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Clinical challenges in cutaneous leishmaniasis: A cohort from Southern Province, Sri Lanka

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ABSTRACT

Southern Province of Sri Lanka is endemic to cutaneous leishmaniasis (CL). This study aims to describe the clinico-demographic profile of a cohort of CL patients (n=115, CL confirmed by PCR), reported at two main hospitals in the Matara and Hambantota districts of the Southern Province, highlighting the novel clinical presentations and possible challenges and/or favourable findings in the elimination of CL from the Province, along with a comparison with the provincial literature (Quality-checked publications of similar data) to identify possible disease trends, which could be useful in planning control programmes. We have found that CL is common in young males, and typically appears as single nodules in the upper limb. These nodules often contain high parasite loads. Our observations show that ulceration of papules and plaques is a new development in the province. This could have significant implications for differential diagnosis and chronicity. One positive trend we have observed is the early seeking of treatment, which had improved diagnostic rates. Additionally, there has been an increase in reporting of papules, which were silent reservoirs of CL. This indicates an increased awareness of the disease among patients in this cohort. However, several negative trends were identified as well. The Tangalle divisional secretariat division has emerged as a possible new disease focus. Furthermore, the high number of nodules and lesions with high parasite loads, which are likely to be less responsive to treatment, could pose challenges for CL elimination. It is important to note that these findings are based on a limited sample size and should be further investigated with a larger sample to gain more comprehensive understanding of the situation.

KEYWORDS: *Cutaneous leishmaniasis, Southern Province, Sri Lanka, clinical, demographic, Leishmania donovani*

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1. INTRODUCTION

Cutaneous leishmaniasis (CL) is endemic in Sri Lanka. It is caused by a naturally attenuated strain of *Leishmania donovani*, that confines its parasitism to the skin (Karunaweera et al., 2003; Kariyawasam et al., 2017). This parasite has no genetic variation with different geographical origins within the country (Kariyawasam et al., 2017). *Phlebotomus argentipes* is the identified vector in Sri Lanka (Senanayake et al., 2021).

Since 2008, CL has been a notifiable disease in Sri Lanka; to date, there has been an exponential increase in the reported cases (Epidemiology Unit, 2023). Following the end of the civil war, which prevailed for almost 30 years, urbanization due to resettlements and deforestation may have increased the contact of reservoir host/s, vector and man, increasing the number of CL cases (Wijerathna et al., 2017). From 2017 to 2018, a four-fold increase in the average incidence rate in endemic districts was observed and a disease outbreak was confirmed (Karunaweera et al., 2021). A model-based evaluation has predicted approximately 20,000 new CL cases to occur in a year by 2025 (Karunaweera et al., 2021).

The first local spread of CL was reported from the Sothern Province, Sri Lanka, in 1992 (Athukorale et al., 1992). The Southern Province includes three districts: Galle, Matara and Hambantota; has an area of 5,544 km2; and is the 3rd most populated province on the island with a population of 12, 464,732 (Chief Secretariat Southern Province, 2021). Fishing and farming are the commonest livelihoods in this region. The prevailing tropical wet and dry climate, especially in the Hambantota district, and fragments of forest areas and paddy fields in the province could be the main reasons for the continuation of CL. From 2018-2022, an average of 3,318 new CL cases was reported annually, out of which 1,112 were from the Southern Province (Epidemiology Unit, 2023). Hambantota District reported the most significant number of cases from the Southern Province, followed by Matara and Galle districts; the latter contributing less than 10 cases per year (Epidemiology Unit, 2023). The CL foci in the Southern Province are predicted to expand inland from coastal areas (Karunaweera et al., 2021).

This manuscript discusses the clinico-demographic findings of a cohort of CL patients reported at two main hospitals in

the Matara and Hambantota districts of the Southern Province, identifying novel clinical presentations, disease trends (by comparing with the previous literature) and possible challenges/ favourable findings that may impact on the control programmes in the province.

2. RESEARCH METHODOLOGY

2.1 Study Design

A descriptive cross-sectional study was carried out in two hospitals in the Southern Province of Sri Lanka viz., the District-General Hospital Matara in the Matara District and Base Hospital Tangalle in the Hambantota District, from August 2018 to January 2020. Patients with clinically highly suspected CL lesions meeting the criteria below were enrolled by convenience sampling. Patients were referred by a consultant dermatologist based on clinical suspicion and were recruited for the study and the samples were confirmed as CL positive by previously described 18S PCR (Ranasinghe et al., 2015).

2.2 Patient recruitment – Inclusion and Exclusion criteria

A total of 123 patients were recruited and screened for CL. Patients above the age of 18 years, with lesions clinically highly suggestive of CL, screened by a consultant dermatologist, with no previous treatment history for the presenting lesion, were recruited. In addition, patients having the lesion at an eligible site for taking a biopsy as well as providing informed written consent were included in the study. These patients had no travel history to other CL-endemic countries. Patients with debilitating illnesses/ immunosuppression and children < 17 years were excluded due to ethical reasons, especially in view of the invasive sampling in the case of the latter.

2.3 Collection of clinico-demographic data

Clinico-demographic data were gathered using an interviewer-administered questionnaire. The demographic parameters were categorized to assess the risk of acquiring CL and the clinical parameters were assessed. Categorizing both types of data was done to assist in comparison with other studies to look for prevailing trends.

Demographic data: gender, age, resident Divisional Secretariat (DS) division, level of education, occupation and housing conditions were recorded. Age was grouped as 20 to <49 years and > 50 years (the 18 and 19-year-olds in the current study were considered separately); level of

education was divided as primary (preschool to up to grade 5), secondary (grade 6 to grade 11) and post-secondary (grade 12 and higher educational qualifications) levels; Occupation was differentiated as outdoor and indoor. Outdoor workers included farmers, military personnel, drivers, businessmen and fishermen. Individuals working at government and private sector offices, homemakers, retired personnel, elders, and students were grouped as indoor workers. Houses with plastered bricked walls were grouped as satisfactory and houses with un-plastered brick and clay walls were grouped as unsatisfactory. The presence of other CL-confirmed cases in the household was also recorded as a risk factor.

Type of lesion, number of lesions in a patient, duration of the lesion at the time of presentation, affected body area, the maximum diameter of the index lesion and presence of associated symptoms such as pain and/or itching were recorded as clinical data. Lesions were categorised as ulcerated and non-ulcerated. The number of lesions in a patient was recorded as single or multiple. The duration of the lesion was categorized as less than 6 months, 6-12 months, and more than 12 months. The affected body area was classified into four, namely, the face, the trunk, and upper and lower limbs. The maximum diameter of the lesion was measured from the edge of the induration to the opposite end of the induration. The diameter of the induration was further subdivided as less than/ equal to 2 cm and more than 2 cm (Siriwardana et al., 2015).

2.4 Grading of the parasite load in cutaneous leishmaniasis lesions

The slit skin smears were Giemsa stained and examined for the presence of *Leishmania* amastigotes under oil immersion. A thousand fields were examined before concluding a negative smear. Each slit skin smear was graded for parasite load and was categorized as nil, 1+ (1-10 amastigotes/1000 fields), 2+ (1-10/100 fields), 3+ (1-10/10 fields), 4+ (1-10/field), 5+ (10-100/field) and 6+ (>100/field) (WHO Technical Report Series 2021). This was further subdivided into lesions with low parasite load (nil and 1+ lesions) and lesions with moderate to high parasite loads (lesions with parasite load >2+) (Parkash,2009).

2.5 Selection of literature for comparison with the current data

Full research papers describing clinical and/or demographic data of CL patients in the Southern Province, Sri Lanka, were

searched in the PubMed database in November 2021 using the search term - Galle OR Hambantota OR Matara AND "cutaneous leishmaniasis" applying no filters. The results included 11 articles of which only seven had relevant details. Among the seven, one included patient data from the Anuradhapura District (Galgamuwa, Dharmaratne and Iddawela, 2018), and another had included Kalutara, Monaragala and Rathnapura districts, Sri Lanka (Siriwardana et al., 2021) along with data from the Southern province; as such, due to the inability to distinguish the data from the relevant geographical area, these studies were excluded. One study was included following a manual search for articles in Google Scholar (Sudarshani et al., 2019). This way, six studies were selected for comparison with the current study (Rajapaksa et al., 2007; Kariyawasam et al., 2015; De Silva et al., 2017; Somaratne et al., 2018; Sudarshani et al., 2019; Silva et al., 2021). The quality checking of the included articles was done adhering to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Cuschieri 2019).

2.6 Statistical analysis

Statistical analysis was carried out using R Version 4.0.1. Pearson chi-square test was used to assess differences between the groups of the categorical variables.

2.7 Ethical approval

Ethical approval for this study was obtained from the Ethics Review Committee, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka (Approval numbers 69/17 and 27/19).

3. RESULTS & DISCUSSION

3.1 STUDY FINDINGS

According to weekly epidemiological reports published by the Epidemiology Unit, Ministry of Health, Sri Lanka, from August 2018 to January 2020, 120 new CL cases per month were reported from Hambantota and Matara Regional Divisional Health Secretariat Divisions (Epidemiology Unit, 2023). At respective institutions, the total number of patients suspected of CL, during this study's data collection period (August 2018 to January 2020) was approximately 2000. Of these, 123 patients were screened for CL in the present study, resulting in 115 PCR positives and 8 PCR negatives.

This cohort had a 53.9% male preponderance (n = 62). The age range of 20–49 comprised most CL patients (n=56, 48.7%). Furthermore, there were one 19-year-old and seven 18-year-old CL patients. CL cases were reported from nine DS divisions, comprising six from Hambantota District (Angunukolapelaessa, Beliatta, Okewela, Tangalle, Walasmulla, and Weeraketiya) and three from Matara District (Devinuwara, Dickwella, and Hakmana) (Figure 1).

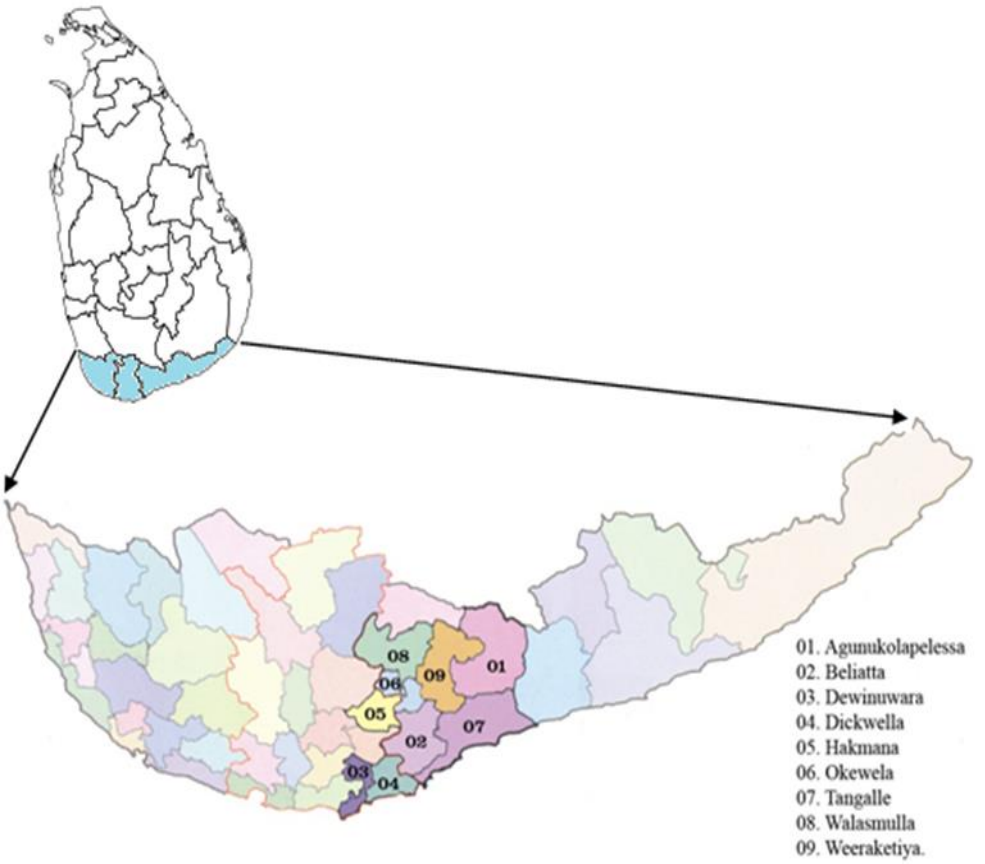

Figure 1: Distributional map of the Divisional Secretariat divisions from which cutaneous leishmaniasis patients reported.

Nearly all of the patients had completed primary education, and the majority (n=69, 60%) had completed secondary education. Seventy percent (70.4%) of the individuals

with CL earned more than Rs. 20,000 per month. Ninety-eight percent of the patients enrolled in our study had homes with brick walls plastered. 95.7% of the CL patients said they did not have any other CL-positive cases at home. Of the CL patients we report, the majority (n=70, 61%) were engaged in indoor occupations.

In our study, 72% of the lesions (n=83) were less than 2 cm in size and most were non-itchy and non-painful (n=85, 74%). Ulcerated lesions (n=90, 78.3%) were more common than non-ulcerated lesions and single lesions (n=102, 88.7%) were the most common. We found that nodular-type lesions (n=45, 39.2%) were the most frequent, followed by dry ulcers (n=23, 20%), papular lesions (n=21, 18.3%), and plaque-like lesions (n=14, 12.1%). Wet ulcers (n=12, 10.4%) were the least common type of presentation. In addition, 57% of the lesions (n=66) had high parasite loads with a parasite load grading of >2+. Most of the lesions were observed in the upper limbs (n=67, 58.3%).

3.2 COMPARISON WITH THE LITERATURE

Table 1 describes the key characteristics of the current study compared with the 6 selected studies conducted in Matara and/or Hambantota districts of the Southern province. The reference studies span from 2003 to 2018, while the current study includes data from 2018 to 2020. Each included study from the provincial literature had a STROBE score of >18/22.

Table 1: Characteristics of the current study compared with the literature

Reference	Study population	Province	Year	Number of clinically suspected CL cases	Laboratory confirmation	The detection rate of CL in the screened group
Current study	Patients reporting to DGH Matara and BH Tangalle	Southern	2018-2020	123	PCR	115 (93.5%)
(Silva et al., 2021)	Patients reporting to DGH Hambantota and BH Tangalle	Southern	2016-2018	*	*	201
(Sudarshani et al., 2019)	Patients reporting to BH Tangalle	Southern	2016-2017	310	SSS	183 (59%)
(Kariyawasam et al., 2015)	Matara district	Southern	2015	80	PCR	38 (47.5%)

(De Silva et al., 2017)	Patients reporting to DGH Hambantota	Southern	2014-2015	74	PCR	59 (79.7%)
(Somaratne et al., 2018)	Patients reporting to DGH Hambantota	Southern	2014-2015	*	SSS and Histology	188
(Rajapaksa et al., 2007)	Matara and Hambantota district	Southern	2003-2004	140	Culture	113 (80.7%)

CL: cutaneous leishmaniasis; DGH: District-General-Hospital; BH: Base-Hospital; SSS: Slit skin smear; *: data not available

Each of the previous studies have used different laboratory tests to confirm CL; PCR, culture, slit skin smear (SSS) & histology. After 2015, the diagnostic methods have improved from basic SSS, histology and culture to endpoint PCR, except for one study done in 2016/2017 (Sudarshani et al., 2019). Detection rates of CL by laboratory methods have varied over the years. The highest detection rate was seen in the current cohort, where we report a 93.5% detection rate of CL by PCR in clinically suspected patients. The lowest detection rate was seen in the year 2015 in the study conducted in the Matara district, where they reported a 47.5% detection rate of CL by PCR in clinically suspected patients in which the PCR sensitivity was reported to be 100% (Kariyawasam et al., 2015).

Table 2.1 and 2.2 contain demographic data of the current study aligned with the local literature of the province.

Table 2.1: Demographic data (Gender, Age, Housing, Monthly income and Occupation) of the current study compared with the literature

Reference		**Current study**	**(Silva et al., 2021)**	**(Sudarshani et al., 2019)**	**(Kariyawasam et al., 2015)**	**(De Silva et al., 2017)**	**(Somaratne et al., 2018)**	**(Rajapaksa et al., 2007)**
Gender %	Male	53.9 (n=62)	63.7 (n=128)	63.9 (n=117)	39.5 (n=15)	*	*	50.4 (n=57)
	Female	46.1 (n=53)	36.3 (n=73)	36.1 (n=66)	60.5 (n=23)	*	*	49.6 (n=56)
Age %	20-49	48.7** (n=56)	53.7*** (n=108)	43.2 (n=79)	*	*	*	37.2 (n=42)
	>50	44.3 (n=51)	46.3 (n=93)	31.7 (n=58)	*	*	*	25.7 (n=29)
Education %	Primary	33.9 (n=39)	*	*	*	*	*	*

	Secondary	60 (n=69)	*	*	*	*	*	*
	Post-secondary	6.1 (n=7)	*	*	*	*	*	*
Housing %	Satisfactory	93.9 (n=108)	*	*	10.5 (n=4)	*	*	*
	Unsatisfactory	6.1 (n=7)	*	*	89.5 (n=34)	*	*	*
Monthly income %	Rs. <20,000	29.6 (n=34)	*	*	97.4 (n=37)	*	*	*
	Rs. >20,000	70.4 (n=81)	*	*	2.6 (n=1)	*	*	*
Occupation %	Indoor	61 (n=70)	*	*	63.2 (n=24)	*	*	*
	Outdoor	39 (n=45)	*	*	36.8 (n=14)	*	*	*

Data in this table are presented as percentages. *: Data not available or could not be aligned; **: 18- and 19-year-old patients with CL not included in the given percentage; ***: Age category included 20-50.

Table 2.2: Demographic data (Resident Divisional Secretariat division and Other CL cases in the household) of the current study compared with the literature

Reference		**Current study**	**(Silva et al., 2021)**	**(Sudarshani et al., 2019)**	**(Kariyawasam et al., 2015)**	**(De Silva et al., 2017)**	**(Somaratne et al., 2018)**	**(Rajapaksa et al., 2007)**
Resident Divisional Secretariat division %	Angunukolapelaessa	9.6 (n=11)	*	*	*	*	*	*
	Beliatta	29.6 (n=34)	*	*	*	*	*	23 (n=26)
	Devinuwara	4.3 (n=5)	*	*	2.6 (n=1)	*	*	6.1 (n=7)
	Dickwella	12.2 (n=14)	*	*	55.3 (n=21)	*	*	25.6 (n=29)
	Hakmana	0.9 (n=1)	*	*	28.9 (n=11)	*	*	*
	Okewela	6.1 (n=7)	*	*	*	*	*	5.3 (n=6)
	Tangalle	33.9 (n=39)	*	*	*	*	*	*
	Walasmulla	1.7 (n=2)	*	*	*	*	*	*
	Weeraketiya	1.7 (n=2)	*	*	*	*	*	*
	Kirinda-Puhulwella	0	*	*	13.2 (n=5)	*	*	9.7 (n=11)
Other CL cases in the household %	Yes	4.3 (n=5)	*	*	*	*	*	*
	No	95.7 (n=110)	*	*	*	*	*	*

Data in this table are presented as percentages. *: data not available

Table 2.2: Demographic data (Resident Divisional Secretariat division and Other CL cases in the household) of the current study compared with the literature

Reference		Current study	(Silva et al., 2021)	(Sudarshani et al., 2019)	(Kariyawasam et al., 2015)	(De Silva et al., 2017)	(Somaratne et al., 2018)	(Rajapaksa et al., 2007)
Resident Divisional Secretariat division %	Angunukolapelaessa	9.6 (n=11)	*	*	*	*	*	*
	Beliatta	29.6 (n=34)	*	*	*	*	*	23 (n=26)
	Devinuwara	4.3 (n=5)	*	*	2.6 (n=1)	*	*	6.1 (n=7)
	Dickwella	12.2 (n=14)	*	*	55.3 (n=21)	*	*	25.6 (n=29)
	Hakmana	0.9 (n=1)	*	*	28.9 (n=11)	*	*	*
	Okewela	6.1 (n=7)	*	*	*	*	*	5.3 (n=6)
	Tangalle	33.9 (n=39)	*	*	*	*	*	*
	Walasmulla	1.7 (n=2)	*	*	*	*	*	*
	Weeraketiya	1.7 (n=2)	*	*	*	*	*	*
	Kirinda-Puhulwella	0	*	*	13.2 (n=5)	*	*	9.7 (n=11)
Other CL cases in the household %	Yes	4.3 (n=5)	*	*	*	*	*	*
	No	95.7 (n=110)	*	*	*	*	*	*

Data in this table are presented as percentages. *: data not available

Data in this table are presented as percentages. *: Data not available or could not be aligned.The male predominance of the cohort was in line with the research published in the province prior to 2004. One possible explanation for this could be that, with 64.5% of the males in the cohort spending more time outside than females, males are more likely to get bitten by sand flies. On the other hand, more female patients with CL (60.5%) were observed in the Matara district in 2015 (Kariyawasam et al., 2015). The current study's male-to-female ratio was 1.17, while those from the other research were 1.75 (Silva et al., 2021), 1.77 (Sudarshani et al., 2019), 0.65 (Kariyawasam et al., 2015), and 1.01 (Rajapaksa et al., 2007).

The age range of 20–49 accounted for the majority of CL patients (n=56, 48.7%).

Research conducted in 2003/2004 (Rajapaksa et al., 2007) and 2016/2017 (Sudarshani et al., 2019) show that 25.2% and 37.2% (respectively) of CL patients were under the age of 19, 43.2% and 37.2% (respectively) of CL patients were in the 20–49 age group, and 31.7% and 25.7% (respectively) were beyond the age of 50. Furthermore, according to a 2016–2018 survey, 53.7% of CL patients were between the ages of 21 and 50 (Silva et al., 2021). According to studies done between 2016 and 2018, the majority of CL patients fell into the 20–49 age range (Sudarshani et al., 2019, Silva et al., 2021). In a 2003–2004 study (Rajapaksa et al., 2007), similar percentages of CL patients were younger than 19 and in the 20–49 age range. The exclusion of children under the age of 18 from the study was a constraint on the assessment of clinico-demographic data. It would be helpful to find out what proportion of CL patients were children, as suggested by the authors, and recommend incorporating children in future research.

Most of the research participants of this study were between the ages of 20 and 49 and were men; of those between the ages of 18 and 19, 75% (6/8) and those between the ages of 20 and 49, 55.4% (31/56) were men. Males (n = 25, 49%) and females (n = 26, 50.9%) made up nearly equal proportions of the CL patients over the age of 50. Of the CL patients in the 20–49 age range, 59.5% (25/42) were men and 58.6% (17/29) were females, according to data released in 2003–2004 (Rajapaksa et al., 2007). Data are insufficient in the other studies to compare the trends of age, gender, and disease prevalence.

In contrast to statistics from 2003/2004 (Rajapaksa et al., 2007) and 2015 (Kariyawasam et al., 2015), we did not get any patients from the Kirinda-Puhulwella DS division, Matara. In our study, most of the CL patients reported from Dickwella DS division, Matara district (n=14, 12.2%) and Tangalle (33.9%, n=39) and Beliatta (29.6%, n=34) DS divisions, from the Hambantota district. These are town areas that are quickly becoming urbanized due to the province's ongoing development projects. Deforestation and population movements are frequently mentioned as risk factors for the spread of CL. Furthermore, there is no literature on CL cases from the Tangalle DS division other than the present study. Therefore, further research is required to determine whether Tangalle in the Hambantota district is a developing CL hot zone. Compared to the data in Matara District in 2015

(Kariyawasam et al., 2015), we report a reduction of cases presented from the Dickwella and Hakmana DS divisions. Consistent with the data in 2003/2004 (Rajapaksa et al., 2007), Beliatta DS division reported a similar percentage of CL cases.

The level of education of CL patients in the province has not been investigated before. We found that almost all the patients have had up to primary education and the majority were educated up to the secondary level (n=69, 60%). Additionally, an improvement in the family monthly income was observed compared to Matara district data in 2015 (Kariyawasam et al., 2015), where it was reported that 70.4% of the CL patients had a monthly income of Rs. >20,000. Improved literacy and income must have increased public awareness of CL, influencing early seeking of medical care, as the majority of the CL patients in the present study (86.1%) were observed to be presented for treatment in < 6 months of first noticing the lesion.

Compared to the study conducted in the Matara district in the year 2015 (Kariyawasam et al., 2015) which reports 89.5% of the housing conditions to be unsatisfactory, we observed a major improvement in the housing conditions among patients who reported to Matara and Tangalle hospitals. The majority of the patients enrolled in our study had plastered brick-walled houses instead of clay/ un-plastered brick walls (n=108, 93.9%). Sandfly is known to reside in cool dark humid corners/ cracks in houses; thus housing conditions may have contributed minimally to the spread of the disease in this cohort (Wijerathna & Gunathilaka, 2020).

Patients with CL can act as reservoirs for disease transmission. However, in the current study, 95.7% of the CL patients denied having other CL-positive cases at home. We could not compare this with previous studies as none of the previous studies had investigated having other CL-positive cases in the household. This observation along with satisfactory housing conditions makes domestic transmission of CL less possible in this cohort.

Consistent with the data from the Matara District in 2015 (Kariyawasam et al., 2015), the majority of the CL patients we report were occupied indoors (n=70, 61%). Of the indoor occupants, 60% (42/70) were housewives. The percentage of housewives accounted for about 36.5%

(42/115) of the total CL-positive patients. The 2016/1017 data also, report approximately 21% (the highest) of housewives among their CL posCL-positive. The lifestyle of a Sri Lankan housewife includes going to scrub jungles to collect firewood and milking cows/ goats in open sheds (Iddawela et al., 2018). This increases the risk of them getting exposed to more sandfly bites. In addition, cattle and goats are now identified as possible reservoir hosts of *L. donovani* (Akter et al., 2018). In this cohort of patients, there was a minimum possibility for domestic transmission. Thus, it could be concluded that these housewives must have got CL mainly due to the peri-domestic transmission of the disease. Of the males, the majority were outdoor workers (40/62, 64.51%) which was statistically significant ($X^2=36.39$, df=1, $p<0.001$). In the current study, among the CL positives, it was interesting to observe more fishermen (n=6, 5.2%) than farmers (n=5, 4.3%). The study conducted in 2016/2017 reported similar results: fishermen - ~4.5% and farmers - ~4% (Sudarshani et al., 2019). Of the six fishermen in the present study, one had a delay in presenting to the hospital of eight months, whereas the rest had lesions of < 6 months of duration. The main drawback of fishermen being affected is that there is a high possibility of them defaulting treatment as they spend most of their time away in the sea. However, in the current study, reporting of fishermen with CL lesions to the hospital was satisfactory. It was unexpected to see such a small number of farmers in this cohort. Since the majority of patients reported from towns, farming might not be the primary occupation for most. However, it is well known that the majority of the population in the Southern province engages in paddy farming either as a primary or secondary occupation (Anputhas et al., 2021).

Table 3 contains clinical data of the current study aligned with the included local literature of the province.

In our study, a spectrum of clinical presentations of CL, including both ulcerated (Ulcerated papules, ulcerated nodules, dry ulcers, wet ulcers, and ulcerated plaques) and non-ulcerated (Papules, nodules, and plaques) lesions were observed (Figure 2).

Figure 2: Spectrum of clinical presentations of cutaneous leishmaniasis observed in the current study. A: Papule; B: Ulcerated papule; C: Nodule; D: Ulcerated nodule; E: Dry ulcer; F: Wet ulcer; G: Plaque; H: Ulcerated plaque.

Table 3: Clinical data of the current study compared with the literature

Reference		**Current study**	**(Silva et al., 2021)**	**(Sudarshani et al., 2019)**	**(Kariyawasam et al., 2015)**	**(De Silva et al., 2017)**	**(Somaratne et al., 2018)**	**(Rajapaksa et al., 2007)**
Type of lesions %	**Papule**	11.3 (n=13)	21.9 (n=44)	*	*	5.1 (n=3)	*	5.3 (n=6)
	Ulcerated papule	7 (n=8)	*	*	*	*	*	*
	Nodules	7 (n=8)	15.4 (n=31)	*	34.2 (n=13)	35.6 (n=21)	*	28.3 (n=32)
	Ulcerated nodules	32.2 (n=37)		*		6.8 (n=4)	51.8 (n=97)	17.7 (n=20)
	Dry ulcers	20 (n=23)	47.8 (n=96)	*	*	38.9 (n=23)	*	36.3 (n=41)
	Wet ulcers	10.4 (n=12)		*	*	5.1 (n=3)	*	

	Plaques	3.4 (n=4)	13.4 (n=27)	*	*	6.8 (n=4)	*	6.2 (n=7)
	Ulcerated plaques	8.7 (n=10)	*	*	*	*	*	6.2 (n=7)
Number of lesions in a patient %	**Single**	88.7 (n=102)	94 (n=189)	96.3 (n=176)	84.2 (n=32)	*	89.6 (n=168)	74.3 (n=84)
	Multiple	11.3 (n=13)	6 (n=12)	3.7 (n=7)	15.8 (n=6)	*	10.4 (n=20)	25.7 (n=29)
Duration of the index lesion %	**<6 months**	86.1 (n=99)	86.6 (n=174)	*	*	88.1 (n=52)	*	*
	>6 months	13.9 (n=16)	13.4 (n=27)	*	*	11.9 (n=7)	*	*
The affected area of the body %	**Head and neck**	1.7 (n=2)	21.9 (n=44)	22.7 (n=41)	26.3 (n=10)	*	13.2 (n=25)	44.2 (n=50)
	Trunk	6.9 (n=8)	9 (n=18)	15.9 (n=29)		*	13.2 (n=25)	11.5 (n=13)
	Upper limb	58.3 (n=67)	43.3 (n=87)	44.3 (n=81)	39.5 (n=15)	*	48.7 (n=92)	32.7 (n=37)
	Lower limb	33 (n=38)	19.9 (n=40)	17.3 (n=32)		*	24.9 (n=46)	2.7 (n=3)
Diameter of the index lesion %	**<2cm**	72.2 (n=83)	*	*	*	*	*	*
	>2cm	27.8 (n=32)	*	*	*	*	*	*
Presence of associated symptoms in the lesion %	**Yes**	26.1 (n=30)	*	*	*	*	*	22 (n=25)
	No	73.9 (n=85)	*	*	*	*	*	78 (n=88)

Data in this table are presented as percentages. *: Data not available or could not be aligned.

Seventy-two per cent of the lesions (n=83) in our study were <2 cm in size and the majority were non-itchy and non-painful lesions (n=85, 74%). Rajapaksa et al, (2007) also report that 78% of the CL lesions were asymptomatic. A recent publication explains that in the Southern province, unlike the northern focus of the disease, a larger proportion of CL lesions become enlarged (>1cm) and ulcerated and many do not multiply (Siriwardana et al., 2021). The difference in the results could be due to the different categorizations of the lesion size. However, in the current study, ulcerated lesions (n=90, 78.3%) were more common than non-ulcerated lesions. And single lesions were predominant (n=102, 88.7%). However, we observed multiple papular lesions in the upper limbs and multiple wet ulcers in the

lower limbs of patients. Multiple papular lesions were seen in a female patient whose lesions were of 12 weeks' duration. These papules have remained the same without progressing to nodular lesions. However, it was difficult to conclude whether these were due to multiple bites of the sand fly or lymphatic or haematogenous spread.

We observed more nodular-type lesions (n=45, 39.2%), followed by dry ulcers (n=23, 20%), papular lesions (n=21, 18.3%) and plaque-like lesions (n=14, 12.1%); the wet ulcers were the least common type of presentation (n=12, 10.4%). Apart from the data from 2016/2018 (Silva et al., 2021), which reports more ulcers, nodular type of CL lesions had been the most common type of presentation in the past. A recent study in the province reveals that nodules were less responsive to sodium stibogluconate treatment (Silva et al., 2021). Thus, the abundance of nodular presentation of CL in the cohort could be a potential challenge to provincial CL elimination programmes.

Fifty-seven per cent (n=66) of the lesions had high parasite loads with a parasite load grading of >2+. Only one study had done a similar grading of the lesions in the province and reported similar results; 57.6% were lesions with high parasite loads (De Silva et al., 2017). A recent publication on parasite load in CL tissue explains that the parasite load in tissue has a significant positive correlation with the number of sodium stibogluconate treatment cycles (Riyal et al., 2021). Even though the parasite loads in the lesions have not changed over the past 3-4 years, the majority of CL wounds had high parasite loads of >2+, highlighting that CL elimination in the province could be challenging. The same study describes that there is no association between parasite load and lesion type, and size (Riyal et al., 2021). Similarly, in this study too, there was no statistically significant association between lesion size and ulceration of lesions, compared with the parasite load in lesion smear.

Our study (18.3%) and the study done in 2016/2018 (21.9%) (Silva et al., 2021) report a higher percentage of papular lesions as compared to earlier reported studies in the province: i.e., 5.1% in 2014/2015 (De Silva et al., 2017) and 5.3% in 2004/2004 (Rajapaksa et al., 2007). Increased awareness of the disease might have influenced less negligence of such small lesions. This is an important finding as these small lesions are suggested to be

silent reservoirs of CL in the province (Siriwardana et al., 2021). Also, we report ulceration of (Figure 2B) 8/21 papular CL lesions, which have not been reported in the past. These ulcerated papules were seen mainly in males (5/8) from Beliatta (4/8), Tangalle (3/8) and Dickwella (1/8) DS divisions. All the ulcerated papules were < 6 months in duration and the earliest presentation was at two weeks. Also, all these ulcerated papules were asymptomatic and were present in the upper limbs. Five of the eight ulcerated papules had a high parasite load of >2+. Further, Ulceration of plaques (10/14, Figure 2H) has not been reported in the province earlier. Ulceration of these lesions exposes them to secondary bacterial infection.

The majority of the lesions in the current study were of <6 months in duration (n=99, 86.1%). This corresponds to the data from 2016/2018 (86.6% in Silva et al., 2021) and 2014/2015 – (88.1% in De Silva et al., 2017). Early seeking of medical care was a positive trend in the cohort. According to Siriwardana et al. (2021), to increase laboratory confirmation of CL in the Southern Province, early sampling is required. Thus, this early seeking of medical care must have improved laboratory diagnosis of CL, improving diagnostic rates from 47.5% in 2015 by PCR (Kariyawasam et al., 2015) to 93.5% in the current study.

Consistent with the provincial literature, the majority of the lesions in our study were also seen in the upper limbs (n=67, 58.3%). This could be strongly related to the dressing habits of Sri Lankans mainly males, who expose the upper body and risk more sandfly bites. Compared to the included studies, we report a lesser number of head and neck lesions (n=2, 1.7%) because we excluded most of the lesions in the head and neck area i.e., ear, nose, and eyelids due to difficulties in obtaining a punch biopsy. Also, compared to the other studies, we report a lesser percentage of lesions in the trunk (n=8, 6.9%). Of the currently reported lesions in the trunk, six were in the back and two in the chest. We observed that all the head & neck, and trunk lesions were reported within 4 months of noticing the lesion. Further, in our study, patients with lower limb lesions (33%) seemed to have increased over the years and markedly increased compared to the year 2003-2004 data (2.7%;Rajapaksa et al., 2007).

Further, in our study, the following was observed. There was no significant

association ($p>0.05$), between lesion type, ulceration of lesions, size of lesions or presence of symptoms, when compared with the duration of the lesion. Even though we did not observe a statistically significant difference between lesion size and duration of lesions ($X2= 0.762$, $df=1$, $p=0.55$), of the lesions presented <6 months, the majority were small (<2cm) in size (n=70, 70.7%).

Due to the limited number of samples obtained through convenience sampling, generalization of the results to the entire Province is not possible. Thus, further investigations with larger number of samples are encouraged to facilitate case detection, diagnosis, management and control of CL in the province.

4 CONCLUSION & RECOMMENDATIONS

CL is common among young males, as single nodules in the upper limb. These lesions harbour high parasite loads. Ulceration of papules and plaques was observed for the first time in the province, which might have implications concerning differential diagnosis and chronicity. Early seeking of treatment which affects the improvement of diagnostic rates, and increased reporting of papules which are silent reservoirs of CL, are positive trends observed in this cohort. Further, early seeking and reporting of small lesions like papules indicate increased awareness of the disease among the patients of this cohort. As negative trends, Tangalle divisional secretariat division was identified as a possible emerging disease focus. Also, presenting a higher number of nodules and lesions with high parasite loads found to be less responsive to treatment, could be possible challenges in CL elimination. However, these findings should be further investigated with large sample numbers.

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