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Impact of face-washing on trachoma in Kongwa, Tanzania

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Summary

Observational studies have suggested that the prevalence of trachoma is lower in children with clean faces than in those with ocular or nasal discharge or flies on the face. We carried out a community-based randomised trial in three pairs of villages to assess the impact on trachoma of a face-washing intervention programme following a mass topical antibiotic treatment campaign.

Six villages in Kongwa, Tanzania, were randomly assigned mass treatment plus the face-washing programme or treatment only. 1417 children aged 1–7 years in these villages were randomly selected and followed up for trachoma status and observations of facial cleanliness at baseline and 2, 6, and 12 months. At 12 months, children in the intervention villages were 60% more likely to have had clean faces at two or more follow-up visits than children in the control villages. The odds of having severe trachoma in the intervention villages were 0·62 (95% CI 0·40–0·97) compared with control villages. A clean face at two or more follow-up visits was protective for any trachoma (odds ratio 0·58 [0·47–0·72]) and severe trachoma (0·35 [0·21–0·59]).

This community-based participatory approach to face-washing intervention had variable penetration rates in the villages and was labour intensive. However, we found that, combined with topical treatment, community-based strategies for improving hygiene in children in trachoma-endemic villages can reduce the prevalence of trachoma.

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Introduction

Trachoma, an ocular infection caused by *Chlamydia trachomatis*, continues to be hyperendemic in many parts of Africa, Latin America, Australia, and Asia. Trachoma control efforts have been built around targeted use of antibiotics and provision of surgery in hyperendemic communities, but such programmes have had limited success in controlling active disease in children or later complications.[1–3] In our cross-sectional study, clean faces (especially faces free of flies and nasal discharge) were associated with a lower prevalence of trachoma.[4,5] We postulated that active disease might be less likely in children whose faces were kept clean after treatment for trachoma. We designed a community-based clinical trial to test the impact on active trachoma in children of a hygiene intervention programme following a mass topical antibiotic treatment campaign.

Methods

The study was carried out in Kongwa, in the Dodoma Region of Tanzania, where hyperendemic trachoma is a significant cause of blindness.[6,7] Rates of active disease in children aged 1–7 years average 60%.[4] Because a face-washing campaign would have to be carried out at the village level, we randomised three pairs of

	Number of children enrolled	Percentage of children			
		With any trachoma	With severe trachoma	With clean faces	Whose mothers had no education
Pair 1					
Intervention	178	58	13	27	71
Control	231	70	14	25	69
Pair 2					
Intervention	248	64	13	15	54
Control	247	57	16	17	55
Pair 3					
Intervention	254	77	22	16	66
Control	259	66	16	17	64
Total					
Intervention	680	69	16	18	63
Control	737	64	16	19	62

Table 1: **Baseline characteristics of villages**

villages—one of each pair would receive mass treatment followed by the health education campaign, and the other would receive mass treatment alone. The pairs of villages were matched for maternal education (years of formal education), baseline prevalence of clean faces in young children, and trachoma status (based on clinical observation at enrolment). Within each village, a complete census was taken by trained field-workers. 250 eligible households containing at least 1 child aged 1–7 years were randomly selected in each village. Within the household, 1 child was randomly selected to take part in the study.

A community-based participatory hygiene intervention programme was designed to improve face-washing of the young children in these villages.[8] Neighbourhood meetings to build consensus for increasing face-washing as an important approach to trachoma control were followed by several reinforcement activities, including school plays, seminars with the traditional healers, and meetings with other village groups. Field-workers also met villagers individually to discern problems in carrying out various activities and to provide reinforcement for improving face-washing. The intervention activities were intensely carried out for 1 month during and after mass treatment.

The goal of the mass treatment campaign was to provide 30 days of topical tetracycline ointment, 1 instillation per day, to every member of the village. Village treatment assistants were trained by field-workers to instil tetracycline for assigned families and to record compliance with the regimen. Overall estimates of compliance showed that 87% of the village received 27 or more days of treatment.

Data collection for each index child included age, sex, household characteristics, facial cleanliness, and trachoma status. Household characteristics included whether the roof was tin and whether a household member was responsible for herding cattle. Records of facial cleanliness were made by trained observers who were not part of the hygiene intervention team. They visited each participating household and inquired about the index child. The observer then made unobtrusive observations on the presence or absence of nasal discharge, ocular discharge, and flies on the face of the index child, and recorded the details on a data collection form immediately after leaving the house. Good inter-observer reliability of the trained observers has been documented.[2]

Data were collected at baseline and then at 2 months (1 month after the end of the mass treatment campaign), 6 months, and 12 months. At each time, the tarsal plate of the right eye of each index child was photographed. The photographs were graded on the WHO simplified grading scheme[9] by one examiner who was unaware of the randomisation status of the village and the time of the photograph.

For analysis, follicular trachoma was defined as the presence of five or more follicles. The presence of severe inflammation was defined as inflammation obscuring 50% or more of the deep vessels of the tarsal plate. Any trachoma was defined as follicular trachoma with or without inflammation. The grader also assessed the photograph for severe trachoma, defined as the presence of fifteen or more follicles or the presence of inflammation that obscured all vessels of the tarsal plate. Reproducibility of the trachoma grader was consistently high when checked over the year of study. A clean face was defined as the absence of signs or presence of only one sign on two separate days of observation. A sustained clean face was defined as the presence of a clean face at two or more of the follow-up examinations.

Contingency table analysis of the association between the outcome variables (sustained clean face, any trachoma, severe trachoma) and possible risk factors was carried out. Multiple logistic regression models were used to estimate the independent contributions of the risk factors to an outcome. To account for the clustering effect at village level, standard errors were adjusted by the generalised estimated equation method.[10]

Results

1417 children were enrolled in the study and 92% were followed up for 1 year. The main reasons for loss to follow-up were that the child died (2%) or that the family moved out of the village or out of the study area (6%). The villages were well matched for baseline characteristics, although photographic evidence of trachoma indicated higher rates in the intervention villages than control villages (table 1).

The intervention strategy had a modest effect in increasing the proportion of children with clean faces in two of the three intervention villages (table 2). At 12 months, the proportion with clean faces was higher in all the intervention villages, than in their matched controls,

	Percentage of children with clean faces				% with sustained clean faces
	Baseline	2 months	6 months	12 months	
Pair 1					
Intervention	27	59	36	39	44*
Control	25	35	22	22	20
Pair 2					
Intervention	15	47	37	41	42
Control	17	40	38	33	36
Pair 3					
Intervention	16	24	26	27	22
Control	17	30	29	23	22
Total					
Intervention	18	41	33	35	35*
Control	19	35	30	26	26

*p<0·05 for difference between intervention and control.

Table 2: **Effect of intervention on proportion of clean faces**

Characteristic	Odds ratio (95% CI)
Intervention village	1·61 (0·94–2·74)
Age (1 year increment)	1·42 (1·34–1·48)
Female	1·61 (1·16–2·35)
Clean at baseline	2·03 (1·53–2·66)
Cattle	0·62 (0·42–0·91)
Tin roof on house	2·26 (1·63–3·04)

Table 3: **Logistic regression analyses predicting sustained facial cleanliness**

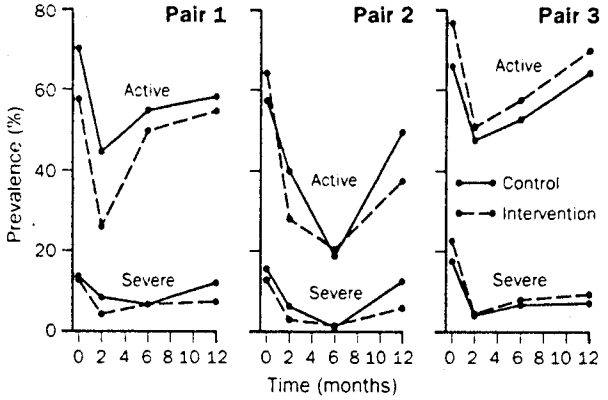

Figure 1: **Prevalence of trachoma in the intervention and control villages during study**

although the proportion who had sustained clean faces did not differ between the control and intervention villages in pair 3. With adjustment for baseline characteristics, children in the intervention villages were 60% more likely than those in control villages to have had sustained clean faces, although because of the lack of effect in pair 3, the wide confidence interval includes 1 (table 3). Other characteristics, such as number of children aged 1–7 years in the household and distance to water did not increase the likelihood of sustained facial cleanliness.

Crude prevalence rates of active trachoma and severe trachoma at 1 year were slightly lower in intervention than in control villages except for pair 3, in which the intervention did not have an effect (figure 1). After adjustment for age and baseline trachoma status, the odds of having severe trachoma at 1 year in an intervention village were 0·62 (95% CI 0·40–0·94, table 4). Other variables examined, such as sex and the presence of a tin roof, did not predict severe trachoma at 1 year.

The data were then pooled, and the crude rates of trachoma and severe trachoma were examined according to clean face status at baseline, and behaviour over time (figure 2). Children who were found to have sustained clean faces had lower initial rates of trachoma than other children, but at 1 year there was an even more pronounced difference between these children and those who never had a clean face or had a clean face at only one follow-up visit. We analysed the data specifically to assess the impact of sustained facial cleanliness on trachoma status at 1 year, with control for disease status at baseline.

	Odds ratio (95% CI) for severe trachoma	Odds ratio (95% CI) for any trachoma
Intervention village	0·62 (0·40–0·97)	0·81 (0·42–1·59)
Age	0·76 (0·68–0·85)	0·85 (0·80–0·90)
Trachoma at baseline*	5·21 (3·51–7·74)	5·07 (3·28–7·84)
Cattle	..	1·62 (1·22–2·15)

*Trachoma of the relevant category.

Table 4: **Odds of trachoma at 1 year for children in intervention villages compared with control villages**

	Odds ratio (95% CI) for severe trachoma	Odds ratio (95% CI) for any trachoma
Sustained facial cleanliness	0·35 (0·21–0·59)	0·58 (0·47–0·72)
Age	0·81 (0·72–0·91)	0·89 (0·82–0·96)
Disease at baseline	4·74 (3·28–6·83)	4·69 (2·91–7·57)
Intervention	0·59 (0·38–0·91)	..
Cattle	..	1·45 (1·04–2·03)

Table 5: **Effect of sustained facial cleanliness on trachoma in children at 1 year**

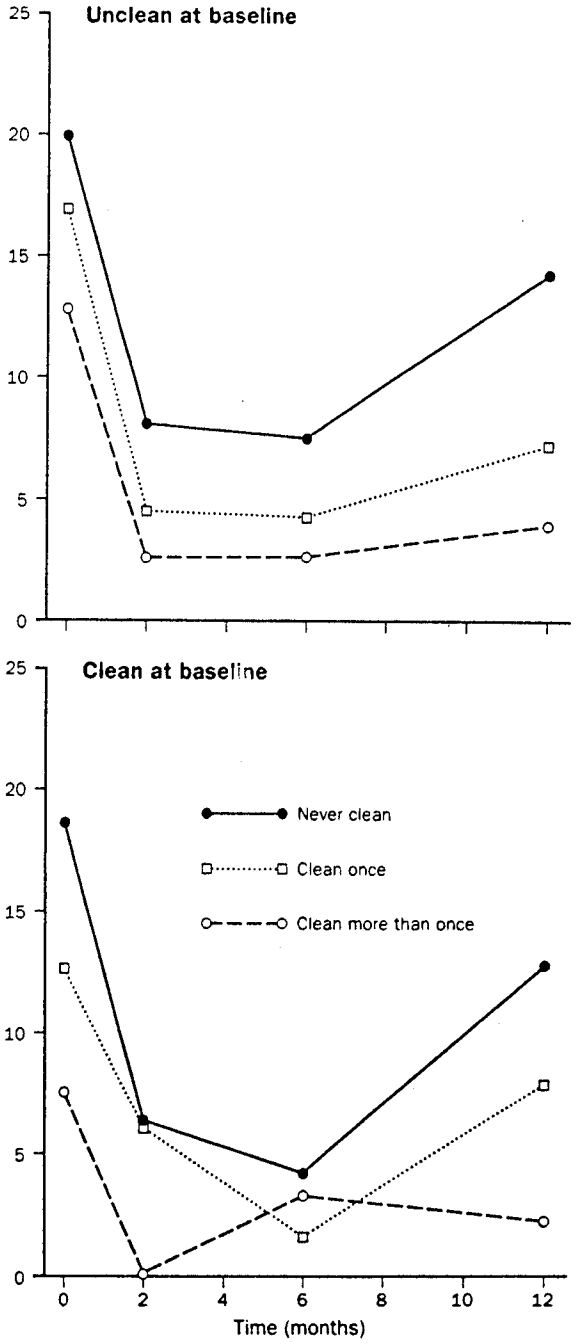

Figure 2: **Severe trachoma prevalence according to cleanliness of faces at baseline**

In this analysis, having a clean face at two or more follow-up visits was clearly protective for both any trachoma and severe trachoma (table 5).

Discussion

We have found that face-washing after a mass treatment campaign with topical tetracycline can reduce the prevalence of trachoma, especially severe trachoma, for up to 10 months after treatment. To improve face-washing practices, we adopted a community-based, participatory model.[8] This model is very labour intensive, and results take some time to be evident. Moreover, the approach does not work in all villages, and certainly not in every family. The intervention village in pair 3, for example, did not seem to be affected by the intervention. This village

was quite large and also had a very strong community ethos of disapproval for families who tried to be better than other families or "put on airs". To change hygiene practices in such a setting is extremely difficult. Nevertheless, the intervention achieved penetration similar to those of other hygiene intervention programmes.[11]

Since trachoma can produce ocular discharge, it can be argued that a clean face is not truly protective of trachoma but is the result of the absence of trachoma. In our definition of clean face we allowed one feature to be present in an effort to avoid this difficulty; in most of the unclean faces all three features were present, most importantly flies on the face and nasal discharge, although these features could also be linked.

Trachoma status at baseline was one of the most important predictors of trachoma status at 1 year. The fall in trachoma rates after treatment and the high compliance rates suggest that this finding is not a result of treatment failure. Instead, it is likely that children who have trachoma at baseline are at high risk of re-infection. Our data suggest high rates of re-emergent infection immediately after treatment in the absence of an intervention.[1] It is likely that children with trachoma at baseline are more liable to be in environments conducive to constant re-infection. However, after control for both baseline trachoma and baseline clean face status, children who had sustained clean faces were much less likely to show re-emergent severe trachoma after treatment. Our findings show that efforts to design effective, sustainable face-washing strategies for community control of trachoma are clearly warranted.

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SHORT REPORTS

Haemoglobin-based blood substitutes and sepsis

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An important concern that has received little attention is the possible increased susceptibility to bacterial infections of patients infused with cell-free haemoglobin-based blood substitutes. We show that pyridoxalated polymerised human haemoglobin promotes fulminating *Escherichia coli* septicaemia in mice, which draws attention to the potential danger of such products in the clinic.

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Aqueous solutions of modified human and bovine haemoglobins, as well as haemoglobins derived from recombinant DNA, are being investigated as replacements for red blood cells or whole blood in transfusion medicine.[1] Solutions of unmodified stroma-free haemoglobins are unsuitable clinically because the oxygen affinity is too high to allow efficient tissue oxygenation and the haemoglobin molecule is too unstable, dissociating rapidly into αβ-dimers that are cleared by renal filtration and result in long-term kidney damage. Various strategies have been devised to overcome these difficulties, including treatment with pyridoxal-5'-phosphate to lower the oxygen affinity, and cross-linking and polymerisation with agents such as glycolaldehyde to stabilise the haemoglobin molecule.[2] Recombinant haemoglobin has been engineered with oxygen binding and dissociation characteristics similar to whole blood as well as having increased circulatory half-life.[1,3]

Patients treated with cell-free haemoglobin-based blood substitutes may have increased susceptibility to bacterial infections.[4] The trace of cell-free haemoglobin normally in plasma is bound to haptoglobin. Increases in the amount of cell-free haemoglobin greatly enhance the susceptibility of animals and human beings to bacterial infections,[5] and freely available, native haemoglobin is the virulence-enhancing factor in certain catastrophic peritoneal infections.[5,6] This effect arises from haemoglobin's ability to provide invading bacteria with a ready supply of iron to sustain rapid bacterial multiplication in the otherwise iron-restricted environment of host-tissues.[5,6] Freely available haemoglobin, heme, or iron also abolish the bactericidal and bacteriostatic effects of plasma on some organisms[5] and inactivate neutrophils.[7] If modified haemoglobins behave in the same way as the native molecule, they might be expected to be hazardous in clinical use, where many patients are likely to be already infected subclinically before transfusion.[8] Hoyt et al[9] suggested that the use of pyridoxalated stroma-free haemoglobin does not compromise host defences against sepsis. However, their bacterial challenge was given 5 days after infusion of haemoglobin when virtually all the circulating free haemoglobin would have been eliminated. Crowley et al[10] reported that infusion of stroma-free cross-linked haemoglobin had no effect on the clearance of bacteria from blood but they monitored for only 4 h after infusion of *Escherichia coli*. Using a mouse model, we have