Climate variability/change and schistosomiasis prevalence in the Ga Districts of Ghana

Climate variability/change poses significant direct and indirect risks to human health mainly through transmission of vector-borne and other infectious diseases (Hunter; 2003; Haines et al, 2005). Infectious disease vectors that do not regulate their internal temperatures are sensitive to external temperature changes (IPCC, 2001). Climate change may therefore affect the distribution of these vector species by increasing or decreasing their abundance (Hunter, 2003; WHO 2009).

Urinary schistosomiasis can lead to iron deficiency, anaemia, stunted growth in children, cognitive malfunctions, cancer of the bladder, kidney and liver disease, protein-energy malnutrition and sometimes death (Ross et al., 2002; WHO, 2009; King, 2010; Carter Centre, 2010). Also, urogenital schistosomiasis damages the hymen and clitoris leading to bleeding after coitus and could increase the risk of contracting HIV and other STIs (WHO, 2009; Schistosomiasis fact Sheet, 2010).

Schistosomiasis prevalence in Ghana ranges from 2% to 90% depending on the geographical location (WHO, 2009). A study conducted among school children in Sunyani in 2008 and 2009 found the prevalence rate to be 60.1% and 60.3% respectively (Tay et al., 2012). In another study by Nsowah-Nuamah et al., (2006) in Ga and Akuapem South districts in Ghana, the prevalence ranged between 54.8 and 60.0%. This shows that schistosomiasis is still a major problem in some parts of the country.

Despite the numbers they affect, and their health and social consequences, schistosomiasis attract less than one percent of the total health funding for the developing world (National Health Profile, 2004). In Ghana, although the Ga Districts have been identified by the WHO as endemic, it has received little attention from researchers. As a result, the transmission-promoting factors, the pattern of spread and the population at risk as well as the water contact patterns remain unknown let alone the potential links with climate change and other environmental factors.

Changes in temperature and rainfall patterns would directly affect the reproductive behaviour and the development of the parasites (Barbosa and Barbosa, 1994). For instance, while schistosomiasis infection is virtually absent when temperature is below 9^{o}C, the infection rate increases from 15^{o}C to a maximum of 27^{o}C beyond which thermal death begins for the parasites (Martens et al., 1995; Mangal, et al., 2008). In extreme droughts, snail breeding sites could be eliminated due to the drying up of snail habitats (Dazo et al; 1966; Barbosa, 1989). Rainfall on the other hand could create seasonal standing ponds for the breeding of the schistosomes; however, excess rainfall resulting in floods creates turbulence in the snail habitat (Paull and Johnson, 2011).

The objectives are to examine the trend in the variability of the climate variables and its effects on schistosomiasis prevalence. The study also examines the knowledge and perceptions of climate change and schistosomiasis infection.

Methodology and Description of the Study Area

Design

The study employed a mixed method using both qualitative and quantitative methods.

Data sources

Secondary data sources: The secondary data constitute monthly rainfall and temperature data from the Meteorological Services Agency (GMet) for the Greater Accra Region (GAR) from 1970 to 2010 and schistosomiasis epidemiological data from the Centre for Health Information Management (CHIM) of the Ministry of Health.

Primary data sources: Focus group discussions, in-depth interviews and participant observations formed the main primary data source. A total of 7 focus group discussions were held with about 78 participants segmented by age, sex and community of residence. Also in-depth interviews were conducted with some key informants.

Population: Two communities -Oboom and Kojo Ashong were purposively selected due to the high schistosomiasis prevalence and also their location along the major rivers in the study area.

Data analysis: The analysis of the qualitative data was undertaken in five steps –familiarisation, identification of thematic frameworks, indexing, charting, mapping and interpretation as discussed by Rabiee, (2004). In the thematic frameworks five themes- knowledge of climate change, knowledge and perceptions of schistosomiasis, climate change-schistosomiasis relationships, coping strategies for people living with schistosomiasis and interventions were identified

With regards to the quantitative aspect, correlation analysis between the climate variables and schistosomiasis prevalence was done. Chi square test was done to find the association between the rainfall amount and schistosomiasis. Finally, the Granger causality test was used to test which of the climate variables could predict schistosomiasis prevalence.

Study area: The Ga District consisting of the Ga West, Ga South and Ga East Districts was selected as the study area because it has one of the highest prevalence in Ghana according to the WHO epidemiological chart (WHO, 2009). The Ga West and South Districts are noted for high buruli ulcer, schistosomiasis and other water-borne diseases (*Ghana Districts*, 2012). One of the developmental challenges in the area is the lack of access to potable water. The large number of the rural population rely on open ponds and streams as sources of water for domestic use. These unhygienic water sources are shared with animals and are often polluted by human activities. There are three major rivers -Densu, Nsaki and Ponpon Rivers that drain all the districts. This plentiful water bodies makes fishing common and swimming is the major recreational activity. The inhabitants of the rural communities including Oboom and Kojo Ashong are predominantly farmers who grow mainly vegetables and raise livestock.

Results and discussion

Knowledge and perceptions of climate change and schistosomiasis prevalence

Though the communities did not have any local term for climate change, they explained it in their own words and gave vivid examples and instances why they think climate change is occurring in their communities. These include the changes in the rainfall pattern, delay in the onset of the rainfall and temperature increases. This indigenous knowledge, perceptions and observations concur with the empirical data from the meteorological service for the area.

The common name for schistosomiasis in the communities was bilharzia and also among the elderly especially, it was also called *"la shamor"* in the local dialect which literally means "urinating blood". Among all the groups, contrary to studies in some communities that blood in the urine was seen as a sign of maturity or as male hood (Takougang et al, 2004; Kloos et al.,2006), the community identified it as a symptom to bilharzia.

Climate variability/ change and schistosomiasis transmission relationship
Community members identified a number of direct and indirect issues regarding the climate change and schistosomiasis nexus. In the first place it was identified that heat stimulates the drive to swim in the river. Rainfall was also associated with water contact activities like swimming, washing and bathing. The water level as influenced by rainfall pattern was said to influence the water contact behaviour like recreational activities. The quantitative analysis showed high degree of inter-annual variability in the rainy days and total rainfall.
Table 5.1 shows a weak positive correlation between both total rainfall and rainy days and schistosomiasis prevalence.

Table 5.1: Correlation between rainfall, rainy days and schistosomiasis prevalence

	Pearson correlation	Significance
Rainfall	0.404	0.086
Rainy days	0.263	0.277

Source: Computed from CHIM and GMet data for Greater Accra Region

Regarding the effect of rainfall extremes on schistosomiasis prevalence, about three quarters (75 percent) of the years with low rainfall recorded low schistosomiasis prevalence, a higher proportion (56.3 percent) of the years with moderate rainfall also recorded high prevalence. Finally, about three-quarters (75.0 percent) of the years with high rainfall also recorded high schistosomiasis prevalence (Table 5.2). However, there is no significant association between the rainfall amount and schistosomiasis (X^2=2.098, df=3, p>0.05).

Temperature trends and variability
The Mean annual maximum temperature for the period 1970 to 2010 varies between 31.0^oC in 1976 and 32.9^oC in 1998. In general, though there is inter-annual variation, the mean maximum temperatures had an increasing trend.
Temperature variability and schistosomiasis prevalence
Also the correlation analysis shows a statistically significant negative association between the two variables ($r=-0.761$, $p<0.05$) as shown in Table 5.3. The same applies to the maximum temperature, which also had a significantly negative correlation with schistosomiasis prevalence ($r=-0.620$, $p<0.05$) (Table 5.3).

Table 5.3: Correlation between temperature and schistosomiasis prevalence

	Pearson correlation	Significance
Tmin	-0.620	0.022
Tmax	-0.761	0.002

Source: Computed from CHIM and GMet data for Greater Accra Region

Granger Causality test on schistosomiasis prevalence and Climate Variables

In the first (restricted) model, about 23.6 percent of the variation in the schistosomiasis prevalence was explained by the previous year's prevalence. With the introduction of the maximum temperature variable, 38.7 percent of the variation in the schistosomiasis was explained and the results showed that maximum temperature Granger-causes schistosomiasis. The other variables like minimum temperature, total rainfall and number of rainy days did not significantly predict schistosomiasis prevalence in the model.

Demographic differentials in schistosomiasis prevalence

Schistosomiasis prevalence was consistently higher among the males than the females. Though the ages could not be grouped into the conventional five years interval form because it was secondary data, consistently schistosomiasis prevalence was higher among the 15-44 age group and then 5-14 Children below five years reported the lowest cases with prevalence ranging from 0 to 6.8 percent.

Conclusion

Maximum and minimum temperature correlated negatively with schistosomiasis prevalence but total rainfall and number of rainy days correlated positively with schistosomiasis prevalence. Also, there was no association between rainfall amount and schistosomiasis prevalence. In addition, it was found that maximum temperature Granger-causes lower schistosomiasis prevalence. The knowledge and perceptions about climate variability/change was similar to the empirical observations. Also, knowledge and perceptions about schistosomiasis was similar to biomedical explanations. Finally there had been control and prevention interventions in both which were targeted to school children to the neglect of other vulnerable groups.

Key References

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