mucus on bare skin surface and enhancing fragility of snail shells.

The negative correlation between water conductivity and snail abundance suggest that water conductivity did not influence snail abundance in the study area. However, this observation was centrally to what was reported by Kazibwe and others in Lake Albert, western Uganda [30].

Of all snail intermediate hosts collected from this study, only 11 *Biomphalaria sudanica* were shedding cercariae. Given the known association of snails to humans, cercariae emergence time corresponds to availability of their definitive host, which enhances the disease transmission cycle among human populations [26],[31].

It may seem surprising that very few snails shed cercariae from a high schistosomiasis transmission area. This findings are similar to other studies conducted in endemic areas with high transmission and snail abundance but with very few or no snails shedding cercariae [33],[34]. In contrast to high human prevalence of *S.mansoni* infection among school children and adults in Mwanza region [35],[36],[3], few percentages of collected snails were capable of shedding cercariae. In Lutale site C one of the sampling site in this study it was observed that cercarial shedding was very low (only one snail shed) while the prevalence of *S.mansoni* infection in the village was 49.9% in adults (results of a parallel study not shown here). In a recent study in Sesse island of Lake Victoria, Uganda, findings reported none of the snails collected from a high transmission areas shed any cercariae [34].
Considering this situation, different explanations may be put forward for the absence or low numbers of snails shedding cercariae. First, fluctuations of snail population abundance, infectivity rates and cercarial productivity could inhibit continuous flow of miracidia for snails infection and subsequent shedding of cercariae [27],[37],[38],[39]. Second, stages of parasite development within the snails intermediate host, the collected snails may be in prepatent infection (the period between penetration of miracidia to the development of infective cercaria) that can last for several weeks with a very few percentages of snails reaching stages of cercariae shedding. This suggests that when snails are in prepatent infection, identification of infection cannot be performed by cercarial shedding observation due to limitation in cercarial release [27] [40],[41]. The timing of the study in relation to the season of transmission may also have contributed to low number of snails shedding cercariae.

Ongoing mass drug administration (MDA) for control of schistosomiasis currently being implemented in the area may have reduced the transmission cycle by killing the parasite within the definitive host as a result less or no continuation of miracidia flow in the environment is occurring in the environment for snail infection. It may also be possible that the number of infected snails is very low or the cercariae are shed in phases. This may be enhanced by the focal nature of schistosomiasis and complication in snail sampling leading to difficulties in recognizing sites with high number of infected snails. Cercarial shedding may be inhibited by various contaminants harbored by snail which may prevent cercariae release. Although it is accepted that verification of schistosomiasis transmission is by identification of infected snails, the findings of the present study suggest that molecular techniques may be useful in determination of infected snails by examining both prepatent and patent snail stages of infection. Repetitions of cercarial shedding several times in the laboratory and crushing of snails in search for larvae may give better estimates of the prevalence of infected snails in the area.

6. Implication of the snail data in designing cost effective control interventions

The insights on snail abundance and infectivity have implications in designing cost effective measures for control and elimination of schistosomiasis. From the current findings, snail abundance was high in the sampling sites but very few snails were infected compared to the infection rates observed in the human population. This suggests that the schistosome parasite is more prevalent in the human host than in the snail intermediate host. This in turn suggests that application of molluscicides may have no impact on schistosomiasis control unless combined with population based mass drug administration (MDA) strategies targeting both school based children and adults. This will allow killing of mature worms in the definitive host and interfering with continuation of the schistosome life cycle. Thus to ensure successful and sustainable control and eventual elimination of schistosomiasis, a combination of control methods is necessary targeting both the snail intermediate hosts and treatment of the definitive host in addition to health education and sanitation.

7. Conclusion

The high abundance of *Bomphalaria* and *Bulinus* species collected in the study site suggest that schistosomiasis could be transmitted easily in this area. However, only few snails were shedding schistosome cercaria which could be caused by many factors including timing of the study in relation to transmission season.

8. Recommendations

The current study was limited by several factors. First, weather condition, majority of the inland transmission sites were dry during sampling period making it difficult to obtain the transmission sources for *Schistosoma haematobium* where *Bulinus* species could be found. Given the known *Bulinus* species distribution throughout the country [42], further studies are required to determine snail abundance and their infection rates in the study area. Second, snails were sampled on a single day at each site. Based on seasonal variation in snail abundance and dynamics of infection, further studies with close follow up may improve snail sampling to determine snail abundance and infectivity rates. Third, the pre-patent stage of infection in snails was not examined, given that infection could be in the early stage in the intermediate host [27]. Further, molecular techniques such as PCR are required in order to improve determination of snail infectivity.

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