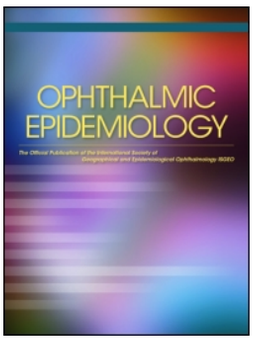

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Assessment of Trachoma in Cambodia: Trachoma Is Not a Public Health Problem

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ABSTRACT

Purpose: To determine whether trachoma is a public health problem requiring intervention in Cambodia.

Methods: Based on historical evidence and reports, 14 evaluation units (EUs) in Cambodia, judged to be most likely to harbor trachoma, were selected. The Global Trachoma Mapping Project methodology was used to carry out rigorous surveys to determine the prevalence of trachomatous inflammation–follicular (TF) and trichiasis in each EU.

Results: The EU-level prevalence of TF among 25,801 1–9-year-old children examined ranged from 0% to 0.2%. Among the 24,502 adults aged 15+ years examined, trichiasis was found in 59 people. Age- and sex-adjusted prevalences of trichiasis in all ages in the EUs studied ranged from 0% to 0.14%; five EUs had a prevalence of trichiasis ≥0.1%.

Conclusions: There appears to be no need nor justification at this time for implementing public health measures to control trachoma in Cambodia.

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Cambodia; eye health; Global Trachoma Mapping Project; trachoma; trichiasis

Introduction

Trachoma is a neglected tropical disease, and an important infectious cause of blindness.[1] Blindness from trachoma is difficult to cure, but possible to prevent, and the SAFE strategy (Surgery for trichiasis, Antibiotics to treat *C. trachomatis* infection, Facial cleanliness and environmental improvement to limit transmission) is widely accepted as the method to do this.[2] Cambodia is located on the Indochina Peninsula, surrounded by Thailand, Laos, Vietnam and the Gulf of Thailand; the estimated total national population was 13.4 million in the 2008 census.[3] About 80% of the population live in rural areas, with the overall population density estimated to be 75 people/km^2. Trachoma has been recognized in Cambodia and documented in three peer reviewed publications in the 1990s.[4–6]

In 2000, a series of trachoma rapid assessments (TRAs)[7] was conducted in Prey Veng, Svay Rieng and Takeo provinces.[8] On the basis of these assessments, some trachoma control activities including surgery provision, educational posters and leaflets, and distribution of tetracycline eye ointment at the health center and health post level were carried out for a short time when funding was available.

In 2004, the National Programme for Eye Health undertook a second TRA round in 80 villages of the provinces of Battambang, Kampong Chhnang, and Phnom Penh. These showed trachoma inflammation–follicular (TF)[9] in up to 15% of children examined in some villages.[10]

Following review of the evidence described above and consultancies with the National Programme for Eye Health, the World Health Organization (WHO) Western Pacific Regional Office, the WHO Country Office, and non-governmental development organizations with an interest in trachoma control in Cambodia, it was concluded in 2013 that there was some trachoma in Cambodia but it was not possible to say whether or not the prevalence was currently of public health significance.

Therefore, a decision was made to conduct a study of sufficient rigor to determine if any provinces had a prevalence of TF in 1–9-year-old children of 10% or more, or a prevalence of trichiasis in all ages of 0.1% or more, so that Cambodia could implement SAFE if necessary or, alternatively, provide the evidence needed to document elimination of the disease as a public health problem.[11] The Global Trachoma Mapping Project (GTMP) methodology[12] was selected for the survey.

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*See Appendix

Materials and methods

GTMP methods require that the survey area be divided into evaluation units (EUs). The EUs determined for the mapping were based on the 24 provinces, however because of the wide range in number of people resident within the provinces, (40,208 in Kep to 2,234,566 in Phnom Penh) some were split and others combined for more uniformity in population size. Kep (population 40,208) and Kampot (population 585,110) were combined into one evaluation unit; Pailin (population 70,483) and Battambang (population 1,038,789) were combined and then the resulting area divided in half into two evaluation units. Mondulkiri has a relatively small population (60,811), but a large area, so it was surveyed as a single evaluation unit. Because Kampong Chhnang and Kandal each have populations greater than 1 million, each was divided into two evaluation units of approximately equal size. A total of 24 EUs were therefore defined, as shown in Table 1. Approval for the study was provided by the local Cambodian Ministry of Health, through the lead author, and the study adhered to the tenets of the Declaration of Helsinki.

The 14 EUs believed most likely to have significant trachoma were selected for investigation. These EUs comprised areas from the 2000 and 2004 TRAs (6 EUs), areas with relatively high population densities, areas based on knowledge of cases of trichiasis presenting to the hospitals serving those provinces and perception of poor access to water and sanitation (6 EUs), and two EUs (Ratanak Kiri and Mondul Kiri) in very mountainous, isolated, poorly developed areas with minority populations, similar to areas in neighboring countries that have reported trachoma. Surveys were planned in these 14 EUs.

Table 1. Evaluation units defined for Cambodia, Global Trachoma Mapping Project, 2014–2015.

Province	Evaluation unit	Population, *n*
Battambang	Banteay Meanchay	678,033
Battambang	Battambang A[a]	558,640
Battambang	Battambang/Pailin[a]	550,632
Kampong Cham	Kampong Cham A	861,320
Kampong Cham	Kampong Cham B	989,420
Kandal	Kampong Chnang[a]	472,616
Kandal	Kampong Speun[a]	716,517
Kampong Cham	Kampong Thom	708,398
Kompot	Kampot	585,110
Kompot	Kep (to combine with Kampot)	40,208
Kandal	Kandal A[a]	638,321
Kandal	Kandal B[a]	643,631
Kompot	Koh Kong	139,722
Stueng Treng	Kratie[a]	318,523
Stueng Treng	Mondul Kiri[a]	60,811
Battambang	Odam Meanchay	185,443
Kompot	Preah Sihanouk	199,902
Stueng Treng	Preah Vihear[a]	170,852
Battambang	Pursat	397,107
Kampong Cham	Prey Veng A[a]	538,014
Kampong Cham	Prey Veng B[a]	596,170
Stueng Treng	Ratanakiri[a]	149,997
Battambang	Siem Reap	896,309
Stueng Treng	Stung Treng	111,734
Kampong Cham	Svay Ring[a]	571,491
Kompot	Takeo[a]	964,471

[a]Selected for survey.

The sample size calculation for each survey was based on TF prevalence and used the single population proportion for precision formula.[13] To estimate a true TF prevalence of 10% in 1–9-year-olds with an absolute precision of 3%, assuming a cluster survey design effect of 2.65 and inflation by a factor of 1.2 to account for non-response, each survey required sufficient households to yield 1222 children.[12] In rural Cambodia, the mean household size is 4.6 people of whom 23% were expected to be aged 1–9 years (a mean of 1.1 children aged 1–9 years/household). Therefore, 1222/1.1=1155 households were required per survey. Assuming that a team could complete 30 households per day, this required 39 clusters per survey.

For each survey, two-stage cluster sampling was used. In the first stage, 39 clusters within each EU were selected from a census list of all villages, using a probability proportional to size, systematic sampling method. In the second stage, at the village, a systematic sample of 30 households was selected from a list of all households with children aged 1–9 years. It was necessary to select from a list of households with appropriately aged children because during the pilot phase it became clear that up to 2/3 households did not have any resident 1–9-year-old children, and much time was wasted going house to house to learn this.

In selected households, the standard GTMP protocol[12] was observed, with one GTMP-certified grader, one GTMP-certified recorder, and a local guide from the health center. GPS data were collected at each household.

Informed verbal consent for examination was obtained from all participants, or (for those younger than 15 years) their parent or legal guardian. Examination of each consenting individual for the signs trichiasis, TF and trachomatous inflammation-intense (TI) was conducted using binocular magnifying loupes and sunlight or a torch for illumination. The presence of trichiasis was recorded as "trachomatous trichiasis" (TT), implying causation by trachoma, although the presence or absence of trachomatous scarring was not recorded. Consent or refusal was formally noted by the data recorder for each household resident. Teams were trained following the GTMP training system.[14] In order to ensure that there would be enough children with TF for adequate training, grader candidates travelled to Ethiopia in May 2014 to undergo the standard GTMP grader training and certification. Graders who qualified then joined the

recorders in Battambang Province, Cambodia, for additional team training in the survey methodology and field procedures.

All data, including consent, were captured electronically, using the purpose-built Open Data Kit-based Android smartphone application developed by the GTMP.[15] The data tool was in English. Once approved by a national official, data were sent and stored in the dedicated cloud-based, high security GTMP server. Data were cleaned and analyzed to provide a report of the prevalence of TF and TT in the sample population for each EU; the methodology for calculating prevalences involved age- and sex-adjustment, as previously described.[12] Confidence intervals were determined by bootstrap.[12]

Following completion of the population-based prevalence surveys described above, it was noted that of the villages in which the 2004 TRAs had been undertaken, none of the three with the highest TF prevalences had been selected for sampling. Additional fieldwork was therefore undertaken in and around these villages. These potential hot-spots, grouped around the index villages, were as follows:

(1) Roung Ampil Village, Romeas Commune, Battambang Province; 13% of examined children had TF in the 2004 TRA. Its closest neighboring village, Khos Ream was also included.
(2) Chroark Thnoat Village, Chhaen Laeung Commune, Kampong Chhnang Province; 15% of examined children had TF in the 2004 TRA. Neighboring villages Krang Samrong and Anlong Pring were also included.
(3) Damnak Key Village, Choeung Kriev Commune, Kampong Chhnang Province; 14% of examined children had TF in the 2004 TRA. Neighboring villages Souphi and Trapeng Popel were also included.

In each of these villages, all children aged 1–9 years were requested to come to a central location for examination by GTMP-certified graders, following an advance visit by a member of the survey team to explain the purpose and methods of the investigation. Teams were assisted by the head of the respective village.

Results

Surveys in 14 EUs were carried out from June 2014 through March 2015 by eight teams. Results for TF and TT are shown in Table 2. In total, 25,801 children aged 1–9 years, and 24,502 adults over 15 years were examined, with participation rates of 97.3% and 59.6%, respectively. The prevalence of TF in 1–9-year-olds varied from 0% to 0.2%, well under the threshold of 5% in each EU. The estimated prevalence of trichiasis in all ages ranged from 0% to 0.14%; five EUs had a prevalence of trichiasis between 0.1% and 0.14%. TI was not found in 11 EUs; the age-adjusted prevalence of TI in Mondul Kiri, Preyveng A, and Takeo was 0.03%, 0.16% and 0.05%, respectively.

Discussion

The results of the rigorously executed national trachoma survey in Cambodia, using GTMP methods, clearly indicate that active trachoma, based on prevalence of TF, is not a public health problem in Cambodia. Additional surveys in village groups with historical data suggesting high TF burdens provide extra weight to this assertion. This is despite the fact that minimal activities aimed at trachoma elimination have been undertaken in the country over the past decade. On the other hand, general socioeconomic conditions have improved[16] and the birth rate has decreased,[16] resulting in far fewer children per household than in the past, and it is likely that these factors have contributed to the current situation.

The age- and sex-adjusted all-age prevalence of trichiasis was 0.1% or slightly higher in five surveyed EUs. Since carrying out the survey, there has been a shift to using TT prevalence in over 15-year-olds to gauge success against elimination thresholds, with <0.2% in this age group being equivalent to <0.1% in the all-ages population; in Cambodia this would result in only one district (Battambang/Pailin) being above the WHO elimination threshold. Although the WHO has set a TT prevalence target as part of the definition of elimination of trachoma as a public health problem, it is well recognized[12] that the sample size for measuring TT prevalence in the GTMP is too small to demonstrate this prevalence with precision. Indeed, the confidence intervals of TT prevalence in adults overlapped 0.2% in six EUs (Table 2). However, since no examination was performed for trachomatous scarring, it is not even certain that the cases of trichiasis that we identified were due to trachoma. In any event, facilities with capacity to provide surgery for trichiasis exist in all six of these EUs.

In view of these findings, we conclude that there is no need or justification for starting special outreach programs to identify people with TT, nor for implementing the SAFE strategy in Cambodia. Routine surveillance, including reporting of cases of TF or TT within each province, is recommended.

Table 2. Prevalence of trachomatous inflammation–follicular (TF) and trichiasis, in 14 evaluation units of Cambodia, Global Trachoma Mapping Project, 2014–2015.

Province	Evaluation unit	Children (1–9 years) enumerated, *n*	Children (1–9 years) examined, *n* (%)	Children with TF, *n*	Age-sex-adjusted TF prevalence in children, % (95% CI)	Adults (15+ years) enumerated, *n*	Adults examined (15+ years), *n* (%)	Adults with trichiasis, *n*	Age-sex-cluster size-adjusted trichiasis prevalence in adults, % (95% CI)	Trichiasis prevalence in whole population[a], %
Battambang	Battambang A	2014	1967 (97.7)	2	0.10 (0.00–0.24)	2845	1900 (66.8)	7	0.17 (0.04–0.34)	0.11
Battambang	Battambang/ Pailin	1932	1883 (97.5)	1	0.09 (0.00–0.27)	2787	1808 (64.9)	4	0.22 (0.02–0.51)	0.14
Kandal	Kampong Chnang	1955	1905 (97.4)	1	0.03 (0.00–0.10)	3050	1797 (58.9)	3	0.07 (0.00–0.17)	0.04
Kandal	Kampong Speun	1807	1769 (97.9)	1	0.10 (0.00–0.29)	2763	1527 (55.3)	12	0.18 (0.05–0.34)	0.12
Kandal	Kandal A	1832	1801 (98.3)	1	0.09 (0.00–0.27)	2861	1609 (56.2)	3	0.06 (0.00–0.12)	0.04
Kandal	Kandal B	1842	1787 (97.0)	0	0.00 (0.00–0.00)	3049	1795 (58.9)	8	0.17 (0.02–0.39)	0.12
Stueng Treng	Kratie	1932	1871 (96.8)	0	0.00 (0.00–0.00)	3052	1902 (62.3)	3	0.04 (0.00–0.08)	0.03
Stueng Treng	Mondul Kiri	2104	2038 (96.9)	0	0.00 (0.00–0.00)	2793	1767 (63.3)	2	0.06 (0.00–0.17)	0.04
Stueng Treng	Preah Vihear	1879	1803 (95.9)	2	0.17 (0.00–0.35)	2805	1686 (60.1)	5	0.10 (0.00–0.23)	0.06
Kampong Cham	Prey Veng A	1768	1702 (96.3)	3	0.20 (0.00–0.46)	3311	1715 (51.8)	2	0.04 (0.00–0.11)	0.03
Kampong Cham	Prey Veng B	1813	1740 (95.9)	0	0.00 (0.00–0.00)	2949	1707 (57.9)	4	0.06 (0.00–0.14)	0.04
Stueng Treng	Ratanakiri	2161	2133 (98.7)	1	0.03 (0.00–0.08)	2770	1735 (62.6)	0	0.00 (0.00–0.00)	0.00
Kampong Cham	Svay Ring	1707	1666 (97.6)	0	0.00 (0.00–0.00)	2937	1697 (57.8)	0	0.00 (0.00–0.00)	0.00
Kompot	Takeo	1782	1736 (97.4)	0	0.00 (0.00–0.00)	3108	1857 (59.7)	6	0.15 (0.03–0.31)	0.10

[a]Assumed 0.66% is 15+ years.
CI, confidence interval.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the writing and content of this article.

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Appendix

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Key: (1) Advisory Committee, (2) Information Technology, Geographical Information Systems, and Data Processing, (3) Epidemiological Support, (4) Ethiopia Pilot Team, (5) Master Grader Trainers, (6) Methodologies Working Group, (7) Prioritisation Working Group, (8) Proposal Development, Finances and Logistics, (9) Statistics and Data Analysis, (10) Tools Working Group, (11) Training Working Group.