Introduction

Epidermal parasitic skin diseases (EPSD) occur worldwide and have been known since ancient times. Despite the considerable burden caused by EPSD, this category of parasitic diseases has been widely neglected by the scientific community and health-care providers. This is illustrated by the fact that in the recent edition of The Communicable disease control handbook, a reference manual for public health interventions, only one EPSD (scabies) is mentioned. EPSD fulfill the criteria defined by Ehrenberg & Ault (2005) for neglected diseases of neglected populations, but are not listed on national or international agendas concerning disease control priorities. This probably explains why efforts to control EPSD at the community level have very rarely been undertaken.

Six EPSD are of particular importance: scabies, pediculosis (head lice, body lice and pubic lice infestation), tungiasis (sand flea disease) and hookworm-related cutaneous larva migrans (HrCLM). They are either prevalent in resource-poor settings or are associated with important morbidity. In this paper we focus on these diseases, summarize the existing knowledge on the epidemiology and the morbidity in resource-poor settings and focus on the interactions between EPSD and poverty.

We use the term “underprivileged population” to designate a typical resource-poor setting in low-income countries, in contrast to the socioeconomic characteristics of affluent communities in high-income countries. The expressions “hot-climate country” and “cold-climate country” are used when we refer to climatic restrictions on the occurrence of EPSD.

Searches of PubMed and LILACS using keywords “parasitic skin disease”, “scabies”, “pediculosis”, “tungiasis”, “cutaneous larva migrans” and their synonyms were used as a source of references. Searches were made without time limitations. In addition, we used references retrieved by the authors during previous work on EPSD. Articles in English, French, Portuguese and Spanish were reviewed and analysed where quantitative data were provided, the study design was sound and the study had been performed in a resource-poor setting in a low-income country. Of 95 articles identified by these criteria, 50 were selected and cited in the reference list.

Background

The six major EPSD differ considerably in their biological and epidemiological characteristics and life cycles (Table 1). Scabies is caused by a mite (Sarcoptes scabiei), pediculosis by lice, tungiasis by sand fleas (Tunga penetrans) and HrCLM by nematode larvae. Although HrCLM and tungiasis are self-limiting diseases, the parasites may persist for months and can cause long-lasting sequels. S. scabiei and lice propagate continuously and cause persisting symptoms if the infestation remains untreated.

In EPSD, host-parasite interactions are restricted to the stratum corneum, the upper layer of the epidermis, which is where the ectoparasites complete their life-cycles, in part or entirely. In other parasitic skin diseases, such as leishmaniasis, loiasis or onchocerciasis, other layers of the dermis are also affected. Whereas S. scabiei and lice accomplish their life-cycle within or on top of the epidermis, T. penetrans needs the host only for the production of eggs and completes its other developmental stages off-host. In contrast, animal hookworm larvae that have penetrated into the epidermis find themselves at a biological impasse and cannot develop further.

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Epidemic parasitic skin diseases

Epidemiology

Scabies, pediculosis capitis and pediculosis corporis occur worldwide but pediculosis pubis is restricted to cold-climate countries and is virtually absent in the tropics (Table 1). HrCLM is very rare in industrialized parts of the world but is ubiquitously present in developing countries. Tungiasis is geographically restricted to the Caribbean, sub-Saharan Africa and South America.

Except in epidemic circumstances, data on EPSD are not recorded so there is no reliable information available on global disease occurrence, changes in incidence over time, and spatial distribution in endemic areas. Hengge et al. suggested that 300 million cases of scabies exist worldwide, with many more individuals being at risk at any point in time. Similarly, in resource-poor settings, virtually all individuals are permanently at risk for head-lice infestation, i.e. several billion people globally. As tungiasis and HrCLM are climatically and spatially restricted, the number of people at risk is lower, although still sufficient to merit attention.

The distribution of EPSD is irregular, and incidence and prevalence vary in relation to area and population studied. A study in a resource-poor community in urban Bangladesh, for example, showed that virtually all children aged less than 6 years developed scabies within a period of 12 months. In a rural village in the United Republic of Tanzania, the overall prevalence was 6%, in rural and urban Brazil 8–10%, and in rural India 13%. In Egyptian children, the prevalence was estimated to be 5% but in Australian Aboriginal communities the prevalence in this age group approached 50%. Of 5–9-year-olds children living in a displacement camp in Sierra Leone, 86% were found to be infested with S. scabiei.

In some native populations in the Amazon lowland, head-lice infestation is present in virtually all inhabitants, while it is quite rare among adults in affluent societies. In an urban slum in Fortaleza, Brazil, girls experienced 19 new head-lice infestations per year, and boys 15 (authors’ unpublished data, 2008). In contrast, in Germany the incidence was estimated at 1 500 per 10 000 children per year.

During peak transmission, the prevalence of tungiasis in children living in resource-poor rural and urban communities in Brazil and Nigeria reached more than 60%. In contrast, in high-income communities in these

Table 1. Biological and epidemiological characteristics of the six major EPSD

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Scabies</th>
<th>Pediculosis capitis</th>
<th>Pediculosis corporis</th>
<th>Pediculosis pubis</th>
<th>Tungiasis</th>
<th>HrCLM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infective agent</td>
<td>Sarcoptes scabiei</td>
<td>Pediculus humanus var. capitis</td>
<td>Pediculus humanus var. corporis</td>
<td>Phthirus pubis</td>
<td>Tunga penetrans</td>
<td>Animal hookworm species such as A. caninum, A. braziliense, Uncinaria stenocephala</td>
</tr>
<tr>
<td>Taxonomical classification</td>
<td>Acaridae (mite)</td>
<td>Phthiraptera (louse)</td>
<td>Phthiraptera (louse)</td>
<td>Phthiraptera (louse)</td>
<td>Siphonaptera (flea)</td>
<td>Helminths (nematode)</td>
</tr>
<tr>
<td>Life-cycle</td>
<td>Completely on-host</td>
<td>Completely on-host</td>
<td>Completely on-host</td>
<td>Completely on-host</td>
<td>Partially on-host</td>
<td>Partially on-host (biological impasse)</td>
</tr>
<tr>
<td><strong>Epidemiological</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>(+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Person-to-person</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>(+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fomite</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>Soil-to-skin</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Capacity to transfer pathogenic microorganisms</td>
<td>Not known</td>
<td>(+)</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>Not known</td>
</tr>
<tr>
<td>Actively</td>
<td>Not known</td>
<td>(+)</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Passively</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td><strong>Occurrence</strong></td>
<td>Worldwide</td>
<td>Worldwide</td>
<td>Restricted mainly to cold-climate regions</td>
<td>Worldwide</td>
<td>Caribbean, sub-Saharan Africa, South America</td>
<td>Predominantly in hot-climate countries</td>
</tr>
<tr>
<td>Seasonal variation</td>
<td>Peak during cold season</td>
<td>Peak during cold season</td>
<td>Inconsistent data</td>
<td>Peak during cold season</td>
<td>Peak in hot and dry season</td>
<td>Peak in rainy season</td>
</tr>
<tr>
<td>Animal reservoir</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>Dogs, cats, pigs, rats</td>
<td>Dogs, cats</td>
</tr>
</tbody>
</table>

EPSD, epidemic parasitic skin diseases; HrCLM, hookworm-related cutaneous larva migrans.

+, rare; ++, frequent; ++++, very frequent.

* Female fleas penetrate into the epidermis, develop and produce eggs; Eggs develop into larvae, pupae, adults off-host in soil.

† Other than sexual.

‡ Only in cold-climate countries.

§ Other animals may serve as a reservoir.
same countries, tungiasis is restricted to single cases that typically occur when people visit local beaches. The situation is similar for HrCLM, with prevalence in children as high as 15% during the rainy season and an incidence of 1,840 cases per 10,000 individuals per year.20

EPSD usually show considerable seasonal variation of disease occurrence (Table 1).20–23 In the tropics, the cyclical changes are particularly evident in tungiasis and HrCLM; prevalence of tungiasis is highest in the dry season and of HrCLM in the rainy season.19,20

The factors responsible for the high burden of EPSD in resource-poor communities are complex and have not been clarified. It has been suggested that crowding, sharing of beds, frequent population movements, poor hygiene, lack of access to health care, inadequate treatment, malnutrition and social attitudes contribute to the high burden of scabies in these settings.24 It is difficult to disentangle the relative importance of economic, environmental and behavioural factors, since they frequently coexist.25 There is, however, circumstantial evidence that extreme poverty and its economic and social consequences play a pivotal role (Fig. 1).9,25

Tungiasis is a paradigmatic example for this complex web of causation. Sand flea disease is a zoonosis affecting a broad spectrum of animals, with pigs, dogs, cats and rats as the principal reservoirs. In resource-poor settings, stray dogs and cats are common and organic waste frequently litters the soil. Rats are attracted if garbage is not collected, sewage not disposed of properly and food stored inadequately. The risk for infestation is high if feet are not protected by shoes and socks, either because people cannot afford them or if wearing shoes is not part of local custom.26,27

In resource-poor rural and indigenous populations in the hinterland of Brazil, the transmission of T. penetrans occurred almost exclusively indoors.7 Dwellings in these settings typically do not possess a solid floor, or the ground is covered with rough concrete or broken tiles with many crevices, thus providing an ideal habitat for the off-host development of T. penetrans. In an urban environment it spreads in slums, where roads and paths are not paved, waste litters the area and yards consist of sand or mud.

Atypical paths of transmission in resource-poor settings are another epidemiological characteristic of EPSD. When laundry is dried on the ground, instead of using clothes lines, there is a high risk of contamination from dog and cat faeces containing hookworm larvae. In resource-poor settings, the high frequency of lesions of HrCLM on the upper part of the body, including the face, probably reflects this particular type of transmission.28

Another epidemiological peculiarity in poor settings is the observation that deficient sanitation is a significant risk factor for scabies.29 So far, it seems that scabies is not influenced by hygienic practices or the availability of water, since the prevalence of scabies is very high in the Kuna Indians in Panama and among children in the Solomon Islands, where individuals take frequent baths and where careful daily personal hygiene is traditional.29,30

We suggest that deficient sanitation is a characteristic of poor households and that poor hygiene does not by itself increase the odds of acquiring scabies. Interestingly, in rural Egypt, high prevalence of scabies was associated with households receiving their water supply from a hand pump, which the authors considered an indicator of low socioeconomic status rather than of deficient hygiene.13 In resource-poor settings, scabies is usually not a sexually transmitted disease, while this seems to be a common mode of transmission in high-income countries.25

Poverty also plays a role in the transmission dynamics of head lice. In children living in a poor urban neighbourhood in north-eastern Brazil, the infestation rate depended significantly on the income of the household: the lower the family’s income, the more head-llice episodes a child experienced per unit of time. In high-income countries, children of all socioeconomic groups are at similar risk for infestation with Pediculus humanus var. capitis.16

Within a resource-poor population, certain groups are at a particularly high risk for disease occurrence and severe morbidity. These may be girls and women (head-lice infestation), children (head-lice infestation, scabies, HrCLM, tungiasis), the elderly (scabies, tungiasis) or displaced or homeless people (scabies, pediculosis corporis, pediculosis pubis).7,11,30,32

A peculiar epidemiological characteristic of EPSD is the concomitant...
presence of several ectoparasites on the same individual. In a fishing community in Brazil, for instance, 9% of the inhabitants were simultaneously infested with two or more ectoparasites. Not surprisingly, individuals with EPSD also tend to be co-infected with intestinal helminths.

Morbidity

Although the morbidity associated with EPSD is significant, a systematic assessment of the severity of the burden is still lacking. Engels & Savioli suggested that EPSD may represent a considerable subjective burden, although disability-adjusted life years (DALYS) have not yet been calculated.

According to its pathophysiological basis, pathology can be schematically divided into two patterns, namely inflammation-related and itch-related. In tungiasis, the predominant morbidity is the result of heavy inflammation surrounding the lesions, together with secondary bacterial infection (Fig. 2 and Fig. 3). Superinfection reinforces the inflammatory process. Persistent inflammation and superinfection frequently lead to long-lasting sequelae – i.e. secondary morbidity – such as suppuration, ulceration, gangrene, necrosis of surrounding tissue, deformation and loss of nails, resulting in physical disability. Tungiasis has also been associated with tetanus in non-vaccinated individuals. In a study in São Paulo, Brazil, tungiasis was identified as the port of entry for 10% of tetanus cases. All heavily infested individuals living in a resource-poor neighbourhood in north-eastern Brazil showed signs of acute and chronic inflammation: 19% had fissures; 50% presented with ulcers; deformation and/or loss of nails occurred in 69%, resulting in walking difficulty in all patients and difficulty in gripping in half of the patients with lesions at the fingers. A broad host of pathogenic microorganisms has been isolated from superinfected lesions, such as *Staphylococcus aureus*, *Streptococcus pyogenes*, *Enterobacteriaceae*, *Bacillus spp.*, *Enterococcus faecalis*, *Pseudomonas spp.*, as well as various anaerobic pathogens.

Body lice are vectors of a host of pathogenic bacteria, such as *Rickettsia prowazekii* (the agent of epidemic typhus), *Borrelia recurrentis* (the agent of relapsing fever), *Bartonella quintana* (the agent of trench fever and bacillary angiomatosis) and *Yersinia pestis* (the agent of plague), and can cause important secondary morbidity through life-threatening infections. Head lice can transfer *Y. pestis* during blood sucking. Lice can passively carry staphylococci, streptococci, *Acinetobacter spp.* and *Serratia marcescens* and transfer them from infected lesions to other areas of the skin.

Morbidity related to itching (pruritus) is best studied in scabies as it is such a common symptom that patients scratch their lesions almost constantly. Repeated scratching of a lesion causes excoriation and denudation of the skin thus creating portals of entry for pathogenic bacteria. The clinical consequences of secondary bacterial infection, especially with group A streptococci, result in significant, frequently unrecognized illnesses, such as cellulitis, boils, pyomyositis, lymphangitis and generalized lymphadenopathy. Streptococci and staphylococci bacteria have been isolated from skin burrows as well as from faecal pellets of the ectoparasite, suggesting that the mites themselves may contribute to the spread of pathogenic bacteria. Moreover, secondary infection of scabies lesions with group A streptococci is a major precipitant of post-streptococcal glomerulonephritis and possibly also of rheumatic fever.
The debilitating impact of persistent itch has repeatedly been stressed for a variety of non-infectious diseases but remains to be assessed for EPSD. In neurophysiology it is known that chronic itch leads to persistent firing of specialized A and C itch fibres in the skin. As a consequence, pain fibres in the neighbourhood are transformed into itch fibres, eventually leading to a sensitization of spinal neurons. A similar consequence can be anticipated to occur in EPSD. Since the pruritus intensifies at night, disturbance of sleep is to be expected. Recently, alterations of sleep have been confirmed in 84% of patients with HrCLM and in 72% patients with scabies. An aspect of morbidity which has been completely neglected is the psychological impact of EPSD. Since lesions on the skin can be seen by the naked eye, in the case of HrCLM and tungiasis even from a distance, the fact that an individual is infested with ectoparasites does not go unnoticed and can be a source of mental strain and distress. The unhealthy aspect of the skin in EPSD and constant scratching of lesions could influence self-esteem and affect the ability to adjust socially.

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In north-eastern Brazil, mothers of children with scabies were treated with topically applicable insecticides/acaricides or with oral ivermectin. First, the diagnosis of EPSD has to be scrutinized. Second, five of the six major EPSD can be effectively treated with topically applicable insecticides/acaricides or with oral ivermectin. Third, since there is a considerable overlap in the spatial distribution of EPSD and because these diseases cluster in similar population groups, interventions against different EPSD could be performed simultaneously.

Control of scabies by mass treatment with topical permethrin has been achieved in hyperendemic indigenous communities in Australia and Panama. The interventions resulted in a significant reduction in prevalence of scabies and severity of pyoderma without concomitant use of antibiotics. In a low-income fishing community in Ceará State, Brazil, where scabies, pediculosis, tungiasis and HrCLM were endemic, mass treatment with ivermectin was performed (2 doses of 200 μg/kg body weight 10 days apart) and the population was followed up for a period of 9 months. Prevalence 30 days after treatment dropped by 97% for active pediculosis and 82% for scabies. Tungiasis and HrCLM also decreased, although, due to the seasonal variation of these ectoparasitoses, the reduction of disease occurrence could not be quantified. Nine months after mass treatment, the prevalences of pediculosis and scabies were reduced by a factor of 2.1 and 2.6, respectively, when compared to pre-intervention.

A plant-based repellent based on coconut oil was used to prevent infestation with sand fleas in an area with extremely high transmission. The twice-daily application of the repellent on the skin of the feet decreased the infestation rate by 86% and reduced intensity of infestation by 90% despite ongoing transmission.

Future goals and strategies
Since major knowledge gaps currently impede the calculation of the global burden of EPSD, it is important to assess disease occurrence and morbidity in a systematic manner. This would lead to an adjustment of the global burden of neglected diseases because existing data suggest that EPSD have a more substantial impact on health than previously thought. Looking at EPSD as a coherent family of infectious skin diseases will make sense in different ways: they tend to cluster in the same populations, they share similar animal reservoirs/ways of transmission and, to make progress in controlling them, they have to be addressed in an integrated manner.

What is needed?
First, sound epidemiological research should be encouraged. We urgently need reliable data on the spatial distribution, incidence, prevalence, seasonal variation, clustering of different EPSD in the same population and on risk factors for development of severe disease. Second, clinical and epidemiological methods have to be combined to determine primary and secondary morbidity associated with EPSD. The association of skin lesions with pathogenic micro-organisms, particularly group A streptococci, warrants indepth investigations. The possible relationship between EPSD, pyoderma and debilitating sequels such as post-streptococcal glomerulonephritis has to be scrutinized.

What can be done?
Since EPSD are so intricately linked with poverty, it seems unlikely that they can be eradicated as long as people continue to live in extreme poverty. Since prevalence, intensity of infestation and morbidity are correlated, a reduction in prevalence will presumably be followed by a decrease in morbidity. This can be achieved by repeated mass treatment with ivermectin. Alternatively, interventions could be targeted at the most vulnerable groups in a defined setting. In
Les maladies parasitaires de l’épiderme : une catégorie négligée de pathologies liées à la pauvreté

Les maladies parasitaires de l’épiderme constituent une catégorie hétérogène de maladies infectieuses, dans lesquelles les interactions parasite-hôte sont confinées dans la couche supérieure de la peau. Les six principales maladies de ce type sont la gale, la pédiculose (de la tête, du corps et du pubis), la tungiase et les larva migrans cutanées dues à des ankylostomes. Nous présentons un résumé des connaissances actuelles sur les PE et montrons que les maladies sont très répandues, s’intègrent souvent dans un polyparasitisme et sont à l’origine d’une morbidité primaire et secondaire importantes. Nous montrons également que la pauvreté favorise la présence de réservoirs animaux, permet à la transmission de se poursuivre, facilite la propagation des agents infectieux par des méthodes atypiques et accroît la probabilité d’exposition. Il en résulte une prévalence et une intensité extraordinairement élevées de l’infestation des populations pauvres par les maladies parasitaires de l’épiderme. La stigmatisation, le manque d’accès aux soins de santé et le comportement négatif face à la nécessité de consulter expliquent pourquoi ces maladies progressent souvent sans être traitées et entraînent couramment une morbidité très lourde parmi les populations démunies. L’urbanisation non contrôlée qui sévit dans de nombreux pays en développement maintiendra probablement les maladies parasitaires de l’épiderme parmi les principales parasitoses touchant les personnes vivant dans l’extrême pauvreté. Nous préconisons d’intégrer la lutte contre ces maladies dans les interventions visant les autres maladies négligées, telles que la filariose et les helminthiases intestinales.

Parasitosis epidémicas: un problema desatendido asociado a la pobreza

Las parasitosis epidémicas (PE) son un grupo heterogéneo de enfermedades infecciosas en las que la interacción parasito- huésped se limita a la capa superior de la piel. Las seis PE principales son la escabiosis, las pediculosis (de cuero cabelludo, cuerpo y pubis), la tungiase y la larva migrans cutánea por anquilostoma. En este resumen acerca de los conocimientos actuales sobre las PE se explica que estas enfermedades están muy extendidas, que el poliparasitismo es un problema
أعمال الجلد الطفيلية التي تصيب البشرة: فئة مهملة من الأمراض المرتبطة بالفقر

ومع ذلك، فإن اكتشاف أمراض الجلد الطفيلية التي تصيب البشرة، وتقليل الوعي، وعدم الحصول على الرعاية الصحية، والتقاعس عن التماس الرعاية العادية، وشد الوضع، الأمر الذي يُقلل من وجود المستودعات الحيوانية، كما أن الفقر يؤدي إلى استمرار سراية الأمراض، إلى وقوع مرضة أولية وثانوية كبيرة. ويبين الباحثون أنه مع الفقر يشيع انتشار هذه الأمراض، حيث تشيع الإصابة بالطفيليات المعددة التي تؤدي إلى قوى مضاعفات شديدة، ونوعية فقرية. وتعود الفكرة إلى أن انتشار هذه الأمراض، والحد من الإبادة المتصلة بها، مهما كانت السبب، والدواء المعول.

References


