olohari, Koraghasa, Raimoni, Mothbari, Ishamoti, Amianvangur, Kathal, Dori kathal, Patchpara, Shatrapara, Bagan, Kondhari, Shakua, Bishinopur, Gandokhola, Babupara, Magurjara, Harirampur, Golavita, Nigurkanda, Chouladi, Kanihari, Rayer gram, Ahmedabad, Hodder vita, Bikrampur, Kona Baghail, Boilor, Balipara, Ranigonj, Dorirampur, Kakchar, Deopara, Shankibhanga, Mandatia, Govindapur, Baludia, Sutiakhali, Chalkrampur, Biara, Kaldia and Mofpur. The sampling part of the work has been organized in collaboration with the team of physicians and technicians of the ICDDR, B.

**Study period;** Duration of this study was carried out from January 2005 to June 2007.

Out of fifty one study areas, sampling scheme was limited to 174 treated patients. They were divided into 6 age groups for analysis. These were- 1-10 yrs, 11-20 yrs 21-30 yrs, 31-40 yrs, 41-50 yrs and 51-60 yrs. House type was also a subject of the study. It was divided into five types. Such as: Thatched, Mud + Straw, Mud + Tinshed, Building and Others.

**Collection of blood sample:** Blood samples were collected by finger prick technique. The ball of the left ring finger was pricked with a sterile lancet and the first drop of blood was wiped away with a piece of dry cotton. Gentle pressure was applied to the finger and three separate drops of blood were collected on to the glass slides.

## Results and Discussion

Trisal Thana consists of 12 unions. Of them, nine are enrolled in this study. From the present data (Table-1), the highest prevalence was found at Kanihari union with 102 patients (29.31%), and the lowest prevalence was found at Balipara and Kathal with 12 patients (3.44%) approximately. It was found that the higher prevalence was at Danikhola village (10.34%), followed by Solimpur village (9.19%) and lower prevalence found at Magurjora village (6.89%), Noupara, Kustia (6.32%) and Bagan (5.74%).

**Table 1.** Prevalence of Kala-Azar patients in selected nine (9) unions of Trishal Thana

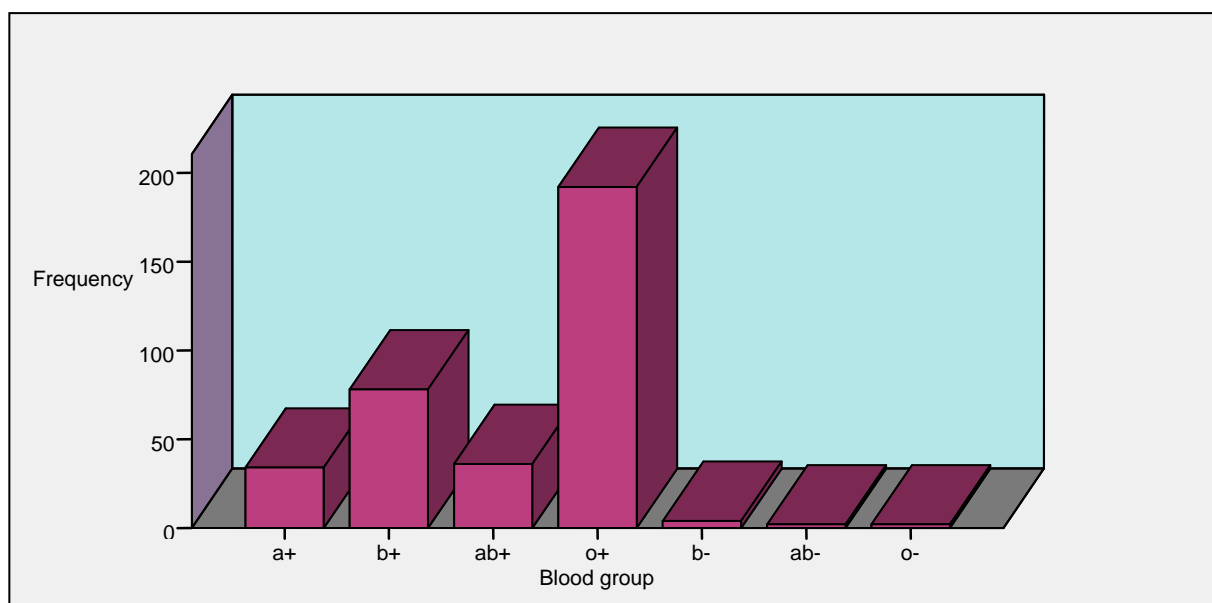
Name of Union	Frequency	Percent
Trishal	64	18.4
Dhanikhola	36	10.3
Shakua	18	5.2
Kanahari	10	29.3
Mothbari	28	8.0
Balipara	12	3.4
Kathal	12	3.4
Bagan	20	5.7
Harirumpur	56	16.1
Total	348	100.0

**Table 2.** Prevalence of Kala-Azar in different age groups at Trishal Thana

Age Group	Frequency	Percent
1-10	128	36.8
11-20	104	29.9
21-30	62	17.8
31-40	24	6.9
41-50	24	6.9
51-60	6	1.7
Total	348	100.0

Out of 348 patients (Table-2) the highest prevalence of the patients was found in the 1-10 age group (36.78%) and the lowest prevalence (1.72%) was found in the 51-60 age group.

Among the 34 patients were found in the A<sup>+</sup> blood group, 78 in the B<sup>+</sup> blood group, 36 in the AB<sup>+</sup> blood group, and 192 were in the O<sup>+</sup> blood group (Fig. 1).

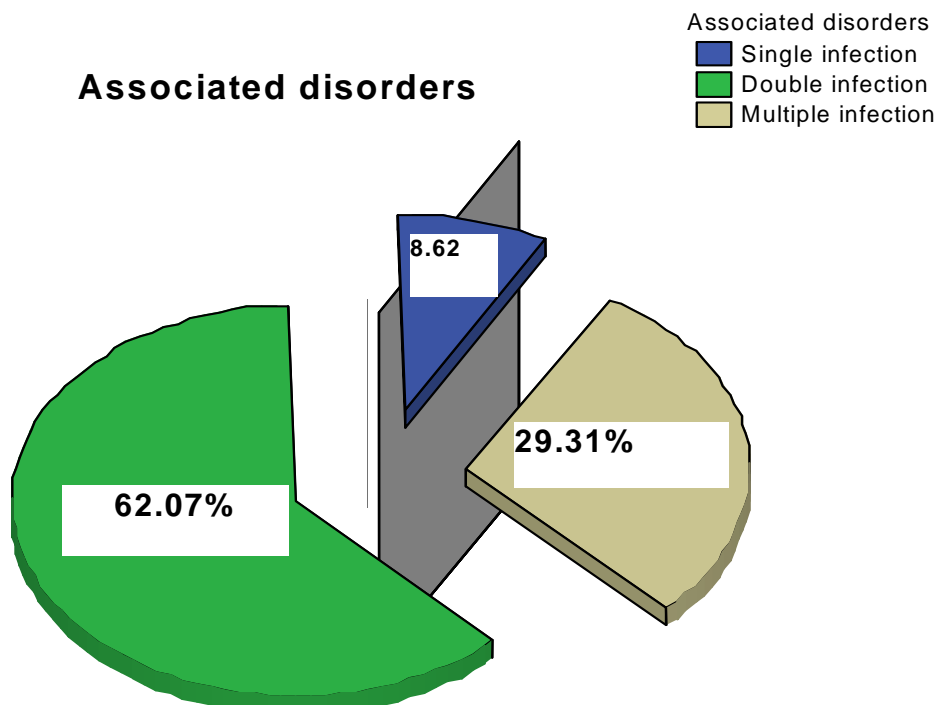
**Fig. 1.** Occurrence of Kala-Azar in accordance with different blood groups of the patients.

It was found that the status of education in Trisal Thana was below satisfactory level. It was found that out of 348 patients, only 26 patients (7.47%) had secondary school qualification, 134 patients

(38.50%) had primary school qualification and 188 patients (54.02%) were illiterate. The highest prevalence belong to the illiterate patients group.

Among the treated patients, most patients had more than one clinical disorders. Common clinical disorders included- Jaundice, Ascites, Anemia, Oedema. Out of 348 patients, 40 patients (11.49%) had single infection, 100 patients

(28.73%) had double infection with jaundice, and the other 208 patients (59.77%) had multiple infection along with jaundice, ascites, anemia and oedema (Fig. 2).



**Fig. 2.** Associated disorders among the Kala-Azar patients at Trishal Thana.

In Trisal Thana, most of the inhabitants were illiterate and poor it was found that (Table 3), 94 patients (27.01%) were farmers, 64 patients (18.39%) were house wives who have no earning

source, and 2 patients (0.57%) were service holder, 102 patients (29.31%) were students and 86 patients (24.71%) have no occupation.

**Table 3.** Prevalence of Kala-Azar among the patients of different occupation at Trishal Thana

Members of Different Occupations	Frequency	Percent
Farmer	94	27.0
House wife	64	18.4
Service holder	2	.6
Student	102	29.3
None	86	24.7
<b>Total</b>	<b>348</b>	<b>100.0</b>

Most of the inhabitants of Trishal Thana live in low quality of houses, out of 348 patients (Table 4) 48 patients (13.79%) were inhabitants of thatched houses, 132 patients (37.93%) inhabitants of mud straw house and 166 patients (47.70%)

inhabitants of mud tin house and only 2 patients (0.57%) inhabitants of building. The highest percentage was found among the patients who inhabitants of mud tin and mud straw houses.

**Table 4.** Percentage of types of houses of the treated patients of Trishal Thana

	Frequency	Percent
Thatched	48	13.8
mud+straw	132	37.9
mud+tin	166	47.7
Building	2	.6
Total	348	100.0

**Table 5.** Percentage of monthly expenditure among the treated patients at Trishal Thana

Income range	Frequency	Percent
1000-2000	32	9.2
2000-3000	192	55.2
3000-4000	118	33.9
4000+	6	1.7
Total	348	100.0

In Trisal Thana, most of the inhabitants have low income capacity. Out of 348 patients surveyed (Table-5), 32 patients (9.19%) were belong to 1000-2000 Tk. income group, 192 patients (34.48%) belong to 2001-3000 Tk. income group, 118 patients (54.59%) belong to 3001-4000 Tk. income group, and only 6 patients (1.72%) belonging to 4000+ Tk. income group. The highest percentage of the patients belong to 2001-3000 Tk. income group.

Cattle shed near the living rooms are the vital factor for the higher prevalence of Kala-Azar. Out of 348 patients, (Table 6) 296 patients (85.05%) have cattle shed and only 52 patients (14.94%) have no cattle shed. So, the highest prevalence was found among the patients who have cattle sheds.

**Table 6.** Prevalence of cattle shed among the treated patients at Trishal Thana

Cow Shed	Frequency	Percent
Present	296	85.1
Absent	52	14.9
Total	348	100.0

Using bed net is very useful for the protection from any kind of flies and mosquitoes. Out of 348 patients, 86.78% have no bed nets, and 23 patients (13.21%) only use bed net. The highest percentage was found among the patients who do not use bed net. Moreover, 312 patients (89.65%) used to sleep inside the room and the rest (10.34%) used to sleep outside of the room; and the highest prevalence was found among the patients who used to sleep inside the room (Table 7).

In present the investigation, the highest percentage (Fig. 3) of patients' enrollment was found at June (19.5%) and the lowest at December (2.3%). The prevalence of sandfly population is directly proportionate to pre-monsoon period. That's why, the highest prevalence of Kala-Azar patients enrollment usually increases at April, May, June and July and it decrease in November and December period.

**Table 7.** Prevalence of the patients at Trishal Thana using inside or outside of the room as sleeping places

	Frequency	Percent
inside of the room	312	89.7
outside of the room	36	10.3
Total	348	100.0

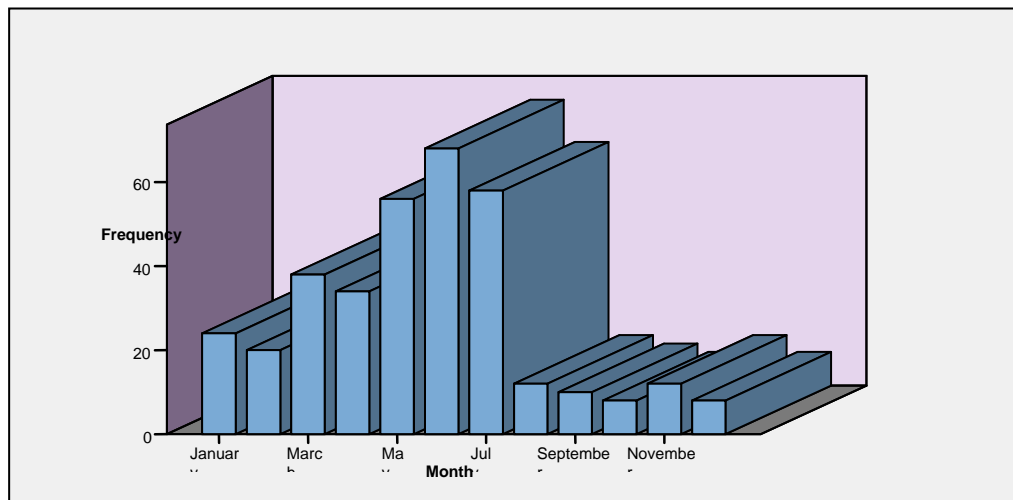


Fig. 3. Monthly variation of Kala-Azar patients in Trishal Thana.

**The Association Between Diseased Group (Kala-Azar Patients) and Non-Diseases Group at Trishal Thana:** To reveal the association between the diseased group and the control group was “Retrospective statistical analysis”. The same number of inhabitants at Trishal Thana (348) were taken. The members of control group were randomly taken from the selected 51 villages to show the association between the disease status and the respective factors. The statistical analysis was accomplished by Chi-square method.

The aim of the study was to determine the prevalence of Kala-Azar and to find out the relationship between infection of Kala-Azar and the socio-economic conditions, blood group of the treated patients and associated clinical disorders of the patients of the affected areas. Among the patients of diseased group, the highest prevalence of Kala-Azar fall into Illiterate (54.0%) group and among the members of non-diseased group, the highest prevalence was also found into Illiterate (46.0%) group.

Present study provided some information regarding the status and epidemiology of Kala-Azar of different unions under Trishal Thana. Higher prevalence was related to the socio-economic conditions and their housing pattern. The present data shows that, among the patients of diseased group, the highest prevalence of Kala-Azar fall into 1-10 years age group (36.8%) and among the members of non-diseased group, the highest prevalence was found into 21-30 years age group (21.3%). From the Chi-square test, the p-value was 0.00 and it was less than 0.05 significant levels. So, it strongly rejects the Null

hypothesis. Moreover, above data showed that the age groups of non-diseased group were independent from those of diseased group. That is why, it can conclude that there is a relationship between the disease status (Kala-Azar) and age group of the treated patients. In 1996, Masum and Chowdhury reported a total of 183 chronic fever cases from different areas of Bangladesh, out of male cases 64.4% and female cases 59.1% were found positive. The majority of the cases were among 0-15 years of age.

Among the patients of diseased group, the highest prevalence of Kala-Azar belongs to the group O<sup>+</sup> (55.2%) and among the members of non-diseased group, the highest prevalence belong to O<sup>+</sup> (46.0%) blood group. From the Chi-square test, the P-value was 0.389 and it was greater than 0.05 significant levels. So, it strongly rejects the alternative hypothesis. But present study shows that most of the patients having Kala-Azar belong to O<sup>+</sup> blood group at Trishal Thana (Fig. 4).

Leishmaniasis is one of the major neglected diseases in the world which been heavily impacted by the global climate change. The climate of Bangladesh is also changing which making people more prone to infectious diseases. Visceral leishmaniasis or Kala-Azar is not out of that list. Kala-Azar incidence rate, climatic factors, vectors breeding sites and adult vectors were collected from 70 different locations of Mymensingh District. It was found that the high or medium high land areas were more endemic for Kala-Azar. In comparison Kala-Azar was found almost absent from medium low or low land areas (Bern and Chawdhury, 2006).

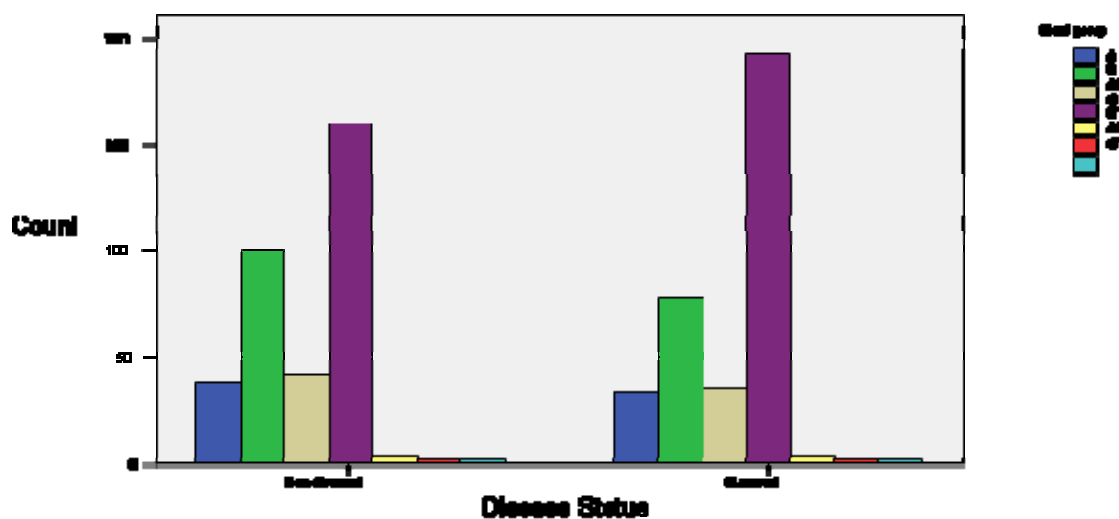


Fig. 4. Association of blood groups in non-diseased and Kala-Azar patients.

Favorable climatic condition and unhygienic environment are ideal for the multiplication of the *L. donovani* and the vectors are also abundant (Islam, 1992). Kala azar is mostly confined to the plains. It does not occur in altitudes over 2000 ft. During and after rains there is a high prevalence (Park and Park, 1987; Akter *et al.*, 1999). It occurs in rural areas where peoples are with very low socioeconomic conditions and their houses made up of mud, where there are many cracks and crevices which form day time resting places for sand fly. The presence of cattle sheds in close proximity to their dwelling units also serve as the suitable habitat for the vectors. All these environmental conditions favor the high incidence of Kala-Azar in our country (Chowdhury *et al.*, 1990; Bern *et al.*, 2000, Bern *et al.*, 2007).

Kala-Azar can occur in all age groups including infants below the age of one year. But the majority cases are reported in the age group 5 to 30 years (Park and Park, 1987; Masood *et al.*, 1991; Manson, 1982; Thakur, 1984; Aikat *et al.*, 1979). The ratio of prevalence among male and female is 2:1 (Masum and Chowdhury, 1996). The onset of visceral leishmaniasis may be gradual or acute. There is usually fever for long time at least three weeks, cough, anorexia, malaise, and weight loss. The organism found in large number in reticulo-endothelial system (Masum and Evans, 1995). As a result, Spleen and liver becomes enlarged and the red marrow extends beyond its normal limit (Hasan *et al.*, 2009).

Most of the Kala-Azar patients have more than one associated clinical disorders such as

jaundice, ascities, anemia, oedema, hepatomegaly and splenomegaly. In the present study, out of 217 patients at Trishal Thana, 8.6% had single infection, 18.9% had double infection associated with jaundice and 72.5% had multiple infection associated with jaundice, ascities, anemia and oedema. In fulbaria district, out of 213 patients, 7.4% had single infection, 33.7% had double infection associated with jaundice and 58.9% had multiple infection associated with jaundice, ascities, anemia and oedema. Kala-Azar affected person usually have low immunity level due to deficiency of macrophage cell as a result of dysfunction of liver. So, it proved and showed the relationship between disease status and associated clinical disorders. Sarker *et al.* (1996) and reported that majority (67.25%) of the patients were from low socio-economic group.

## References

- Aikat, B.K., Sahaya, S., & Pathania, A.G.S. 1979. Clinical profile of cases of Kala-Azar in Bihar. *Ind j Med. Res.* **70**: 563-570.
- Akhter, S., Chowdhury, M.S., Khanum, H. & Hossain, M. 1999. Effect of flood on sandfly density and prevalence of visceral leishmaniasis in a Kala-Azar endemic village of Bangladesh. *J. Pre. Soc. Med.* **18**(2): 32-39.
- Bangladesh Bureau of Statistics. 1986. Small area atlas of Mymensingh district. 127 pp.
- Bangladesh Bureau of Statistics. 1995. Bangladesh population census. 1991. Mymensingh.
- Bangladesh Bureau of Statistics. 2003, Statistical pocket book of Bangladesh 2002. 493 pp

- Bern, C. Joshi, A.B., Jha, S.N., Das, M. L., Hightower, A., Thakur, G.D. & Bista, M.B. 2000. Factors associated with visceral leishmaniasis in Nepal: bed-net use is strongly protective. *A. J Trop. Med. & Hyg.* **63**(3,4):184-188.
- Bern, C., Haque, R., Chowdhury, R., Ali, M. & Kurkjian, K.M. 2007. The epidemiology of visceral leishmaniasis and asymptomatic leishmanial infection in a highly endemic Bangladeshi village. *American Journal of Tropical Medicine and Hygiene*, **76**: 909–914.
- Bern, C. & Chowdhury, R. 2006. The epidemiology of visceral leishmaniasis in Bangladesh: prospects for improved control. *Indian Journal of Medical Research.* **123**: 275-288.
- Chatterjee, K.D. 1995. Parasitology, protozoology and Helminthology. 12<sup>th</sup> edition. Chatterjee Medical Publishers, Calcutta: pp. 238.
- Chowdhury, A.H.K., Rahman, A.J.M., & Khan, N.I. 1988. Post Kala-Azar Dermal Leishmaniasis (PKDL), Study of 8 cases. *Bang. Med. J.* **17**: 27-33.
- Chowdhury, M.A.J., Alam, M.N., Uddin, A.K.M.R, Hussain, A. Rahman, H. Siddiqui, A.B., Nazir, M.F.H., Rahman, K.M. & Biswas, A. 1990. Clinical profile of Kala-Azar in Rajshahi: a prospective study of 273 hospitalised patients during one year. *J Bang. Coll. Phys. Surg.* **8**(1): 18-28.
- Hossain, S.M. & Rashid, M.A. 1987. Prevalence of Kala-Azar on the sides of the river Buriganga. *Bang. Med. J.*; **16**(2&3): 54-57.
- Hasan, M.S, Khanum, H & Easmin, F. 2009. Prevalence of Leishmaniasis in Trishal, Mymensing: Relation with blood group, Age group and associated clinical disorders. *Bangladesh J. Zool.* **37**(2): 239- 246.
- Hossain, S.M. & Rashid, M.A. 1987. Prevalence of Kala-Azar on the sides of River Buriganga. *Bangladesh Med. J.* **16**: 54-57.
- Islam, S.A.F.M. 1992. Kala-Azar in Barishal. *Bangladesh Medical Review.* **82**(1&2): 1-3.
- ICDDR,B: Center for Health and Population Research. *Health and Science Bulletin.* 2003; **1**(2): 1-5. IEDCR. 2000. Yearly health situation report; p 171-175.
- Khan, H.K. 1977. Post Kala-Azar dermal leishmaniasis (a review of 10 cases). *Bang. Med Res. Coun. Bull.* **3**(2): 130-136.
- Masum, M.A., Chowdhury, M.S., Ahmed, R.U. & Mia, M.A.H. 1990. Outbreak of Visceral Leishmaniasis in Thakurgaon, *Bangladesh. J Prev. Soc. Med.* **4-9**(2): 38-41.
- Masum, M.A. & Evanas, D.A. 1995. Characterization Leishmania isolated from patients with Kala-Azar and post Kala-Azar dermal leishmaniasis in Bangladesh. *Transactions of the Royal Society of Tropical Medicine and Hygiene.* **89**: 331-332.
- Masum, M.A., Alam, B. & Ahmed, R.U. 1990. An epidemiological investigation of Kala-Azar outbreak at Kalihati Upazilla of Tangail District, Bangladesh. *Journal of Preventive and social Medicine*, **1**(4-9): 13-15.
- Masum, M.A., Chowdhury, M.S., Ahmed, R.U. & Mia, M.A.H. 1995. Outbreak of Visceral Leishmaniasis in Thakurgaon, Bangladesh. *Journal of Preventive and Social Medicine*, **2**(4-9): 38-44.
- Manson, B.P.E.C. 1982. Leishmaniasis in Manson Bahr PEC and Tropical Disease. 18<sup>th</sup> edition. ELBS and Bailliere-Tindall. London: 93-115.
- Masood, A.F.M., Khan, A.R. & Islam, M.K. 1991. Kala-Azar in children- A study of 100 patients. *Dhaka Shishu Hospital Journal.* **7**(1): 17-23.
- Newsletter. 1996. Competed and Circulated Beximco Pharmaceuticals Ltd, Dhaka. Lishmaniasis. **6**(2): 8-10.
- Park, J.E. & Park, K. 1987. *Text book of preventive and social medicine.* India: M/S Banarsidas Bhanot. India 11<sup>th</sup> edition: 246-248.
- Rahman, H.M. 1994. Treatment and Prevention of Kala-Azar – A Review *Journal of Dhaka Medical College.* **3**(1): 27-30.
- Rahman, K.M. & Islam, N. 1983. Resurgence of visceral leishmaniasis in Bangladesh. *Bull. WHO.* **61**(1): 113-116.
- Sarker, C.B., Bari M.I., Islam, M.R., Das, A.B., Hossain, S.Z., Sharma, J.D., Rahman, H. & Siddiui, F.M. 1996. Clinical profile of Kala-Azar in North-Western District Hospital of Bangladesh: A prospective study of 55 Hospitalized patients during period of six months. *Health-Today, Journal of DAB, SBMC, Barishal.* **1**: 30-45.
- Thakur, C.P. 1984. Epidemiological, Clinical, and Therapeutic features of Bihar Kala-Azar (including post Kala-Azar dermal leishmaniasis). *Transactions of the Royal Society of Tropical Medicine and Hygiene.* **78**: 391-398.
- WHO (World Health Organization). 1990. *Control of the Leishmaniases, Report of a WHO Expert Committee.* Technical Report Series No. **793**.
- WHO (World Health Organization). 1996. *World health report.* 1996; Report of the director general, WHO, Geneva, Switzerland.
- World Health Organization. 1993. *Control of Tropical Disease, The Leishmaniasis.* 8.
- World Health Organization and Institute Of Epidemiology Disease Control and Research( IEDCR) 1993. *Visceral leishmaniasis and its control.* 57pp.