



## Knowledge and practices regarding leishmaniasis in Portugal – Comparison between blood donors and health students/professionals

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### ABSTRACT

**Objective:** To compare the current knowledge and practices regarding leishmaniasis among blood donors and health students and professionals, in Portugal.

**Material and methods:** Data were collected through the application of two questionnaires (one online and one in paper) with similar questions in two distinct cross-sectional independent studies, each targeting one of the groups. Descriptive statistics and hypothesis testing were performed using IBM® SPSS® Statistics.

**Results:** In total, 3763 blood donors, 254 students and 232 professionals were included in the comparative analysis. Over 95% of students and professionals, but only around 70% of blood donors had previously heard of leishmaniasis. Over 90% of participants in each group admitted leishmaniasis affected animals, but only in the professional group over 90% were aware of human leishmaniasis.

**Conclusions:** Even though canine leishmaniasis is recognized by many blood donors and by most students and professionals, awareness of the disease in humans is less common, highlighting the importance of promoting an approach to this infection through a One Health lens.

### 1. Introduction

Control of leishmaniasis in the Mediterranean basin relies on individual contributions by the general population and on active interventions from the fields of animal, human and environmental health. Application of knowledge and practices (KP) questionnaires in Europe could be fundamental from a Public (One) Health perspective, to highlight the diversity of conceptions related to this disease among the students/professionals and the populations at risk in endemic areas. Non-standardized KP questionnaires applied in *Leishmania* endemic areas, such as South America [1,2], South Asia [3–5] and East Africa [6], showed heterogenous results among countries, regions and different sectors of the general population. Although the Mediterranean region is also endemic, few studies have addressed the KP of the resident population and these were mostly directed to animal owners, including three studies performed in Portugal [7–9]. In these studies, 83–91% of the

owners heard of animal leishmaniasis, but only 38.6% of human leishmaniasis. Hearing of leishmaniasis was significantly associated with non-rural areas and academic degree. Concerning health professionals, studies directed at KP of veterinary doctors have been performed in the Mediterranean region, generally focusing on the epidemiology and clinical approach to canine leishmaniasis [10–13]. However, in this region, medical doctors and environmental health technicians (EHTs), as well as students, have not been systematically included. Lastly, no studies have attempted to compare the KP of the general population with that of the professionals/students, even though this approach could help understand if differential knowledge between groups could explain distinct practices related to leishmaniasis and/or to arthropod-borne infections in general. The aim of this work is to compare the current knowledge and practices regarding leishmaniasis among blood donors and health students and professionals, in Portugal, through the application of an online or paper questionnaire.

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## 2. Material and methods

Data for this work were collected via two distinct cross-sectional independent studies. One targeting the population of health students and professionals in Portugal: students currently enrolled in the course of Medicine, Veterinary Medicine, or Environmental Health in public or private higher education institutions; actively practicing physicians, veterinarians, and Environmental Health technicians [14]. Potential participants were approached by email via universities and professional societies and organizations, providing the link to access the online, anonymous, questionnaire (built on Redcap®). Answers to the self-administered sociodemographic and KP questionnaire were collected between July and December 2022. The second study targeted the population of people who donate blood in mainland Portugal through the Portuguese Institute of Blood and Transplantation (IPST) or the Immunohemotherapy departments (IHDs) of public hospitals in the Alentejo and Algarve regions [15]. Although not representative of the general Portuguese population, this target population was chosen due to ease of nation-wide sampling. Participants, distributed proportionally by municipality, aged between 18 and 65 years old, were selected randomly in 347 blood collection points, between February and June 2022, and filled in a self-administered paper sociodemographic and KP questionnaire. For the comparative analysis, absolute and relative frequencies and hypothesis testing were performed using IBM® SPSS® Statistics Version 29.0. Descriptive statistics were expressed as absolute frequencies and percentages for categorical variables or as a median with interquartile ranges (IQRs) for the continuous variable (age). Comparisons between groups were performed using Pearson Chi-Square test for categorical variables (or Fisher's exact test in case of failure of the assumptions of the Chi-square test). For the continuous variable, after checking the assumptions of normality and homogeneity of the variances, the Kruskal-Wallis test was used, for comparing more than two independent groups. A value of  $p < 0.05$  was considered statistically significant.

## 3. Results

In total, 3763 blood donors, 254 students and 232 professionals were included in the comparative analysis. Female sex was predominant among students and professionals, but not among blood donors. Findings from the knowledge and practices questions are summarized in Tables 1 and 2, respectively. Over 95% of students and professionals had previously heard of leishmaniasis, compared to only around 70% of blood donors ( $p < 0.001$ ). Television advertisements and conversation with a veterinarian were common non-academic sources of information for all groups. Unawareness regarding mode of transmission of leishmaniasis was more common in blood donors ( $p < 0.001$ ); arthropod bite was the mode of transmission most often pointed by participants, especially health students/professionals; sand flies were identified as the vectors much more commonly by students/professionals than by blood donors ( $p < 0.001$ ), who preferentially selected mosquito bites. Over 10% of participants in every group considered direct contact with animals could be a major route of transmission. Over 90% of participants in each group admitted leishmaniasis affected animals; however, only in the professional group over 90% of participants were aware of human leishmaniasis. All groups equally acknowledged dogs as the most affected animal species ( $p = 0.319$ ) and recognized the endemic status of the disease ( $p = 0.085$ ). In humans, however, endemicity was recognized more often by professionals and less by students ( $p < 0.001$ ). Leishmaniasis was more often considered treatable (both in animals and in humans) by professionals than by students or blood donors ( $p = 0.001$  and  $p < 0.001$ , respectively). Students and professionals were more frequently aware of availability of vaccination against canine leishmaniasis ( $p < 0.001$ ) and were almost twice likely to provide it yearly for their dogs. Use of insecticide/repellent in dogs was reported in similar proportions in all groups ( $p = 0.317$ ), but use of collars and administration all year round were more frequently stated by students and

**Table 1**

Answers to knowledge questions, by group.

	Global blood donors	Global health students	Global health professionals	p-value
<b>Total (n)</b>	3763	254	232	
Median age (y)	41	21	38	<b>&lt;0.001</b>
(IQR)	(31–48)	(19–24)	(30–46)	
Male sex (%)	49.8 (1867/3749)	16.7 (42/252)	23.3 (54/232)	<b>&lt;0.001</b>
Heard of leishmaniasis (%)	72.3 (2704/3740)	95.7 (243/254)	99.1 (230/232)	<b>&lt;0.001</b>
Source of information (%)				
Television	53.2 (1406/2643)	58.8 (143/243)	40.0 (92/230)	<b>&lt;0.001</b>
Veterinarian	48.1 (1273/2643)	40.3 (98/243)	39.1 (68/174)	<b>0.006</b>
Route of transmission (%)				
DK/CR	19.5 (526/2704)	5.3 (13/243)	2.2 (5/230)	<b>&lt;0.001</b>
Arthropod bite	88.2 (1922/2178)	97.8 (225/230)	96.4 (217/225)	<b>&lt;0.001</b>
Sand fly bite	13.5 (260/1922)	66.2 (149/225)	78.8 (171/217)	<b>&lt;0.001</b>
Contact with animals	19.6 (426/2178)	13.5 (31/230)	12.0 (27/225)	<b>0.003</b>
Affects animals (%)	91.0 (2451/2693)	95.9 (233/243)	95.2 (219/230)	<b>0.004</b>
Species most affected (%)				
Dogs	97.4 (1893/1937)	97.0 (194/200)	99.3 (151/152)	0.319
Cats	32.6 (632/1937)	26.5 (53/200)	11.3 (17/151)	<b>&lt;0.001</b>
Present in Portugal (%)	86.1 (2081/2418)	85.5 (200/234)	91.3 (200/219)	0.085
Treatable in animals (%)	62.8 (1397/2226)	57.3 (63/110)	85.0 (51/60)	<b>0.001</b>
Vaccine available (%)	52.2 (1092/2090)	82.8 (82/99)	72.0 (108/150)	<b>&lt;0.001</b>
Affects humans (%)	53.8 (1433/2666)	70.4 (171/243)	93.9 (216/230)	<b>&lt;0.001</b>
Present in Portugal (%)	78.7 (1135/1442)	49.3 (73/148)	87.3 (145/166)	<b>&lt;0.001</b>
Treatable in humans (%)	55.6 (772/1388)	57.4 (81/141)	86.7 (78/90)	<b>&lt;0.001</b>

Abbreviations: n - number; y - years; IQR - interquartile range; DK/CR - don't know/can't remember.

professionals ( $p = 0.001$  and  $p < 0.001$ , respectively). Regular veterinarian follow-up (at least once a year) was reported in similar proportions (89.0–96.4%,  $p = 0.155$ ).

## 4. Discussion

Awareness of leishmaniasis was high both in blood donors and in health students/professionals. The role of veterinarians as providers of information regarding leishmaniasis was highlighted by every group; in this sense, academic training and continuous education of veterinarians in this disease could be a decisive strategy for control of leishmaniasis in Portugal, as well as in other zoonotic settings. In blood donors, identification of phlebotomine sand flies as vectors is insufficient; potential sandfly breeding sites, such as animal burrows and shelters and leaf

**Table 2**  
Answers to practices questions, by group.

	Global blood donors	Global health students	Global health professionals	p-value
Nets in some/all windows/doors (%)	23.7 (848/3572)	22.9 (58/253)	15.6 (36/231)	0.017
Dog ownership (%)	48.1 (1775/3688)	57.7 (146/253)	35.9 (83/231)	<0.001
Dog outdoors during nighttime	63.8 (1055/1653)	77.4 (113/146)	63.9 (53/83)	0.004
Use of repellents/insecticides (%)	82.2 (1320/1605)	77.2 (112/145)	80.7 (67/83)	0.317
Spot-on	55.0 (726/1320)	59.8 (67/112)	53.7 (36/67)	0.594
Collar	40.9 (540/1320)	57.1 (64/112)	50.7 (34/67)	0.001
All year round	62.8 (829/1320)	82.1 (92/112)	73.1 (49/67)	<0.001
Regular veterinarian follow-up (at least once a year) (%)	90.6 (1472/1625)	89.0 (129/145)	96.4 (80/83)	0.155
Use of vaccine against canine leishmaniasis every year (%)	21.7 (385/1775)	42.4 (56/132)	42.5 (17/40)	<0.001

litter, differ from mosquito breeding sites (small or large bodies of water); as such, confusion between these two arthropods could lead to improper individual management of potential *Leishmania* vector breeding sites. Additionally, belief of transmission via direct contact (excluding bites or scratches), even in professionals, could lead to inadequate isolation measures or rejection of diseased animals. In blood donors, decreased recognition of potential human infection with *Leishmania*, including in endemic areas in Portugal, could implicate a lower perception of individual or community risk, even in areas where canine cases are seen, and a low stimulus to implement animal protective measures. Lower awareness of vaccine availability for dogs and lower effective implementation by blood donors could also represent barriers to disease control. Although systematic use of repellents in dogs was consistently reported by students/professionals and blood donors, the latter were less likely to apply them spanning all the phlebotomine season (in Portugal, mostly from May to October [16]); other practices that could be different between groups and impact prevention, such as type of repellent substance used, frequency and mode of application, were not assessed in these studies.

A national structured plan to control leishmaniasis could overcome some of these challenges, namely by implementing systematic surveillance and integrated reporting of animal and human cases of disease and by investing in health education and promotion concerning vector-borne infections. A limitation of this comparative analysis is that participants in each group were not equally distributed regarding sex and region of residence, which could have impacted knowledge, since endemicity of leishmaniasis and access to information is not homogeneous across the country. Future studies should target a broader sector of the Portuguese population and could prospectively evaluate the effect of education in changing practices.

## 5. Conclusions

Even though canine leishmaniasis is recognized by many blood donors and most students and professionals, awareness of the disease in humans is less common, highlighting the importance of promoting an

approach to this infection through a One Health lens. Gaps in knowledge in the general population could explain insufficient protective practices, such as lower adherence to canine vaccination against leishmaniasis. Health professionals from different fields could play an important role in promoting health related to vector-borne infections.

## Ethical statement

For this study, only data produced in two previous studies were used. The study in health students and professionals received a favorable opinion of the Ethics Committee of the Instituto de Higiene e Medicina Tropical (IHMT), Universidade Nova de Lisboa (UNL) (reference 12.22). The study in blood donors received a favorable opinion of the Ethics Committees of the following institutions: IHMT, UNL (reference 1.22); Instituto Português do Sangue e da Transplantação; Centro Hospitalar Universitário do Algarve; Hospital do Espírito Santo de Évora; Unidade Local de Saúde do Norte Alentejano; Unidade Local de Saúde do Baixo Alentejo; Unidade Local de Saúde do Litoral Alentejano. Additionally, the study was authorized by the Administration Council of all the involved Hospitals. All participants in the two studies were informed about the study protocol and signed an informed consent form allowing for data collection.

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## CRedit authorship contribution statement

**Rafael Rocha:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Validation, Visualization. **Cláudia Conceição:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. **Luzia Gonçalves:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. **Carla Maia:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing, Funding acquisition.

## Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors did not use any Generative AI and AI-assisted technologies.

## Declaration of competing interest

The authors declare that they have no competing interests.

## Data availability

No new datasets were generated in the current study.

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