Cutaneous leishmaniasis (CL) is reported among Kani tribes in forest settlements of Tiruvananthapuram district, Kerala, India. Epidemiological investigations are ongoing and 27 histopathologically confirmed cases of CL have been reported from five settlements indicating transmission of disease within settlements. One of the priorities for control/prevention of CL is to create awareness among the community and ensure optimal utilization of interventions. First step in this direction would be to carry out a situation analysis on prevailing knowledge, attitude and practice (KAP) of inhabitants. A study among 103 respondents from 10 Kani tribal settlements showed that though 39.8% of respondents recognized pictures of CL shown to them, but did not have any lay perceptions. There was absolutely no awareness on vector, transmission, risk factors and control measures. The role of sandflies in CL causation was not known to the residents and this prevented them from using any personal protection and adhering to control measures which in turn pose risk of spread of infection within settlements and to newer areas. CL has emerged as a challenging infection in this area and an urgent need for designing appropriate preventive measures and health education strategies is addressed in this article.

Introduction

Leishmaniasis is one of world’s most neglected diseases [1, 2] affecting largely the poorest of the poor, mainly in developing countries. A total of 98 countries and 3 territories on 5 continents reported endemic leishmaniasis transmission [3]. Each year approximately 1.5–2 million new cases are reported [4]. Published disease burden estimates place leishmaniasis second in mortality and fourth in morbidity among all tropical diseases [5] and an estimated 24 million disability-adjusted life-years are lost due to the disease [6].

This sandfly-borne disease caused by more than 20 species of the protozoan genus Leishmania appears in three basic clinical forms according to the location of parasites in mammalian tissues: visceral, cutaneous and mucocutaneous leishmaniasis [7]. Visceral leishmaniasis is the most serious form, and is potentially fatal if untreated. Mucocutaneous leishmaniasis commences with skin ulcers which spread, causing tissue damage, particularly to the nose and mouth. Cutaneous leishmaniasis (CL) is the most common form, which causing a sore at the site of insect bite, mainly on face, arms and legs, which heals in a few months to a year, leaving an unpleasant-looking scar [8].

About 70–75% of global estimated CL incidence is reported from 10 countries, Afghanistan, Algeria, Colombia, Brazil, Iran, Syria, Ethiopia, North
Sudan, Costa Rica and Peru [3]. In India, indigenous cases of anthroponotic (infected human–sandfly–human) as well as zoonotic (infected animals–sandfly–human) CL are mainly confined to the hot dry north-western region in deserts of Rajasthan and parts of Himachal Pradesh [9]. In Kerala, two imported cases of CL were reported from Trivandrum in 1988 [10] followed by the first indigenous case from Malappuram district after 2 years [11]. In 2010, 12 cases of CL have been reported from one of the forest tribal settlements of Kani tribes in Western Ghats of Thiruvananthapuram district [12]. Disfigurement, disability, social stigma and isolation are the severe consequences [13] and cutaneous ulcers in a woman can be a pretext for spousal abandonment [14].

Kani, a forest dwelling tribe is scattered in 28 settlements in Western Ghats of Thiruvananthapuram District, Kerala. This area comes under the jurisdiction of Vellanad Community Health Centre (CHC) in Nedumangad Taluk and is approximately 30 km into the forest from the nearest town, Kottoor. Surveys carried out by this study group in 2012–2013 revealed that there are 27 (Female 13, male 14) histopathologically confirmed cases of CL (including the 12 cases reported previously) in 5 of these settlements [Vector Control Research Centre (VCRC) unpublished data] which indicated transmission of CL within settlements. Movement of Kani tribes to foothill town for marketing and visits of labourers from foothill to settlements for rubber tapping threatens the spread of infection to newer areas. An effective control strategy is needed to contain further spread and avert CL becoming endemic in the area.

A situation analysis on prevailing Knowledge, Attitude and Practice (KAP) of residents of these settlements was carried out in order to develop health education strategies suiting to local tribal culture and to create awareness and improve proper utilization of CL control/preventive interventions. Studies on KAP are a prerequisite for implementing interventional strategies towards active community participation in controlling the disease [15–19]. Need to consider gaps in knowledge, perception and practices of the community with regard to CL in developing educational strategies and planning intervention for control/prevention of CL in tribal settlements is discussed in this article.

Study area

Kani tribes live together in small communities in the forest which is a haven for wildlife, and is marked by moist deciduous trees, grass lands, rivulets and streams. It is also noted for its rich wealth of medicinal plants, some of which are rare in occurrence [20]. Many wild animals are prevalent in this reserve forest, which pose a threat to these tribes and their crops. Tribal settlements are located at different altitudes, ranging from 267 to 2425 feet in a difficult-to-reach area (Fig. 1). All settlements cannot be reached by vehicle. The major threat faced while trekking to these settlements is presence of blood-sucking leeches.

The climate of this region is moderately hot and humid with temperature varying from 16 to 35°C. Maximum temperature is recorded in March and April. Mean annual rainfall is 2800 mm and the tract receives both southwest and northeast monsoons. Each tribal settlement spreads over a vast area and is located 5–10 km away from the others. There are no adequate facilities for transport, communication, education, medical treatment and electricity. Protected drinking water supply and sufficient food crops are also sparse.

Within a settlement, each dwelling is located, 100–500 m apart. Traditional houses are huts consisting of one room and kitchen with roof thatched with palm leaves and walls made of bamboo splits. Floor inside huts is smeared with mud or left as loose soil. Their staple food is root tubers such as Neduvan, Noora and Kavala from forest and they also consume rice. Family pattern is nuclear in nature and they live in independent houses. Forest floor is densely covered with leaf litter, which retains moisture and support sandfly breeding. Sandflies and CL cases are recorded in these settlements.

The traditional ‘hunter gatherer instinct’ still exists and their main occupation includes hunting
and collection of non-timber forest products such as honey, bee’s wax, medicinal plants, gums and wild edible root tubers. Majority of adult population do not have any formal education. Main source of water for all purposes is from springs in hill tops and for some of the houses wells are provided by the local body administration of the government. Lighting is from solar energy. To meet health requirements, there are two Primary Health Centres (PHC) viz., Kuttichal and Aryanad which are 25 and 27 km away from the centre of tribal settlements. Due to lack of transport, inhabitants are reluctant to visit PHC or CHC to seek medical assistance, and medical team from these PHCs visit settlements at weekly intervals. They move on foot to neighbouring settlements and to the nearby town. School going children are put up in hostels run by Tribal Welfare Board and also by voluntary agencies at foothill town, Kottoor. Kanis visit Kottoor once a week for marketing and exchange forest products such as honey, gum, medicinal turmeric, tapioca, tuber, yam and areca nut for rice and other essential commodities for their livelihood.

Methods

We obtained official permission from Tribal Welfare Department and Forest Department of Kerala to visit tribal settlements. To establish rapport and gain confidence of inhabitants, we took the help of a well-accepted and influential jeep driver who is engaged in transportation of their forest products for marketing.

This study formed the part of a project on ‘Entomological and epidemiological investigations on leishmaniasis among the Kani forest Tribes in the
tribal settlements of Thiruvananthapuram District, Kerala’. For the epidemiological and entomological investigations, a cross-sectional survey was carried out in all 28 tribal settlements with 402 human dwellings and a population of 1444 people. Using stratified sampling followed by population proportion size techniques, 10 settlements have been selected for a longitudinal study based on sandfly density and number of CL suspected cases. There are 176 houses in the 10 selected settlements, with a population of 614 people with an average family size of 3. KAP study was also carried out in these 10 settlements taking into consideration, the feasibility and logistics of relating the pre and post interventional results with entomological and epidemiological parameters. Household was taken as a unit for the study. Though we intended to cover all houses, we could only include 103 houses despite repeated attempts as residents will be out in the forest during day time for work. The tribal settlements are located deep inside the forest and going there at night hours to interview left out houses is dangerous as there are wild elephants and other animals in the forest. In Kamalagam and Cherumangal settlements, houses are widely scattered and deep inside the forest. We visited these places repeatedly but could cover only 32 and 46% of the houses, respectively. Being very far from foothill town, people in these two settlements return to their dwellings 2–3 days later after attending weekly markets. This was also a limitation for us to cover all houses. In the remaining eight settlements, houses covered ranged from 58.3 to 100%. Further, forest authorities restrict outsiders from visiting tribal settlements at night.

A household-based KAP survey consisting of quantitative components on knowledge, attitude and practices concerning CL was administered through a semi-structured questionnaire. Head of household was preferred as interviewee and in his/her absence one adult member (18 years and above) per household available at home at the time of our visit was interviewed. Questions included respondents’ knowledge, attitudes and common practices related to CL and its prevention/control. Data were also recorded on socioeconomic particulars of respondents and type, pattern and location of dwellings. Information on accessibility to health care, distance, mode of transport and treatment seeking behaviour for CL were also collected. We also showed flip charts with pictures of CL cases and live sandflies collected from the houses to generate information on disease and its transmission.

Some of the cultural practices very peculiar to the area were also noted down. Data on educational level of family members other than the respondent, availability of Accredited Social Health Activists (ASHAs) and traditional healers in the settlements were also collected to facilitate planning of intervention strategies. Information on the presence of Kudumbashree, a programme of Neighbourhood groups of Government of Kerala was also collected. Database was organized using excel spreadsheet and data cleaning was carried out by verifying any inconsistency against the original questionnaire. Data was analysed using SPSS version 16.

The study got ethical clearance from the author’s Institute ethical committee and objectives and study procedure were explained to each respondent in their local language ‘Malayalam’ and informed consent was obtained to participate. Interviews were carried out in their respective houses with adequate privacy by a female social scientist from the research group. Houses are located on hill tops and plains and need a lot of trekking on foot. Hence she was accompanied by the Jeep driver who is familiar with the area and tribal population. It took approximately 25 min to interview one respondent.

**Results**

Respondents consisted of 103 inhabitants from 10 settlements (Table I) of which 8 persons had lesions (Fig. 2) or scars indicative of CL and 9 had an active case of CL in the family. The study group constitutes 52.9% of female and 47.1% male. Among respondents, adult men and women are engaged in agriculture in their own land apart from collecting forest products. Number of houses ranges from 7 to 43 in the selected settlements. Average family size of the respondents ranged from three to five in different
settlements. Except one settlement Kunnadi, all the other nine settlements are lighted with solar energy and none of them has piped water supply, sewage system and latrines.

All settlements had at least one educated person. Kudumbasree and ASHA were present in four settlements. There are six traditional health practitioners in 10 settlements and each settlement has a tribal leader (*muthukani*). Ownership of dogs was common in all settlements and 80.6% of houses had two or more dogs, while 13.6% had one dog each and 5.8% did not own a dog. None of the respondent uphill owned cattle and 1.9% of the respondents had goats.

### Knowledge about CL

CL did not have a local name in the area and was colloquially explained as *Maikkuru* meaning ‘heat boil’. When asked about common diseases in the locality, none of the respondents reported CL and fever though not a disease was mentioned as the major health problem. The main skin problems were reported to be itching due to mosquito bites. When shown pictures of CL manifestation, 41 respondents (39.8%) from 5 of the 10 settlements recognized CL and were able to name patients in their settlements. The 16 (15.5%) respondents from the two settlements from where 52% of cases are reported had knowledge on the role of an insect in contracting the disease. Out of them, 6 respondents (37.5%) claimed the role of mosquitoes in the spread of the disease and the remaining 10 could not name the insect. Among 62 (60.2%) of those who did not have knowledge on CL, 37 (59.7%) felt that it is a skin disease transmitted from person to person through contact and 18 (29%) attributed lesions to other causes such as malnutrition and allergy due to contact with plants and the rest 7 (11.3%) could not

### Table I. Demographic particulars of study population

<table>
<thead>
<tr>
<th>SL.No.</th>
<th>Settlement</th>
<th>Altitude (ft)</th>
<th>Total no. of houses</th>
<th>No. of houses included in the study</th>
<th>Total population in the study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mulamoodu</td>
<td>389</td>
<td>15</td>
<td>9</td>
<td>Male: 31, Female: 36, Total: 67</td>
</tr>
<tr>
<td>2</td>
<td>Kunnadi</td>
<td>480</td>
<td>10</td>
<td>6</td>
<td>Male: 21, Female: 20, Total: 41</td>
</tr>
<tr>
<td>3</td>
<td>Chonampara</td>
<td>621</td>
<td>17</td>
<td>11</td>
<td>Male: 41, Female: 43, Total: 84</td>
</tr>
<tr>
<td>4</td>
<td>Podiyam</td>
<td>625</td>
<td>24</td>
<td>14</td>
<td>Male: 39, Female: 43, Total: 82</td>
</tr>
<tr>
<td>5</td>
<td>Kombidi</td>
<td>653</td>
<td>24</td>
<td>16</td>
<td>Male: 33, Female: 38, Total: 71</td>
</tr>
<tr>
<td>6</td>
<td>Kamalakom</td>
<td>716</td>
<td>43</td>
<td>14</td>
<td>Male: 52, Female: 60, Total: 112</td>
</tr>
<tr>
<td>7</td>
<td>Keezheamala</td>
<td>733</td>
<td>7</td>
<td>7</td>
<td>Male: 16, Female: 20, Total: 36</td>
</tr>
<tr>
<td>8</td>
<td>Ayiramkal</td>
<td>751</td>
<td>14</td>
<td>11</td>
<td>Male: 18, Female: 23, Total: 41</td>
</tr>
<tr>
<td>9</td>
<td>Melaamala</td>
<td>1221</td>
<td>9</td>
<td>9</td>
<td>Male: 18, Female: 23, Total: 41</td>
</tr>
<tr>
<td>10</td>
<td>Cherumankal</td>
<td>2425</td>
<td>13</td>
<td>6</td>
<td>Male: 18, Female: 21, Total: 39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th>Total</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>176</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>103</td>
<td>614</td>
</tr>
</tbody>
</table>

Fig. 2. Patient with CL lesion.
answer. On showing them live sandflies collected from their houses, none of the respondents knew about the biting and blood sucking behaviour of sandflies and 65% misunderstood sandflies for fruit flies (*Drosophila melanogaster*).

Questions on the possible risk factors and association of risk factors to CL infection were asked to each respondent. None of the respondents were aware of from where sandflies come and could not mention measures to control the disease. On prodding, they felt that presence of decayed leaf litter in the immediate background of houses had nothing to do with the disease and just avoid walking on leaf litter to prevent snake bites. The possibility of involvement of dogs was just laughed away as silly question by majority of respondents. They said, dogs are harmless and the question even posed a suspicion in 11.7% of respondents as to whether this disease is caused due to licking of dog. Not using personal protective measures at night was considered as a favourable factor for exposure to mosquito bites and economic reason was attributed by 69.9%. CL was not considered as a severe disease which needs immediate attention by any of the respondents. As many as 5.8% felt that Health authorities are responsible for containment of the disease.

**Practices**

Presence of damp surfaces within as well as outside houses and accumulation of decayed leaf litter in the immediate background that are conducive for sandfly breeding were common in all settlements. Children who died before they started walking on their own were buried inside the house opposite to kitchen pyre and this cultural practice is still continuing. Using personal protection against bite of insects is rare and only 1.9% reported use of mosquito nets at night. According to respondents, two mosquito nets each per family was issued free of cost to all 16 households in two endemic settlements by Government Medical College, Trivandrum. A total of 57 (55.3%) respondents reported to sleep along with dogs in open tents in the cultivation area except during rainy season (May–July) to chase wild animals from attacking their crops at night. Practice of dogs living in close association and sleeping with family members is common in all the settlements. In all the houses children slept inside houses. Though going into forest during night is uncommon, all adults as well as children visit forest during day time to collect firewood and various forest products and stay back till evening. They also go for fishing in lakes in forest.

**Treatment seeking behaviour**

All residents reported to use herbs as self medication for all ailments on onset. Second resort is witch craft for which trained people are available in most of the settlements and are carried out towards propitiating supernatural forces. Apart from these two systems they also visit camps conducted by PHCs at weekly intervals and take allopathic medicine. ASHA workers in settlements also issue paracetamol tablets on request for treating aches and fevers and refer them to hospital if necessary. Traditional healers are mostly approached for snake bites and scorpion stings.

CL has not been recognized as a major disease and no treatment is taken for CL if symptoms do not persist. In the case of persons with ulceration and severe itching, use of natural herbs was reported by 90.2% (n = 37) among those who have recognized the disease (n = 41). The inhabitants are reluctant to share information on the actual usage of traditional healing practices involving herbs to outsiders. To reduce itching of CL lesions herbs were reported to be used liberally (as and when required) as local application by all the 8 respondents who had lesions or scars indicative of CL and 9 who had CL patients in the family which together constitute 63% of the total 27 cases. The name, type and nature of the herb used was not disclosed on probing and answered with a smile. Relief rate of itching on using the herb was reported to be 50%. None of the respondents reported use of medicines taken orally.

All 12 initial cases of CL were given free allopathic treatment at Government Medical College including cost of transportation and food during
the period of admission. They were followed up by
subsequent visits by health staff to the settlements.
All cases with moderate manifestation and non-
ulcerating skin lesions have not sought medical
care prior to our visit.

Discussion

One of the priorities for control of CL is to investi-
gate socio-demographical and environmental risk
factors to develop rational prevention and control
strategies and one of the first steps in this direction
would be assessment of baseline knowledge and
practices of endemic population [21]. Our aim
through this study is to provide information on lay
perceptions and practices in CL endemic Kani forest
tribal settlements and devise site specific interven-
tion strategies. We learned that currently there was
no lay perceptions and awareness for important epi-
demiological aspects like transmission of the dis-
ease, risk factors and control/preventive measures.
A study among the same Kani tribes reported that
none of the CL patients gave history of travel outside
the district before onset of the disease and no one
had newly moved into forest settlements 2 years
prior to detection of the very first case of CL [12].
This reveals that CL has emerged as a challenging
infection in this area indicating an urgent need for
designing appropriate preventive measures and
health education strategies.

CL foci have wide ecological variation and
sandflies are able to find cool, shaded, humid micro-
habitats such as rock crevices or animal burrows in
dry areas and tree buttress roots or leaf litter in for-
est [22]. As Kani settlements are located within the
forest, environmental factors such as presence of
organic debris in proximity of houses play an im-
portant role in facilitating sandfly breeding.
Favourable topography along with ignorance on in-
volvement of sandflies in the occurrence of CL and
their breeding places contribute to risk of transmis-
sion. Knowledge on CL and involvement of sand-
flies had a significant correlation to practicing
sandfly control measures reported in Columbia
[23] and Guatamala [15]. It is also reported that
understanding of the disease resulted in behaviour
directed towards its prophylaxis and treatment [24].
Kani tribal communities do not perceive CL as a
health problem and also lag behind in awareness
and practices to control CL in the area.

The transmission cycle of Leishmania exhibits
characteristics that are particular to each endemic
area, which does not always allow the extrapolation
of data from one region to another [25]. The sandfly
vector and the animal reservoir in the area are under
investigation by this research group. In case of zoo-
notic CL, infected dogs serve as parasite reservoirs
and contribute to human transmission [26, 27]. Dog
ownership had the greatest correlation for CL in
Turkey [28]. In India zoonotic and anthropogenic
focus of CL transmission has been reported.
Zoonotic transmission is reported [29] through
desert gerbils (Meriones hurrianae) and dogs [30]
from Rajasthan. Moreover, the natural blood meal
source of sandflies is under investigation by this re-
search team and a majority of female sandflies were
found to have triple host blood meal from human,
rodents and dogs which does not rule out risk of
involvement of animal reservoirs in the area. The
inhabitants of study settlements have the habit of
sleeping outside to guard crops with their dogs in
close proximity. However, the role of animal reser-
voir is yet to be ascertained and the study is pending
for approval from Animal Ethics Committee.

Measures involving the participation of at-risk
human population focus on personal protection
from CL, including insecticide-impregnated mat-
erials which may offer an alternative in places with
poor health-service infra structure and peri-domestic
leishmania transmission [31]. Sleeping without per-
sonal protection may place people at risk of sandfly
exposure and use of bed nets is important in protect-
ing themselves against CL. In the settlements, only
1.9% of respondents are using mosquito nets and
sandflies are perennial in the area with marked sea-
sonal fluctuations hitting the peak density in the
month of October.

Potentially harmful application of acids, gasoline,
and lighted matches were reported to be used for
treating CL lesions in Eucador [16]. Kani tribes
have vast knowledge about traditional medicine
for various diseases. Self treatment using herbs as topical application in the initial stages of CL is common in the study area and information on type and names of herbs has not been revealed due to the superstitious belief that, healing power of herbs may be lost on sharing medicinal knowledge to others [20]. Traditional healers elsewhere play an important role in health care delivery in malaria and majority of the population depend on them for most of their ailments [32]. A review of projects in various countries suggests that traditional healers, if properly trained, can contribute significantly to the work of primary health care teams and recommendations are offered with a view to making the best possible use of this valuable resource [33]. The traditional healers in the study area also need to be equipped with CL related information to be disseminated to the inhabitants.

On market days, the Kani tribes come to foothill town to exchange forest products for essential commodities. We observed two market days in foothill town to explore the possibility of reaching them for education. Market place is scattered and getting them together was found to be impossible. Distribution of pamphlets was also not possible as majority of them cannot read and write.

Awareness among Kani tribes on measures to prevent CL is important from the point of curtailing the increase in incidence of this disease in the area. Prevention and control strategies aim at environmental management for source reduction, reduction of human–vector contact, detection of cases, diagnosis and treatment. In the current situation, none of these can be achieved unless otherwise the affected tribal population is aware of the scenario. Adequately educating the inhabitants with a long-term programme on personal protection and prevention is mandatory for adopting preventive measures against CL. Distance from health facility, difficult-to-reach nature of settlements in interior forest and lack of regular transport contribute to lack of accessibility to health information among inhabitants. Moreover, people work in their cultivable land and collect forest products during day time and are not available at home for any health related information. Access to these areas by outsiders in evening hours for educational activities is not feasible for threat of wild animals.

These indicators underline the importance of the need for utilizing local resources. We intend to use the services of the ASHA and members of Kudumbasree programmes of the government and involve educated youth in the settlements where ever these programmes are not available. There is also a need to foster training of traditional healers and tribal leaders of settlements (muthukanis) to deal with people so that community acceptance is guaranteed. Towards this, it is essential to organize daytime training workshops and build capacity among them who in turn can deliver CL-related health information to the rest of the tribal population and reinforce at frequent intervals with technical support from research group. This is expected to enable inhabitants to perceive CL as a health problem, thereby participating in control/elimination of CL.

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Conflict of interest statement

None declared.

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