SUMMARY

Schistosomiasis is one of the most prevalent parasitic infections and an important public health problem in many developing countries. The main early symptom of Schistosoma haematobium infection is blood in urine (haematuria) and S. mansoni infection causes bloody diarrhoea. The symptoms are caused by eggs that get trapped while migrating from the blood vessels of the urinary or intestinal tract through the wall of the bladder or intestines. After prolonged infection, severe pathological changes may develop such as hydro-ureter and hydronephrosis in individuals infected with S. haematobium and ascitis and haematemesis in individuals infected with S. mansoni. Current estimates of the number of individuals with symptoms and the burden of disease due to schistosome infection lack detail and precision and are considered to be too low. Therefore, we aimed at determining more accurate estimates using data from published field studies in Part I of this thesis.

In Chapter 2, we developed a method to associate prevalence of schistosome infection with prevalence of morbidity in a population. In this chapter, we showed the resulting associations for morbidity due to S. mansoni infection. The associations suggested that diarrhoea and blood in stool due to S. mansoni infection mainly occurs in communities with the highest prevalence of infection (>70%). Whereas an influence on hepatosplenic morbidity was already present at low community prevalence of infection. For the aspecific symptom abdominal pain we could not find an association. The data did not indicate different associations for schools and communities. Similar associations derived for S. haematobium infection and bladder pathology (by ultrasound) and haematuria (by reagent strips, questionnaires or inspection of a urine sample) were the subject of Chapter 3. All four methods to detect early pathology and morbidity showed a clear association with prevalence of S. haematobium infection. Also, as expected, prevalence of micro-haematuria by reagent
strip was higher than that of macro-haematuria by questionnaire, which was again higher than macro-haematuria by inspection. Study setting (school or community survey) had a clear impact on bladder wall pathology, but not on haematuria. This implies that ultrasound gives less often a positive outcome in adults compared to children with the same level of bladder pathology. In Chapter 4, we showed that the recall period length used in the questionnaires measuring self-reported haematuria had no effect on the association of prevalence of S. haematobium infection with haematuria. Finally, in Chapter 5, we used the associations between prevalence of schistosome infection and morbidity to estimate the number of individuals with schistosomiasis related morbidity in Africa. In total, 70 million individuals were estimated to experience haematuria, 32 million dysuria, 18 million major bladder wall pathology and 10 million major hydronephrosis associated with S. haematobium infection. Infection with S. mansoni was estimated to cause diarrhoea in 0.78 million individuals, blood in stool in 4.4 million and hepatomegaly in 8.5 million. In Chapter 10.1 we calculated DALYs lost due to schistosomiasis using the estimated number of individuals with morbidity and death due to schistosomiasis. We made the conservative assumption that all severe symptoms are present in those individuals with milder symptoms. Also, symptoms about which no quantitative information was available (e.g. subtle morbidity) were not included in our calculations. In spite of this, we found that the burden of schistosomiasis is about three times higher than suggested by the Global Burden of Disease calculations published for 1990. If mortality is included in the calculations, our estimations are minimal four times higher.

Morbidity control is the main goal of most initiatives to control schistosomiasis. This became feasible after the introduction of praziquantel, an effective safe single dose drug. According to WHO recommendations, morbidity control should be integrated in the Primary Health Care system with at least adequate diagnosis and treatment of patients reporting with symptoms of schistosomiasis at the health system. In Part II of this thesis, we explored the quality of schistosomiasis case management and determined the probability that patients with symptoms from S. haematobium or S. mansoni infection that report at the health system receive adequate treatment.

In Chapters 6, 7 and 8, we assessed whether the main prerequisites for diagnosis and treatment of schistosomiasis patients were available in the health care facilities by interviewing health workers employed at different levels of the health system in Ghana, Mali and Senegal using a structured questionnaire. We assessed knowledge of the presenting symptoms, treatment strategy and availability of diagnostic materials and drugs. Active knowledge of the main presenting symptom of S. haematobium, haematuria, was good. The main presenting symptom of S. mansoni infection, blood in stool, was less well known than
that of *S. haematobium* infection in all three countries. Overall knowledge about schistosomiasis was best in Senegal and Mali. Diagnostic tests were frequently requested, also in health care facilities without a laboratory. Most laboratories used the urine centrifugation test for diagnosing *S. haematobium* infection. For diagnosis of *S. mansoni* infection the direct smear test was used, but several health care facilities in Senegal reported to perform the more sensitive Kato-Katz test. Praziquantel was more often prescribed for treatment of *S. haematobium* infection by health workers in Mali and Senegal than in Ghana. It was often not in stock in Ghana. In conclusion, pre-requisites for schistosomiasis case management were less favourable in Ghana than in Mali and Senegal. In **Chapter 9**, we studied schistosomiasis case management by presenting four clinical scenarios, two presenting with symptoms compatible with *S. haematobium* and two with symptoms compatible with *S. mansoni* infection, to health workers in Ghana and Mali. It appeared that patients reporting with *S. haematobium* symptoms can expect proper treatment at approximately 60% of the health care facilities, whereas those presenting with *S. mansoni* symptoms only have a very limited chance (about 15%). In **Chapter 10.2** we showed that a Ghanaian schistosomiasis patient has a very low chance of receiving praziquantel. Therefore, it is questionable if passive case detection is a sufficient basis for effective schistosomiasis morbidity control. Still, we consider it an essential component of schistosomiasis control as it is unacceptable if knowledge of schistosomiasis treatment and drugs would be available in other sectors (e.g. schools and companies) and not in the health sector.