SCABIES
AN UNEASY AND UNDERESTIMATED INFECTIOUS SKIN DISEASE

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SUMMARY

Scabies as one of the most common infectious skin diseases in tropical and subtropical countries, is a forgotten disease. Although it is a high prevalence disease in many developing countries, and the cause of epidemics in developed countries, there is not a lot written about it. Literature is very weak, most of the few studies found are from the 70's, thus in consequence, there is an actual lack of update.

Some conditions such as crowding, have been considered of great importance in the transmission of the disease, crowding being looked upon as favouring close contact. But this is not an easy aspect to control, especially in developing countries, where demographic conditions are high and poor living conditions frequent. Also increased travelling, facilitating the spread of scabies and other infectious diseases, is a condition of transmissibility difficult to control. Travelling to tropical countries, where scabies is endemic, has become more and more common to many people.

Therefore, controlling scabies is difficult, and needs more than restrictive measures on travelling and crowding. Treatment seems the only effective measure of control; in this particular disease stressing community treatment rather than individual treatment. But this type of control is expensive and not often affordable for economies in less developed countries.

Scabies being classified as a water-washed disease (suspicious of poor hygiene), another control measure suggested has been improving water supplies: water being a help to cleanliness. But studies show a lot of controversy on the impact of water supplies in the prevalence of scabies.

In order to clarify these and other questions about this forgotten disease, a literature review of scabies, stressing on conditions for transmission and control measures, including the relationship of scabies with water, is done. Also, an epidemiological study in rural communities, where the predisposing factors for scabies are present, is proposed.

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1.- SCABIES AND WATER DEVELOPMENT

1.1 International water decade

The international drinking water supply and sanitation decade (IWSSD), 1981-1990, was declared because a majority of the world's population was inadequately served with water supplies and waste disposal, both perceived as basic human needs (Roundy 1985). Its aim was the provision of potable (safe) water supply and adequate excreta disposal facilities to all.

The availability of water supplies has improved in recent years. In the 70's, World Bank and WHO estimated that 70% of the urban population and 15% of the rural population, in the less developed countries had access to water supplies (Roundy 1985); more recent figures demonstrate a coverage of 74% (in 1980) and of 77% (in 1985) for urban water supply and of 33% (in 1980) and of 41% (in 1985) for rural water supply (Cairncross 1987). The expansion has been considered inadequate. Although the percentage of the population with access to water has increased, so also did the world's population, therefore the absolute number of people unserved is the same or even higher. Thus, due to the increased population and demand, the actual coverage of safe water is not complete.

In the international decade, the WHO established high standards for the provision of water of very good quality in developing countries. However for health and skin diseases, pure water (minimal bacterial contamination is possible, but without the WHO standards) is less important than the provision of sufficient quantity of this element in order to cover the demands of the population (domestic use, personal hygiene, irrigation,..). Porter (1977) has suggested that by increasing only the amount of water available, in less developed countries, the level of scabies would be reduced by 80%, fungal infections by 80%, bacterial skin infections by 50% and leg ulcers by 40%. However, these are only estimates and it has not yet been proven.

Despite the above mentioned negative aspects, the international decade brought international interest and progress in the development of consensus among experts to ensure technology, maintenance, training and community participation in water systems; but it did not have great impact on the availability of more resources for the programmes (Cairncross 1987).

1.2 Health, a major motive

The provision of an adequate quantity of safe water and proper facilities are basic necessities for the maintenance of good health. Although water supplies are beneficial to health, there is little evidence of how much improvement one might expect, since this will be influenced by a number of conditioning factors like seasonal variation, behavioural elements, and socio-economic status. Therefore it is difficult to establish a cause-effect relationship.

It seems also probable that in communities, where people need to travel far to collect water, they may use less water for personal hygiene or washing. It is suggested that in communities where one must walk more than 30 minutes to reach the water source, there will be a decrease in water consumption (variable depending of queuing, size of the household, collectors). But when the water source is within 30 minutes of distance, the consumption is more or less the same, independent of the time spent (10 minutes or 30 minutes). This consumption is illustrated as a plateau (Cairncross 1987). Only in cases where the source is situated at home (tap) the water consumption increases greatly. As an illustration of the assumptions, the results of a study carried out by Cairncross et al, (1987) in Mozambique are presented:

	Community far*	Community close*
Total water consumption	3.24 l/pers/day	12.30 l/pers/day
Personal hygiene	0.80 l (25%)	4.75 l (38.7%)
Children's hygiene	0.04 l (1%)	1.23 l (10%)
Washing clothes	0.54 l (17%)	2.64 l (21%)
Washing food	0.50 l (15%)	1.36 l (11%)

(* far was ± 5 hours and close was ± 15 minutes)

These are only partial results of the study, although it is not correct to assume that everywhere it will happen the same way, these figures show that the closer the water source is, the more likely it is that people use water for their personal and children's hygiene. This may be advantageous for their health status. However, it would be a fallacy to assume that communities closer to water sources, will have as a result better health, because this is dependent of the use of the water. As this has been explained before, a very close relationship with behaviour, education, culture. Feachem (1973) pointed out that programmes directed to reduce morbidity of diseases only by improving water supply will not achieve their aim, because of the need for educating people on matters of personal hygiene and cultural practices.

1.3 Classification of water related diseases

A water related disease is one which is related to water or to impurities within water; it is possible to distinguish between the infectious water related diseases and others associated to clinical property of the water. The first type is seen more often in developing countries, and the second one, are of more importance in industrialized countries.

In order to assess the health effects of water supplies, it is necessary to have a clear understanding of the possible interactions between water and health. Diseases may spread through

water supplies, because inadequate water is available for personal and domestic hygiene or some agents for disease develop in aquatic animals or vectors for diseases have the breeding places in water. Thus, understanding of this interactions, can be provided by a classification of water related diseases.

In 1977, Bradley proposed a classification of water related diseases, since the classification was in relation to the trasmission mechanisms, correspondent preventive strategies on water improvement were already indicated. This classification was improved by Feachem in 1978. The four basic water-disease associations are:

1. Water-borne diseases, where the transmission of the pathogens is realised by drinking contaminated water. Examples of this category are cholera, bacillary dysenterie and hepatitis. The method of prevention proposed is providing safe drinking water.

2. Water-washed diseases, due to pathogens that have their habitat in poor hygienic conditions (personal, utensils, clothes and surroundings). Examples are skin-(scabies) and eye-(trachoma) infections, louse-borne fever (pediculosis). These diseases can be prevented through the improvement of water accessibility and quantity, and through the improvement of hygiene (personal and domestic) (Bradley 1977,Roundy 1985).

3. Water-based diseases, the transmission occurs by contact of the human being with contaminated water. Examples include schistosomiasis and guinea worm. Preventive measures are protection of the human bodies from these waters and control of the snail population.

4. Water-related diseases, occurring when surface water is used as a breeding places for some type of mosquitoes-vectors of diseases. Examples are malaria, onchocerciasis, dengue fever. Prevention includes spraying and draining of water surfaces, or avoidance of bites by use of repellents, mosquito nets, and likewise.

It is thus easy to agree, after this classification, that safe water supply is desirable in the control of water washed diseases. Scabies being considered as a water washed disease (Bradley 1977), and with suggested reductions, when water supplies are available, of about 80% in its prevalence (Porter 1977). But provision of safe water is not an easy task. The difficulties are not just from technical and economic deficiencies, but also from problems dealing with the use of water, in the human population, due to cultural and religious habits.

2. RATIONALE FOR THE PROTOCOL AND LITERATURE REVIEW

As explained already in the summary, literature on scabies is weak, and in most of the important articles found, it is

necessary to refer to the 70's and beginning of the 80's. This situation may be due to disinterest for the disease, or to lack of new knowledges about it.

Although being a disease of public health importance, because its high transmissibility and strong endemicity, especially in areas of tropical countries; and because the higher number of population being actually affected or having been affected once in their life, literature is still narrow in some aspects of the disease. Epidemiological factors of scabies are only guesses, such as cyclic evolution of scabies in epidemics, or it has controversial discussions about the different aspects of transmissibility, some of them being very bitter, such as fomites transmission (for references, see specific chapter).

Thus scabies is still underestimated as a disease, not only for the health professionals that miss its diagnosis, but also for the affected population with the disease (if reinfections are often, there is tendency to seek less health care).

Scabies is not a killing disease, only few exceptions are mentioned, mostly due to mismanagement. However, it is a very unpleasant disease (not by own experience, but by trustable references), and can end up with serious complications, if the treatment is dilated.

The presence of scabies was mostly in countries where the disease seat endemic and exportable, and where the water conditions were poor. Its inclusion in the 70's as one of the water-washed diseases, and also its implication of being associated to poor hygienic conditions, ended by proposing the improvement of water supplies as a unique control measure. This was only a few years before the water decade was started.

But literature has been showing controversial findings about provision of water supplies in infectious diseases in general, and in scabies in particular. The water supply improvement, as the only control measure, did not have the expected impact in the reduction of scabies. In scabies, hygiene has an especial importance, and although not being the key factor for its control, it can be improved with the assistance of big amounts of water available. Thus water supply is an aid for hygiene and cleanliness, this establishes that after an increase on availability of water, there will follow an increase on the use of water.

It is possible, that not only one measure, but a combination of measures will modify the degree of infectious skin diseases (scabies, pyoderma) on populations in the less developed countries. However, depending on the available economic resources, cost-effective analysis will be needed in order to provide a sequence of priorities in the introduction of control measures.

Therefore, more literature is needed about scabies, in order

to offer a good understanding and a deep interest in it. At the moment, only a literature review, knowing that some updated figures are missing, and a protocol are suggested, with the wish to estimate this underestimated disease more.

3.- INTRODUCTION TO LITERATURE REVIEW

3.1 Skin diseases

Skin diseases account for a high proportion of visits to primary health centres in rural and urban communities in the tropics, often limiting their capacity to carry out other important activities such as immunisation. The consultations are in general limited to endemic diseases such as tropical ulcer, impetigo, framboesia, scabies and to other problems such as wounds. The social and economic impact of skin diseases in the developing world can be important: dermatologic disorders are among the five most common causes of morbidity and loss of manpower in rural areas. From 60 to 80% of skin diseases encountered in tropical areas are preventable, curable and controllable (Ryan 1990). In most of them 90% of skin diseases are firstly attended by personnel not trained in dermatological skills, such as: the auxiliary health worker; in Africa 25 of 50 countries have no dermatologist (Ryan 1990).

Although the pattern of non infectious skin diseases remains relatively constant through the world, what makes the difference between developed countries and developing countries, is the prevalence on infectious skin diseases.

Presence of bacterial, fungal, viral, parasitic infections on skin diseases, and exposure to the same agents, has been found more often in less developed countries. Some authors like to talk about (sub)tropical and non tropical countries (Porter 1977), however the climatic distribution follows, in general, the economic distribution. The causes can be complex, but an interrelationship between climate, as a favouriser that give oportunity to all the causal agents to live. Living conditions, due to economical or cultural or educational factors, as a favouriser for proliferation of all these agents. And individual resistance, mostly weaker in less developed countries, due to poor nutritional status among others, as a favouriser for transmissibility.

Related to this causes, certain skin conditions have been regarded as dermatological markers for the levels of environmental hygiene, personal and commnunity (home surroundings). In various community surveys carried out in East and Central Africa (Jelliffe 1972), the following were indicative of poor environmental conditions:

- in infants and young children: scabies and molluscum contagiosum, impetigo.

- in older children and adults: tropical ulcers, yaws.

- in men: carcinoma of penis.

- in women: carcinoma of cervix.

Some figures illustrating this differences between developed and developing countries, in infectious skin diseases, have been reported (Porter 1977), for developed countries the range of infectious skin disease was 29.2 % (from a study in clinics in UK) and of 65.6 % (Nigeria), 74.2 % (Mozambique) and 53.1% (India) for developing countries. The differences between developed and non developed countries are significative, however this figures are at least from 1977, it is possible that actual figures of prevalence will be different, due to the increase travelling by people coming from the developed countries and going to the tropical and subtropical countries, and the continous migration from tropical to non tropical areas, but this will need further investigation.

3.2 Scabies

Scabies is one of the most common infectious diseases of the skin in man, overall prevalence rates of 29.9% (30.7% in urban areas and 29.6% in rural areas) has been described in Rwanda (Van Ecke 1980). Caused by infestation of the itchmite Sarcoptes scabiei, has become a major health problem, together with its secondary infection (explained in detail in section 9.), in developing countries. A study in a community in Mexico, encountered that 60% of all skin diseases could be attributed to scabies, childhood pyoderma, fungal infections and conditions causing pigmentary abnormalities (Hay 1991), although the percentage attributed specifically to scabies is not known, the prevalence rate on skin infectious diseases follows the general pattern in developing countries.

It has been suggested that the main determinants for scabies are individual and environmental factors rather than climatic, however, some differences of association with climate (in Peru, higher prevalence of scabies in dry communities in the Andes and in the lowlands, whereas in Papua New Guinea the higher prevalence was in the highlands) has been reported (Porter 1977). Moreover climate only plays an important role in the presence of secondary infections like pyoderma (Taplin et al 1973); also seasonal variability in the prevalence of pyoderma and fungal infections has been described (Porter - 1979). Within each climatic zone there is significant differences in the presence of this (secondary) bacterial infections, a study of skin infections in Colombia showed higher prevalence rates of pyoderma in the jungle, intermediate in temperate area and lowest in cool climate (Taplin et al 1973) more presence of insects and flies was associated to the differences.
Important factors like levels of hygiene and socio-economic status, and individual factors like age, sex, race, nutritional and immunity status, migration, could form part of a more

complex relation in determining the presence of scabies, but these possible risk factors are explained in more detail in section 6.2.

4.- LIFE CYCLE OF THE PARASITE

Human scabies is caused almost exclusively by Sarcoptes Scabiei hominis. Different varieties of Sarcoptes can affect cats, dogs, sheeps and other wild animals. Only the species parasiting dogs may cause problems in humans.

The fertilised adult female mite, which is responsible for the symptoms of scabies infestation, excavates burrows (holes) in the skin (between the stratum corneum and the stratum granulosum, see diagram 1 in the appendix), within one and six hours after being transferred to a new host. The female will stay in this skin layer for all her life, ie. between 4 and 5 weeks, laying two to three eggs a day and extending the burrow every day. The eggs that are layed may mature to adults in 10-14 days and after mating, the lifetime egg-laying cycle starts for a new female mite.

5.- EPIDEMIOLOGY OF SCABIES

Although its presence is worldwide, scabies is extremely common and widely distributed through the (sub)tropics. It is a contagious disease that spreads in households and neighbourhoods in which there is a high frequency of intimate personal contact.

Scabies is known to go through long cyclical changes in endemicity, thirty year cycles of scabies epidemics exist. The cyclic nature of scabies epidemics is not well understood, although group immunologic factors, especially delayed hypersensitivity, probably play a significant role (Orkin 1971); also the decrease of a population's immunity (ie. by famine). May be important changes in the immune status of the host population (herd immunity) has been hypothesized as the cause of this cyclical epidemics of scabies (Burkhart 1983). Immunity will increase during an epidemic and after a period of 15 to 30 years, the immunity in the population will be only partial; then more and more people will again become susceptible for the infection. However it is possible that some people may either naturally be immune for scabies infection or due to repeated exposures to the mites.

The achievement of herd immunity implies that infection will not be maintained in population (net case reproduction rate <1) when the number of susceptibles is below the epidemic threshold 1/r*. Although there will be people infected in the community, the number of immune people will be greater than the number of susceptible people that is needed for continuation of the infection. But this theory has some weak points, such as:

a) there is insufficient data on this cyclical threshold of scabies epidemics.

b) there is no specific immunity against scabies; only general immunologic reactions occur: Ig E around vessels, circulating immunocomplexes, immediate hypersensitivity reactions, modification of serum immunogolobulin levels,.. This means that reinfestation can happen.

c) herd immunity does not protect against being infected and even against the predisposition to be reinfected.

*r= transmission parameter (proportion of all possible contacts between prevalent and susceptible, leading to new cases).

Many other factors have also been suggested to contribute to this cyclical nature of scabies: changes in social attitudes, population movements, wars, natural disasters, misdiagnosis and inadequate treatment.

The long inter epidemic interval is also suggestive for a low reproduction rate of infection, in addition to the above mentioned factors.

As in many other diseases, patients infected with the mite but not yet symptomatic play a major role in the transmission. Patients affected can transmit the mite before symptoms appear (carriers) and this may extend over a period of one month or more (Orkin 1976). The consequences of this characteristic are that, although prevention measures can be applied, they will not always be successful in controlling transmission of scabies.

6.- **TRANSMISSION OF THE PARASITE**

6.1 Parasite characteristics

Scabies mites are most readily spread through close body contact, since the mite cannot "jump" from one person to another. It is important that the contact is prolonged in order to provide enough time for the mite to pass to the new host.

For the mite Sarcoptes Scabiei transmission to another suitable host is heavily dependent on its ability to survive outside from the host. The mites can use limited quantity of water vapor from the air and must obtain water from the host if not dessication occurs; survival time is thus proportional to the ambient relative humidity. The estimated survival at room temperature and typical humidity is no more than 2 days. High humidity and low temperatures lead to early death. In the host, the important factor on the skin surface is the hydration of the stratum corneum, which has a function of the sweat proliferation and the ability to evaporate water from the skin surface. This evaporation depends on the amount of

pore's occlusion, wind velocity, temperature and relative humidity.

Transmissions other than by human beings, like fomites (explained more in detail in section 6.2.3) and by Sarcoptes species of animal origin (cats, dogs, cattle) have also been described, although this last one is considered as a self-limiting infestation (Fain 1978).

6.2 Conditions for transmission

6.2.1.- Intrafamiliar transmission

Since scabies is transmitted by physical contact the household can be taken as a basic unit for surveys.

Intrafamily spread of scabies is common, with transmission in the household considered as a cluster. Larger households are more likely to have infected individuals because of the larger numbers of susceptible people at risk. Also due to the quick transmission because of the smaller space. In a study by Srivastava (1980), 57.3% of the cases of scabies were contracted through the family, 28.3% through the neighbourhood, and 9.7% through school or classmates (only children were affected).

Although scabies has been found to be very common among school children, there is no evidence that transmission occurs within the school room (Mellanby 1942). Typically a few children from all parts of the school will be infected and more often than not, they will be members of only one or two families. Blumenthal (1976) found in a study of a community oubreak of scabies a lack of room-clustering of the cases and pointed out a possible transmission outside the school.

The higher prevalence in pre-school (<5 years) and school children (6-10 years) than in adults and older people (few studies have been found also high prevalence in this group Nair 1977), may be due to the higher chance of close contact while playing outside or inside the house. Small children are at increased risk of infection. The children are carried by mothers or by other infected members of the family (younger brothers and sisters). They have close and permanent contact with infested surfaces (floors, dust). Moreover, their immuno system is weaker.

Other studies mention conditions of overcrowding, in houses, during wars, in refugee camps, in case of natural disasters (Mellanby 1942, Alexander 1969). An article in the Lancet (1991) suggested chemoattraction of mites to suitable hosts, which is evidently facilitated by overcrowding in houses or in the community. The sharing of beds and clothes and the close contact enable the mites to be selective and find the most adequate elements (suitable hosts). Gulati (1977) found that in India scabies was more prevalent in crowded families, with 41% of prevalence in crowded families versus 25% in small

families. He defined the sleeping space as an index for crowding. Thus in larger families, living together in the same house, the available sleeping space may be very limited, depending on the family's resources. Orkin (1971) suggested also that poverty, is related to these last comments.

However, it has been demonstrated in other studies, that although crowding and poverty have been associated with endemic scabies, these factors were not important in epidemics (Gooch 1978). Other factors like higher numbers of susceptibles together, the immune status of the population and social behaviour may be more strongly associated in the spread of the disease.

6.2.2.- Sexual transmission

Scabies is usually considered a sexually transmitted disease (Orkin 1971, Green 1989), based upon the fact that the disease is mostly transmitted by intimate contact. However, there are different opinions about the appropriateness of this description (Burkhart 1983). It has been stressed that transmission of the mites requires close body contact but not necessarily sexual contact, unlike sexually transmitted diseases, such as syphillis or pubic lice infestation.

Moreover, scabies does not fit the classic epidemiological patterns of a sexually transmitted disease; the secular and seasonal trends of known sexual diseases, such as gonorrhoea are not the same. More important is the fact that the disease is common in children and that the genitalia are frequently unaffected.

Thus, although the close contact involved in sexual activity can promote transmission simply through the act of sleeping together, the really strong association would be the sharing of the bedding rather than the sexual act itself. In an Indian study (Gulati 1977), the habit of sharing the bed with an infested person gave a prevalence of 45% of scabies versus 22% for people who did not share beds.

In a study in the USA carried out by Judson (1980),comparing disease prevalence rates between homosexual and heterosexual men, found that, although homosexual men were more likely to have gonorrhoea and syphilis, the presence of scabies was less likely in homosexuals than in heterosexuals (0.42% vs 0.72%). In other words, while the presence of the classical sexually transmitted diseases was higher in homosexuals, the prevalence of scabies did not accompany this. Homosexual men are known to have many occasional sexual contacts with partners, without necessarily sleeping with them. Thus, for transmission of the mite, intimate body contact alone is not enough. The duration of the contact with an infected person should also be adequate.

6.2.3.- Fomites transmission

The practice of exchanging clothes or spending nights at friends homes is also correlated with infestation. The spread of scabies via inanimate objects (fomites) has been (Mellanby 1942, Taylor 1979) and still is (Maunder 1991) questioned. For other authors (Burkhart 1983, Arlian 1989), fomites transmission is relevant. In a study in India, about prevalence of scabies, Gulati (1977) found that sharing inanimate materials (towels, bed linnen) was responsible for 45% of transmissions vs 26% that did not share.

The controversy about the role played by fomites in the transmission of scabies comes from:

a) the morphology of the parasite: due to its small legs, the parasite is not able to jump; as a consequence, the transmission can only occur by prolonged contact.

b) mites are not capable to exist freely; thus, fomites are not able to transmit scabies (Maunder 1991).

However, an article in the Lancet 1991 (describing Norwegian scabies), does mention transmission through fomites due to the survival of mites in homes, in furniture, in floors, in curtains. However:

a) it was not demonstrated that these fomites were the focus of scabies transmission in the study

b) in Norwegian scabies the presence of thousands of mites can facilitate the spread of mites all around the infected person.

There exist some contradictions between the authors, and for both view points, not enough evidence is given to support one theory or the other. It could be possible that fomites play a minor role in transmission of scabies; although they cannot jump to a new host, they can stay (maybe a limited time, depen ding of ambient temperature) outside the host, and a prolonged contact with a (possible) new host by infected bed linnen, clothes, furniture, can favorise the "pass" of the mites to this new host.

In tropical areas, the type of housing and the presence of earthen floors, together with other characteristics, will influence the endemicity in the presence of the mite.

6.2.4.- Mobile populations (travel, migration, tourism)

Increased travelling is another risk factor for the spreading of many infectious diseases, and may promote the spreading of scabies from one country to another.

Human scabies outbreaks frequently arise due to:

1) the introduction of infection into an area where the disease has temporarily been absent, by migrants coming from endemic areas,

2) human mobilitiy, when susceptible people have been moving into endemic areas (transmission foci of scabies).

High numbers of susceptible individuals travelling to areas where scabies is prevalent, may share the same living circumstances, may be present promiscuity (Orkin 1971), and may have contact not only with infected people but also with parasites responsible of the infection. This importation of an infectious disease by travelers or migrants tends to diminish the seasonality of the disease in a specific country, because of the differences in conditions of endemicity and climate.

Studies carried by Lange (1987) demonstrated that another source of imported infectious diseases (scabies and others*) are adoptees (from Korean origin to be adopted in USA).
* hepatitis B.

6.2.5.- Racial factors

Racial differences in the incidence of scabies have been seen in South Africa, where the prevalence has been higher among dark-skinned people. And in New Zealand among Maori population and Polynesian inmigrants, the prevalence was higher than among the European community (Burkhart 1983, Green 1989). The disparity in prevalence may be due to the different cultural habits: in hygiene, social attitudes, living conditions,..

Differences in prevalence have been also described between adherents of different religious cultures. Gulati (1977) found that the prevalence of scabies was higher in Christian families than in families from Hindu origin, certainly due to their differences in hygienic practices and in socio-economic level.

Despite frequent literature references about racial differences, the findings do not appear to support the existence of different racial susceptibility. Social behaviour related to cultural beliefs and socio-economic status seems to be the determinant, for the differences in health status, rather than race conditions.

It is known that in some diseases, race can be a determinant of pathology (sickle cell anaemia, and 6 GPD deficiency are more common in black people; mola hydatiforme is more common in Asiatic women). However, although there are differences in skin morphology between races (differences in the epitelium of the stratum) there is not enough evidence in order to assume that one special type of skin is much more susceptible to scabies infection than another.

6.2.6.- Nutritional factors

Poor nutritional status, has been suggested as being associated with scabies in India (Nair 1977). However this cannot be generalized to other countries, taken into consideration the particularly poor nutritional status in some parts of India

and the characteristics of endemicity of scabies in this country.

Whether poor nutritional status finding is correlated with scabies as specific factor or as a coexisting factor in the population, is a question that in order to be answered needs further investigation.

6.2.7.- Hygienic factors

The role of hygienic practices, not only personal but also at community level, has been mentioned by some authors (Mellanby 1942, Orkin 1971, Bradley 1972, Gulati 1977).

The correlation between poor hygiene practices and higher rates of infection was found in a study in Bangladesh (Stanton 1987). However, the higher rates were found among children. And children are not often, in any society, associated with cleanliness. Instead, Gulati (1977) found no association between personal hygiene and disease and according to Orkin (1971) and Gooch (1978), the presence of epidemic scabies was found in populations with hygienic habits and during periods of increased prosperity. However, it is not clear whether these epidemics started following a cyclical pattern; epidemic circumstances depend on factors other than hygiene for the transmissibility. The presence of a big quantity of parasites in the environment and of a high number of infected persons, makes the contact with the mites easy, independent of the hygienic status. Also good hygiene did not protect against scabies in nosocomial outbreaks (hospitals, residences) (Burkhart 1983).

The action of self washing with soap (not indispensable, some soaps have been accused of favorising the proliferation of parasites and bacteries in the skin, due to the decrease on cutaneous bacterial flora) and water may favorise the killing of mites, that have burrowed very close to the surface or that have not yet started the burrow (it takes between 1 and 6 hours before the mite penetrates in the skin). Thus frequent washings may prevent the parasite to establish itself, but if infection takes place during the sleep, in a bed with infected bed linnen, the chances of removing the parasite by washing are not very good.

Moreover its possible that scabies is more frequently seen in people coming from not very clean environments, poor hygienic conditions, but once the parasite is introduced in the epidermis, the development of the infection will proceed irrespective of the skin cleanliness.

Other risk factors mentioned by different authors are:

6.2.8- Misdiagnosis

Scabies is often mistakenly treated with local and sometimes systemic corticoids, which may cause amelioration of symptoms

and signs, while the infestation persists. The resultant clinical picture is atypical and more difficult to diagnose, although infestation and transmissibility persist.

Misdiagnosis is due to factors which include:

a) a lack of professionals skilled in diagnosing skin diseases in the tropics.

b) a lack of training in dermatological problems, which results in a low index of suspicion for scabies.

c) and the presence of atypical features of the disease.

7.- CLINICAL MANIFESTATIONS

The skin lesions in scabies, associated with the presence of the mite, are burrows and vesicles (dues to primary sensitization); in dark skin burrows are difficult to distinguish, favorising misdiagnosis and wrong treatments in tropical areas. The localisation of this lesions are predominantly where skin folds: flexor surface of the wrist, extensor surface of the elbow, interdigital spaces, knuckles, anterior axillary folds, buttocks, knees, scrotum and penis in males and breast region in females. The belt line has also been reported as a frequent site, may be due to pressure points which enable the mite to start a burrow.

Severe itching is the cardinal symptom of scabies; it is more frequent at night, but can also occur at other times. However, Nair (1977) found that nocturnal itching was not a common feature in a study in India. The cause is unknown although some people blame more, sensitization rather than the parasite itself (Arlian 1988). Scratching serves to kill some scabies mites but also causes bleeding, spread of the mites to other areas and the development of secondary infection.

Secondary lesions can sometimes dominate the clinical picture, among them the eczema as a result of the scratching or the secondary bacterial infections like pyoderma, most reported in young people (Taylor 1979), but are rarely seen in young babies (may be due to less scratching).

In Zimbabwe and Rhodesia, cases of glomerulonephritis associated to the presence of scabies, have been reported. May be due to neglected scabies cases (Taylor 1979), (this complication will be explained more in detail in section 9.)

The clinical manifestations of infection by animal species of Scabies are distinguished from human scabies by the distribution of papules and vesicles on the arms, shoulders, trunk, thighs and by the absence of burrows on the hands.

Untreated scabies can terminate often spontaneously after several months, due to the development of sensitization by the

host, that creates a reduction in the normal activity of the mite.

8.- NORWEGIAN SCABIES

Norwegian scabies was first described by Danielssen and Boeck who noted the condition among leprosy patients in Norway in 1848.

Norwegian scabies is usually characterized by:

a) very large numbers of mites; up to two million mites could be present. This is in contrast with the normal scabies where only between 200-300 mites are present.

b) the lesions have a hyperkeratotic and crusted aspect, specially in palms and soles, often with thickened nails.

c) exfoliating scales and redness often widespread all over the body.

d) delayed clinical diagnosis.

The most characteristic lesions are seen in the extremities, as above mentioned. The neck, the face and the scalp can be also affected, the last one with presence of alopecia. Burrows and pruritus can be present but they are not characteristic. The disease can have an incubation period of up 1 year, before manifestations occur, and can last for more than 21 years (Fain 1978). This form of crusted scabies is highly infectious, and has been described as source of outbreaks (Haydon 1971, Reilly 1985).

This form of scabies has been associated with a number of underlying disorders, generally of the immune system, but not specifically, although the condition generally occurs in people with lowered immunologic reactions. A number of reports of Norwegian scabies in mongoloids have been described (Haydon 1971). It is not clear why specifically mongoloids are affected. Possible reasons are immune deficiency and ineffective scratching in order to remove the mite. Other descriptions of Norwegian scabies have been reported in patients affected by the AIDS virus (Sirera 1990).

9.- COMPLICATIONS

Scabies, as an important skin disease, is of concern not only because of the considerable discomfort, associated with its intense and prolonged pruritus, in terms of unpleasantness and debilitation; but also because of its more serious complications.

The scabetic lesions frequently become superinfected, due mostly to scratching, that causes excoriations which, when

infected by bacterial agents, may lead to serious wound infections and sepsis. Taplin (1991) found that the common cause of pyoderma, considered the most frequent secondary infection in scabies, and defined as a superficial bacterial infection of the skin, in tropical and subtropical countries, was Streptococcus pyogenes although more lesions became secondarily infected with Staphylococcus aureus (Taplin 1973).

Masawe (1975) found in Tanzania that the most predisposing factors for pyoderma were trauma, insect bites, hot climate which favorise the presence of wound-feeding flies. The same findings as those in a study in Colombia (Taplin et al 1973).

Another complication seen in scabies, that may lead to death, if not treated, was acute glomerulonephritis. It may occur in patients whose scabetic lesions are complicated by a virulent nephritogenic streptococcal strain, Streptococcus group A (Masawe 1975). This complication has been reported mainly in Trinidad, where epidemics of acute glomerulonephritis have been described (Sharret 1974, Porter 1977), and in Africa among underprivileged patients, already with chronic diseases like tuberculoid lepra (Porter 1979). Therefore will be advisable, to health workers, to think about the possibility of glomerulonephritis, when scabies and bacterial infection coexist.

In addition to the attendant pruritus and sepsis, scabies can also be a conditioning infection in the causation of malnutrition in young children in tropical countries, mainly due to the nutritional stress of pyogenic infection and to the sleeplessness which can interfere with the child's appetite.

10.- **TREATMENT**

10.1 General considerations

The treatment is curative, there is no need for symptomatic treatment, because the curative is relatively quick, more or less reliable and cuts the transmission of the disease. This is different from many chronic diseases, like Tb., where the treatment is long, with sometimes the presence of resistance and losses to the follow-up, thus without halting in the transmission.

The principles of case management of scabies are: the diagnosis should be made with certainty, preferably by identifying the mite, prior to instituting therapy. If the mite cannot be detected, there should be a review of suggestive features, and the more to be found, the more positive is the diagnosis.

All members of the household and also occasional contacts of infected patients, can be treated at the same time. However, some physicians prefer to treat only the cases. Since the incubation period may be up to 6-8 weeks, persons without scabies (asymptomatic) can have many mites prior the starting

of the pruritus or the development of lesions, with a possibility to transmit the disease; the latent period of scabies is similar to the incubation period, explaining the high infectivity of the disease. This is called the "ping-pong" situation (Orkin 1976). Thus scabies can spread rapidly through a community of numerous unaware carriers. Taplin (1991) found that random treatment of symptomatic individuals, was a waste of time and resources, because most of them became reinfected very soon.

Following effective therapy, it may take several weeks before all the symptoms and signs have gone. The hypersensitivity will not disappear immediately on destruction of the mites; on the other hand the patient is unlikely to transmit scabies 24 hours after initiation of the treatment with an effective scabicide. Retreatment is rarely needed, unless scabies infection is reacquired. Concomitant infections may require systemic antibiotics, but can cure spontaneously when scabies is over.

Treatment failure can occur, if the patient does not follow instructions completely, or neglects to treat all the members of the household or the significant contacts outside the household. Persistent itching is a common manifestation of hypersensitivity, and is not a sign of drug resistance in the mites; such resistance has been suggested in some studies (Orkin 1976) but not conclusively proven. Resistance can only be proven by demonstrating the continued presence of the mites in the patient after the treatment has been well applied.

Economically, the impact of scabies can be important: a) the cost of the treatment is high, not only due to the treatment itself, but also because it is often incorrectly prescribed and wrongly used, b) there is not an integral approach in the treatment of the whole community. Both factors are leading to a path of retreatments.

10.2 Specific agents

10.2.1.- Gamma benzene hexachloride

Or Lindane 1%, is the scabicide more widely used in the treatment of scabies and pediculosis, the preparation is usually effective and easy to use, although some irritant contact dermatitis from frequent use is not uncommon (Orkin 1976), however the product presents some toxicologic effects when used excessively.

In some studies they recommend not to use this product in application in infants or young children (Orkin 1976), some authors have demonstrated transcutaneous absorption, which the result of high blood levels of insecticide. In one case it was a clinical seizure (Green 1989) and a death case reported in a child of two months old (the same reference). Adverse effects in premature,malnourished infants and pregnant mothers have also been reported (Davies 1983). Lindane toxicity

includes potentially serious effects on the central nervous system, in man and the possibility of being carcinogenetic in high doses (malignant tumors in rats and mice).

As with other scabicides, therapy is preceded by soap and water washing, although the use of this technique is no longer recommended in general (Merck 1987). As Sharrett et al (1974) showed in Trinidad, use of soap is not correlated with decrease of bacterial flora in the skin, thus in less developed countries where presence of soap in the households is practically inexistent, its non use will not affect the evolution of scabies lesions. Usually one application of Lindane is sufficient, but there is some theoretical reason for a second appli -cation after one week to destroy recent larvae.

The preparation is available in cream and lotion form, under the name of Quellada and the price per treatment is ± 0.63 £ (references by Stafford-Miller Ltd.).

10.2.2.- Crotamiton

Is an effective nonspecific antipruritic agent, the itching associated with scabies responds rapidly to the use of this medication.

Several cases of crotamiton sensitization have been reported, usually after prolonged use in patients with eczema, or can be occasionally irritating after applied to inflamed skin.

Crotamiton is presented in form of cream 10%, and must be applied twice with 24 hours of difference. Crotamiton is available under the name of Eurax and the price per treatment is 2.57 £ (references by Stafford-Miller Ltd).

10.2.3.- Sulfur ointment

This product, has been used for centuries and is preferable for infants and small children (Orkin 1976). Although it is frequently stated to be irritating, this product is an excellent acaricide.

Sulfur is usually prescribed as precipitated sulfur (concentration from 5% to 10%) in petrolatum. Some people prefer to add peruvian balsam (3%) to the sulfur ointment. The application is nightly for 3 nights.

10.2.4.- Benzyl benzoate 25-30%

In cream or lotion. Although this preparation is a good scabicide, it has not been used much in general, because the painful effect of the spirit, particularly in children, also the solution tends to settle out quite rapidly, thus if the lotion is not mixed constantly during the application, a lower preparation could be applied. Some patients have increased itching or irritation after application of this preparation especially in the male genitalia, however it is not considered

one of the typical localisations of scabies lesions.

The application is nightly or every other night for 3 applications. It is available under the name of Ascabiol and the price/person of treatment is 1.17 £ (references by Stafford-Miller Ltd).

10.2.5.- Permethrin 5%

In cream, seems safer and more effective, but has been not yet commercialised. Is a pirethroid with potent insecticidal activity, because of its lower potential for neurologic toxicity, may be preferable to Lindane for the treatment of scabies, particularly in children. Schultz (1990) in a study in USA, showed that a single 8-14 hour application of Permethrin cream was as effective as a single application of Lindane lotion for the treatment of scabies. The pruritus resolved within 4 weeks in much more patient treated with Permethrin than with Lindane. In conclusion this study showed the efficacy and safety of Permethrin, been considered as a posible alternative to Lindane in the treatment of scabies. Also Taplin (1991) recommended as a drug in the mass-treatment campaigns, due to the effectiveness and well-tolerated medication. The application is at once, and after 14 hours it is possible to wash-off.

Because of being a not widely distributed drug, the treatment is still expensive (figures are not available to the author), although because of its safety, specially in children, its properties of spreading (one of the better ones in all scabicides) to all parts of the body and at least the same efficacity than with Lindane, this drug has a promising future in scabies treatment, once marketing and distribution have solved the final prices in personal cost.

11.- **MEASURES OF CONTROL**

11.1 Role of prevention at individual level

Because transmission occurs mostly by contact, the first line of prevention is to <u>avoid proximity to the mite</u>, in other words to infected persons with scabies. This recommendation does not seem so easy due the asymptomatic but transmissible period before the manifestations appear. This measure means avoidance of sharing an infected person's clothes, towels and bed linnen, chairs or coats, and contact with family members or roommates who may have the disease.

11.2 Role of community treatment

The high prevalence of scabies in some areas of the world, especially in tropical countries, is due to the failure, in large part to <u>treat family and community reservoirs</u> once an index case is found. Taplin and colleagues (1991) have argued that the management of many skin conditions, and in concrete

scabies, requires a planned community approach. In practice scabies treatment aimed at the entire community has both a) scientific and b) economic merits.

a) the elimination of reservoirs of infected persons, makes the spread of the disease through a community impossible.

b) although the economic effort of treating everybody is high, the benefits of no retreatments and the avoidance of secondary infections or complications may result in a posterior economic benefit.

To Rhode & Gardner (1973) the control of scabies would be very difficult if not all the members of the family are treated simultaneously (Estes 1968), due to the spread of the infection within the family. In crowded living conditions (situations with population concentrations) where scabies is endemic, simultaneous community wide treatment is necessary.

11.3 Role of Health professionals

In the endemic areas, and during epidemic outbreaks of scabies, the need of the presence of a team of health professionals has been suggested (Burkhart 1983). Taplin (1991) found that this was one of the keys for the success of a project on scabies control in Panama.

Misdiagnosis and thus wrong management, is shown to be an important risk factor in some outbreak situations (Haydon 1971, Reilly 1985). A lower index of suspicion leads to an increased spread of scabies. For a rapid diagnosis and proper treatment of the disease, a continual education of health professionals, is essential in order to maintain a high index of suspicion of scabies where it is appropriate.

11.4 Role of Health education in Hygienic practices

The interest in the role of education in disease control has increased considerably in recent years. It is probable that better educated communities have relative protection against several diseases compared to less educated, but otherwise similar communities. This protection may be conferred both by general education and by disease specific education.

International Public Health recommendations underline also the importance of education in controlling skin diseases, but there is little documented experience of hygiene education programmes related to scabies and their feasibility and even less about their costs. But other examples of health education suggest that such programmes are feasible on either national or local level and that they can use a combination of mass media techniques and direct interaction between target families and hygiene promoters.

In conclusion, the adoption of hygienic behaviour can only be achieved by sustained (long term) and culturally appropriate

educational programmes (Feachem 1984).

11.5 Role of communicable disease condition

The realisation of an international registry of skin diseases, making scabies a reportable disease (Andrews 1981) has been proposed in order to improve the understanding of the disease. Currently, there is no international cooperative scheme to report on the incidence of scabies or pediculosis on a regular basis. Some data on incidence and prevalence have been collected within individual countries, but the quality and quantity of the data have been highly variable.

For these two diseases, scabies and pediculosis, there are conditions present in many countries and obviously there are advantages in having as much reporting as possible. However there are also some disadvantages in the realisation of this international registry:

a) It is true that scabies, being a endemic condition in some areas, would be unreported because motivation of reporting will be decreasing.

b) The realisation of an international registry, will need strong logistical support and therefore, its cost-effectiveness may be low.

11.6 Role of multinationals

Although scabies has been considered as one of the most infectious skin diseases, with high prevalence in tropical areas; there have been no attempts made by the World Bank to include scabies as one of its subjects of review. A little attempt come from WHO, in the person of one of his directors (Porter 1977), to advise a change of view in the allocation of priorities, referring to infectious skin diseases. A shift in attitude for scabies seems to be necessary.

11.7 Role of animal reservoir

Other species Sarcoptes mites from dogs, cats, cattle, can infect humans, but they do not multiply on the human host and they do not burrow into the skin, although some swelling can give the appearance of penetration. Only the specie from dogs can give some problems. Although this type of transmission is limited, and does not spread to big populations, its control would be quite difficult.

Other communicable diseases are dealt with by immunisation programmes, preventive actions, public education and human patient treatment. For scabies there is no vaccine, although after infection by the mites of scabies, humans develope some type of immunity that gives protection against recurrence of scabies. If reinfestation occurs, the disease has a shorter incubation period and there are less mites; prevention is

impossible in crowded conditions (families, communities, natural disasters,..) and public education is a measure that although it is very effective, needs time in order to change behaviours. Treatment is also very effective, but costly. And in order to be effective, it should be available and provided to the whole target population.

12.- RATIONALE FOR THE STUDY

While further comments are in the protocol itself, now only a few commentaries of introduction.

Communities from a mountainous area in South-America, were chosen to participate in an assessment study of preventive measures in the control of scabies. The choice of this area was due firstly because the author knew the area, spending some time there, and secondly because of its geographical characteristics. Only few studies have been done at higher altitudes (Buch, 1968, is one of them); it seems that higher altitudes favorise the presence of scabies, due to the amount of clothes, and the frequent close contact in order to keep warm. Communities are separated from each other, and also have similar characteristics of education and of living conditions: type of housing and hygienic habits.

The realization of the study is in two phases. Because of the lack of information about the actual number of population and the prevalence of scabies, and on the other hand to provide a base of comparability before and after the interventions and between households, a cross sectional survey will be provided to gather this information. The second part will be a follow-up study of intervention and control communities.

The choice of three different types of intervention measures will provide more understanding of which prevention is the most adequate for these communities: looking for decreasing incidence of scabies and sustainability of the methods. With the choice of 3 villages in the control group and only 2 in the intervention group, it is expected to avoid the methodological problem of one to one comparison, where the inter variation between villages is an aspect that can confound the real effect of an intervention. Also, the choice of the control group within the lower prevalence rates of scabies, is in order to avoid that any unexpected factors, introduced in the control community, could influence the impact of the results on the intervention group.

13.- PROTOCOL

13.1 **Aims:** To establish the real importance of water supply and other environmental conditions in scabies transmission.

13.2 Objectives:

1. To see whether improvement of water supply can reduce the prevalence of scabies.

2. To study the possible influence of water supply and other control measures in secondary bacterial infec tions like pyoderma, at higher alti tudes.
3. To investigate the effects of other measures, like health education and hygiene, or community treatment in scabies.

13.3 Choice of study population:

Ayacucho is an administrativ department situated south-east from Lima (Peru), in the Andes mountains. The population in 1990, was 716.000 inhabitants (source the anuario estadistico 1990), distributed as following:

- < 1 year	22500	inhabitants
- 1-4 years	84300	"
- 6-14 years	170300	"
- (10-24 years)	208500	"
- 65 or > years	38700	"

By areas the distribution was:

- urban	278600 inhabitants
- rural	434400 inhabitants

It is deduced from these numbers that more of the half of the population live in rural areas.

Also, from the same source, the number of people, in 1990, in Peru, with access to water supply was only 55%. Coverage was distributed 73% in urban areas and 17% in rural areas.

Ayacucho is divided into 11 provinces and 107 districts (anuario estadistico 1990). Vilcas is one of this provinces situated 110 km south east from Ayacucho, connecte with the capital of the department, by a main road (see diagram map in the appendix). The population in 1986-1987 was between 5000-7000 inhabitants (approximatif numbers, thus no census was available).

People live in small communities, of about 300-500 inhabitants, distance from Vilcas: between 5-35 km. The population depends on farming; agriculture is the main source of income, although the production is mainly limited to domestic use. The main crops are potatoes, maize, quinua and coca leafs.

The province has 1 health center in charge of curative and preventive tasks (immunisations); there is no doctor and the

health facility is run by a trained nurse in charge, assisted by 2 auxiliary nurses, 1 pharmacist, 1 lab and dentist technician (sources MSF 1987). The health center provides also inpatients service (10-15 beds). In the rest of the province only 1 dispensary is functioning, run by a qualified nurse doing the 1 year rural service, after completing studies.

In 1986-1987 an NGO (MSF/B) was working in Vilcas, training health workers (promotores de salud) in 11 different communities of the area (2500-3000 inhabitants) and curative work in the same places. In this time the area was considered an emergency zone, and the work stopped suddenly in June 1987; actually is not expected the area will be in the same special conditions as before, due to the displacement of subversive activities to amazonic areas, and presence of some military personnel.

13.4 Reasons for choice of this area:

Most comments in studies from developing countries about scabies prevalence, draw attention to a complex of poverty, ignorance, illiteracy and crowding and suggest that associated with these circumstances are behaviours that promote transmission of the disease. The chosen communities, are rural, with similar characteristics of behavior and education. Their situation, at higher altitude, where few studies have been done (Buck 1968) and the presence of community committees, women clubs and trained health workers, make the area easy for cooperation and with special characteristics: more or less stable population, to test presence and seasonality for scabies and pyoderma infections.

13.5 Study design:

The realisation of the study will be done in two phases:

1. **A cross sectional study.** Since the main objectives of the study are to test the effectiveness of water supply and other complementary measures in scabies prevention; the first step will be to gather baseline information on all the 11 communities, in order to have a base for comparison after the interventions. The choice is for these 11 communities where the NGO did work, due to the presence of a previous trained health worker, a helpful element in the study, in order to collect specific information about hygienic behaviours.

The study will follow a systematic collection of information:

a) due to the lack of figures in the area and to the possible change in real number of habitants since 1987, a census of the population in each community will be initiated. Stressing the collection of information about the number of people by household and age distribution.

b) additional information, about presence of water sources in the community, distance to the water source used by the house-

hold, methods and frequency of water collection, presence of latrines (household or community), will be asked in each of the communities. Also other characteristics of the household, like type of housing, number of people/ room, level of education and work of the family's head will be annotated.

c) dermatological survey on skin diseases of the whole population from these 11 communities. Stressing the presence of scabies and pyoderma, in age prevalence and in household, due to the tendency of scabies to cluster intrafamiliar and in younger age groups.

d) an alternative approach suggested by Roundy (1978), in order to determine health hazards of the population by studying human behavior, will be introduced. This technique will be useful to study hygienic habits in the communities. Therefore personnel is needed with little medical training, and only a little support and facilities. It can be carried out by health workers, beside local residents in the communities, together with the trained nurse.

Once the information has been gathered between 1-2 months, the second phase will start.

2. **A longitudinal, randomized, intervention study.**

a) Communities with characteristics of comparability, from the 11 communities, will be followed over a period of 1 year. Defining comparability, as having similar dermatologic indicators in scabies and pyoderma prevalence. And in having comparison with respect to confounding variables, like socio-economic status and education. The follow-up for 1 year, is in order to test the possible seasonal trend of scabies, as parasitic infection, and pyoderma, as bacterial infection, at higher altitudes. Most of these communities are between 3200-4100m above the sea level. At sea level, Porter (1979), in the Gambia, did not find seasonal pattern for scabies, although did find it for fungal and bacterial infections (pyoderma). It is of interest to assess, how different is the pattern at higher altitudes; and also 1 year is a minimum time to see some possible changes on behaviour due to the health education programme.

b) The communities will be assigned to one of each intervention types. The allocation will be done by simple random sample, although not in each intervention.

c) The four types of interventions proposed are:

1. IMPLEMENTATION ON WATER SUPPLY. The supply of a water source in the same locality. Realization of a water system, pipeline with taps locate in the community. With the determinants of 1 tap/ 100 persons and distance to the water source less than 1/2 mile.

2. PROGRAMME OF HEALTH EDUCATION. Adressed to the whole com-

munity; stressing the messages about: what is scabies, its transmission and favorising behaviours, may be presents in the community, involved in this transmission. Weekly sessions, done by a trained peruvian nurse in local language, with assistance of the local health worker. Importance must be given to the participation and cooperation of the local committee.

3. COMMUNITY TREATMENT. Community treatment, to all members of the community with or without scabies in the start of the study. The application will be at once, from head to toe of 5% permethrin cream, considered as explained before, as having good results and being less dangerous for children than Lindane. The aim is to stop transmission of scabies in the community, all possible carriers will be treated simultaneously, together with symptomatic scabies patients and other susceptibles, stopping the parasite transmission. To simulate laboratory conditions, new arrivals to the community will be treated, although it will be quite impossible to control people travelling regularly outside of the community, for this group periodic retreatment will be necessary. The easy way is to intervent in communities with difficult access, where there is no important movement of population.

4. CONTROL GROUP. Communities will be chosen where no intervention will be done, neither in water supply nor community treatment nor health education. Although regular re-assessments will be done, the same as for interventions group.

Because interventions in the study are very clear, it appears not appropriate to blind the study, although blindness will be present when analysing results.

13.6 Sampling scheme and sample size:

From the communities, with lower prevalence rates of scabies, once results of prevalence are know, three will be chosen as control group, by simple random sample. Independent of geographical situation and other characteristics. In order to avoid the methodological problem of one to one comparison, one control to one intervention (Blum, Feachem 1983), more controls than intervention are chosen. Due to the presence of an inter-village variation, that may give false results of the real effect of an intervention.

Water supply and health education are typical community wide activities. Therefore having more controls for each of the interventions will avoid problems of been two villages very different between them. Also the choice of communities with the lower levels of scabies, will avoid that unanticipated events affect control groups, which could in themselves influence the impact of selected indicators in intervention communities.

From the most isolated communities, defined as having the most difficult access and the less mobility of the population, two

will be taken, by s.r.s, for the community treatment intervention. To avoid occasional visitors, difficult to control, and to have a reasonable control of all movement in the community, that could interfere in the results.

The rest of the communities, six, by simple random sample, will be allocated two to water supply and two to health education programmes. The stressing of community participation, will be of relevant importance in this two interventions. For water supply it is needed the collaboration of all the community, to ensure rapidity, in the realization of the programme.

The sampling unit will be the household, since water is used by the household rather than by individual, and also because scabies seems to cluster within the household. To know how many households are needed for each intervention, it is necessary to assume the prevalence of scabies in the area. Van Ecke et al (1980) talk about prevalence rates of scabies, in Rwanda, of ± 30%. Also Masawe (1975), found prevalence rates, in Tanzania, up to 32%; and Taplin (1991), in Panama, showed levels of scabies around 33%.

It is supposed that the prevalence rate of scabies in the communities is about 25%, a similar level of scabies than in the above studies, and that after intervention the prevalence will drop until 5%. Although not all interventions may have the same level of reduction; community treatment may have the maximum of reduction, like in the study by Taplin (1991), where the reduction dropped to 1%, and health education may have the minimum, due to the time needed to see some health impact in the population. Applying the formula of comparing two proportions, and with 95% power at 5% significance level (*), the number of households needed will be:

$$n = \frac{2x\ 0.15x\ 0.85x\ 13^*}{0.20^2} = 83 \text{ households}$$

Accounting for possible drop outs in the study, more in the health education programme than in the water supply intervention or community treatment, 20% more of households are needed. The total number will be:

n= 20% more from 83 households= 100 households

Due that each intervention is done in 2 communities, only control group will be in 3 communities, and that the number of inhabitants in each community is around 300-500 inhabitants (MSF/B, report 1987). Thus it is expected to have enough households, in the two communities, for each of the interventions.

13.7 Methods of data collection:

A questionnaire, in the cross sectional survey, will be applied to each household. In all the 11 communities. Ques-

tions like distance to the water source used by the household, in minutes spent to collect the water; methods of water collection and frequency of collection, to assess quantity of water used by the household; or number of people/household and number of persons/room, in order to assess crowding characteristics.

The technique of study of human behavior, seems appropriate to the study. Aspects like use of latrines, by direct observation; personal and household hygiene, by asking about water uses and also by direct observation, will be of interest in assess actual and future hygienic behaviors.

The dermatological survey, will assess the actual prevalence on scabies and pyoderma in the area, stressing the presence within households and age prevalence groups.

All this baseline information seems necessary, as a starting point where to built the intervention programme, and in order to perform further analysis in the study.

Periodical surveillance at 4,8,12 months, to re-assess levels of scabies and pyoderma, in the study communities, will be realized. A special case, in the villages with community treatment, will be necessary to re-assess scabies prevalence after 1 month from starting, to evaluate effects of the intervention and to maintain a record of new arrivals to the community. During the duration of the intervention, information about movement of the population through registry of deaths, migration, births and new arrivals, will be maintained.

The periodical surveillance will not be realized for the whole community, due to cost in time and work. Subsamples of households in each of the interventions, will be matched, by education and socio-economic status, with households in the control group, to assess levels of scabies and pyoderma prevalence. Only in the last re-assessment, before concluding the follow-up study, information will be gathered from all the households been in the study.

Incentive motivation of the population of the area will be done by monthly free consultation, although treatment against scabies will be not provided during the whole time of the study. The cooperation with the health centre in this matter, is vital, with compatible actions, avoiding external treatments for scabies. Complicated scabies cases with surinfected lesions with pyoderma and risk of glomerulonephritis, will be dropped from the study and treated.

13.8 Possible source of bias:

1. Not excluding of villages that are close to a water source, will introduce some selection bias. But the number of communities is not very high, from 11 communities, are already necessary for the study 9, also it is important that it is these villages and not others, the elected, due to the presence of

trained health worker, community committees, and women clubs, all of them with a specific task in the study.

2. Interviewer (observation) bias would be introduced in questions related to hygienic behaviors and conditions of living. Thus it is necessary that these questions are submitted by the same interviewer in all the communities, in order that if some bias is introduced it will be equal in all the interviewed communities.

3. Due that interventions are directed to the communities rather than to individuals, losses to follow-up are unlikely to occur, although it is necessary to have a control of possible population movements.

4. Missclassification is unlikely to occur, because of the presence of a dermatologist or a qualified doctor skilled in dermatologic diagnosis. Misdiagnosis usually occurs because clinicians are not expecting to find scabies, this problem does not apply in this study.

5. An ethical problem will arise from the control group, where nothing will be done about scabies. Although scabies is not a life threatening condition, and complicated cases will be treated.

6. Socio-economic status and education as a possible confounder factors in the study, will be matched for, in the subsamples of households with intervention and in control groups.

13.9 Data handling and analysis:

The responses gathered in the cross sectional survey will have codified numbers, not only the binary answers (yes or no) but also the qualitative answers (type of house, hygienic conditions personal and home surroundings, or water collection), to facilite the further analysis. Each of the households will have a codified number, individual, and not repeated in households from other villages. To allow simplicity in the choice of subsamples for the re-assessment surveys. Also, villages will be codified, with individual number; and the type of intervention to allow for blindness in the analysis.

Before start of the interventions, analysis of comparison between water source and scabies prevalence, will be performed, by α^2 significance test, for the association between variables, in each of the study communities.

During and after the intervention, the main analysis will be, comparison between each of the interventions with the control group. Performance of analysis will be done, taken subsamples of households in intervention villages, by simple random sample, and matching them with households in control group, with same characteristics of economic status and education, in order to assess:

1. if interventions have been negatively correlated with

incidence of scabies and pyoderma.

2. which of the interventions has been more closely correlated to this incidence.

Comparison of results will be performed by statistical test of significance: Z test in comparing two proportions, and a 95% confidence interval for the difference between proportions.

Analysis of changes of scabies through time in the intervention(s) sample, alone, and in the control sample alone, by com- paring two proportions. To assess seasonality of the disease.

Analysis of comparison between means of water use, in households, before and after the interventions (water supply, health education), and between interventions.

13.10 Logistics, time schedule, staff requirements:

The total period of the study is of 14 months. The first two months will be taken for the cross sectional survey, and the rest, 12 months will be for the follow-up in the longitudinal survey.

Time schedule for the cross sectional survey:

-2 weeks: Information to the leaders in the communities (11), about the intentions of the survey team, and to recall the maximum of cooperation from them, from the health workers, and from all the community. To programmate also, the schedule in the visits for the survey.

-3 weeks: Start of the baseline survey: census, dermatological examination, gathering of quantitative and qualitative data.

-2 weeks: Analyse of the results and planning of the follow-up study.

-1 week : Meeting with the communities that will entry in the survey, information about the intentions, the expectations and compensations.

Time schedule for the longitudinal intervention study: the total duration is 12 months. At (1),4,8,12 months will be reassessed prevalence rates of scabies and pyoderma, from subsamples of the communities,(() only be done in the community treatment interventions). Last re-assessment will be realised to all the households participating in the follow-up survey.

At the start of the follow-up, two interventions will be realised:

- community treatment at once to the whole communities (2),

and during all the year re-treatment to the mobile population from these communities and treatment to the new arrivals. This last point can be performed by the local health worker.

- realisation of the water supply implementation, under the supervision of a water engineer and participation of the whole community. Urgence to be accomplished.

During all the study:

- weekly session of health education, in the communities, taking into account the best day of finding most of the population together (market day, church reunions,). The performance will be done by a trained Peruvian nurse together with the local health worker.

- monthly free consultation, in the health center, except for scabies, perform by the doctor in charge of the study.

- possible re-training of the health workers, in an intensive weekly training, twice during the duration of the study.

- occasional visits to the health center, to ensure a good level of performance by the health staff.

Staff needed:

- 1 dermatologist or instead a skilled doctor in dermatologic diagnosis.

- 1 trained peruvian nurse, in charge of the health education programme.

- 1 statistician, blind to the study in charge of analysing the results.

- 1 local driver.

- 1 peruvian water engineer or, failing that, a technician.

- 1 or 2 fieldworkers, one of them will be the local health worker and the other, people from the community.

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APPENDIX 3

QUESTIONNAIRE

These two questionnaires will be used in the cross sectional survey and in the re-assessments of the follow-up study. Information will be gathered by household and in three specific matters: a general and dermatological information, water source information and hygienic practices.

BACKGROUND INFORMATION

DATE ☐☐ ☐☐ ☐☐
d d m m y y

1.- VILLAGE NUMBER ☐☐
from 1 to 11, see list

2.- HOUSEHOLD NUMBER ☐☐☐☐

3.- NAME HEAD OF THE HOUSEHOLD .....

4.- EDUCATION LEVEL HEAD OF THE HOUSEHOLD ☐
1.none 2.primary 3.above secondary
Indicate the appropriate

5.- OCCUPATION HEAD OF THE HOUSEHOLD ☐
1.farmer 2.housewife 3.paid worker 4.other, specify..

6.- TYPE OF HOUSING ☐
1.stone 2.mud with iron sheet roof 3.thatched 4.other

7.- NUMBER OF MEMBERS IN THE HOUSEHOLD ☐

Specify:	Name	Age	Relation	Scabies	Pyoderma
1					
2					
3					
4					
5					
6					
7					

For the dermatological information specify presence by +, and absence by -.

8.- *NUMBER OF PERSONS/ROOM* ☐
Specify number of persons sleeping together in the same room.

ONLY FOR RE-ASSESSMENT SURVEYS:

9.- *ANY CHANGES IN THE HOUSEHOLD DURING THIS TIME?* ☐
1.yes 2.no
If yes, specify any change in the questionnaire

10.- TYPE OF INTERVENTION ☐
See the codified list

APPENDIX 4

QUESTIONNAIRE

DATE ☐☐ ☐☐ ☐☐

SOURCE OF WATER

1.- PRESENCE OF WATER SOURCE IN THE COMMUNITY ☐
1.river 2. public tap 3.none 4. other, specify....

2.- WHERE DOES THE HOUSEHOLD COLLECT THE WATER? ☐
1.river 2.public tap 3.stream 4.rain water
5.other, specify....

3.- HOW LONG TAKES THE RETURN JOURNEY TO COLLECT WATER? ☐
1.less than 5' 2.between 5-10' 3.between 10-20'
4.between 20-30' 5.more than 30'

4.- WHAT DO YOU USE TO COLLECT WATER? ☐
1.teapot 2.cooking pot 3.washing bowl
4.jerrycan 5.others, specify....

5.- HOW OFTEN DO YOU COLLECT WATER, DAILY? ☐
Indicate the appropriate number

6.- MEAN DAILY USE OF WATER COLLECTED
in litres/capita/day

Drinking	.....
Cooking	.....
Bathing,personal	.....
Bathing children	.....
Washing clothes	.....
Others	.....

HYGIENIC HABITS

1.- WHAT TYPE OF SANITATION IS PRESENT IN THE COMMUNITY? ☐
1.community latrines 2.household latrine 3.none
4.others,specify....

2.- USE OF LATRINES BY THE HOUSEHOLD ☐
1.regular use 2.no use 3. use at times
This question must be answered by the local health worker, by direct observation

3.- REGULARLY, BY WHOM? ☐
1.men 2.women 3.children 4.all 5. only adults

4.- PRESENCE OF ANIMALS INSIDE OF THE HOUSE? ☐
1. yes 2.no

5.- HYGIENIC CONDITIONS IN THE HOUSEHOLD AND IN HOME SURROUNDINGS ☐
1.fair 2.average 3.poor
This question must be answered by the same person that does the questionnaire, in each of the communities, by direct observation