RESEARCH ARTICLE

Awareness of residents about kala-azar and its related practices in two endemic areas of Bangladesh

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Abstract

Kala-azar, a worldwide disease, is caused by the parasitic protozoan species of genus *Leishmania* and transmitted by species of sandflies. Awareness of the population about the disease is essential to run a successful control-strategies program. This cross-sectional study was conducted to assess the awareness of residents about it and related practices in two highly-endemic areas of Bangladesh. In total, 511 household respondents were selected conveniently from two unions (Kushmail and Kanihari) under two sub-districts (Trishal and Fulbaria) of Mymensingh district. Interviewer-administered questionnaires were used for assessing the awareness of the respondents about kala-azar and their practices. Knowledge scores were categorized as poor (<mean –1SD), average (mean ±1SD), good (>mean +1SD). Statistical tests were considered significant at p value of ≤5% (≤0.05). Chi-squared and Student’s t-tests were performed for statistical analysis. The mean knowledge score of the respondents of Kanihari union regarding kala-azar was significantly higher than that of the respondents of Kushmail union (mean ±SD, 4.30±0.86 versus 4.12±0.75, p = 0.002). Of the respondents, 11% and 20% had good (>5.04), 77% and 72% had average (3.43–5.04), 12% and 8% had poor (<3.43) (GAP) knowledge on kala-azar in Kushmail union and Kanihari union respectively. However, the mean knowledge score of the respondents of Kanihari union relating sandfly was significantly lower compared to that of the respondents of Kushmail union (mean ±SD, 2.49±0.79 versus 2.65±0.85, p = 0.03). Of them, 22% and 19% had good (>3.39), 67% and 64% had average (3.39–1.75), and 11% and 17% had poor (<1.75) knowledge on sandfly in Kushmail union and Kanihari union respectively. More than 70% of the respondents from Kushmail and Kanihari mentioned only injection as the preferred treatment of kala-azar. Eighty-seven percent and 88% of the respondents in the two unions had chosen upazilla health complex for the treatment of their kala-azar. About 50% of the respondents in Kushmail and Kanihari liked to use coil or mat as a preventive measure to avoid sandfly bites. The findings of this study indicate the importance of awareness and related practices of the community people in two endemic areas that will help implement the kala-azar-elimination program successfully in Bangladesh.
Introduction

The World Health Organization (WHO) reported that more than 147 million people in the South-East Asia (SEA) region are at risk of contracting the *Leishmania* parasites that cause kala-azar, a life-threatening disease [1]. It is spread by the bite of 'female'-infected phlebotomine ‘sandfly’. Clinical signs and symptoms include long-lasting, irregular fever, weight-loss, and hepatosplenomegaly and it could be fatal if left untreated [2]. Bangladesh, India, and Nepal have the largest burden of the disease in the region, and random cases have also recently been reported from Bhutan and Thailand [1].

Each year an estimated 200,000–400,000 new cases of *Visceral leishmaniasis* (VL) have been reported worldwide, and >90% of the new cases of VL occurred in Bangladesh, Brazil, Ethiopia, India, Sudan, and South Sudan. 2.4 million disability-adjusted life-years (DALYs) are lost each year due to kala-azar, and the South-East Asia region accounts for the loss of about 400,000 DALYs. Kala-azar is the disease of poverty and mostly distresses the socially-downgraded and deprived communities of the rural population and is recognized as the neglected tropical disease (NTD) [3].

In Bangladesh, VL became apparent in the early 1980s, and since then, more than 90,000 cases have been documented [4, 5]. Since 1996, the reported incidence of VL in the country has ranged from 7,000 to 9,000 cases per year; however, the number may be underestimated [6]. The estimated annual incidence of VL in Bangladesh in 2004–2008 was 12,400–24,900 cases [7]. The disease is prevalent in 45 of 64 districts of Bangladesh; however, most cases are reported from Mymensingh district [4, 5].

In 2005, the Health Ministries of Bangladesh, India, and Nepal launched a joint national program to eliminate VL by 2015 [8]. Although some progress has been made towards eliminating the disease from Bangladesh, 16 sub-districts (upazillas) could not reach the target in 2013 [9]. Therefore, with the revised objectives, a program for the elimination of kala-azar from this region was started with the collaboration of WHO and set the target to eliminate VL by 2020 [10].

Results of a study in Rajshahi district in 2008 showed that the frequency of VL was 27 times higher than the elimination target, the community people had poor knowledge on VL and its vector, and their health-seeking behavior was not acceptable [11]. Another study in non-endemic districts of Bangladesh during 2011–2012 reported that 65% of inhabitants were aware that kala-azar is curable, and only 13% heard of sandfly that indicates the poor awareness of the inhabitants regarding kala-azar [12]. A study in rural Fulbaria during 2015–2016 found that 100% of respondents heard about kala-azar, although only 0.93% were aware of sandfly [13]. In the non-program districts in Nepal, lack of its awareness among population was identified as one of the important barriers to the surveillance program [14].

It has been troubling both children and adults for many years and remains a significant public-health problem in our country. Ahluwalia *et al.* and Boelaert *et al.* reported that the majority of the people in the endemic areas of kala-azar have low levels of education, awareness, income, and poor-quality housing [15, 16].

The Government of Bangladesh aims to eliminate VL from the country by 2020. However, despite the Government’s control efforts in terms of diagnosis, treatment, spraying of insecticide (IRS), and IEC (information, education, and communication) activities, the general public still have misconceptions about kala-azar [17].

Community participation is the most important prerequisite for the success of prevention and control programs of any disease, and cooperation of the affected people is essential for the implementation and use of control program activities [18]. Therefore, researchers need to understand the extent of awareness of the community people about, or their knowledge on,
kala-azar and its related preventive practices because these are the two important determinants of community participation.

Little is known about how individuals and communities in different areas of Bangladesh perceive the disease and its management [12, 13, 17], however, studies such as these are crucial for the appropriate use of limited resources in poor socioeconomic and educational conditions. The present study was, therefore, undertaken to assess the awareness of residents about kala-azar and related practices to control it in highly-endemic areas of Bangladesh.

Materials and methods

Study area and design

This cross-sectional study was carried out during January-May 2017 in two VL-endemic areas in Mymensingh district, Bangladesh: Kanihari union in Trishal sub-district and Kushmail union in Fulbaria sub-district. Based on the geographical coverage of the KalaCORE project Bangladesh, they categorized different districts as hyper-endemic, moderate-endemic, and low-endemic. Mymensingh district is the hyper-endemic, and Fulbaria, Trishal, Bhaluka, Muktagacha, and Gafargaon are the hyper-endemic sub-districts (upazillas) in this district [19]. A study found that the overall prevalence of kala-azar patients in seven unions of Fulbaria sub-district was 45.12% [13].

Another study was also done in nine unions of Trishal sub-district in 2005–2007, and the highest prevalence (29.31%) was found in Kanihari union [20]. Many programs have been implemented to eliminate the incidence of kala-azar in these areas. The researchers of the present study assumed that the inhabitants of the endemic areas are well aware of vector control, early diagnosis, and prompt treatment of kala-azar. For this, the researchers chose Kanihari union in Trishal sub-district and Kushmail union in Fulbaria sub-district as the two study area.

Trishal and Fulbaria have a population of 372,498 and 448,467 respectively. Males comprise 50% of the population and females 49% in the two sub-districts. In both the upazillas, 97% are Muslims, 2.5% Hindus, 0.23% Christians, and 0.04% others. The literacy rate (40%) is similar in the two sub-districts. A large number of unskilled and semi-skilled labourers, such as hawkers, rickshaw-pullers, taxi drivers, mechanics, and other such professions, primarily earn their livelihoods. Agriculture is the most important sector contributing to GDP. The increasing demand for fish in the local and global markets has generated a new opportunity for the local fishermen and businessmen. People have changed their paddy fields to ponds for the cultivation of fish (Fig 1).

Sample-size and sampling techniques

In total, 511 household respondents were selected conveniently following the inclusion and exclusion criteria. Of them, 260 were from Kushmail and 251 from Kanihari. Respondents who were living in the study areas and who were willing to participate in the study were included. A trained interviewer interviewed the head of each household (preferably male heads) using a structured questionnaire. Respondents who had other medical complications or were unable to answer a short list of simple questions (sociodemographic information, such as name, address, complications due to disease) were excluded from the study.

The sample-size was calculated using the formula: $n = \frac{z^2 pq}{d^2}$.

$n = \text{sample-size}$
$z = \text{level of confidence (for a level of confidence of 95%, } z = 1.96)$
$p = \text{estimated proportion of the population (p = 45.12%) [13]}$
$d = \text{tolerated margin of error (5%)}$
Data-collection

A five-part structured (interviewer-administered) questionnaire was used for assessing the awareness of the residents about VL and related practices. Its Part 1 had a provision to collect demographic information. Part 2 was designed to record the description of each respondent’s house and environmental characteristics, such as presence of plants, wastes, and cattle shade and chicken shelters, distance from the shelters, and cleaning methods of cow dung and rubbish. The knowledge questions on kala-azar and its signs and symptoms, contamination procedure, and treatment method of kala-azar were included in Part 3.

Part 4 contained the questions relating to the vector, features of the insect, its preferred habitats, and hours of the greatest activity. Knowledge on kala-azar was assessed using eight questions and on the vector five questions. Part 5 focused on steps taken to control the vector, and the questions on practices had eight items relating to the prevention of sandfly bites. A questionnaire with open questions was used in the pilot study for pre-testing to validate the
questions. Twenty-five individuals were included in the pilot study. Based on their responses, the final questionnaire was formulated. The final questionnaire was structured and closed-ended. Table 1 presents the summarized information of results.

**Scoring**

Each correct response was assigned a score of 1, and each incorrect response was assigned 0. In Part 3 of the questionnaire, the correct answers relating to signs and symptoms of kala-azar included loss of weight, spleen/liver enlargement, and grayish discoloration of the skin of hands, feet, and face. Kala-azar is transmitted through sandfly bites from sick persons to others. It is a curable disease, and people receive proper treatment at Upazilla Health Complex (UHC). Regarding treatment method, injection is widely used. The respondents who gave these correct answers received score 1 for each question.

About the awareness about vector in Part 4, the right answers of the features of the vector was as big as mosquito, the bite time of the sandfly was at night, the resting place of the vector is inside a house and in the cattle shed, and sandfly laid eggs in loose soil. The respondents who gave these correct answers to the vector questions received score 1.

Thus, eight items of the knowledge questions on kala-azar were assigned a maximum attainable score of 8, and the minimum score was 0. For five items used for assessing knowledge on the vector, the maximum attainable score was 5, and the minimum score was 0. Poor knowledge corresponded to a score of (<mean –1SD); average knowledge corresponded to a score between (mean±1SD); and good knowledge corresponded to a score of (>mean+1SD) [21].

**Management and analysis of data**

During the data-collection process, data were checked for completeness, and all the incomplete or misfiled questions were sent back to the respondents for correction. Frequencies and mean ±SD were calculated for descriptive analysis. Chi-squared tests were performed on categorical data to find the relationships among the variables. The differences between the two unions were calculated using Student’s t-test. Data were analyzed using the SPSS software for Windows version 22 (SPSS Inc, Chicago, USA). Statistical tests were considered significant at p values of ≤5% (≤0.05).

**Ethical consideration**

Informed written consents were obtained from all the respondents after a full explanation of the nature, purpose, and procedures of the study. Ethical approval was obtained from the ethics and the research review committees of the Diabetic Association of Bangladesh (BADAS).

**Table 1. Presentation of results.**

| Part 2 | Test results |
|--------|--------------|
| Association | |
| Presence of chicken shelters vs unions | χ² = 4.26; p = 0.04 |
| Presence of cow dung/rubbish pit near the house vs unions | χ² = 6.42; p = 0.01 |
| Surroundings of the house vs unions | χ² = 14.6; p = 0.001 |
| Part 3 | Differences |
| The mean awareness score on kala-azar between Kushmail union and Kanihari union | t = 3.076; p = 0.002 |
| Part 4 | Differences |
| The mean awareness score on sandfly between Kushmail and Kanihari | t = 2.254; p = 0.03 |

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Results

The mean ±SD age of the respondents in Kushmail and Kanihari was 38.91 ±13.12 and 38.01 ±13.31 years respectively. Of the respondents, 73% females came from Kanihari and 51% males from Kushmail. Most (90%) respondents from the two unions were Muslims. However, 59% of the respondents from Kushmail were illiterate, and 46% were illiterate in Kanihari. More than 30% were engaged in business in Kushmail and had own agriculture in Kanihari. About 34% and 26% were skilled laborers, such as carpenters, masons, mechanics, tailors, plumbers, etc., in Kushmail and Kanihari respectively (Table 2).

Table 3 shows the results of comparison of the physical features in or around the residences of the respondents between the two unions. In both the unions, one-third of the respondents had cattle sheds in or around their houses. The majority (53%) of the respondents in Kanihari and 44% in Kushmail had chicken shelters inside their houses, and the association was significant (p = 0.04). Seventy-two percent of the respondents in Kushmail had cow dung or rubbish pits near their houses compared to 61% in Kanihari. The assessment was significant (p = 0.01). Most (90%) respondents from the two unions lived in mud and thatch houses. About 50–60% of the houses in the two unions were partially shaded, and the association was significant (p = 0.001).

The result of comparison of the level of awareness of the respondents about kala-azar and sandfly in Kushmail and Kanihari are presented in Table 4. The mean knowledge score of the respondents in Kanihari union relating to kala-azar was significantly high compared to that of the respondents in Kushmail union (mean ±SD, 4.30 ±0.86 versus 4.12 ±0.75, p = 0.002). However, the mean knowledge score of the respondents in Kanihari union relating to sandfly bites was significantly lower compared to that of the respondents of Kushmail union (mean ±SD, 2.49 ±0.79 versus 2.65 ±0.85, p = 0.03).

Table 2. Characteristics of the study respondents (n = 511).

| Variable                              | Kushmail (n = 260) | Kanihari (n = 251) |
|---------------------------------------|-------------------|--------------------|
| Age (years)                           | 38.91±13.12       | 38.01±13.31        |
| Gender                                |                   |                    |
| Female                                | 128 (49)          | 183 (73)           |
| Male                                  | 132 (51)          | 68 (27)            |
| Religion                              |                   |                    |
| Islam                                 | 247 (95)          | 245 (98)           |
| Hinduism                              | 13 (5)            | 6 (2)              |
| Total no. of members per family       | 4.95±2.1          | 4.89±1.8           |
| Educational qualification             |                   |                    |
| Illiterate                            | 153 (59)          | 116 (46)           |
| Class I-V                             | 51 (20)           | 70 (28)            |
| SSC/HSC                               | 54 (20)           | 59 (24)            |
| Graduation/above                      | 2 (1)             | 6 (2)              |
| Occupation of household heads         |                   |                    |
| Own agriculture                       | 51 (20)           | 78 (31)            |
| Business                              | 90 (34)           | 46 (18)            |
| Service                               | 13 (5)            | 34 (14)            |
| Skilled labor                         | 89 (34)           | 64 (26)            |
| Unskilled labor                       | 17 (7)            | 29 (11)            |

Results are expressed as mean ±SD and number (%).

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Table 3. Comparison of the physical features in or around residences of the respondents based on observations of interviewers between Kushmail and Kanihari (n = 511).

| Variables                                      | Kushmail (n = 260) | Kanihari (n = 251) | p- value |
|------------------------------------------------|-------------------|--------------------|----------|
| Cattle shed in or around the house             |                   |                    |          |
| Yes                                            | 95 (36)           | 93 (37)            | 0.014    |
| No                                             | 165 (64)          | 158 (63)           | 0.91     |
| Presence of chicken shelters                   |                   |                    |          |
| Yes                                            | 113 (44)          | 132 (53)           | 4.26     |
| No                                             | 147 (56)          | 119 (47)           | *0.04    |
| Presence of cow dung/rubbish pits near the house|                   |                    |          |
| Yes                                            | 187 (72)          | 154 (61)           | 6.42     |
| No                                             | 73 (28)           | 97 (39)            | *0.01    |
| Type of the main house (based on wall)         |                   |                    |          |
| Mud and thatched house                         | 235 (90)          | 219 (87)           | 3.87     |
| Tin house                                      | 23 (9)            | 32 (13)            | 0.14     |
| Tin and thatched house                         | 2 (1)             | 0                  |          |
| Surroundings of the house                      |                   |                    |          |
| Open                                           | 76 (29)           | 40 (16)            | 14.6     |
| Shaded                                         | 50 (19)           | 45 (18)            | *0.001   |
| Partially shaded                               | 134 (52)          | 166 (66)           |          |

Results are expressed as number (%). Pearson’s $χ^2$ test was performed as the test of significance; df = degree of freedom.

* $p \leq 0.05$ was taken as level of significance.

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Table 4. Comparison of the awareness among the respondents in Kushmail and Kanihari on kala-azar and sandfly.

| Awareness on       | Kushmail (n = 184) | Kanihari (n = 145) | p   |
|--------------------|-------------------|--------------------|-----|
| Kala-azar (n = 329)| 4.12 ±0.75        | 4.30 ±0.86         | *0.002 |
|                    | **Kushmail (n = 226)** | **Kanihari (n = 238)** | p   |
| Sandfly (n = 464)  | 2.65 ±0.85        | 2.49 ±0.79         | *0.03 |

Results are expressed as mean ±SD. Student’s t-test was performed as the test of significance.

* $p \leq 0.05$ was taken as level of significance.

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Table 5 shows the distribution of the respondents according to their practices relating to the control of kala-azar in the two unions. More than 70% of the respondents in Kushmail and Kanihari preferred only injection for the treatment of kala-azar. Eighty-seven to eighty-eight percent of the respondents in the two unions had chosen the UHC for the treatment of kala-azar.
azar. About 50% of the respondents in Kushmail and Kanihari liked coil or mat as a preventive measure to avoid the sandfly bites.

Although all the respondents heard of the disease, 65% (n = 329) completed the full set of knowledge questions relating to kala-azar. The mean (±SD) basic knowledge score of the respondents was 4.24 ±0.81. Of the respondents, 11% and 20% had good (>5.04), 77% and 72% had average (3.43–5.04), and 12% and 8% had poor (<3.43) (GAP) knowledge on kala-azar in Kushmail union and Kanihari union respectively (Fig 2). Fig 3 shows the distribution of the level of awareness relating to sandfly among the respondents from Kushmail and Kanihari. The mean (±SD) score was 2.57 ±0.82, and 91% (n = 464) heard of sandfly. Of them, 22% and 19% had good (>3.39), 67% and 64% had average (3.39–1.75), 11% and 17% had poor (<1.75) knowledge on sandfly in Kushmail union and Kanihari union respectively.

### Discussion

Understanding the level of awareness of people about beliefs and practices relating to any infectious or non-infectious disease is a primary step in implementing prevention programs successfully. Kala-azar is endemic in Bangladesh for many decades, and it is causing a major public-health problem [3]. The first national VL-elimination program was launched in 2005 to eliminate the disease by 2015 but it failed to reach the target [8, 9]. Then, with the revised objectives and with the collaboration of WHO, the kala-azar-elimination program was started in this sub-continent, and the target of eliminating VL from the region by 2020 [10] was set. Now, the burden of kala-azar in Bangladesh has been gradually declining [3]. However, the vector-borne disease-control programs primarily depend on controlling the vector though, it is important to identify the level of awareness about the vector and the community practices before introducing any disease-control program. By acquiring these data, the Government of Bangladesh can plan a successful kala-azar-control and elimination program.

### Table 5. Distribution of the respondents according to their practices for the control of kala-azar (n = 511).

| Variables                          | Kushmail (n = 260) | Kanihari (n = 251) |
|-----------------------------------|-------------------|-------------------|
| Preferred treatment of kala-azar  |                   |                   |
| Tablet only                       | 44 (17)           | 35 (14)           |
| Injection only                    | 190 (73)          | 186 (74)          |
| Either is ok                      | -                 | 5 (2)             |
| Don’t know                        | 26 (10)           | 20 (8)            |
| Missing                           | -                 | 5 (2)             |
| Choice of health services for treatment of kala-azar |                   |                   |
| Quack/village doctors            | 34 (13)           | 22 (9)            |
| MBBS doctor                       | -                 | 3 (1)             |
| Upazilla Health Complex           | 226 (87)          | 220 (88)          |
| Missing                           | -                 | 6 (2)             |
| Use of preventive measures to avoid sandfly bites |                   |                   |
| Coil/mat                          | 136 (52)          | 129 (51)          |
| Smoke                             | 4 (2)             | 4 (2)             |
| Mosquito net                      | 117 (45)          | 111 (44)          |
| Don’t know                        | 3 (1)             | 7 (3)             |

Results are expressed as number (%).

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The results of our study showed that the mean kala-azar-related knowledge score of the respondents in Kanihari union was significantly (4.30 ±0.86 vs 4.12 ±0.75; p = 0.002) higher than that of the respondents in Kushmail union and vice-versa in the mean knowledge score (2.49 ±0.79 vs 2.65 ±0.85; p = 0.03) relating to sandfly among the respondents.

However, according to the level of awareness, 77% and 72% of the respondents in Kushmail and Kanihari had average knowledge on kala-azar. Sixty-seven percent and 64% of the respondents in Kushmail and Kanihari respectively had average knowledge on sandfly.

Result of a study showed that knowledge on kala-azar and its vectors is poor among the Bangladeshi people but it is good among the Indian and the Nepalese people [11]. Mondal et al. reported in 2008 that the perceptions of the Bangladeshi community about kala-azar vector is poor [17]. In our study, the overall knowledge on kala-azar and its vector among the respondents in the two unions is average. Regarding specific questions on kala-azar, 65% of the villagers were knowledgeable about kala-azar, but knowledge on its transmission and signs and symptoms was absent among 35% of the villagers. Similar results were found in Ethiopia.
In one study in Fulbaria, Mymensingh, it was found that 99% of the respondents did not hear about sandfly [13], although in our study the combined percentage was 13% in Kushmail and Kanihari unions.

These findings of our study are unusual because Mymensingh is an endemic area, and the VL-elimination program has been in place there since 2005, and if sandflies are not recognized by the villagers, they may not take appropriate measures to protect themselves from the bites of sandflies. The probable reasons may be the less involvement of the villagers in the VL-elimination program and the inadequate health education program for the community people.

Rijal et al. highlighted some issues with relating to the VL-elimination program in South Asia and identified some priorities for the post-plan that, due to the considerable improvement in the epidemiological surveillance of the kala-azar-elimination program, underreporting of kala-azar cases is now minimal. As the incidence of the disease declines, there is a possibility of reducing the level of awareness about kala-azar and knowledge on the disease in both patients and clinicians. However, caution is needed as a resurgence of kala-azar is possible. Since the program did not target the “elimination of the pathogen”, its transmission may continue. Continued vigilance is required to sustain the gains achieved through kala-azar elimination efforts. The program will need to evolve and straighten strategies to meet the requirements of the post-elimination phase. This will necessitate proportionate investments in research and development of new tools, training of health workers, and logistics and infrastructure to improve the quality of primary care. Commitment to eliminating the scourge of kala-azar from this region and globally must continue [24].

Besides, to increase the awareness among the general population about kala-azar, a strong political commitment, appropriate behavioral change-communication (BCC) strategies, community involvement, and empowering the community with information are necessary. The strategy for the elimination of kala-azar should focus on behavior change among the community people. Increasing public awareness could be promoted to reduce the vulnerability of poor communities in the endemic areas. The objective of our national guidelines was to provide information regarding diagnosis, treatment, health education, and follow-up of the cases with kala-azar though the information relating to BCC in the guideline was inadequate [3]. A study in India found that inhabitants exposed to community-based BCC activities had better knowledge, attitudes, and practices relating to VL and kala-azar than inhabitants not exposed [25]. Therefore, BCC activities are an important component of VL-elimination strategies. Although this may vary from locality to locality, taking socioeconomic conditions and available resources into consideration may help eliminate the disease. The example of the Government of Bangladesh may be followed to control the dengue outbreak. The Government took an initiative to increase the level of awareness among the community people about the signs and symptoms of dengue and ensured their participation in controlling the mosquito-breeding sites [26].

It has been documented that environmental manipulation and management may be an important intervention for kala-azar [8]. Spatial heterogeneity of the disease is also important for prioritizing the areas for intervention in our country [27]. One study in Bangladesh found that three of the four statistically significant clusters identified by the spatial scan test were located in Trishal sub-district, a continuous VL hotspot and a very underprivileged sub-district [28]. Spatial heterogeneity was not observed in the present study, although physical features, which are the risk factors for developing kala-azar, were observed. In the present study, result of comparison of the physical features in the two unions showed that about 37% of the residents in Kushmail and Kanihari had cattle sheds in or around their houses. About 44% and 53% of the respondents in the two unions had chicken shelters respectively. Seventy-two percent of the residents in Kushmail had cow dung and rubbish pit near the house, 61% of the...
residents had similar features in Kanihari. Most (90%) respondents in Kanihari and Kushmail lived in mud- and thatch-made houses. Twenty-nine percent of the inhabitants in Kushmail and 16% in Kanihari had open houses. About 60% of the houses were partially shaded in Kushmail and Kanihari unions. Results of a study during June 2015-May 2016 in rural areas of Fulbaria upazilla showed that 63.89% of the kala-azar patients lived in mud houses, 97% had cattle sheds, and 93% had chicken/pigeon sheds in their houses [13]. It was also found in a Bihar study that the use of mud for wall construction or for plastering walls was significantly associated with kala-azar [29]. Yared et al. found that the presence of cattle, keeping dogs, goats, and donkeys increased the chances of VL [30]. The findings suggest that the awareness about environmental condition of the study villages was still not adequate.

Using an ecological niche model framework in Fulbaria, Trishal, and Gaffargaon, results of analysis of ENM demonstrated that precipitation during the warmest season, land surface temperature, and normalized difference water index were the main environmental factors influenced the occurrence of the disease [31]. It was reported that the closeness of house to cowsheds, and the presence of organic rubbish facilitate the breeding sites, cracks, and crevices in the walls of houses made of mud and dried grass provide resting places for adult sandflies. Palpable dampness in houses and peri-domestic vegetation may increase the risk of sandfly infection through enhanced density and prolonged survival of the vector and may also increase the risk of progression to kala-azar. The numerous ponds and the high sub-soil water level keep the soil moist and the level of humidity high; these may be suitable for the survival of the sandfly vector [32].

More than 50% of the residents in the study areas were illiterate. The low level of education of population and their less awareness about the environmental condition may be the increased burden of kala-azar in Mymensining. Better housing and improved living conditions in these endemic areas might reduce the transmission of the disease by eliminating conditions suitable for the breeding of sandflies inside the houses. Proper implementation of the existing health-awareness programs could also help people alter their behavioral patterns, such as keeping cattle sheds and chicken shelters far away from the living place, no cow dung or rubbish pit near the house, and complete shading of the surroundings of the house.

Seventy percent of the respondents in Kushmail and 74% in Kanihari were aware that kala-azar could be treated using injections while 10% and 8%, respectively, in Kushmail and Kanihari stated that they were unaware of the use of injections for the treatment of the disease. This result is similar to that of a study in rural areas of Titaria, Nepal [23]. However, in Bihar, India, 93% of respondents preferred specific drug for the treatment of kala-azar [18]. In Ethiopia, 95.7% were aware that the disease can be treated [22]. According to the WHO (2013), most drugs of VL have to be administered through intravenous injection for the treatment of kala-azar [33]. In Dhaka in 2009, the Regional Technical Advisory Group (RTAG) of WHO/SEARO recommended introducing single-dose Liposomal Amphotericin B (LAmB) for the treatment of the disease, which is safe, is highly effective, and has treatment compliance [3]. The NKEP has accepted the recommendation of RTAG and has approved the policy of introducing LAmB (AmBisome), although the use of the drug was limited in developing countries, like Bangladesh, because it is expensive.

The probable reasons behind the low figure in our study might be incomplete treatment, economic constrains, less follow-up visits, and lack of coordination among the public and the private sector providers. Therefore, we should make serious efforts to ensure the complete treatment of kala-azar of those who have been suffering from it. Hospitalization and close monitoring of patients are also required for the completion of the treatment.

Eighty-seven percent of the study respondents in the two unions preferred a UHC for its treatment. The preference for its treatment at a UHC may be due to the impact of the kala-
azar-elimination program under which diagnosis is made and free treatment is given to the mass people.

More than half of the study respondents in Kushmail and Kanihari used coil/mat, 45% used only mosquito nets, and 1–3% were not aware of any preventive method against sandfly bites. The inspiring fact found in the present study was that 90% of the houses had at least one mosquito net. Only 45% of the respondents in the two study unions used nets as a preventive measure. The findings of our study corroborate the findings of a study in Titaria, Nepal [23], but not with the findings of a study in Bangladesh [17].

The results of our study differ from that of a study in Bangladesh due to inclusion of only two unions under two sub-districts in Mymensingh whereas the previous study covered a large number of samples [17]. The results of our study are good compared to those of a study in India [18]. So, based on this knowledge, health workers might be able to reinforce further the use of mosquito nets by explaining that they can also prevent bites of sandfly using mosquito nets and should promote their use for the remaining 55% of the respondents who did not use this preventive measure.

Mymensingh is a VL-endemic area, and the results of our study showed that all the respondents in Kanihari and Kushmail unions heard of kala-azar. Considering the results of the present study, it is true that the UHCs in Trishal and Fulbaria have created healthcare facilities for VL patients, although the high-level awareness was absent among the residents. However, increasing this high-level awareness could be an important strategy that can reinforce the regional VL-elimination program. Otherwise, demographic changes and, dams may devastate the elimination program.

**Limitation of the study**
The present study had several limitations. Since the study was conducted only in two unions under two sub-districts and included 511 households using convenient sampling technique, the results may not be truly representative of all the endemic areas in Bangladesh. Due to lack of fund and time, it was not possible to involve the whole community in the study. However, it was a cross-sectional study, it could not, therefore, be possible to compare with the non-endemic area.

Another limitation of the study was the economic classification. This classification was done based on the observations made by the interviewers. As the respondents could not properly answer their monthly income and the interviewers did not collect information on the household assets or land ownership the variable economic status was omitted. Surya Kanta Kala-azar Research Centre (SKKRC), a specialized public-health facility for the treatment of kala-azar cases in Bangladesh had not been included in the study. Since only two interviewers conducted the interviews, there might have been subjective variations in gathering data too.

**Conclusions**
In general, the findings of this study showed that the community people had insufficient knowledge on the transmission mode, causes, signs and symptoms of the kala-azar, vector, habitat, its breeding sites, cleaning practices, and preventive measures of VL.

Although the healthcare facilities are comprehensive, acceptable, and accessible, the results suggest that the objective cannot be achieved unless the community itself is involved in the kala-azar-elimination or control programs. It is, therefore, vital to know the level of awareness and related practices of a community and to improve these at a satisfactory level by involving the health workers, community leaders, religious people and, school teachers on a massive scale before launching any kala-azar-elimination or control program. To achieve the target by
2020, the policy-makers should emphasize on an appropriate and effective health-education program, particularly in the kala-azar-endemic areas of Bangladesh; else, elimination of kala-azar from the country may not be achievable. For this, an extensive study is required for proper explanation.

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