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Review article

The role of health education and sanitation in the control of helminth infections

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Abstract

Health education and sanitation are two important components of primary health care system introduced by the World Health Organization (WHO) as a basis for the prevention and control of communicable diseases. However, the roles of health education and sanitation in disease control have been controversial, especially in the wake of recent advances in safe and effective oral drugs. This article has reviewed the various health education and sanitation interventions around the world to determine what roles they have played in the past relative to other intervention strategies and the role they have to play in future control efforts. It appears clear-cut from the review, that while chemotherapy has been and will remain the best option for morbidity control, sanitation has an important role to play not only to sustain the benefits of chemotherapy but also to protect the uninfected. Health education that is effective, simple and low-cost remains the only tool for creating the enabling environment for both chemotherapy and sanitation to thrive.

Keywords: Health education; Sanitation; Water supply; Chemotherapy; Helminth infections; Disease control

1. Introduction

Helminth infections constitute one of the most important public health problems around the world, especially in the tropical and sub-tropical regions of Africa, Asia, Central and South America. The most widely distributed helminth infections include cestode infections (e.g. taeniasis and echinococcosis); intestinal nematode infections (e.g. ascariasis, hookworm, strongyloidiasis, enterobiasis, trichuriasis, trichostrogyliasis and capillariasis); tissue nematode infections (e.g. dracunculiasis, trichinellosis, anisakiasis and angiostrogyliasis); filarial nematode infections (e.g. loiasis, lymphatic filariasis and onchocerciasis); and trematode infections (e.g. schistosomiasis and other flukes) (WHO, 1990). Transmission of most of these diseases involves environmental contamination with eggs and infective larvae, for which reason, the parasites are also classified as soil-transmitted (if it involves contamination of the soil environment) or water related (if it involves contamination of the water environment) (Bradley and Emurvon, 1968; Feachem, 1975). The most important soil-transmitted helminth

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infections are ascariasis, hookworms and trichuriasis, while the most important water-based helminth infection is schistosomiasis (Jordan, 1985; Crompton et al., 1989; Huttly, 1990). Together, the four diseases infect over 2.6 billion people around the world inflicting injuries that range from simple allergic reactions to severe life-threatening complications (Davis, 1985; WHO, 1990).

Ascariasis and trichuriasis are transmitted by the faecal–oral route while transmission of hookworm and schistosomiasis involves larval penetration of any parts of the skin exposed to soil and water, respectively (Crompton and Pawlowski, 1985; WHO, 1990; Sturrock, 1993). According to existing transmission models for most helminth infections (Macdonald, 1965; Lewis, 1975; Anderson, 1985), four factors influence the rate of attainment of the critical community parasite load or break-point below which the infection tends to die out (Kloos, 1995). These factors are:

i) the potential for environmental contamination with eggs or infective larvae;
ii) the number and characteristics of vector/intermediate host species (if any);
iii) human exposure patterns to infective pathogenic stages;
iv) abundance and characteristics of adult parasites in human definitive host.

Until about 1970, intervention programs, especially schistosomiasis control, were pivoted on vector/intermediate host control on the assumption that a non-dynamic population decline in vector/intermediate host density will initiate a one-directional reduction in community worm load until it falls below the critical break point and the infection dies out (Hairston, 1961; Webbe, 1964). This approach was later to be changed for two important reasons. First, it became evident that though snail control is often followed by a fall in snail density, the break point is never reached, hence, transmission continues unabated (WHO, 1980; Webbe and Jordan, 1982; Jordan, 1985; Thomas, 1987). Secondly, the recent advances in diagnosis of major parasitic infections (WHO, 1965; Peters and Kazura, 1987; Lengeler et al., 1991; Feldmeier, 1993), and safe and effective oral drugs (Wegner, 1984; Davis, 1985; Mcintosh et al., 1989; WHO, 1990), shifted emphasis from vector/intermediate host control to morbidity control. This means that the human definitive host has become central in contemporary control strategies, while vector control now plays only a supportive role (Duke and Moore, 1976; Klumpp and Chu, 1987).

One of the most important advantages of the new approach is the proven ability of drug therapy to achieve high levels of morbidity reduction through rapid parasite and egg clearance (Arfaa, 1984; Michaelsen, 1985; Elkins et al., 1986; Webbe and Jordan, 1993; Xianmin et al., 1999). However, the inevitability of reinfection remaining unaffected (Thein Hlaing et al., 1987; Wilkins, 1989; Abonico et al., 1995; Ofoezie, 2000) suggests that control outcome can be sustained only by a corresponding reduction in human exposure patterns. For both soil and water transmitted helminth infections, this will require a significant reduction in environmental contamination, an improvement in the hygiene practices and conditions of community members and significant modifications in peoples' behavior and attitude to social, cultural and environmental risk factors. This review assesses the role health education and sanitation has played in the past and the role they will play in the future to achieve these goals.

2. Materials and methods

A comprehensive computer search of titles related to the influence of water supply, sanitation and health education on ascariasis, trichuriasis, hookworm and schistosomiasis infections were undertaken using MEDLINE for 1976–2000.

The abstracts of relevant titles were printed and where necessary the full texts were sought and obtained from journals held in stock by libraries in the Obafemi Awolowo University, Ile-Ife, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, University College Hospital, Ibadan and the University of Ibadan, all in Nigeria. Additional titles and information were obtained from references cited by articles consulted, from publications of the World Health Organization (WHO) and from textbooks.

3. Results

3.1. Relationship between sanitation and helminth infection

In order to appreciate the role sanitation could play in helminth disease control, it is important to evaluate the mechanisms of environmental contamination and its impact on disease transmission and human health. Using a framework proposed by Bradley and Emurvon (1968) and modified by Feachem (1975), Huttly (1990), showed that sanitation has an inverse relationship with environmental contamination and disease transmission while environmental contamination and disease transmission are directly related. Thus, as sanitation means disposal of human excreta, sullage and solid waste (Pickford, 1988), it follows that in communities where people live under conditions of poor sanitation human faecal matter may be indiscriminately thrown around. As a result, faecally-borne pathogens, especially infective eggs and larvae of helminths would litter the environment. As these diseases are transmitted by the faecal–oral route or by direct penetration of the skin, the risk of infection will increase with such environmental contamination (Oshevskaia, 1995; Uga et al., 1995; Nozais, 1998; Yeager et al., 1999). There are many types of latrine facilities available for the management of human excreta: bucket latrine, pit latrine, compost latrine, aqua privies, flush toilets, etc (Kilama, 1985, 1989; Sridhar and Oyemade, 1987; Pickford, 1988). Where none of these are available, people have been known to defecate indiscriminately in the surrounding bushes. Where the facilities are available, the level of environmental contamination may depend on their use. According to the literature, bucket and pit latrines contaminate the environment more intensely than either the aqua privies or the flush toilets (Kilama, 1985, 1989; Sridhar and Oyemade, 1987). This is corroborated by several epidemiological studies of helminth infections which revealed that high prevalence and heavy intensity of infections are associated more with the use of bucket and pit latrines than with aqua privies and flush toilets (Elkins et al., 1986; Bundy et al., 1987; Asaolu et al., 1992).

Probably as a result of the obvious link between sanitation and disease transmission, the WHO declared 1981–1990 as an International Drinking Water Supply and Sanitation Decade (IDWSD). Although the target coverage of 78 and 31% for sanitation in the urban and rural areas, respectively, may not have been met, significant improvements were achieved by the end of the decade (WHO, 1987, 1988; Huttly, 1990). However, strong evidence in the literature shows that while lack of sanitation facility precipitates high environmental contamination and rapid disease transmission, the reverse is not always true. That is, it does not follow that increasing the number of latrines in a community reduces environmental contamination and rate of disease transmission, neither does the overall human health improve (Thomas, 1987; Holland et al., 1988; Huttly, 1990). This is because provision of latrine facilities does not always imply they are used, and even where they are used, they may not be used properly (Arfaa et al., 1977). As a result of this complex relationship between sanitation and human health, the outcome of sanitation interventions have varied widely in different settings.

3.2. Outcome of past interventions

A rigorous search of the literature revealed that most sanitation programs adopted two major designs. First, is the longitudinal trial design that assesses the effect of sanitation on helminth infections by comparing prevalence levels in the same population before and after control implementation. Second, is the cross-sectional cohort design that compares prevalence levels in two populations, one with and the other without access to sanitation facilities. Results from both designs point to one conclusion: that sanitation intervention leads to reduction in the prevalence of helminth infections. However, the relative effect of sanitation is not clear-cut as only one of the programs assessed the impact of sanitation alone while the others assessed its effect in combination with water supply, chemotherapy and/or health education.

3.2.1. Sanitation

In the one program where the effect of sanitation alone was assessed, the prevalence of *Ascaris lumbricoides* decreased from 71 to 51% and that of hookworm from 71 to 68%, a reduction of 28.2 and 4.2%, respectively. Mean intensity of *A. lumbricoides* also decreased by 60% (9558–3834 epg) and that of hookworm by 26.2% (1549–1143 epg) (Table 1).

3.2.2. Sanitation and water supply

Twenty programs evaluated the effect of sanitation in combination with water supply (Table 2a and b). Thirteen of the programs used the longitudinal trial approach (Table 2a) while seven used the cohort design (Table 2b). For the programs using the longitudinal trial approach, four programs assessed the effect of intervention on the prevalence and intensity of *A. lumbricoides*, four on the prevalence and intensity of *T. trichiura* and five on the patterns of schistosomiasis (*Schistosoma mansoni*) infection. The reduction rate in the prevalence of *A. lumbricoides* ranged from 17.9 to 31.1%, *T. trichiura* from 15.9 to 56.75% and schistosomiasis from 25.6 to 64.9%. In one instance, however, the prevalence of *A. lumbricoides* actually increased by 13.5% 4 years after control implementation. However, all available evidence points to this outcome as an exception rather than the norm (Henry, 1981). In contrast, to the clear-cut reductions in prevalence of infections, intensity of infections increased markedly in most instances confirming that while water supply and sanitation interventions may reduce the risk of infection they have little or no relieving effect on the already affected.

Out of the seven programs that employed the cohort design, only one assessed the impact of water supply and sanitation on the prevalence and intensity of *A. lumbricoides*, while the rest assessed their impact on schistosomiasis (Table 2b). In each instance, there was a clear evidence that access to water supply and sanitation facilities reduces the risk of helminth infections. Thus, in all the programs, decreasing access to water supply and

Table 1
Changes in the prevalence and intensity of helminth infections before and after sanitation interventions* in Iran

Disease	Prevalence (%)		Change (%)	Mean intensity (epg)[a]		Change (%)	Period (years)	Location	Reference
	Pre-control	Post-control		Pre-control	Post-control				
Ascaris	71	51	−28.2	9558	3834	59.9	3–4	Iran	Arfaa et al. (1977)
Hookworm	71	68	−4.2	1549	1143	26.2	3–4	Iran	Arfaa et al. (1977)

*Provision of latrine for each household.
[a] Arithmetic mean.

Table 2
Changes in the prevalence and intensity of helminth infections

Disease parasite	Prevalence (%)		Change (%)	Mean intensity[a] (epg)		Change (%)	Period (years)	Location	Reference
	Pre-control	Post-control		Pre-control	Post-control				
(a) Before and after sanitation and water supply interventions[b] in different endemic regions of the world									
A. lumbricoides	36.2	41.1	+13.5	29.9	41.4	38.5	4	Cul-de-sac, St. Lucia	Henry (1981)
A. lumbricoides	47.4	33.3	−29.7	6.4	19.3	201.6	4	Desruiseau, St Lucia	Henry (1981)
A. lumbricoides	37.9	26.1	−31.1	1	12.6	1160	4	Ti Rocher, St. Lucia	Henry (1981)
A. lumbricoides	55.4	45.5	−17.9	NA	NA		2	Belo Horizonte, Brazil	Gross et al. (1989)
T. trichiura	37.0	31.1	−15.9	4.7	35.5	655.3	4	Cul-de-sac, St. Lucia	Henry (1981)
T. trichiura	30.7	13.3	−56.7	NA	5.8		4	Desruiseau, St. Lucia	Henry (1981)
T. trichiura	32.5	17.5	−46.2	NA	9.5		4	Ti Rocher, St. Lucia	Henry (1981)
T. trichiura	19.6	15.0	−23.5	NA	NA		2	Belo Horizonte, Brazil	Gross et al. (1989)
S. mansoni	49.7	37.0	−25.6	35	28.2	−19.4	3	Riche Fond, St. Lucia	Jordan et al. (1975)
S. mansoni	38.2	13.4	−69.9	16.3	17.3	6.1	1	Riche Fond, St. Lucia	Jordan et al. (1982)
S. mansoni	13.4	8.6	−36.0	17.3	16.3	−5.8	4	Riche Fond, St. Lucia	Jordan et al. (1982)
S. mansoni	24	14	−41.7	NA	NA			Puerto Rico	Negron-Apontè and Jobin (1979)
S. mansoni	14	5.3	−62.1	NA	NA		7	Puerto Rico	Negron-Apontè and Jobin (1979)
	Prevalence (%)		Difference (%)	Mean intensity[a] (epg)		Difference (%)	Location	Reference	
	Present	Absent		Present	Absent				
(b) In communities with or without facilities for sanitation and/or water supply[c,d,e]									
S. haematobium	21.1	34.0	61.1	NA	NA		Egypt	Farooq et al. (1966)	
S. mansoni	16.3	33.9	108.0	NA	NA		Egypt	Farooq et al. (1966)	
Schistosoma (mixed)	8.4	19.9	137.0	NA	NA		Egypt	Farooq et al. (1966)	
S. mansoni	23.5	69.2	194.5	NA	NA		Puerto Rico	Pimentel et al. (1961)	

Table 2 (*Continued*)

Disease parasite	Prevalence (%)		Change (%)	Mean intensity[a] (epg)		Change (%)	Period (years)	Location	Reference
	Pre-control	Post-control		Pre-control	Post-control				
Ascaris	13.5	18.8	39.3	NA	NA			Puerto Rico	Pimentel et al. (1961)
S. mansoni	64.5	81.7	26.7	237.3	523.1	54.6		Brazil	Lima et al. (1985)
S. mansoni	26.8	59.1	120.5	NA	NA			Brazil	Lima et al. (1987)

NA, not available.
[a] Geometric mean.
[b] Provision of a latrine for each household, well/hand pump and a public laundry at strategic positions in each community.
[c] Provision of latrine and well for each household and community standpipes at strategic positions.
[d] Present indicates presence of facilities for water supply and/or sanitation.
[e] Absent indicates absence of facilities for water supply and/or sanitation.

sanitation facilities increased the prevalence of helminth infections, at rates ranging from 27% to as high as 194.5%. In Brazil where the effect of intensity was investigated, it was found that intensity of schistosomiasis infection was over 54% lower in communities with access to better water supply and sanitation facilities than those that lack access (Lima et al., 1985).

3.2.3. Sanitation and chemotherapy

Nine programs assessed the influence of sanitation in combination with drug therapy (Table 3). Two of the programs assessed impact of the intervention on *A. lumbricoides* and hookworm, four on schistosomiasis and one on *T. trichiura*. In each instance, the outcome appeared impressive. For instance, prevalence of infections declined from 13.6 to 87% and intensity by over 87% in Iran (Arfaa, 1977). In Zimbabwe prevalence of heavy infection (>50 *S. haematobium* eggs per 10 ml urine or >100 *S. mansoni* eggs per g faeces) also decreased by over 90% following praziquantel treatment and provision of improved ventilated pit latrines to the study households (Chandiwana et al., 1991). It must be emphasized that reduction rates of less than 60% were obtained only by longitudinal studies where long term interventions were associated with repeated assessments over specified intervals. In such cases, initial assessments often achieve high reduction rates, which usually decrease in subsequent assessments. Shuval et al. (1981) explained that the outcome of initial intervention against disease transmission is usually high but decreases gradually towards a saturation point at which further investments no longer result in commensurate benefits. This case is best illustrated by the Brazil project reported by Barbosa et al. (1971).

This project started in 1961. Latrine facilities were provided for each household, central laundry facilities for groups of households, dug wells and hand pumps for community use and infected persons received treatment intermittently. By 1966 the prevalence of schistosomiasis decreased from 30 to 10.1%, a rate reduction of 66.3%. During this period additional facilities were provided but by 1967 the prevalence had declined to

Table 3
Changes in the prevalence and intensity of helminth infections before and after sanitation* and chemotherapy** interventions in different endemic regions of the world

Parasite	Prevalence (%)		Change (%)	Mean intensity (epg)[a]		Change (%)	Period (years)	Location	Reference
	Pre-control	Post-control		Pre-control	Post-control				
Ascaris	57	8	−86.0	6725	755	−88.8	3–4	Dezful, Iran	Arfaa et al. (1977)
Ascaris	49.3	10.5	−78.7	NA	NA		2.5	Nigeria	Udonsi and Ogan (1993)
Hookworm	62.0	19.0	−69.4	1590	193	−87.9	3–4	Dezful, Iran	Arfaa et al. (1977)
Hookworm[b]	31.4	4.1	−86.9	NA	NA		2.5	Nigeria	Udonsi and Ogan (1993)
Trichuris	40.7	6.5	−84.0	NA	NA		2.5	Nigeria	Udonsi and Ogan (1993)
Schistosoma	60.0	20.0	−66.7	NA	NA		4	Zimbabwe	Chandiwana et al. (1991)
Schistosoma[b]	30.0	10.1	−66.3	NA	NA		5	Brazil	Barbosa et al. (1971)
Schistosoma[b]	10.1	4.4	−56.4	NA	NA		1	Brazil	Barbosa et al. (1971)
Schistosoma	4.4	3.8	−13.6	NA	NA		1	Brazil	Barbosa et al. (1971)

*Provision of latrine and well for each household. **Treatment with piperazine salt (Antipar), bephenuim hydroxynaphthrate (Alcopar) and praziquantel. NA, not available.

[a] Geometric mean.

[b] In combination with water supply and health education.

as low as 4.4%, a reduction rate of 56.4% over the 1966 level.

3.2.4. Health education

Although most programs of water supply and sanitation employed limited levels of health education, only seven programs specifically assessed the impact of health education on helminth infection (Table 4). Two of these involved only health education intervention while five combined health education with chemotherapy and/or snail control. One of the two programs of exclusive health education intervention assessed impact on *A. lumbricoides* and the other on schistosomiasis. Out of the five combining chemotherapy and snail control, two assessed impact on *A. lumbricoides* infection, one each on impact on *T. trichiura*, hookworm and schistosomiasis.

Results show that in one of the two programs of exclusive health education intervention prevalence of *A. lumbricoides* and *S. mansoni* declined by over 26 and 18%, respectively. The intensity of *A. lumbricoides* also reduced by over 35%. In combination with chemotherapy, the two programs that assessed impact on *A. lumbricoides* achieved reduction rates of 42–75% for prevalence and 73–85% in intensity. Rates of reduction achieved by intervention programs against *T. trichiura*, hookworm and schistosomiasis were 49, 33 and 86%, respectively, for prevalence and 53 and 33% in the intensity of *Trichuris* and hookworm, respectively. There was no data on the intensity of schistosomiasis.

4. Discussion

Analyses of the various outcome of sanitation and/or health education interventions revealed that:

i) intervention with either or both sanitation and health education reduces the prevalence and intensity of helminth infections;
ii) the rate of reduction in prevalence and intensity is comparable for sanitation and health education implemented separately or in com-

Table 4
Changes in the prevalence and intensity of helminth infections before and after health education[1] with or without chemotherapy[2] interventions in different endemic regions of the world

Parasite	Prevalence (%)		Change (%)	Mean intensity (epg)[c]		Change (%)	Period (years)	Location	Reference
	Pre-control	Post-control		Pre-control	Post-control				
Ascaris[a]	49.1	36.1	−26.5	1264	812	−35.8	0.5	Indonesia	Hadidjaja et al. (1998)
Ascaris[b]	71.4	41.8	−41.5	2435	657	−73.0	0.5	Indonesia	Hadidjaja et al. (1998)
Ascaris[b]	17.7	4.4	−75.1	1617	244	−84.9	0.5	Seychelles	Albonico et al. (1996)
Trichuris[b]	53.3	27.3	−48.8	782	367	−53.1	0.5	Seychelles	Albonico et al. (1996)
Hookworm[b]	6.3	4.2	−33.3	40	27	−32.5	0.5	Seychelles	Albonico et al. (1996)
Schistosoma[b]	6.6	0.9	−86.4	NA	NA		4	Mauritius	Dhunputh (1994)
Schistosoma[a]	11.0	9.0	−18.2	NA	NA		1	Brazil	Schall (1995)

[1]School and/or community based awareness program. [2]Treatment with mebendazole or praziquantel. NA, not available.
[a] In combination with chemotherapy and/or snail control.
[b] Exclusive health education intervention.
[c] Arithmetic mean.

bination with one another or with water supply;

iii) rate of reduction for either sanitation and/or health education is significantly better when combined with chemotherapy;

iv) though sanitation and health education may not achieve rapid rates of reduction, they sustain control outcome over long periods of time (see Barbosa et al., 1971; Jordan et al., 1975, 1982);

v) rate of reduction associated with specific interventions vary from one place to the other but is probably unaffected by the choice of helminth infection adopted for assessment.

Many studies have attempted to explain why the outcome of several water supply and sanitation interventions are program specific. Kilama (1985, 1989) reviewed the role of sanitation in the control of ascariasis and concluded that its overall impact depends largely on the type of facilities available for human excreta disposal and the level of community awareness on the modes of parasitic disease transmission. Yeager et al. (1999) arrived at the same conclusion after investigating the defecation practices of young children in a Peruvian shantytown. Feachem et al. (1983), on the other hand, disagreed, contending that what is important is the presence or absence of facilities and, not necessarily, their cost and sophistication. However, it appears that Feachem and his co-researchers ignored totally the fact that some latrines (e.g. bucket and pit latrines) have a greater propensity to leak faecal matter into the environment than others (e.g. aqua privies connected to soak-a-ways and flush toilets). It is, therefore, conceivable that those latrines that limit access to human faecal matter are more likely to protect public health than their counterparts.

It has also been suggested that the outcome of any sanitation intervention on human health would depend on the socio-economic background of a community. According to Shuval et al. (1981) the effect of sanitation intervention is most manifest in medium rather than in either low or high socio-economic status communities. However, the criteria for classifying communities into low, medium and high socio-economic status are not clear cut except that low socio-economic status are generally associated with ignorance, poverty, illiteracy and general deprivation in terms of good roads, health care facilities, alternative water supply, sanitation facilities, good housing etc. (Tshikuka et al., 1995).

For most low socio-economic communities, intervention on health education is often recommended as a first option to create the enabling environment for other strategies to thrive (Murda, 1985; Ekeh and Adeniyi, 1988). In this regard, health education improves peoples knowledge on the cause, prevention and treatment of endemic diseases, encourages community participation in control programs, modifies peoples beliefs and customs on disease-causing habits and taboos and promotes practice of sanitary behaviors and use of intervention facilities (Arfaa, 1984; Taylor et al., 1987; Kloos, 1995). Unlike sanitation, however, there is a virtual lack of information on the relative effect of different health education tools in disease control. While tools such as the mass media (e.g. television, radio, newspapers, etc), posters, public enlightenment campaigns (using cinemas, primary healthcare attendants, school-based educators etc) have been used variously at different times and places, no study has specifically compared their relative efficacies in modifying communities for helminth disease control. That this kind of study is very essential for determining the best approach to health education intervention cannot be said more forcefully.

The several articles reviewed in this paper have shown that chemotherapy remains the best option for morbidity control and for relieving the afflicted, an ethical imperative, akin to providing food during famine (Okun, 1988). However, as food relief does not prevent the next famine, chemotherapy neither prevents re-infection nor the next new infection (Henry, 1988; Wilkins, 1989; Henry et al., 1993; Ofoezie, 2000). Esrey et al. (1991) reviewed several intervention programs on helminth infections and concluded that health education and sanitation are the options of choice not only for mitigating helminth infections but also for sustaining the control outcome of other intervention programs. Okun (1988) drew a similar conclusion emphasizing that the benefits of safe water supply and sanitation go far beyond control and prevention of particular diseases to addressing the root causes of many diseases resulting from substandard living conditions.

It has, therefore, been suggested time without number, that the living standard in the developed countries today may be attributed to the fact that safe water supply is uninterrupted and facilities for sanitary disposal of human excreta provided in all public and private places (Huttly, 1990; Okun, 1988). This underscores the goal of the IDWSD, which aims at providing safe water and sanitation facilities to every individual. Although the decade is now behind us, the WHO must insist on renewed government and donor agencies commitments until the required target is met. To achieve this goal on a sustainable basis, emphasis should be on maintenance as it is on initial provision of infrastructure. An array of well conceived, well constructed but poorly maintained and sometimes abandoned pipes, treatment plants, flush toilets, soak-a-ways and a host of others are not uncommon in many cities of Africa, Asia and South America. In a recent study of schistosomiasis problem in two resettlement camps in Southwest Nigeria, it was observed that though each household was provided with a well-constructed in-house flush toilet they were not used because none was functioning due to lack of water supply. Subsequently, prevalence of schistosomiasis in both communities was very high (Ofoezie et al., 1991, 1997). In another investigation of the effect of investment on sanitation on *A. lumbricoides* infection, no difference in infection pattern was observed between a community with high investment on latrine facilities and another with none, again due to non-operation (personal observation).

It can, therefore, be concluded that health education and sanitation interventions still have important roles to play in the control of helminth infections. However, the success of sanitation interventions would depend on coverage in each community, their operational state and community acceptance. Coverage is particularly important because only a few individuals defecating in the open are required to maintain transmission (Okun, 1988). In order to achieve the required coverage and acceptability, the facilities must be affordable, available in the local market and compatible with local technologies. It must also be effective and simple to use. Similarly, health education programs must be efficient, simple and low-cost to achieve its goals.

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