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The relationship between prevalence of active trachoma, water availability and its use in a Tanzanian village

Sarah Polack[1], **Hannah Kuper**[1], **Anthony W. Solomon**[1], **Patrick A. Massae**[2], **Carolina Abuelo**[1], **Ewen Cameron**[3], **Vivian Valdarmis**[1], **Michael Mahande**[4], **Allen Foster**[1], **David Mabey**[1]

[1]London School of Hygiene & Tropical Medicine, London, UK

[2]Huruma Hospital, Rombo, Tanzania

[3]Harvard Medical School, Harvard University, Boston, Massachusetts, USA

[4]Kilimanjaro Centre for Community Ophthalmology, P.O. Box 2254, Moshi, Tanzania

Summary

This study aimed to establish the relationship between the prevalence of active trachoma in children, water availability and household water use in a village in Tanzania. Nine hundred and fourteen children aged 1–9 years were examined for signs of trachoma. Data were collected on time taken to collect water, amount of water collected and other trachoma risk factors. In a sub-study, 99 randomly selected households were visited twice daily on two consecutive days to document patterns of water use. The prevalence of active trachoma in the children examined was 18.4% (95% CI 15.9–20.9). Active trachoma prevalence increased with increasing water collection time (OR 2.25; 95% CI 1.13–4.46) but was unrelated to the amount of water collected. In the sub-study, active trachoma prevalence was substantially lower in children from households where more water was used for personal hygiene (P for trend ≤0.01), independent of the total amount of water used. The allocation of water to hygiene was predicted by lower water collection time. The key element in the relationship between water availability and trachoma is the allocation of water within households. Collection time may influence both the quantity of water collected and its allocation within the household.

Keywords

Trachoma; Water; Water-use; Hygiene; Tanzania

Correspondence to: Sarah Polack.

Author for correspondence: Sarah Polack, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK. Tel: 020-7917-2917. Fax: 020-7958-8317. sarah.polack@lshtm.ac.uk.

Competing Interests
None

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Introduction

Trachoma is an eye disease caused by ocular infection with *Chlamydia trachomatis*. It is responsible for approximately 1.3 million cases of blindness worldwide, representing 3.6% of the global burden of blindness (Resnikoff et al. 2004). Trachomatous blindness is concentrated in the deprived, dry and dusty parts of the world, and is particularly prevalent in sub-Saharan Africa. Even within endemic countries, trachoma is found in the poorest parts, which are characterised by inadequate water supplies and sanitation, rural location and economic underdevelopment.

The pathogenesis of trachomatous blindness starts with repeated infection with *C. trachomatis*, an obligate intracellular organism that has its main reservoir in the ocular and nasal secretions of children (West et al. 1993, Solomon et al. 2002, Solomon et al. 2003). Transmission occurs by direct contact, or via flies and fomites. Transmission may be limited if ocular and nasal secretions are removed by keeping faces washed and clean; a number of cross sectional studies have shown that children with clean faces are less likely to have trachoma (Taylor et al. 1985, Tielsch et al. 1988, Taylor et al. 1989, West et al. 1991, West et al. 1996, Guraksin and Gullulu 1997, Hsieh et al. 2000, Schemann et al. 2002). Improving water supplies and encouraging the use of water to ensure that faces are clean therefore form important parts of the 'E' component of the WHO-recommended SAFE strategy (Surgery, Antibiotics, Facial cleanliness and Environmental improvement) for trachoma control. Cross-sectional surveys have shown a positive association between the distance to the water source and the prevalence of active trachoma both in the household overall and in children in particular (Marshall 1968, Assaad et al. 1969, Cairncross and Cliff 1987, Tielsch et al. 1988, West et al. 1989, Katz et al. 1996, West et al. 1996, Hoechsmann et al. 2001). The quantity of household water also predicts the prevalence of trachoma in a variety of settings (Kupka et al. 1968, Luna et al. 1992, Schemann et al. 2002), although not all studies have confirmed these associations (Kupka et al. 1968, West et al. 1989, Bailey et al. 1991).

The mechanisms by which water availability might affect risk of trachoma are not well understood (Rosen and Vincent 2001). It is presumed that water availability influences hygiene behaviour, and thereby the prevalence of trachoma. However, a case-control study in a Gambian village found that households with trachoma used less water for washing children than households without trachoma, irrespective of the total amount of water available (Bailey et al. 1991). This suggests that the key mediating factor in this relationship is what households actually do with water not the absolute amount of water available. Studies on household water use and trachoma are relatively scarce, and more evidence is needed to relate the quantity of water used for hygiene in households with the prevalence of trachoma (Kuper et al. 2003). Understanding this relationship is important to design appropriate trachoma interventions (Rosen and Vincent 2001).

This study explores the relationship between active trachoma in children and household access to water, and water use patterns in a trachoma endemic village in northern Tanzania.

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Methods

This study was conducted in the village of Shimbi Mashiriki, Rombo District, Northern Tanzania during August and September 2003. All households with children aged 1-9 were invited to participate in the study. Only 3 households refused, resulting in a study population of 914 children aged 1–9 years from 416 households.

Both eyes of 914 children were examined for signs of trachoma using 2.5× binocular loupes. Grading of trachoma was undertaken according to the WHO simplified trachoma grading scheme (Thylefors et al. 1987) by a single examiner (PAM), whose reliability had been previously established (unpublished data). In the WHO system, ‘active trachoma’ is defined as TF and/or TI in either eye, where TF is the presence of five or more follicles (each at least 0.5mm in diameter) in the central part of the upper tarsal conjunctiva, and TI is pronounced inflammatory thickening of the the upper tarsal conjunctiva obscuring more than half the normal deep tarsal vessels. Tarsal conjunctiva swabs were taken from the right eye of each subject (according to a previously described protocol (Solomon et al. 2003) to test for the presence of *C. trachomatis* infection using a commercial qualitative PCR assay (Amplicor™, Roche Molecular systems, Branchburg, NJ, USA)(Shattock et al. 1998, Schachter and Moncada 2002). The presence of a dirty face (nasal or ocular discharge) and the height and weight of the children were also measured.

Household interviews were conducted by trained local field assistants. Information was collected from the person usually responsible for water collection on: the water source used, the time taken to collect water (divided into time to and from the water source, and queue time), quantity of water collected each day, and how many times per week water was collected. The carer of the child was asked about hygiene behaviour for the children including frequency of face washing, bathing and hand washing, face drying practices and latrine usage, as well as vitamin A supplementation and all-cause morbidity. Household data collected included: number of animals kept within the household, presence of a latrine and indicators of latrine usage, other socio-economic stats (SES) indicators (asset ownership, building type, education and occupation) and monthly household expenditure.

A sub-sample of 30% of households containing children aged 1–5 years (n=99 households) were randomly selected for more in-depth study of water use. These households were visited twice a day for two consecutive days. One visit was made in the morning to ask about water collection and water use the previous evening and that morning. A second visit was made in the afternoon to ask about collection and use since the morning visit. The member of the household primarily responsible for domestic activities was asked how much water they had used for different activities including: face washing and bathing (adults and children), cooking, drinking, washing utensils, washing clothes, watering cattle, making beer, any other activities and about water recycling. The field workers asked to see the containers that had been used for different activities (as well as for water collection) and the volumes of these containers were recorded to determine the quantities of water used for each activity. This task was simplified by the fact that standard sized buckets tended to be used. As a check at the end of each visit the amount of water reported as being used was added and compared to the amount collected and stored to detect any serious discrepancies. This method was validated by day-long household observations of the amount of water bought into the household carried out in 10 households on the same day as these visits.

A SES index was calculated for each household by using Principle Components Analysis (PCA) to determine weights for an index of assets. Variables entered into the PCA included building materials for walls and floor, ownership of seven household assets, and education and occupation of the head of the household. Animal ownership was not included in this SES index due to the potential association with trachoma (De Sole 1987, West et al. 1991, Sahlu and Larson 1992, West et al. 1996, Hsieh et al. 2000). The association between active trachoma in children and household and child risk factors was analysed using logistic regression adjusting for age, gender, SES index and clustering of trachoma in households. Backwards selection was used was to create a multivariate logistic regression model, removing variables with P-values greater than 0.05, though age, gender and SES index were kept in the model throughout. If data were missing for any of the variables, the child in question was counted as missing.

In the sub-group, the daily per capita total litres of water used and the volume used for different activities were calculated. The relationship between active trachoma and total amount of water used, amount of water used for hygiene and total proportion of household water used for hygiene was analysed using logistic regression analysis adjusted for age, sex, clustering, SES index and total amount of water collected. Predictors of using more water for hygiene were also explored by logistic regression analysis comparing households in the top quartile of per capita water use for hygiene with those in the lowest 3 quartiles.

Ethical approval for the study was obtained from the ethics committees of the Kilimanjaro Christian Medical Centre, Moshi, Tanzania, and the London School of Hygiene & Tropical Medicine, London, United Kingdom. Participation in the study was voluntary and informed consent was obtained from all parents or guardians of children included in the study. As part of a district wide trachoma control program, mass treatment for active trachoma with azithromycin in the village was scheduled for the year after the study, and so the ethical committees did not deem treatment of individuals with trachoma necessary.

Results

The study village covers an area of approximately 20km^2 and contains 700 households. Public water sources in the village are highly unreliable, particularly during the dry season, and therefore springs, rivers, public and private taps in neighbouring villages are used. Only 17 households have a private water supply that functions during the dry season.

The overall prevalence of active trachoma in children aged 1–9 years was 18.4% (95% CI: 15.9–20.9). Only 1% of eyes swabbed were positive for the presence of *C. trachomatis* DNA.

Trachoma and potential confounders

The prevalence of active trachoma was highest in the children under 5 years and decreased with increasing age (p for trend >0.01) (Table 1). Overall 27.6% (95% CI: 24.7–30.5%) of

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children were stunted (defined as height-for-age z-scores <2SD) and 6.0% (CI: 4.4–7.5%) were wasted (defined as weight-for-height z-scores <2SD). There was no significant association between prevalence of trachoma and wasting, however the prevalence of trachoma was significantly higher in stunted children (OR = 1.43, 1.00–2.10). No clear trend was observed between the household SES index score or household expenditure and active trachoma. A significantly lower prevalence of active trachoma was found in children whose families had lived in the village for more than 10 years (OR=0.55, 0.34–0.89).

Crowding within beds (defined as number of people per bed) was associated with the prevalence of trachoma (OR 1.71; 95% CI 1.00–2.93), though crowding within rooms was not. Prevalence of active trachoma increased when more cattle, goats and sheep were kept in the household (P for trend <0.01) and when cattle were kept in the same room as people overnight (OR 2.31; 95% CI 1.32–4.05). Almost all households in the village had their own latrine (97%). A reduced prevalence of active trachoma was observed where there was evidence of a beaten path to the latrine and adequate screening, but these relationships were not statistically significant.

Trachoma, water and hygiene

Prevalence of trachoma increased significantly with increased reported water collection time (p for trend <0.01) but was not associated with the amount of water collected per capita (Table 2). The prevalence was lower in children with a clean face (absence of eye or nose discharge, OR 0.56; 95% CI 0.30–1.05) but was not associated with reported frequency of face washing. Active trachoma prevalence decreased with reported frequency of clothes washing (P for trend <0.05).

Multivariate analyses

The multivariate analyses showed that the prevalence of active trachoma was significantly higher in households with reported water collection time of more than 85 minutes, though there was no further increase in prevalence when water collection time was even higher (Table 3). Cattle staying in the same room as people overnight and the household living in the village for less than 10 years remained significant risk factors.

Trachoma and household water use

A total of 99 households containing 233 children aged 1–9 years were included in the sub-study of household water use. Total per capita water used (excluding water allocated to cattle) ranged from 2 to 50 litres per day, with a mean of 13.1 litres (95% CI: 11.5–14.7), the majority of which was used for drinking and cooking. The amount of daily water used for bathing and face-washing per capita ranged from 1.05 to 10 litres, with a mean of 4.25 litres (95% CI: 3.8–4.6). The proportion of household water used for bathing and face-washing ranged from 6 to 60% with a mean of 24% (95% CI: 23–28%). All activities involving water (including bathing and clothes washing) were reportedly carried out in the household, not at the water source.

A significant inverse relationship was seen between both the amount (P for trend <0.01) and proportion (P for trend <0.01) of water used for hygiene and prevalence of active trachoma

(Table 4). There was no clear relationship between active trachoma prevalence and total daily amount of water used per capita.

The linear regression analysis showed an inverse correlation ($P<0.05$) between water collection time and total amount of water collected, both in the full sample ($r=-0.08$) and in the sub-sample ($r=-0.41$).

Households in the top quartile of amount of water used per capita for personal hygiene were likely to be closer to the water source than households in the lower three quartiles (p for trend <0.01) (Table 5). Higher per capita daily water use was a predictor for using more water on hygiene (OR 7.3, 2.5–21.6) and the less poor households were more likely to use more water for hygiene (OR 5.1, 1.83–14.32).

Discussion

In this study of a large village in northern Tanzania using detailed measures of water availability and use, we observed that the prevalence of active trachoma in children significantly increased with increasing reported water collection time. There was no association between the reported per capita quantity of water and the prevalence of trachoma. However, in the sub-study the prevalence of active trachoma in children was substantially lower in households where more water was used for hygiene, and this was independent of the total amount of water used in the household.

The finding in this study of an increased prevalence of active trachoma in children with increased household water collection time is in accordance with studies in other settings (Marshall 1968, Assaad et al. 1969, Cairncross and Cliff 1987, Tielsch et al. 1988, West et al. 1989, Katz et al. 1996, West et al. 1996, Hoechsmann et al. 2001). In the present village, water collection time in the dry season ranged from 0 minutes to 6 hours and trachoma prevalence was lowest in households who reported spending less than 85 minutes collecting water. We found an inverse relationship between water collection time and quantity of water used and that households using the highest volume of water on hygiene per capita lived closest to their water source. Although the relationship is likely to be complex, these findings suggest that water collection time may influence both water quantity and allocation of water within the household.

While the association between trachoma and time to water source has been frequently observed, the actual reasons for this relationship are less well established. As suggested by this study, distance to water may limit the amount of water available to the household and therefore the quantity of water used by the household could be the actual predictor of trachoma prevalence. However, data collected both by interview (full sample) and through direct observation of containers used for water collection (sub-sample) indicated a lack of association between the prevalence of active trachoma and quantity of water used per household or per capita. This finding corresponds with the data from The Gambia (Bailey et al. 1991) and Tanzania (West et al. 1989), and suggests that absolute quantity of water in the household may not be the key element in establishing the association between distance to water and trachoma.

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In the more detailed exploration of household water use patterns possible with our sub-sample, we observed that children from households where more water was used for hygiene per capita were substantially less likely to have trachoma, irrespective of the total amount of water used per capita. Further, in households where a greater proportion of the total household water was used for hygiene purposes, prevalence of trachoma was significantly lower. These findings complement those of Bailey at al. (1991) who observed that more water was used for washing children in families without trachoma cases than in families with trachoma. They are also in accordance with a study in central Tanzania where a relationship was observed between clean faces and distance to water, but not with daily water quantity used (McCauley et al. 1990). Together these studies lend weight to the hypothesis that the key factor in the association between water and trachoma prevalence is behavioural practices concerning water use within the household rather than the absolute amount of water available. From their investigations in Central Tanzania, McCauley et al (1990) suggest that household priorities for water use, perception of the amount of water needed for hygiene and lack of time for washing of children, may all be more important than the actual amount of water available or time taken to collect it.

No evidence was found in this study for an association between the frequency of face washing and trachoma prevalence. However these data were based on reported hygiene behaviour and a tendency for mothers to over-report 'good' hygiene behaviours when questioned has been previously suggested (Stanton et al. 1987, Curtis et al. 1993, Manun'Ebo et al. 1997). Keeping cattle in the same room as people overnight was another risk factor for trachoma in this study. A relationship between the presence of cattle and prevalence of trachoma has been observed elsewhere (De Sole 1987, West et al. 1991, Sahlu and Larson 1992, West et al. 1996, Hsieh et al. 2000). This association may be due to an increased exposure in the household to flies that transmit trachoma and breed in exposed animal faeces, though entomological work suggests that flies emerging from animal (as opposed to human) faeces are less likely to be attracted to children's faces (Emerson et al. 2001).

This study was conducted in a large village, and there was a high level of participation. An experienced grader was responsible for diagnosing trachoma. Water use was measured through intensive investigation involving twice daily interviews and observations of containers used for water-related activities. The prevalence of active trachoma was relatively low and so the relationship between water use and trachoma may not be generalizable to hyperendemic areas. The prevalence of infection was very low. Poor correlation between clinical signs and laboratory evidence of *C. trachomatis* has been noted elsewhere (Baral et al. 1999, Burton et al. 2003) and a comprehensive review of the mismatch between infection and disease and the possible reasons for it are presented by Solomon et al. (2004). It is possible that children with active trachoma in the current study had all had previous ocular *C. trachomatis* infections and their clinical activity at time of this study reflected ongoing resolution of *C. trachomatis*-induced inflammation. The reasons for such a trend are unclear. No mass antibiotic treatment for trachoma had been undertaken in the village, and informal discussion with village members suggested that water availability (and therefore, presumably, water-use patterns in the village) had been relatively stable over previous years;

thus, any bias in the relationship with clinical signs representing previous infection should be limited.

In conclusion, this study strengthens the evidence that the pattern of water use within the household is the important linking factor between access to water and trachoma prevalence. Further work exploring how to encourage households to allocate a greater proportion of their water for hygiene – despite competing demands and priorities for its use – may be beneficial for designing effective health education for trachoma control.

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Table 1
The association between active trachoma and potential trachoma risk factors

Variable	Number	Number with active trachoma	Prevalence	Adjusted OR (1)	Adjusted OR (2)
Age (years)					
1-2	174	42	24.1%	1.00	1.00 **
3-4	202	59	29.2%	1.29 (0.82-2.06)	1.29 (0.81-2.08)
5-6	207	36	17.4%	0.65 (0.39-1.07)	0.62 (0.37-1.04)
7-9	327	30	9.2%	0.31 (0.19-0.52)	0.29 (0.37-1.04)
Sex					
Male	444	74	16.7%	1.00	1.00
Female	468	94	20.1%	1.35 (0.95-2.09)	1.36 (0.95-1.95)
Stunting (height for age)					
Not severely stunted	660	109	16.5%	1.00	1.00
Severely stunted	250	58	23.2%	1.43 (1.00-2.10)	1.41 (0.98-2.08)
Wasting (weight for height)					
Not severely wasted	852	160	18.8%	1.00	1.00
Severely wasted	54	7	13.0%	0.64 (0.29-1.48)	0.60 (0.25-1.46)
Socio-economic status index of household					
First quartile (poorest)	255	55	21.6%	1.00	1.00
Second quartile	186	37	19.9%	0.89 (0.49-1.67)	0.89 (0.49-1.67)
Third quartile	227	32	14.1%	0.59 (0.32-1.08)	0.59 (0.32-1.08)
Fourth quartile (richest)	212	38	17.9%	0.90 (0.51-1.68)	0.90 (0.51-1.68)
Monthly expenditure per capita (US dollars)					
<$0.20	214	29	13.6%	1.00	1.00
$0.21-2.30	205	41	20.0%	1.57 (0.81-3.05)	1.73 (0.89-3.38)
$2.40-3.90	243	56	23.0%	1.94 (1.04-3.62)	2.20 (1.17-4.14)
>$40	234	38	16.2%	1.05 (0.53-2.09)	1.19 (0.58-2.41)
Years lived in village					
<10	223	58	26.0%	1.00	1.00
≥10	657	101	15.4%	0.55 (0.34-0.89)	0.56 (0.32-0.90)
Number sharing bedroom					
1-2	221	39	17.6%	1.00	1.00
3	302	50	16.6%	0.79 (0.49-1.28)	0.77 (0.47-1.24)
4	204	40	19.6%	0.96 (0.58-1.60)	0.96 (0.57-1.60)
5-7	169	35	20.7%	1.04 (0.61-1.76)	0.98 (0.57-1.71)
Number sharing bed					
1-2	492	75	15.2%	1.00	1.00
3	300	61	20.3%	1.22 (0.83-1.79)	1.19 (0.80-1.77)
4-7	104	28	26.9%	1.76 (1.05-2.94)	1.71 (1.00-2.93)
Number of cattle in household					
0	262	37	14.1%	1.00	1.00 **

Variable	Number	Number with active trachoma	Prevalence	Adjusted OR (1)	Adjusted OR (2)
1	286	50	17.5%	1.37 (0.78-2.44)	1.38 (0.78-2.46)
2	249	48	19.3%	1.64 (0.93-2.90)	1.84 (1.03-3.27)
≥3	99	29	29.3%	2.37 (1.18-4.76)	2.51 (1.23-3.26)
Cattle in same room as people overnight					
No	761	126	16.6%	1.00	1.00
Yes	135	38	28.1%	2.19 (1.29-3.71)	2.31 (1.32-4.05)
Latrine: Beaten path to door					
No	113	29	25.7%	1.00	1.00
Yes	767	133	17.3%	0.64 (0.35-1.18)	0.66 (0.35-1.25)
Latrine: Adequate screening					
No	438	95	21.7%	1.00	1.00
Yes	409	61	14.9%	0.71 (0.45-1.11)	0.63 (0.39-1.03)

Some data were missing

[1] Odds ratio adjusted for age, sex and household clustering

[2] Odds ratio adjusted for age, sex, socio-economic status and household clustering

[¶] Defined as height-for-age z-scores <2SD

[‡] Defined as weight-for-height z-scores <2SD

[*] p for trend ≤0.05

[**] p for trend ≤0.01

Table 2

A univariate analysis of the relationship between active trachoma and potential risk factors

Variable	Number	Number with active trachoma	Prevalence	Adjusted OR (1)	Adjusted OR (2)
Reported water collection time (mins) in household					
≤85	226	27	11.9%	1.00	1.00 *
85 to 150	255	55	21.6%	1.83 (0.99-3.45)	2.02 (1.04-3.89)
150 to 210	242	47	19.4%	1.79 (0.95-3.39)	2.00 (1.00-3.95)
>210	173	35	20.2%	2.03 (1.03-3.99)	2.25 (1.13-4.46)
Litres of water collected per day per capita					
≤8	233	45	19.3%	1.00	1.00
9-15	229	41	17.9%	0.97 (0.53-1.79)	1.02 (0.53-1.94)
15-20	195	31	15.9%	0.81 (0.42-1.56)	1.12 (0.51-2.47)
>20	206	38	18.4%	0.89 (0.48-1.65)	1.22 (0.68-2.18)
Cost water per month (US dollars)					
$0	151	55	36.4%	1.00	1.00 **
<$1	313	46	14.7%	0.31 (0.18-0.54)	0.30 (0.17-0.54)
$1-2	205	29	14.1%	0.29 (0.15-0.57)	0.31 (0.16-0.61)
>$2	227	34	15.0%	0.30 (0.16-0.56)	0.29 (0.15-0.57)
Facial Cleanliness					
Dirty face	86	31	36.0%	1.00	
Clean face	826	137	16.6%	0.55 (0.30-1.02)	0.56 (0.30-1.05)
Frequency of face washing					
1-7 / week	307	59	19.2%	1.00	1.00
8-14 / week	565	101	17.9%	0.8 (0.6-1.2)	0.92 (0.63-1.35)
15-35 / week	25	5	20.0%	0.7 (0.2-2.2)	0.78 (0.24-2.43)
Last time washed hands:					
Today	838	148	17.7%	1.00	1.00
Before today	58	16	27.6%	1.66(0.89-3.11)	1.65 (0.88-3.10)
Frequency of clothes washing					
0-4 / month	364	73	20.1%	1.00	1.00 *
5-8 / month	267	54	20.2%	1.04 (0.49-2.24)	0.98 (0.65-1.49)
9-12 / month	86	11	12.8%	0.49 (0.15-1.16)	0.54 (0.27-1.11)
>12 / month	179	26	14.5%	0.49 (0.20-1.19)	0.63 (0.37-1.06)

Some data were missing

[1] Odds ratio adjusted for age, sex and household clustering

[2] Odds ratio adjusted for age, sex, socio-economic status and household clustering

* p for trend ≤0.05

** p for trend ≤0.01

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Table 3

A backwards selection multivariate logistic regression analysis of variables associated with risk of active trachoma, adjusting for household clustering. Age, sex and socio-economic status index were included in the model at each stage.

Variable	Adjusted OR (95% CI)
Age of child (years)	
1 to 2	1.00 **
3 to 4	1.18 (0.78-1.81)
5 to 6	0.58 (0.34-1.01)
7 to 9	0.31 (0.18-0.54)
Sex	
Male	1.00
Female	1.22 (0.82-1.80)
Socio-economic status index of household	
First quartile (poorest)	1.00
Second quartile	1.01 (0.55-1.87)
Third quartile	0.66 (0.35-1.25)
Fourth quartile (richest)	1.52 (0.79-2.90)
Reported water collection time (mins)	
≤85	1.00
85 to 150	2.15 (1.13-4.10)
150 to 210	1.96 (1.00-3.01)
>210	1.96 (1.00-3.85)
Years lived in village	
<10	1.00
≥10	0.56 (0.35-0.89)
Cattle in same room as people overnight	
No	1.00
Yes	2.21 (1.29-3.79)

** p for trend ≤0.01

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Table 4

Relationship between active trachoma and daily volume of water used per capita for hygiene, sub-sample

	No	Number with active trachoma	Prevalence	Adjusted OR[1] (95% CI)	Adjusted OR[2] (95% CI)	Adjusted OR[3] (95% CI)
Litres water used per capita						
Total						
3.8 - 11.32	58	12	20.7%	1.00	1.00	
11.32 - 14.6	59	11	18.6%	0.82 (0.24-2.82)	0.93 (0.27-3.24)	
14.6 - 21.3	58	10	17.2%	0.81 (0.23-2.79)	0.81 (0.23-2.88)	
21.3 - 15.5	58	11	19.0%	1.00 (0.31-3.32)	1.04 (0.26-3.39)	
Children (<9years): bathing and facewashing						
<2/week(?)	60	18	30.0%	1.00	1.00	1.00
2-3.5/week	60	8	13.3%	0.35 (0.11-1.19)	0.42 (0.12-1.42)	0.39 (0.11-1.34)
3.5-5/wee/k	56	10	17.9%	0.48 (0.16-1.48)	0.37 (0.11-1.26)	0.29 (0.08-1.11)
>5/week	57	8	14.0%	0.37 (0.11-1.23)	0.38 (0.12-1.22)	0.33 (0.09-1.17)
All ages: bathing and facewashing						
< 2.2/week?	59	20	33.9%	1.00	1.00**	1.00**
2.2 - 3.7/week	58	13	22.4%	0.47 (0.15-1.50)	0.46 (0.14-1.50)	0.32 (0.10-1.06)
3.8 - 5.0/week	59	5	8.5%	0.15 (0.05-0.50)	0.16 (0.05-0.52)	0.08 (0.02-0.31)
>5/week	57	6	10.5%	0.21 (0.06-0.68)	0.17 (0.05-0.63)	0.05 (0.01-0.25)
Proportion of total household water used for hygiene						
≤17%	61	17	27.9%	1.00	1.00*	1.00*
18-23%	59	11	18.6%	0.62 (0.20-1.91)	0.65 (0.19-2.21)	0.53 (0.15-1.92)
23-32%	57	12	21.1%	0.70 (0.25-1.99)	0.66 (0.26-1.89)	0.59 (0.20-1.75)
>32%	56	4	7.1%	0.23 (0.06-0.93)	0.20 (0.04-1.00)	0.14 (0.02-0.94)

[1] Odds ratio adjusted for age, sex and household clustering

[2] Odds ratio adjusted for age, sex, socio-economic status, household clustering and keeping cattle in same room as people overnight

[3] Odds ratio adjusted for age, sex, socio-economic status, household clustering, keeping cattle in same room as people overnight and total water use per captia

* p for trend ≤0.05

** p for trend ≤0.01

Table 5

Exploration of potential predictors for using more water for personal hygiene: the relationship between household characteristics and using the highest quartile of water for hygiene (in the sub-sample).

Variable	Number	Number in highest water use-for-hygiene quartile	Percentage	OR
Reported water collection time (mins)				
<130	51	19	37.3%	1.00
>130	48	8	16.7%	0.33 (0.13-0.87)
Per capita water use (litres)				
<15	50	5	10.0%	1.00
>15	49	22	44.9%	7.33 (2.48-21.63)
Number of cattle in household				
0	26	8	30.8%	1.00 **
1	36	13	36.1%	1.27 (0.43-3.72)
>2	37	6	16.2%	0.43 (0.13-1.46)
Socio economic status index of household				
Poorest	49	6	12.2%	1.00
Richest(?)	48	20	41.7%	5.11 (1.83-14.32)
Monthly expenditure per capita (US dollars)				
<$2	27	5	18.5%	1.00
$2 - $3.5	24	7	29.2%	4.11 (1.08-15.62)
$3.5 - $5.5	23	6	26.1%	1.59 (0.37-6.82)
>$5.5	25	9	36.0%	1.43 (0.33-6.09)

** p for trend <=0.01