Chapter 9

General Discussion

Summary and concluding remarks

General Discussion

The aims of this thesis were to measure the prevalence of different skin diseases among schoolchildren in three sub-Saharan African countries, Ghana, Gabon and Rwanda. Population-based prevalence figures are needed for reliable planning of national health and prevention programmes but are scarce in Africa because of the laborious and thus expensive way to achieve them. We were especially interested in the differences of the prevalence between schools in rural and urban areas and between schools with a different socio economic level (SEL) based on school fees paid.

Because of the high prevalence of tinea capitis we analyzed the causative agents in the Ghana 1 and Gabon studies. We also made a summary of other cross-sectional studies restricted to tinea capitis in schoolchildren and carried out in other sub-Saharan countries (Table 3 **Chapter 4**).

Besides the point-prevalence we also estimated the period-prevalence and possible risk factors of eczema in a case control study. During our research in Ghana we unexpectedly discovered a significantly higher prevalence of acne vulgaris in urban areas as compared to rural areas, after which we decided to analyze the possible risk factors.

If we want to improve the quality and availability of skin disease treatment in Africa, community based studies like our study are very important.[1-3]

Although we got a good impression of the prevalence of skin diseases among schoolchildren we didn't investigate the disease burden. In future studies it would be interesting to assess the impact of skin disease on the quality of life in comparison with that of chronic nondermatological diseases. Several studies like this have been carried out in the industrialized world but they are rare in developing countries.[4]

The outcomes of the different studies in relation to the literature are discussed in the following sections.

The prevalence of skin diseases among schoolchildren in Africa

Not many population based studies about skin diseases among schoolchildren have been conducted in Africa.[5-7] Population based prevalence studies are important in order to plan health care services.[8-10] The strength of our population based study is the large number of schoolchildren investigated; the research was conducted by a dermatologist or a team of dermatologists; and it was performed in three different countries in different regions in Africa (**Chapter** 2). We separated skin diseases and skin conditions as different entities, because several skin conditions like dry skin can be indicative of skin disease but not necessarily so. In other epidemiological studies skin conditions like keratosis pilaris and xerosis cutis are counted as skin diseases and increase the overall prevalence rates. The found prevalences in our study are figures of real skin diseases and can now be set against other epidemiological studies to allow a better comparison with other past and future studies. Measuring a point-prevalence, as we did

in our studies, creates a chance of underestimation especially when chronic, relapsing diseases like eczema are involved.[6;11] Also in this respect our figures can be considered as conservative.

The prevalences of one or more skin diseases per child were high: 34.6% and 42% in both Ghana studies and 45.8% and 26.7% in the Gabon and Rwanda studies. For the percentages of infectious and inflammatory diseases together the prevalences were 22% and 26% for both Ghana studies and 37% and 27% in the Gabon and Rwanda studies. In our study the majority of skin diseases found were skin infections.[11] (figure 2 **Chapter 2**)

In a review of prevalence studies of skin diseases in children in sub-Sahara Africa, the prevalences were ranging from 21% to 87%.[12] The major causes of infection in our studies were tinea capitis and pyoderma, this pattern was conform other African studies. The point prevalence of any skin disease in a recent study among schoolchildren from Dar es Salaam (urban environment) in Tanzania was 57% which was comparable with a study from rural Tanzania which showed a prevalence rate of 55%.[6;8] The point-prevalence of infectious skin diseases in the latter study was 30.4% which was comparable with our studies and other studies from African countries like Nigeria, Ethiopia and Kenya.[5-7;13] Also among schoolchildren in other parts of the world, living in poor conditions, the same pattern can be observed.[14;15] Climatic conditions as heat and humidity, overcrowding, malnutrition and other aspects of poverty and negligence can lead to high figures of infectious diseases in the developing world.[12]

The percentages of bacterial infections in our studies were higher in both Ghanaian studies, most probably due to climatic factors like heat and humidity. Pyoderma was the second cause of skin infection. Among pyoderma we considered bacterial skin diseases like impetigo, folliculitis, abscesses, furuncles and carbuncles. In other studies performed in Africa like in Ethiopia, Mali and Tanzania percentages are mentioned between 5.6% and 4%.[5;6;16-18] In one study from Kenya[10] and one from India[14] higher prevalences of 12,7% and 11.4% have been found. In our studies we found a low prevalence of scabies and other infestations like pediculosis capitis. In several other studies prevalence rates between 0.7% and 30.5% are mentioned.[5;6;19-21] A recent review commented upon this considerable differences in prevalence and stated that scabies is quite common in developing countries but its distribution can be subject to a cycle of infection and can also have considerable regional differences.[22] Since dermatologists in our study checked all suspect cases using direct microscopy of material mounted in 20% potassium hydroxide it is not likely that we missed many.

High prevalences of infectious skin diseases as seen in our study and other studies from developing countries can be seen as a sign of poverty and negligence. Although most skin infections are not life threatening and have a lower mortality rate compared with other diseases they can damage the skin and harm the health and wellbeing of children infected.

The prevalence and causative organisms of tinea capitis in Africa

Infections with tinea capitis are endemic among schoolchildren in sub-Sahara-Africa. Tinea capitis is very contagious especially within big families and when there is overcrowding at schools. In several other studies performed in Africa prevalences were found of 29% in Zimbabwe[23], 9.8% in Mozambique[24], and 9.4% in Nigeria[25] (table 3 **Chapter 4**)

In our study there were quite some differences between the different prevalences in tinea capitis (8% and 9% in both Ghana studies and 26% and 21% in Gabon and Rwanda). One of the reasons that the prevalences in the Ghana studies were lower than in Gabon and Rwanda may be that both Ghanaian studies also included schools with a high or middle SEL where prevalences of tinea capitis were much lower. A lower SEL and the consequent overcrowding appear to be a major risk for tinea capitis (**Chapters 3 and 4)**. In several studies from the industrialized world much lower prevalences for tinea capitis are found.[26-29] Apparently, the prevalence rate of tinea capitis is going down rapidly as soon as the SEL increases.

Prevalence figures of clinically positive tinea capitis in Ghana, Gabon and Rwanda

	Ghana 2004	Ghana 2007	Gabon 2005	Rwanda 2007
Number of children	463	1394	454	2528
T.capitis	39 (**8.4**)	121 (**8.7**)	105 (**23.1**)	522 (**20.6**)
Rural	30 (**13.3**)	79 (**10.5**)	55 (**26.3**)	318 (**21.9**)
Urban	9 (**3.8**)	42 (**6.6**)	50 (**20.4**)	204 (**19.0**)
Low SEL	38 /315 (**10.8**)	100 / 967 (**10.3**)		
Middle / High SEL	1 / 112 (**0.9**)	21 / 427 (**4.9**)		

Because little was known about the causative agents of tinea capitis in Ghana and Gabon we send samples from scales and hairs of clinically positive tinea capitis of the Ghana 1 and Gabon studies to the Mycology Laboratory of the Department of Dermatology of the Leiden University Medical Centre in Leiden, the Netherlands for species identification (**Chapters 3 and 4**). T. violaceum (26%) was the most prominent species in Ghana, followed by T. tonsurans (22%) and M. audouinii (15%). No T. soudanense was found while in other studies in the region this species was the most frequent causative agent. [25;30-33] Also in our study in Gabon T. soudanense (29.4%) was the most frequent causative agent followed by T. tonsurans (27.9%) and M. audouinii (25%). Although T. violaceum was the most prominent species in the Ghana study (26%) it had a low prevalence in Gabon (8.8%). In South Africa (90%), Tanzania (14.3%) and

Ethiopia (84%) much higher prevalences are found.[6;34;35] We didn't find any M. canis in Ghana and only 1.5% in Gabon which was conform other studies in Africa where anthropophilic infections are much more common than zoophilic infections. Only in recent studies from Nigeria (7.3%) and Tanzania (46.7%) M. canis had a high prevalence which is normally a pattern seen in the USA and Europe.[6;26;27;36] However, also high prevalences of T. tonsurans can be found in the western world due to immigration patterns.[26;27;29;37]

Which species is causing tinea capitis is highly dependent on geography, time and social status. In our studies the most frequently seen were anthropophilic which are rapidly spreading in circumstances of overcrowding. Tinea capitis caused by anthropophilic species can be considered as a marker of poverty.

The prevalence of eczema among schoolchildren in Africa

The prevalences of inflammatory skin diseases like acne vulgaris and eczema were considerably higher in the urban areas and in both Ghanaian studies especially in the schools with a middle/high SEL (table 3 **Chapter 5**). This is a pattern seen in industrialized countries.

Eczema is a growing problem in Africa, particularly amongst children.[13;38-42] In the last decades the prevalence of eczema in the industrialized world has increased rapidly. Period prevalences between 15% and 30% have been found in Northern Europe, North America, Japan and Australasia.[43-45] Most of these period prevalences were obtained by questionnaires adapted from the International Study of Asthma and Allergies in Childhood (ISAAC).[46;47] The main advantages of the use of questionnaires is that they are relatively easy and cheap to distribute to children and their parents / care takers and they can be used to measure disease prevalences in larger populations.[48] They measure period prevalences which are usually higher than the point- prevalences as determined by physical examination. Because eczema is a chronic relapsing disorder a period-prevalence may be the best method to determine its frequency. In our study (**Chapter 5**) we determined point-prevalences in all four studies by physical examination of all children by a dermatologist or a team of dermatologists (in total 4839 children), which is considered the Gold standard. The found prevalences were low (1.5% and 1.6% in both Ghanaian studies and 4.0% and 0.8% in the Gabon and Rwanda studies). These figures were in agreement with other studies in Africa though recent studies have shown an increase, especially among infants.[7;38;49;50] In both Ghanaian studies we also measured by questionnaire the period-prevalences which were about twofold higher than the point-prevalences (2.6% and 4.4%). These higher figures could be expected because of the chronic relapsing character of eczema. Comparing other period-prevalences in Africa, which in other sub-Saharan countries were generally more than 10%, our figures were low (table 5 **Chapter 5**). Ideally eczema among children, diagnosed at a certain point by physical examination by a dermatologist (point-prevalence) should also be detected

with the questionnaires adapted from ISAAC (period-prevalence). However, in the Ghana 1 study the sensitivity was only 33% and in the Ghana 2 study even lower, 10% (see table 4 **Chapter 5**). The use of ISAAC adapted questionnaires does not seem to be a reliable method to determine prevalence figures of eczema in an African setting. Factors related to translation of the questionnaires from the English language as well as cultural and educational differences in developing countries seem to play an important role.[48;51;52] The conclusion that in Africa ISAAC adapted questionnaires are not a reliable method to determine prevalence figures has been confirmed in another recent study performed in South Africa.[53]

The repeated screening of large groups of children by a team of dermatologists will be too expensive and give (point) prevalences which are, due to the chronic character of eczema, too low. Since the ISAAC adapted questionnaires gave reliable figures about period-prevalence of eczema in Anglophone countries, the difficulties of the translation from the English language as well as the cultural and educational differences have to be reassessed and solved in order to make it an useful tool in an African setting.[48]

Characteristics of eczema among schoolchildren in Africa

Besides the prevalences we were also interested in the allergic characteristics of African schoolchildren and the possible risk factors for developing eczema. The rising prevalence of eczema might be related to improved sanitation and reduction in childhood infections which is known as the hygiene hypothesis.[54-56] Bacterial and viral infections lead to a maturation of the immune system and reduce the expression of the pro-allergic T-helper-2 (Th2) responses. According to this hypothesis an increasing gross national per-capita income, a higher socio-economic status, reduced crowding at home, eradication of endoparasites, vaccinations and the growing urbanization in Africa are all factors which can lead to a higher prevalence of eczema (Chapter **6)**.[41;57-60]

In order to study the risk factors for eczema in an African setting we selected children with a moderate to severe eczema in three hospitals in Accra, Ghana and matched one to three controls for age and gender without any visible symptoms of eczema from the same school and class. Elevated total IgE levels were associated with eczema among the schoolchildren although also a high proportion of elevated total IgE levels was found in children without eczema. Elevated cockroach specific IgE levels appeared to be the main cause behind the association between elevated total IgE levels and eczema in our study. The association between any positive skin prick test (SPT) for house dust mite, cat, dog, grass, peanuts and eczema was less pronounced. The same pattern was seen in a study in Ethiopia where 60% of the children with clinical eczema didn't show any positive SPT.[50] There is evidence for a causal relationship between helminth infections and reduced SPT responsiveness to allergens.[61] This protective effect of helminth infections on the development of eczema could not be found in our study because only very few children in this urban population had a helminthic infection at the time of

the study. Maybe helminth infections in the past could have played a role.[60] In the same study from Ethiopia no evidence was found that the risk of eczema was reduced in the presence of 1 or more parasite infections. They found even an increased risk of eczema in the presence of any parasite infection, especially caused by Trichuris.[50] A non-significant positive association between frequent bathing and eczema was observed in our study. Frequent bathing with water and soap is considered to be a healthy exercise in Ghana. Another non-significant association with the development of eczema was found with sleeping on a mattress, an association not found in an earlier African study.[41] Sleeping on a mattress might be an indicator of a higher socio-economic status and can lead to higher exposure to house dust mite and cockroach antigens which all influence the occurrence of eczema.

Important factors in the development of eczema in individuals from European and Asian descent are mutations in the filaggrin gene (FLG), a key protein involved in maintaining skin barrier function and hydration.[62] Only recently research to this has been carried out in Africa.[63] It would be very interesting to look for mutations in the FLG in our study. Plans for this have been made.

Prevalence and risk factors of acne vulgaris in Africa

Acne vulgaris affects between 30% and 95% of the adolescents in the industrialized countries.[64-66] The prevalence is considerably lower in developing countries.[5;6;14] In our studies (**Chapter 7**) the prevalences of acne vulgaris were 3.2% and 4.7% in both Ghanaian studies and 1.1% and 1.3% in Gabon and Rwanda. The prevalences in Gabon and Rwanda were low comparing with the both Ghanaian studies. One of the reasons might be that in both Ghanaian studies also urban private schools with a higher SEL were involved. In **Chapter 7** we studied especially the Ghana study 2 to look at the difference between the prevalence rates among rural and urban schoolchildren and possible risk factors. There are several hospital-based studies about the prevalence of acne vulgaris in Africa, [17;67;68] but only a few community based studies that compared prevalences of acne among schoolchildren in rural and urban areas.[5;69] In table 1 (**Chapter 7**) the prevalence of acne vulgaris in several developing countries is reported. In the Ghana 2 study the schools were categorized as public (no school fees), private (middle to high school fees) and private rich (very high school fees) to reflect the average socioeconomic level of the children, respectively low, middle to high. The prevalence of acne was less than 1% in the rural schools and varied between 1.3% in boys between 9 and 10 years old to 28.4% in girls between 13 and 14 years old in the urban schools. One of the main reasons of this difference might be the significantly lower height and weight of the rural children. An association between overweight and acne has been described before.[70;71] The observed association between a higher BMI (body mass index) and acne among the children who were attending the urban schools would fit in this hypothesis. In our study we only looked at children between 9 and 16

years. Female gender, increasing age and a high BMI were risk factors for inflammatory acne vulgaris (table 3 **Chapter** 7). The observed relation between the prevalence of acne and a higher BMI is one of the first reported in an African study. With the fast growing urbanization and westernization in developing countries, an increase of inflammatory skin diseases can be expected.

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Summary and concluding remarks

Many skin diseases among schoolchildren in sub-Sahara Africa cause disturbing complaints like itch and pain and several of them are contagious. This high prevalence causes a major public health problem. Although in several studies and also in our studies skin diseases present in large numbers, they don't get the attention they deserve. A high percentage of visits to hospitals or other health institutions are caused by skin diseases. Most of them can easily be prevented and treated.

The studies presented in **Chapter 2** focused on descriptive epidemiology to characterize and report the point-prevalence of skin diseases among schoolchildren in three African countries. We found high figures for the point-prevalence of infectious diseases like tinea capitis and pyoderma. The prevalence of the so called "typical" tropical diseases was very low. Most of the diseases are not difficult to diagnose and can easily be treated. Not many population based studies about the prevalence of skin diseases among schoolchildren in Africa have been published. The majority of studies are hospital or institution based. We have performed 4 studies in 3 different African countries which makes it quite unique. Most other studies present also high figures, especially of skin infections.
Eczema is a growing problem in sub-Sahara Africa but the point-prevalences among schoolchildren are still much lower than those found in the industrialized world. The point-prevalence of acne vulgaris was low in the rural areas and much higher in the urban schools with a higher socioeconomic level (SEL) (i.e. higher school fees).

In **Chapters 3 and 4** the high prevalences of tinea capitis among schoolchildren in Ghana and Gabon were further studied and the causing species analyzed. The prevalences were higher in rural schools with a low SEL. The most prominent causing species were anthropophilic moulds which are mainly spread under circumstances of crowding. They can be seen as poverty markers. T. soudanense was not encountered in our study in Ghana, which was an exceptional observation because in other studies from West Africa it was the main causing species.

In **Chapter 5** we focused especially on the prevalence of eczema. Most of the studies concerning the prevalence rate of eczema in Africa are hospital-based and therefore less reliable when estimating the prevalence of eczema on a national scale. The point-prevalences in our study of eczema amongst schoolchildren, as measured by physical examination by a dermatologist, were low and comparable with other studies in Africa. There was not a significant difference between rural and urban areas however, as was anticipated. We analyzed the use of ISAAC (International Studies on Allergy and Asthma) based questionnaires to determine the period-prevalence of eczema. The sensitivity

and the positive predictive values were very low in our hands, which suggest that this method might be less suitable and reliable to identify children with eczema in an African setting. Most probably these discrepancies are caused by factors related to translation of the questionnaires from the English language as well as cultural and educational differences in developing countries.

In **Chapter 6** we were looking for risk factors of eczema among schoolchildren in Accra, Ghana. Elevated total IgE levels were associated with eczema among the schoolchildren, although also a high proportion of elevated total IgE levels were found in children without eczema. Elevated cockroach specific IgE levels appeared to be the main cause behind the association between elevated total IgE levels and eczema in our study. The association between any positive SPT (skin prick test) and eczema was less pronounced. A positive association, though non-significant, between frequent bathing and eczema was observed. Another non-significant association with the development of eczema was found with sleeping on a mattress which might be an indicator of a higher socio-economic status and can lead to higher exposure to house dust mite and cockroach antigens which can all influence the occurrence of eczema.
Both the studies from **Chapter 5 and 6** contribute to increasing our understanding of epidemiology and characteristics of eczema in sub-Sahara Africa.

Chapter 7 was based on analytic epidemiology where we searched for risk factors of acne vulgaris. Acne is a growing problem in Africa although the prevalence is still much lower than in industrialized countries. In our Ghana 2 study we observed a direct positive relation between an increasing body mass index (BMI) and the prevalence of acne. The relation found between a higher BMI and the prevalence of acne vulgaris, especially among children in urban areas is of importance because of the growing problem of obesity in Africa. Because of the "westernization" in urban areas in developing countries a steep increase of the prevalence of acne vulgaris in Africa can be expected. This was one of the first observations of this kind described in Africa.

In **Chapter 8** the epidemiology, etiology and pathogenesis, clinical symptoms and the management and treatment of the most prevalent skin diseases among schoolchildren in Africa are described. Also some typical tropical diseases and skin conditions are mentioned. Although the prevalences in our studies of classical tropical diseases like leprosy or filarial lymph edema or a condition like albinism were low, the socio -economical impact of these diseases can be enormous. This list of skin diseases is far from complete and needs continuous improvements and additions. All skin diseases described will be freely accessible via the internet: www.africanskindiseases.org.
It is meant to be a practical guide for general practitioners, students and all others who are working with children in the medical field.

In the concluding chapter (**chapter 9**), the descriptive epidemiological aspects as well as the analysis of the causing species in tinea capitis are discussed together with the study of risk factors of eczema and acne. The different studies are discussed in view of recent findings and publications by others. The impact of statistical and methodological biases of the study design on our findings is discussed.

Concluding remarks

Our study shows that skin diseases and conditions are common among schoolchildren in sub-Sahara Africa and about one-third or more of them are affected at any given time.
The majority of skin diseases found was caused by infections and inflammation together and can be grouped into fewer than eight categories. This is important in designing training programs for medical teams involved in the delivery of health care services in sub-Sahara African countries where a big part of the population is less than 15 years of age.