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Assessment of water, sanitation and hygiene (WASH) facilities in Ghanaian prisons: implications for transmission of intestinal parasitic infections

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Abstract

Introduction: *access to potable water and improved personal hygiene are prerequisites for achieving efficient and sustainable control of intestinal parasitic infections (IPIs). This study assessed water, sanitation, and hygiene (WASH) facilities in major prisons in Southern Ghana.* ***Methods:*** *a modified version of the Water and Sanitation for Health Facility Improvement Tool (WASH-FIT 2.0) was employed in three prisons (Nsawam Medium Security Prison, Sekondi Central Prison, and Ho Central Prison) to assess WASH facilities. Data collected from the questionnaires were checked for correctness and entered into the automated Microsoft Excel scoring system for WASH-FIT 2.0 and determined as follows: >80%= High Standards, >60-80%= Moderate Standards, 40-60%= Low Standards, and <40%= Very Low Standards. Additionally, results from 461 prison inmates´ stool samples tested by Ziehl-Nelseen and Formol-Ether Concentration techniques were obtained from a larger study during the same period by the authors and compared with WASH characteristics.* ***Results:*** *overall, Ho central prison had the lowest compliance (60.0%) to combined WASH standards among the three prisons but had the highest prevalence of intestinal parasitic infections among inmates. There was moderate compliance with water standards (63.3%) across the three study sites. However, Nsawam and Ho prisons had leaks in their water supply systems, whilst Sekondi lacked adequate water storage tanks. Also, there was overall moderate compliance with sanitation standards (63.3%). For sanitation, Nsawam prisons had limited toilet facilities to serve their large population. There was moderate compliance with hygiene standards (75.0%) across the three study sites. However, Ho and Nsawam prisons did not have an established cleaning schedule.* ***Conclusion:*** *the study revealed that prisons with low compliance with WASH standards had a high prevalence of intestinal parasitic infections among inmates. This therefore calls on policy makers, WASH providers, and the Ministry of Water Resources and Sanitation to improve WASH facilities in the prisons in Ghana. Additionally, the Ghana Health Service should embark on health promotion exercises in the prison setup to increase awareness among inmates on the impact of poor personal and environmental hygiene on their health.*

Introduction

Water, Sanitation, and Hygiene (WASH) facilities are important in maintaining the health and well-being of any institution [1]. They promote hydration and reduce the spread of infections and illness [2]. In institutions, appropriate WASH infrastructure is essential for boosting morale, productivity, and prevention of disease outbreaks [3]. This, therefore, underscores the importance of proper WASH infrastructure among institutionalized populations such as prisons. Globally, more than 10 million people are incarcerated (144 per 100,000 population), making WASH standards much more difficult to bear due to overcrowding [4]. The situation in Africa is expected to be worse due to limited prison infrastructure and poverty. For instance, evidence suggests that some prisons in Africa are plagued with poor hygienic conditions, and inmates are burdened with maintaining basic personal hygiene [5,6].

It is well established that overcrowding and unsanitary practices contribute to intestinal parasitic infections (IPIs). A cross-sectional study conducted in a prison facility in Shewa-Robit, North-Central Ethiopia, has found the prevalence of intestinal parasitic infections to be as high as

72.7% [7]. Other studies conducted in Kenya [8], Guinea [9], and Nigeria [10] have reported the prevalence of IPIs among inmate populations to be 24.7%, 33.5%, and 22.8%, respectively. These results suggest that at least one-fifth of the inmate population in Africa is living with IPIs, which further strengthens the suspicion of poor WASH infrastructure in prisons. Additionally, the fact that most of these inmates would be present in the facility for years without adequate medical attention may further expose them to life-threatening infections. In Ghana, available data indicates that the prisons house 40% more than the population it is expected to hold, ranking Ghana as the 56th country with the most crowded prisons [11]. This contributes to poor sanitation and hygiene, predisposing inmates to intestinal parasitic infections. Meanwhile, the general prevalence of intestinal parasitic infections in Ghana is estimated to be within the range of 2% to 78% [12]. Unfortunately, Ghanaian prisons have received little research attention with respect to the WASH factors contributing to the infection. This study, therefore, assessed WASH facilities in major prison facilities in Southern Ghana.

Methods

Study site description/study population: the study was conducted in three (3) prison facilities in Southern Ghana, namely Nsawam Medium Security Prison, Ho Central Prison, and Sekondi Central Prisons for Water, Sanitation and Hygiene Assessment. Additionally, a cross-sectional study design using simple random sampling was used to recruit 461 inmates in total to determine the prevalence of intestinal parasitic infections in each of the three study sites.

Eligibility criteria: the three prisons were selected because they are currently the largest in Southern Ghana. Additionally, inmates who had stayed three months or longer and had taken anti-parasitic drugs more than a month ago were recruited into the study.

Data collection and processing

WASH Assessment: a modified version of the Water and Sanitation for Health Facility Improvement Tool (WASH-FIT 2.0) was used to assess and grade the compliance of the three (3) prison facilities to WASH guidelines. WASH-FIT 2.0 is a standardized checklist that has been validated in more than 46 countries, according to the World Health Organization [13]. A walk-through observation in the prison facilities was conducted, and the WASH-FIT 2.0 observational checklist was applied. Regarding water, key questions such as availability, sufficiency, quality as well as safety were assessed. For sanitation, availability, cleanliness, sufficiency, maintenance, and frequency of emptying of toilet facilities were assessed. Lastly, for hygiene, the availability of a cleaning schedule, food safety in cooking and handling, among others, were investigated. The scoring system was as follows: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards.

Stool sample collection and analysis: a new leak-proof screw capped plastic stool containers with wide neck and assigned unique identification numbers with permanent marker was given to 461 randomly selected participants drawn from the three study sites. Further, stool samples were analyzed using Formol ether concentration and Ziehl-Neelsen (Z-N) techniques to determine the presence of various stages of intestinal parasites (trophozoites, cysts, ova, and larvae) on each sample as described by Cheesbrough M [14]. The above stool sample analysis, which was conducted as part of a broader study by the authors during the same period, was retrieved for comparison with the WASH factors as published [15].

Statistical analysis: data collected from the questionnaires were checked for correctness and entered into the automated Microsoft Excel scoring system for WASH-FIT 2.0. The compiled data was analyzed using Stata SE version 16

(64bit). Descriptive statistics, such as frequencies and percentages were used to group various water, sanitation, and hygiene characteristics based on WASH-FIT guidelines. The association between the prevalence of intestinal parasitic infections and WASH standards was determined using the chi-square test of association.

Ethical clearance: ethical approval was sought from the University of Ghana Medical Centre Institutional Review Board (UGMC-IRB) before commencement [UGMC-IRB/MSRC/002/2023]. Additionally, approval was sought from the Headquarters of the Ghana Prisons Service [HRG/0183/V.4/22/183/939R]. Written consent was also sought from inmates after an explanation of the objective of the study was provided to them. All records of the study were kept highly confidential and only accessible to the research team under Helsinki Declaration.

Results

Overview: water, sanitation, and hygiene (WASH) characteristics across the three (3) study sites were obtained and graded into very low-level, low-level, moderate, and high-level compliance based on WASH-FIT guidelines. Again, overall composite scores were determined for each prison facility (Figure 1).

Assessment of water: inmates in Nsawam and Sekondi prisons had access to improved water characterised by clear, odourless water, free from particles and debris. In contrast, the water facilities at Ho prison, while generally satisfactory, were of moderate quality. Nsawam and Ho Prisons had leaks in their water supply systems. Further, only Sekondi prison reported interruptions in its water supply, with some water sources and taps not flowing with water at the time of assessment. Lastly, both Nsawam and Ho prisons had adequate water storage tanks. However, Sekondi prison lacked an adequate reservoir for water storage, as seen in Figure 1.

Assessment of sanitation facilities: Nsawam prison had a limited number of toilet facilities. However, all available toilets in Nsawam, as well as in the Ho and Sekondi prisons, were in use. Ho prison did not empty their toilet facilities regularly, which could lead to concerns about sanitation and hygiene within the facility. None of the three prison facilities had handwashing stations located within five meters of the toilets. Lastly, all three prison facilities experienced periodic toilet spills into the surrounding environment, as seen in Figure 1.

Assessment of hygiene facilities: Sekondi prison occasionally implemented cleaning protocols for maintaining sanitation, which set it apart from Nsawam and Ho prisons, where such protocols were not consistently followed. Also, except for Nsawam prison, the other facilities—Ho and Sekondi—did not conduct daily cleaning of their toilet facilities. Lastly, all three prison facilities—Nsawam, Ho, and Sekondi—were provided with sanitation supplies, reported that food was clean and safely prepared, and kitchens were adequately protected, as seen in Figure 1. The association between water composite scores and intestinal parasitic infections across study sites was obtained (Figure 2). Overall, there was moderate compliance with water standards (63.3%). Nsawam presented with the highest composite scores for water standard compliance. However, they presented with moderate intestinal parasitic infections. Again, the association between sanitation composite scores and intestinal parasitic infections across study sites (Figure 3). Overall, there was moderate compliance with sanitation standards (63.3%). Sekondi had the highest sanitation assessment score (80.0%) against the least intestinal parasitic infections among the three study sites. Lastly, the association between hygiene composite scores and intestinal parasitic infections across study sites (Figure 4). Overall, the hygiene standard score was 75.0%, representing moderate compliance. Sekondi had the highest hygiene assessment score (90.0%) against the least

intestinal parasitic infections among the three study sites.

Discussion

Water, sanitation, and hygiene (WASH) are important contributors to health and well-being, particularly in the prison setting [16]. Poor WASH conditions lead to the spread of intestinal parasitic infections, contributing to widespread morbidity, low quality of life, and increased healthcare needs among the prison population. This study aimed at assessing the WASH facilities and their implication for the transmission of intestinal parasitic infections among three prisons in Southern Ghana [Nsawam Medium Security Prison, Ho Central Prisons, and Sekondi Central Prisons]. Overall, Ho Central Prison had least compliance with WASH standards and presented the highest prevalence of intestinal parasitic infections among inmates. This is consistent with other studies, which found various WASH factors to be associated with intestinal parasitic infections. For instance, a quasi-experimental study conducted in Thailand found that good practices reduce intestinal parasitic infections [17]. Similarly, a study by Aschale and his colleagues concluded that poor WASH factors [18] has concluded that WASH factors contribute greatly to the spread of intestinal parasitic infections among children. This underscores the importance of WASH facilities and practices to the overall prevalence of intestinal parasites among inmates.

For water standards alone, an average composite score of 63.3% was recorded among the three study sites, indicating moderate compliance. However, Ho Central Prison had slightly lower standards of water quality, characterized by particles and debris found in its drinking water. This finding is consistent with findings from Malawian [19] and United States prisons [20] where water was found to be contaminated with unacceptable standards of *Escherichia coli* and toxic trace metals, respectively. This points to the fact that water quality concerns among prisons are not limited to the low-and middle-income countries, but a matter. Additionally, an average composite score of 63.3% was recorded across the three study sites for sanitation standards, representing moderate compliance. However, key concerns were at Nsawam Medium Security Prison, which had a limited number of toilet facilities for inmates. The facility did not meet the standard of one toilet per 25 detainees [21]. Previous studies have found that the type of toilet facility and the number using it impact cleanliness, which ultimately contributes to intestinal parasitic infections among different populations [22,23]. Conversely, a study conducted among 2,486 immigrant workers in Qatar did not find the type of toilet facility and the number of people using it to be associated with the presence of intestinal parasitic infections [24].

This points to overcrowding concerning the use of the toilet facility, which may invariably cause inmates to defecate in improper places. Further, the overuse of toilet facilities may also result in frequent blockages, which will increase the risk of contamination in the surrounding environment. Thus, increasing the risk of widespread of intestinal parasitic infections. Additionally, all prison facilities had a handwashing station beyond 5 metres from the toilet facility. This is consistent with the results of various studies, which found that the proximity of handwashing stations impacts their practice and indeed closer proximity reduces the spread of intestinal parasitic infections [23,25]. Since inmates must travel a considerable distance to wash their hands after using the toilet, they are more likely to inadvertently touch surfaces, contaminating their immediate environment. This gap in hygiene practices could increase the risk of spreading parasites, as pathogens can transfer from unwashed hands to communal surfaces, potentially impacting other inmates and staff.

Again, for Nsawam and Ho Prisons, there was the presence of leachates from the toilet facilities in the environment. It is important to note that these leachates from toilet reservoirs often contain

intestinal parasites. Research has shown that intestinal parasitic infections, including *Giardia lamblia, Entamoeba histolytica, Ascaris lumbricoides, Trichuris trichiura, Strongyloides stercoralis*, in various faecal sludges [26-29]. Therefore, the interaction of leachate with the prison environment poses an important risk to the prison community and is an important cause for concern. Lastly, there was overall moderate compliance with hygiene standards (75.0%). However, only Sekondi Central Prison had an established cleaning protocol, and the lowest intestinal parasite. A cleaning protocol, particularly in crowded facilities like prisons, can greatly reduce intestinal parasitic infections by ensuring regular cleaning, which helps disrupt parasite transmission on surfaces and in shared spaces. Regular disinfecting of high-touch areas (such as toilets, sinks, and tables) to remove resilient parasites like *Ascaris lumbricoides and Giardia lamblia*, and using disinfectants specifically designed to target hardy parasitic forms [30,31].

Conclusion

The study revealed that prisons with low compliance with WASH standards had a high prevalence of intestinal parasitic infections among inmates. This therefore calls for improvement in WASH facilities in the prisons in Ghana. Additionally, the Ghana Health Service should collaborate with the management of prison facilities to embark on health promotion exercises in the prison setup to increase awareness among inmates on the impact of poor personal and environmental hygiene on their health. The authors recommend that further studies be conducted, such as the microbial contamination of water iin prison facilities in Ghana and elsewhere.

What is known about this topic

- *Africa has the greatest burden of intestinal parasitic infections, of which inmates are no exception;*
- *Water, sanitation and hygiene facilities are key contributors to the control of intestinal parasitic infections.*

What this study adds

- *This study found that none of the prisons understudied had handwashing stations within five metres of the facility, which may contribute to the overall health of prison inmates;*
- *This study found that all the prisons experienced frequent toilet spills, which impacts the overall health of prison inmates.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Albert Abaka-Yawson, Daniel Sai Squire, Serwaa Akoto Bawua and John Arko-Mensah were involved in research conception, design, coordination and drafting of manuscript. Albert Abaka-Yawson, Richard Kobina Dadzie Ephraim and Patricia Asantewaa-Tannor were involved in data collection, analysis and statistical support. The corresponding author had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis. All the authors have read and approved the final version of this manuscript.

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Figures

Figure 1: water, sanitation, and hygiene (WASH) characteristics across the three study sites

Figure 2: association between water composite scores and IPIs across study sites; NB: grading for water scores: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards

Figure 3: association between sanitation composite scores and IPIs across study sites; NB: grading for water scores: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards

Figure 4: association between hygiene composite scores and IPIs across study sites; NB: grading for water scores: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards

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Figure 1: water, sanitation, and hygiene (WASH) characteristics across the three study sites

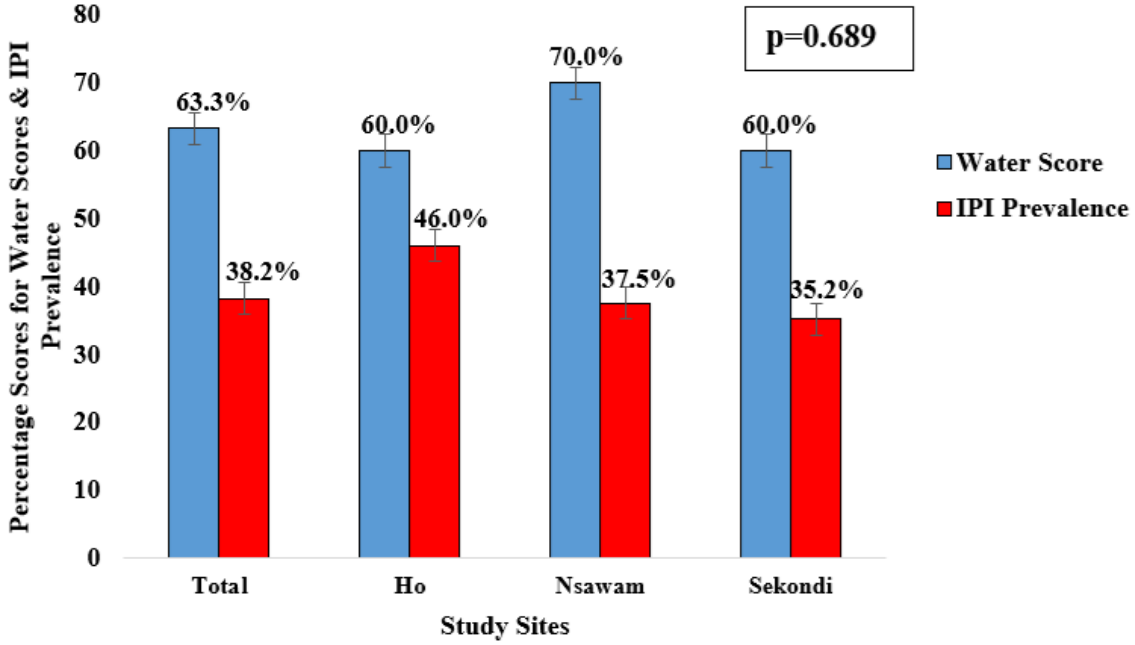

Figure 2: association between water composite scores and IPIs across study sites; NB: grading for water scores: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards

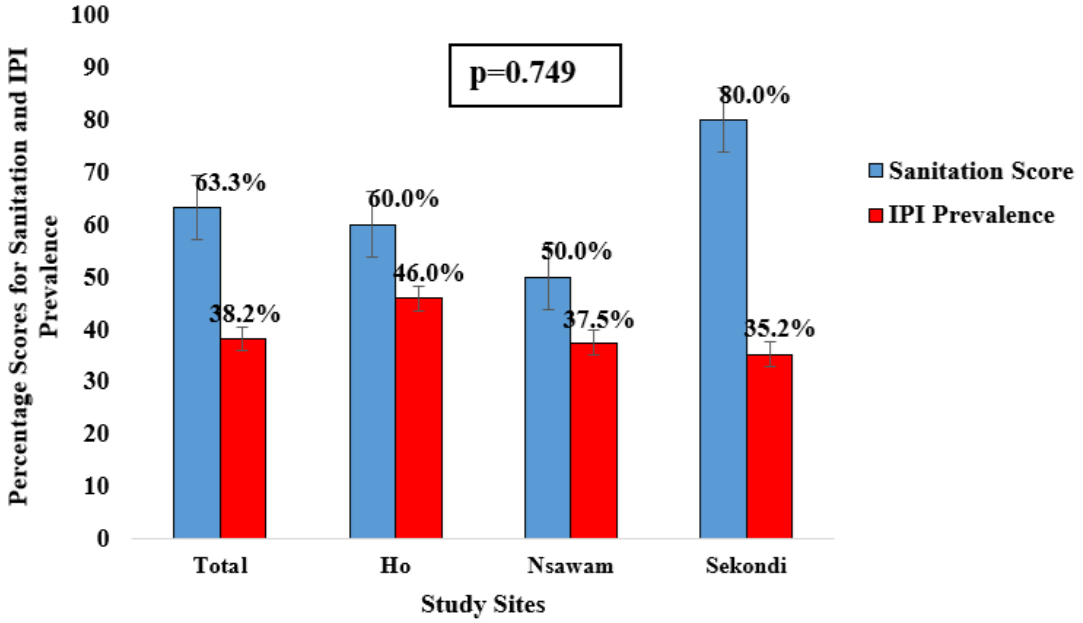

Figure 3: association between sanitation composite scores and IPIs across study sites; NB: grading for water scores: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards

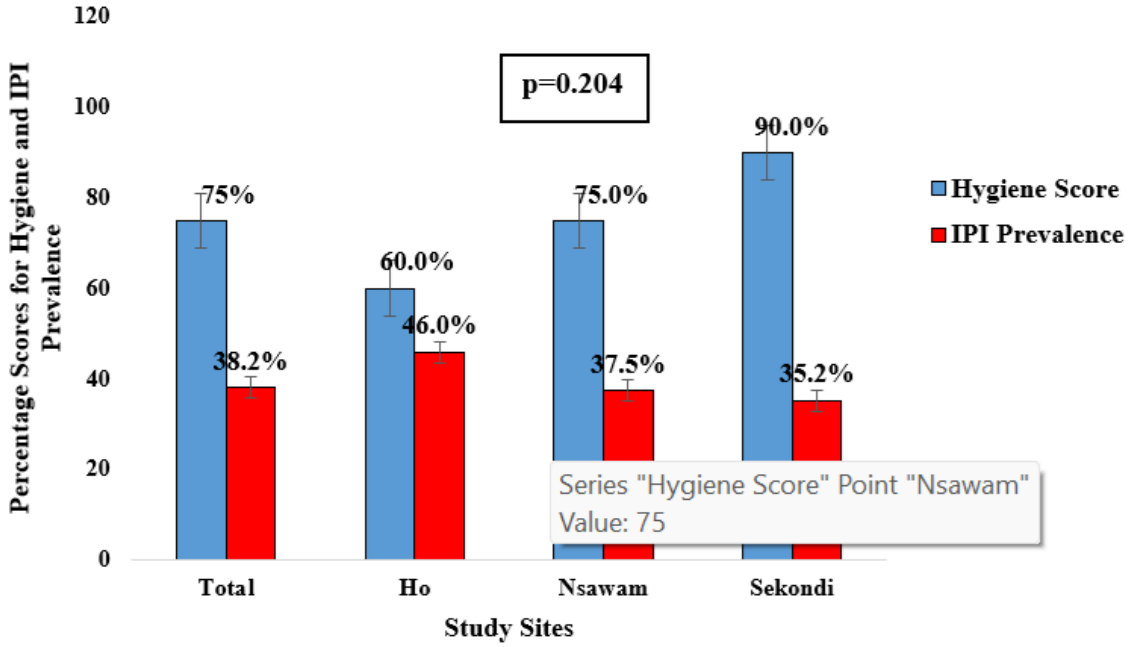

Figure 4: association between hygiene composite scores and IPIs across study sites; NB: grading for water scores: >80%= high standards, >60-80%= moderate standards, 40-60%= low standards, and <40%= very low standards