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Global burden of trichiasis in women as compared to men: Findings from the Global Trachoma Mapping Project

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MPH (Master of Public health)

DECLARATION

I, **George Moyo**, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Dei Gratia

"Global burden of trichiasis in women as compared to men: Findings from the Global Trachoma Mapping Project"

Abstract

The secondary analysis undertaken for this MPH dissertation examines the global prevalence of trichiasis in relation to gender in trachoma endemic countries.

Part A is the research protocol which outlines the background and the process of this research. This study is a population-based analytical study using data from the Global Trachoma Mapping Project (GTMP). GTMP was a standardized population-based trachoma prevalence survey undertaken to provide trachoma prevalence estimates. GTMP data was collected using the World Health Organisation–recommended population based prevalence survey methodology. Trachoma suspect district were identified for inclusion and multi-stage random sampling was used to sample households for examination of residents for clinical trachoma.

Part B presents the background and highlights the importance of this research by exploring the existing theoretical and empirical literature relevant to the topic. It describes how trachoma is transmitted, its clinical manifestations, and the way it can lead to blindness. Results from previous studies on gender and trichiasis are presented.

Part C presents the research project in a format suitable for journal submission. The background of this research project is summarized and the meta-analysis is conducted at the global level, at the country level, the regional level, the state level and at the EU level but all in accordance to prevalence of trichiasis in the EUs. The implications of the findings are discussed and limitations in interpretation presented.

PART A: PROTOCOL

Protocol summary

Title: **Global burden of trichiasis in women as compared to men: Findings from the Global Trachoma Mapping Project**

Trichiasis, whether caused by trachoma or any other cause is the seventh leading cause of blindness in the world. There have been many studies determining the prevalence of trichiasis by age and sex and there has been one systematic review of gender and trichiasis. The systematic review, undertaken in 2009 only includes data from a few surveys in a few countries, where such data was available. It was not possible to undertake any sub-analyses nor was it possible to assess factors which might predict inequity. It has been suggested that women, as the primary care-givers of children (the primary reservoir of infection) have a higher risk of being re-infected with trachoma than men.

We hypothesize that women have an excess prevalence of trichiasis compared to men and that this association is also linked to whether the prevalence of the disease in the population, in particular, that when the prevalence of trichiasis is high, the female excess is high while when the prevalence of trichiasis is low, there is little excess of trichiasis in women. The aim of this study is to use the large GTMP data set to establish the patterns and trends of the association between gender and trichiasis.

Design: Population-based Analytical study.

Population: All countries in the Global Trachoma Mapping Project that agree to share data

Sites: Global

Instrument & Methods: This thesis will use existing national authorized GTMP data for secondary analysis

Purpose and objectives of the study

The overall purpose of this study is to determine the global burden of trichiasis in women as compared to men. The primary objectives of the study are to assess if the ratio of trichiasis in women to men varies by prevalence of trichiasis and if the ratio is the same in all trachoma endemic countries.

Contents

Definition of terms

CO: Corneal Opacity

CSC: Cataract Surgical Coverage

GET2020: Global Elimination of Trachoma by 2020

GTMP: Global Trachoma Mapping Project

SAFE: Surgery, Antibiotics, Facial wash and Environmental Cleanliness

TF: Trachomatous Inflammation: Follicular

TI: Trachomatous Inflammation: Intense

TRA: Trachoma Rapid Assessment

TS: Trachomatous Scarring

TT: Trachomatous trichiasis

UCT: University of Cape Town

VI: Visual Impairment

CI: confidence interval

OR: odds ratio

Key words

Trachoma; [MESH], Trichiasis; Chlamydia: Trachomatis;

Blindness; Gender; Males AND Females, Meta-analysis OR Systematic Review

Background to the research

Blindness is a major global public health concern. An age adjusted systematic review from 1990 to 2010 revealed that globally 32 .4 million people (95% CI: 29.4 – 36.5 million people) were blind. In this study blindness was defined as a vision in the better eye of <3/60. (Bourne, R., et al 2013: 39)This represented 0.5% (95% CI: 0.4 – 0.5) of the global population). In the same study it was estimated that 191 million people (95% CI: 99 – 13 million people) had moderate and severe visual impairment (defined as a vision in the better eye of 3/60 to 6/24) which represented 2.8% of the global population (2.5% – 3.5%). There is strong evidence of an age-adjusted excess burden of blindness in women as compared to men. Eighteen years ago, it was revealed that blindness, adjusted for age, was 40% more in women as compared to men. (Abou-Gareeb, I, et al., 2001; 39 - 56). In Africa there was a 43% (95% CI 33% – 53%) excess burden of blindness in women compared to men. Findings were similar in Africa Asia (OR 1.41 95% CI 1.29 – 1.54) and in industrialised countries OR 1.63, (95% CI: 1.30 - 2.05) (Mganga, H, Lewallen, S. & Courtright, P, 2011: 101), however the interpretation of the findings from industrialized countries is limited by the inability to adjust for age in the oldest age groups. The excess burden of blindness in women was also observed in population-based surveys in Oman during 1996–1997; in these settings women and men had an age-adjusted prevalence of blindness of 1.4% and 0.8% respectively, giving women a 1.89-fold (95% CI, 1.55–2.51) higher prevalence of blindness compared to men.(khandekar, 2002)Similar findings were evident for visual impairment, table 1 below;

Table 1: Prevalence of visual impairment in men and women by age group (Stevens, G.A, et al. 2013: 120(12) 2377- 2384).

Age group	Prevalence of visual impairment (95% CI)	
	Males	Females
0-49 years	0.08 (0.07-0.09)	0.10 (0.09-0.12)
50-69 years	0.85 (0.74-0.97)	1.1 (1.0-1.3)
70+ years	4.2 (3.7-4.8)	5.3 (4.8-6.0)

The Oman researchers found that men (with cataract) were 1.55-fold (95% CI 1.50–1.60) more likely to have received cataract surgery compared to women. (Khandekar, R, & Mohammed, A.J, 2007; 267-272). These findings are similar to the global estimates from a systematic review and Meta – analysis of 23 population based surveys of cataract surgical coverage (CSC); in this review 21 of the 23 surveys showed a higher CSC in men.(Mousa, S, et al., 2009: 298).Men were 1.71 times (95% CI: 1.48 – 1.97) more likely to have had cataract surgery than women. In the Oman 1997 and 2005 surveys a 29.3% reduction in blindness was detected, but women continued to have a statistically higher prevalence of blindness (9.93% among 40+ age) compared to men (6.59% among 40+ age)(khandekar, R &Mohammed, A. F 2007;267 - 272)

The word “trachoma”, was first used in Graeco Roman times. It comes from the Greek word “rough” which describes the surface appearances of the conjunctiva in chronic trachoma.

(Sandford-Smith, J, 1990). Approximately 232 million people live in trachoma endemic areas and are at risk of infection. Trachoma infection spreads through personal contact (hands, clothing) and by flies that have been in contact with discharge from the eyes or nose of an infected person. (Mohammadpour, M et al., 2016: 169). The natural history of trachoma usually includes inflammation during childhood, with the formation of lymphoid follicles and diffuses infiltration with papillae in the conjunctiva. Chronic inflammation eventually results in conjunctival scars, which, in turn, may lead to trichiasis and corneal complications in older children and adults. The World Health Organisation (WHO) recommends a simple classification of trachoma including five clinical signs. (Thylefors et al., 1987: 483) The primary sign of active trachoma, called trachomatous inflammation follicular (TF), is commonly found in children age less than five years. To be considered TF positive there must be five or more follicles (0.5 mm or greater) in the upper tarsal conjunctiva. Follicles are round lumps or spots that are paler than the surrounding conjunctiva upon conjunctival examination. The other sign of inflammation which is also common in children is called trachomatous inflammation intense [TI]. TI is defined as diffused redness caused by vascular tufts. Multiple episodes of TF and/or TI can lead to trachomatous scarring (TS). This is the presence of scarring in tarsal conjunctiva. Scars are easily visible as white lines, bands, or sheets (fibrosis) in the tarsal conjunctiva. Scarring of the conjunctiva can lead to trachomatous trichiasis (TT) this is when one or more eyelashes are touching the eye globe or evidence of epilation (eyelash removal). The process of touching the cornea can lead to ulcers, which, when healed, become opacities. Corneal opacities (CO) can reduce vision and lead to irreversible blindness. (Thylefors et al., 1987: 483)

In 1998 WHO member states signed a Global Alliance for the Elimination of Blinding Trachoma by 2020 (GET 2020) through World Health Assembly resolution 51.1. This declaration called for the elimination of trachoma including requesting members to complete the mapping of trachoma and implementation of interventions to elimination trachoma. (GET 2020 resolution 51.1)

The WHO adopted the SAFE strategy, whereby S refers to surgery, the primary option of managing trachomatous trichiasis. During trichiasis surgery, the eyelid is repositioned in a way that in-turned eyelashes no longer touch the globe. "A" refers to antibiotic treatment of communities to treat infections and decrease transmission. .F refers to facial cleanliness and E refers to environmental improvement, both important to reduce transmission. (Thylefors et al., 1987: 483)

In 2009 Cromwell and colleagues conducted a systematic review and Meta – analysis of population-based surveys of trichiasis to assess if women had a higher age-adjusted prevalence than men. The results, using data from 12 countries revealed overall odds of trichiasis in women 1.82 (95% CI 1.61 – 2.07) times that of men. Table 2 presents the data by study site. (Cromwell E. A, et al., 2009: 985 - 992).

Table 2: Findings from 2009 meta-analysis of trichiasis by gender

Country	Setting	Year of survey	Excess burden of trichiasis in women (OR, 95% CI)
Brazil	Bebedouro State	1992	1.50 (0.25 - 9.02)
Ethiopia	Dalocha District	2001	1.34 (0.51- 3.54)
	Alaba District	2003	3.82 (2.36 – 6.19)
	Damot Gale	2004	3.12 (1.79 – 5.45)
	Tigray Region	2006	1.70 (1.14 – 2.54)
	Amhara TCP	2009	2.81 (2.08 – 3.80)
	Amhara TCP	2009	2.69 (1.51 – 4.79)
Egypt	Nile Delta	1989	1.31 (0.80 – 2.16)
	Monofiya Governate	2001	1.64 (1.08 – 2.47)
Gambia	National Survey	1998	2.10 (1.41 – 3.14)
Ghana	National Survey	2009	1.92 (1.29 – 2.85)
Morocco	Ouarzazate	1992	1.95 (0.84 – 4.55)
Myanmar	Mandalay Division	2007	0.83 (0.40 – 1.73)
Nigeria	Kaita LGA	2001	2.14 (1.36 – 3.37)
	Katsina State	2008	1.93 (1.53 – 2.43)
	Yobe State	2008	1.52 (0.90 – 2.56)
	Plateau and Nassarawa State	2009	2.48 (1.47 – 4.19)

Oman	National Survey	2007	1.50 (0.98 – 2.31)
Sudan	Southern Sudan	2005	1.27 (1.08 – 1.49)
	Mankien District	2006	0.94 (0.72 – 1.21)
	Ayon County	2008	1.61 (1.10 – 2.34)
	Southern Sudan	2008	1.45 (1.06 – 1.97)
Tanzania	National Survey	2008	2.00 (1.83 – 2.19)
Vietnam	12 Districts	2006	1.67 (1.55 – 1.80)

After the pooling, it was revealed through the review that trichiasis was 1.82 more likely to be found in women than in men. Courtright P, and West S, revealed that the sex related excess of trichiasis was more environmental than biological. It was also noted through the same study that the excess burden of trichiasis in women could likely be due to reinfection in women during child care. (Courtright, P, & West, S.K, 2004: 2012 - 2016).

Methodology

Study design

This is a population-based analytical study using existing Global Trachoma Mapping Project (GTMP) data (secondary data analysis). Letters were written to all the relevant national coordinators requesting authority to use baseline GTMP data. All data was compiled into 5 year age groups for calculating age and sex specific prevalence figures. Surveys were pooled by specific characteristics such as geographic location and age-sex TT prevalence (grouped). Age adjusted odds ratio for female excess will be calculated for each survey evaluation unit. For countries with large data sets (e.g., Ethiopia and Nigeria) geographic

variations within countries were explored and sub analysis conducted at regional and state level. The entire sub – analysis were based at EU level results.

Characteristics of study population

GTMP included data from 2.1 million people examined for clinical trachoma from 1469 districts across 22 countries.

Inclusion

Only data from GTMP population-based prevalence surveys (PBPS) were considered for inclusion since they provide a prevalence estimate applicable to the population.

Exclusion criteria

We did not include in our analysis data that was collected through 'Acceptance-based Sampling for Trachoma Rapid Assessment' methodologies or from Trachoma Rapid Assessments as these methods are not population based and do not provide a prevalence estimate that can be generalised to the population. Impact survey data was also not used as differences in utilization of surgical services between men and women may account for some or all variation in gender differences.

Data Analysis

All the GTMP data were collected electronically using Android smart phones with the LINKS app developed and maintained by the Task Force for Global Health, Atlanta, GA, USA. Data are geo-referenced using global positioning system coordinates; they are then transmitted to a high security server for cleaning and approval by the relevant Ministry of Health (using a site-specific password-protected web interface). During our analysis, data was kept in a personal computer which has a password and the personal computer which is only accessed by the author. The GTMP dataset provided by the relevant Ministries of

Health was stored in a personal UCT student account which is protected and only accessible by the author.

Statistical analysis has been conducted using Stata (13.0) statistical software (Stata Corp., College Station, TX, USA). Data from all the included studies including data on age, gender and the presence or absence of signs of trachoma at an individual level were pooled and the OR of the overall effect estimate were calculated using logistic regression in Stata. Revman V5.3 was used to come up with the pooled overall M-H odds ratios for results of different units. Owing to heterogeneity between the studies as a result of the underlying differences in geographical location, cultural context, and possibly the underlying prevalence of trichiasis, a random effects model were used to weight the studies in the summary statistic. Sub-group analyses included assessment of gender-excess at different levels of trichiasis prevalence as well as by units, regions countries in the world.

Ethical Consideration

Description of Risks and Benefits

No risks of any kind were anticipated from this study as only secondary data were used for analysis. There was no contact or communication with study participants.

Potential risks and discomforts

No potential risks and discomfort as secondary data were used for this study.

Potential benefits

The results from this study will inform planners and implementers of trachoma elimination programme on how gender affects the prevalence of trichiasis to the gender-focused

activities can be implemented, if needed. The findings from this research will also be useful for trachoma-related NGOs and donors to advocate for additional resources.

Informed Consent Process

For the collection of the GTMP data, informed consent was provided by all participants. National ethical committees provided approval prior to survey work. Informed consent was not needed for the secondary data analysis conducted. All governments authorised the use of the data; if data was not released by a specified country no analysis was conducted. Through the letters written to different countries, the responsible governmental representatives made informed decisions on releasing the data.

Withholding information

No information about the aim of the study was withheld to the authorising countries.

Privacy and Confidentiality

Only electronic data were used in this study and were only accessed by the author. A password was used for accessing the data, the password only known to the author.

Publication and use of results

The results from this study can be used by national programme managers to focus efforts at specific population groups. Findings will also be useful for global advocacy efforts.

Findings will be published and made available to respective government officials.

Justification of the study

Trichiasis is a serious sign of trachoma; if no intervention is undertaken, the patient is at risk of corneal opacity and blindness. The WHO estimates that there are about 3 million people in the world with trachomatous trichiasis.

In the 2009 systematic review 24 studies from 12 countries met the criteria for inclusion; 7 from Ethiopia, 4 each from Nigeria and Sudan, 2 from Egypt and one each from Brazil, Gambia, Ghana, Tanzania, Morocco, Oman and Myanmar. Because the number of surveys was small there was no opportunity to assess if there was any variation in the excess burden of trichiasis in women according to the baseline prevalence of trichiasis. It is hypothesised that in low prevalence areas there is likely to be little gender excess as much of the trichiasis may not be to trachoma.

It is against all this background that we proposed to use the large GTMP data sets to answer the questions:

- What is the burden of trichiasis in women compared to men?
- Does the ratio of women to men vary at difference prevalence of trichiasis?
- Is the ratio the same in all trachoma endemic countries?

The results from this study can be used by national programme managers to focus efforts at specific population groups. Findings will also be useful for global advocacy efforts.

PART B: LITERATURE REVIEW

Literature Review

Aim of this literature review

The aim of this Literature review is to establish whether there is similarity in the prevalence of trachoma trichiasis in women and men living in different trachoma endemic areas of the world. The review will also establish if there are any trends of odds ratios for gender as the prevalence of trichiasis changes from low to high.

The Study Question

What is the burden of trachoma trichiasis (TT) in women compared to men? Does the ratio of women to men vary at difference prevalence of TT? Is the ratio the same in all trachoma endemic countries?

Literature search strategy

Reference	Year	Country	Men in %	Women in %	Ratio Women to men
			#withTT/#examined	#withTT/# examined	
Alene G.D., and Abode S.	2000	Ethiopia	14/440=3.2%	16/552 = 2.8%	0.875
Luna E.J., Medina N.H., Oliveira M.B., de Barros O.M., Vranjac A., Melle H.H.,	1992	Brazil	2/490=0.4%	3/490= 0.61%	1.53
Regassa K., Teshome T.,	2001	Ethiopia	7/170= 4.1%	11/190 = 5.79%	1.41
Wodimu A., Bejiga A.,	2003	Ethiopia	21/1909=1.1%	83/1976 = 4.2%	3.82
Regassa K., Teshome T.,	2004	Ethiopia	17/405=4.2%	59 450=13.1%	3.12
Mesfin M.M., de la Camera J., Taleke I.G., Emanuel G., Alaya T.,Kadir A.M.	2006	Ethiopia	33/1412=2.33 %	99/2488=3.98%	1.71
Emerson P.M., Ngondi J., Birn E., Graves P.M., Ejigsemahu Y., Gebre T et al	2008	Ethiopia	137/9613=1.43 %	408 10056%=4.06	2.84
Ngondi J., Gebre T., Shargi E.B., Adam L., Eji G., Semahu Y., Teferi et al	2009	Ethiopia	58/1825=3.18 %	187/2094=8.93%	2.81
Ngondi J., Gebre T., Shargi E.B., Adam L.,	2009	Ethiopia	15/973=1.54%	54/1304=4.14%	2.69
Courtright ., Sheppard J., Schacter J., Said M.E., Dawson C.R.,	1989	Egypt	45/79=56.97%	59/79=74.68%	1.31
Dorin P.J., Faal H, Johnson GJ	1998	Gambia	38/2 51=1.85%	69/1771=3.90%	2.1
Yayemain D., King J.D., Debra O., Emerson P.M., Aboe A, Ahasu F et al	2009	Ghana	35/16967=0.21 %	83/20997=0.40	1.9
Negrel A.D.,Khazraj Y.C., Okaley O.,	1992	Morocco	8/321=2.49%	18/370=4.86%	1.95
Durkin S.r., Casso R.J., Newland H.S., Aung T.H., Shein W.K., Muecke J.S. et al	2007	Myanmar	16/1240=1.29 %	13/836=1.56%	1.21
Rabio M.M., Alhasan M., Abiose A.,	2001	Nigeria	26/1233=2.10 %	75/1660=4.51%	2.15
Jip N.F., King J.D.,Diallo M.O., Miri E.S., Hamza A. ., Ngondi J et al	2008	Nigeria	108/4169=2.29 %	236/4721=5.00%	2.18
Mpyet C., Ogosh C., Goyo M.,	2008	Nigeria	21/840=2.5%	47/1237=3.80%	1.52

Cromwell et al	2009	Nigeria	18/9220=0.20 %	64/13218=0.48%	2.4
Khandekar R., Mohammed A.J.,	2007	Oman	3 /990=3.23%	66/1360=4.85%	1.5
Ngondi J., Onsatigo A., Adamu L., Matende I., Baba S., Reacher M et al	2005	Sudan	220/2821=7.80 %	537/5424=9.90%	1.27
Ngondi J., Olensempele F., Onsalinga A., Matende I.,Baba S., Reacher M et al.	2006	Sudan	112/559=2 %	186/991=18.77%	0.94
King J.D.,Ngondi J., Gatpan G., Lipidia B., Becknell S., Emerson P.M.,	2008	Sudan	41/403=10.17 %	114/698=16.33%	1.61
Ngondi J., Reacher M.H.,Mathews F.E.,Brayne C, Gatpan G., Becknell S et al	2008	Sudan	68/5585=1.22 %	98/5570=1. 6%	1.44
Moshiro C., Masesa D.E., masanja H., Mkocha H.,Ngirwamungu E., Kalima P. et al	2008	Tanzania	673/39588=1.7 %	1946/57235=3.4 %	2.00
Khandekar R., Nga N.H., Mai P.,	2006	Vietnam	1037/19392=5. 34%	2166/24205=8.95 %	1.68
Durkin R.S., Casso J.R., Newland S.H.,Aung T.H., Shein W.K., Muecke S.J., Slva D.,Aung T.	2006	Myanmar	13/832=1.56%	16/1241=1.29%	0.83
Arab Al E.G., Tawfik N., Gendey E.L.R., Anwar W., Courtright P.,	2001	Egypt	54/1082=4.99 %1	104/1344=7.7 %	1.55
Khandekar R., Moh mmed A.J.,	2005	Oman	32/990=3.23%	66/1369=4.82%	1.49
Mpyet C., Ongoshi C.,	2008	Nigeria	21 (2.5)%	4.7 (5.1)%	2.04
Assefa T.,Argaw D., Foster A.,Schwartz E.,	2001	Ethiopia	91/443=20.5%	79.46%	3.88
Cevallos V., Whitcher P.J.,Melese M., Alema ebu W.,Yi E.,Chidambaram J.D., Lee S., Reddy H., Gaynor B.D.,Lietman M.T., Keenan J.D.,	2004	Ethiopia	18/36= 50%	83/112=74.1%	1.48
Kalua K.,Chirwa T.,Kalilani L., Abbenyi S., Mukaka M.,Bailey R.	2010	Malawi	3/1244=0.24%	1/1999=0.55%	2.29

We searched the major databases including PubMed, OBSCO, and web of knowledge. We supplemented the search using Google scholar and by scanning reference lists of potential

papers. Table 1 below shows the results we found for trichiasis in women as compared to men in 36 different papers.

Clinical and epidemiological aspect of trachoma

Disease History

The word "trachoma", was first used in Graeco Roman times. It comes from the Greek word "rough" which describes the surface appearances of the conjunctiva in chronic trachoma. (Sandford-Smith, J,1990). Approximately 232 million people live in trachoma endemic areas and are at risk. In trachoma, infection spreads through personal contact (hands, clothing) and by flies that have been in contact with discharge from the eyes or nose of an infected person. (Hatch, T.P, Allan, I, & Pearce, J.H, 1984: 13 - 20) The World Health Organisation (WHO) recommends a simple classification of trachoma including five clinical signs. (Thylefors et al., 1987: 483) The natural history of trachoma usually includes inflammation during childhood, with the formation of lymphoid follicles and diffuses infiltration with papillae in the conjunctiva.

Trachoma remains the leading infectious cause of blindness in the world, (Solomon, A.W, et al., 2015: 214 - 225) and still remains high in various regions of the world such as Asia, Africa and the Middle East. (Silva, M.B.A, et al., 2017:10)

Microbiology and Pathogenesis

Trachoma has a gradual way of causing blindness. The pathogenesis of infection and replication of the causative agent, *Chlamydia trachomatis* is shown in Figure 1. Acute

trachoma (TF) and the potentially blinding sequelae, trachomatous trichiasis (TT) have been illustrated. (Solomon, A.W, et al., 2015: 214 – 225).

Figure 1: Microbiology and pathogenesis of trachoma

Chlamydial trachomatis exist in two forms; in its infectious form is the elementary body which is a metabolically inactive, spore- like structure which is taken by host cells by receptor- mediated endocytosis (Taylor, H, et al., 2014: 2142 – 2152).The life cycle of *C.Trachomatis* is 72 hours within which the elementary body are fully released and are free to attach to new cells. (Mabey, D.C, Solomon, A.W, & Foster, A, 2003: 223 – 229) (Hatch, T.P, Allan, I, & Pearce, J.H, 1984: 13 - 20)

When the cells of the cornea are examined through the microscope, the examination reveals epithelial keratitis, sub epithelial infiltrates and extent of the limbic vessels of the cornea. The inflammatory response to primary infection of the conjunctiva by Chlamydia trachomatis leads to a mild, self-limited frame conjunctivitis, called inclusion conjunctivitis (Silva, M.B.A, et al., 2017:10)

There is a high chance of reinfection for those people living in trachoma endemic regions of the world. Repeated infections lead to a hypersensitive immune response to Chlamydia antigens, causing an inflammatory response becomes increasingly lush and leading to all those stages of trachoma (Solomon, A.W, et al., 2015: 214 – 225).

Clinical Progression signs and Stages of trachoma

Active trachoma is common in children under the age of 10 and repeated re infection by *Chlamydia trachomatis* causing TF can lead to scarring of the upper tarsal conjunctiva. Conjunctival scarring (TS) leads to deformation of the lid in which contraction of the

conjunctiva causes entropion (in turning of the upper eyelid) and trichiasis (eye lashes rubbing the cornea). (Thylefors et al., 1987: 483)

Figure 2: Clinical progression signs of trachoma

The process leading from TF to TS to trichiasis is gradual and trichiasis is uncommon in children. Trichiasis can lead to abrasions on the cornea, a painful condition. If un-managed, these abrasions can become infected and corneal scarring can lead to blindness. (Taylor, H, et al., 2014: 2142 - 2152)

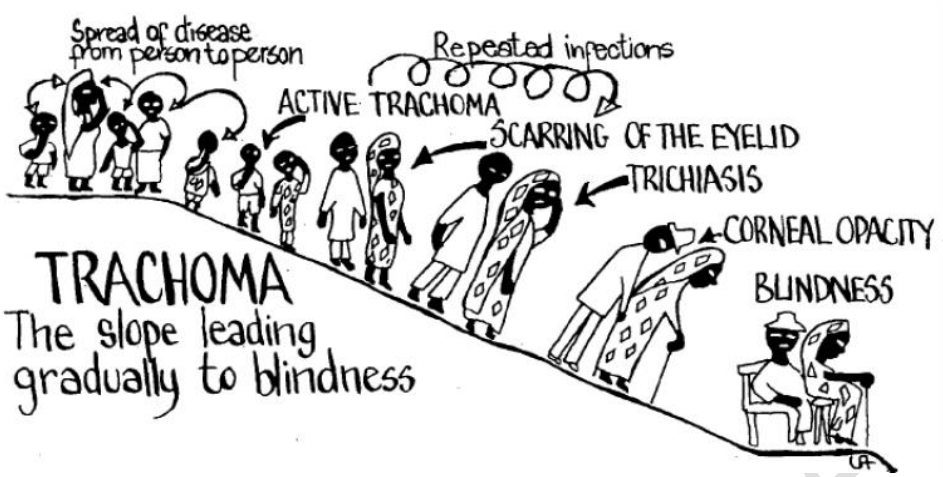
Surgical management options are few when the disease has reached the stage of corneal opacity. Surgery may be undertaken in patients with corneal opacity simply to relieve pain rather than reverse blindness. (Burton, M.J, et al., 2006: 847)

All these signs are not mutually exclusive; they may occur in the same patient and the same eye. (Solomon, A.W, et al., 2015: 214 – 225). Thus, during examination each should be assessed independently. For programme decision making, TF in children age 1-9 years is assessed. TF is considered positive if there are at least five follicles of at least 0.5 mm diameter in the upper tarsal conjunctiva. Follicles are rounded elevations of the conjunctiva, bright and fainter than the conjunctiva around. They should be distinguished from changes caused by small scars and degenerative deposits in the conjunctiva. (Solomon, A.W, et al., 2015: 214 – 225).

Epidemiology of Trachoma

According to Silva and colleagues, trachoma remains endemic in many of the poorest and more remote areas of Africa, Asia, Australia, and the Middle East. The estimated number of people with trichiasis is about 3 million. WHO identifies 53 countries as being trachoma

endemic and estimates that 229 million people live in endemic areas, with most trachoma in Africa. (Silva, M.B.A, et al., 2017:10).



http://www.ircwash.org/sites/default/fil 1

Figure 3: Trachoma progression

Active trachoma (TF) is most common in children younger than 5 years and the prevalence can reach 60% or more. (Courtright, P, et al., 1989: 536 – 540) The greatest load of infection is also in young children. (West, S.K, et al., 2015: 170 - 175) (The prevalence of active trachoma decreases with age and few adults have signs of active trachoma, and even fewer have evidence of infection. (Wright, H.R, Turner, A, &Taylor, H.R, 2008. 37(9628):1945 – 1954) (Munoz, B, et al., 1999; 1167 – 1171) (Ngondi, J, et al., 2005.83(12)904 – 912). As active trachoma wanes, conjunctival scarring (TS) becomes more apparent; the prevalence of TS increases with age; over 25 years of age, up to 90% of people could have conjunctival scarring. (Wright, H.R, Turner, A, & Taylor, H.R, 2008. 37(9628):1945 – 1954) (Munoz, B, et al., 1999; 1167 – 1171) (Ngondi, J, et al., 2005.83(12)904 – 912). While the prevalence of active trachoma is generally similar by

sex at young ages, TS and trichiasis (and loss of vision) are generally more common in women than in men. (Wright, H.R, Turner, A, &Taylor, H.R, 2008. 37(9628):1945 – 1954) (Munoz, B, et al., 1999; 1167 – 1171) (Ngondi, J, et al., 2005.83(12)904 – 912). (West, S.K, et al., 2015: 170 - 175) This difference is attributed to the repeated exposure of women to infection because they are more likely than men to care for young children. (Courtright, P, & West, S.K, 2004; 20012 - 16)The prevalence of scarring, trichiasis, and corneal opacities in older people is predicted by their exposure to trachoma when they were young. This concept is important because even when active trachoma has disappeared, the late sequelae, including trichiasis, can still occur for decades. (Wright, H.R, Turner, A, &Taylor, H.R, 2008. 37(9628):1945 – 1954) (Munoz, B, et al., 1999; 1167 – 1171), (Ngondi, J, et al., 2005.83(12)904 – 912). Persisting episodes of infection with *C trachomatis* or other ocular infections can contribute to progressive scarring, so reduction of these exposures benefit adults. Many cross-sectional and longitudinal studies have linked clean faces to lower risk of trachoma. (Silva, M.B.A, et al., 2017:10). Improvement in facial cleanliness also decreases the severity of active disease, probably by lowering the likelihood of transmission. (Silva, M.B.A, et al., 2017:10).

Summary and conclusion of the literature review

The literature review revealed that all prevalence figures for trachoma trichiasis were conducted at the country level in few countries as compared to the current available data. It was impossible to present some sub analysis in the previous reviews as raw data is not used in systemic reviews.

The primary aim of this thesis was to establish the prevalence of trachoma trichiasis in males and females and to assess the age-adjusted odds of trichiasis in women compared to

men. Secondly, sub analysis of specific countries with variable prevalence figures (e.g. Nigeria and Ethiopia) was undertaken to understand the association of gender with trachoma as the prevalence of the disease changes.

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PART C: JOURNAL MANUSCRIPT

Title: Global burden of trichiasis in women as compared to men: Findings from the Global Trachoma Mapping Project

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Key words: trichiasis, trachoma, gender

Abstract

Trachomatous trichiasis is targeted for elimination by 2020. It is globally accepted that there is an excess risk of trachomatous trichiasis in women compared to men with many factors contributing to these findings. We sought to update previous work on the subject and to undertake some sub-analyses to help interpret the findings. This secondary data analysis used data collected through the Global Trachoma Mapping Project (GTMP), a large set of standardized population-based trachoma prevalence surveys from 2013-16. Our analysis included 693 evaluation units (EUs) in 16 countries with a total sample of 1,143,742 residents' age 15 years and above. RevMan V5 was used to generate an age-adjusted Mantel-Haenszel odds ratio and 95% confidence intervals (CI). Among the 498,317 men examined 3,566 had trichiasis. Among the 645,425 women examined 9,156 women had trichiasis. The overall excess burden of trichiasis in women compared to men was 1.87 (95% CI: 1.45, 2.42) while in the 503 EU with a prevalence of trachomatous trichiasis ≥ 0.2% (the WHO threshold for elimination) the excess burden of trichiasis in women compared to men was 2.01 (95% CI: 1.58 , 2.55). There was considerable heterogeneity in the findings at the country level. Surveys in Ethiopia (24.9% of total participants) had an OR of 3.16 (95% CI 2.95, 3.39) while surveys in Nigeria (33.6% of total participants) had an OR of 1.59 (95% CI; 1.50, 1.69). At the EU level we did not find an association between the odds of trichiasis in women compared to men according to the prevalence of trichiasis. Our findings suggest that gender-specific excess varies considerably across Africa; in all settings however efforts are needed to reach women with trachoma management services.

Background

Trachoma is the leading infectious cause of blindness worldwide and remains endemic in 54 countries of the world. (WHO, 2017) Trachoma is largely found in poor, rural communities in low-income countries, particularly in sub-Saharan Africa (Taylor, H, et al 2014:2142 – 2152) and research has shown that trachoma is associated with poverty, poor hygiene, dust, dirty faces, open defecation and poor access to water. (West, S.K, et al., 2015: 170 – 175). Active trachoma is common in children under the age of 10 years and repeated re infection by the causative agent, *Chlamydia trachomatis*, can lead to scarring of the upper tarsal conjunctiva. Conjunctival scarring can lead to deformation of the lid causing entropion (in-turning of the upper eyelid) and trichiasis (eyelashes rubbing the cornea). The pathologic process leading from active trachoma to conjunctival scarring to trichiasis is gradual; most trichiasis cases are in adults over the age of 40 years. (Solomon, A.W, et al., 2015: 214 – 225). Trichiasis can lead to abrasions on the cornea, a painful condition which can lead to infections, corneal scarring, and blindness. The ideal solution is lid surgery to re-position the eyelid. (Burton, M, J, 2007: 99 – 116)

In 2016 it was estimated that there were 2.8 million people in trachoma endemic countries with trichiasis, most but not all, due to trachoma.(flueckinger, R.M et al, 2019;364) In the same year it was estimated that 260,759 trichiasis surgeries were undertaken globally. (WHO Progress report on trachoma 2014 – 2016; 359)

Analysis of 25 trachoma prevalence surveys in 12 countries before 2009 demonstrated that women had an age-adjusted odds of trichiasis 1.82 times (95% CI 1.61-2.07) compared to men. (Cromwell, E.A., et al 2009: 985-992) This meta-analysis included data from 270,972 people. We sought to use the epidemiologically robust Global Trachoma Mapping Project

(GTMP) data to conduct a similar assessment. Due to the standardized nature of GTMP data collection and the size of the GTMP we also sought to undertake a number of sub-analyses, not possible with the earlier data sets.

Methods

This was a secondary data analysis including data collected through GTMP from 2013 to 2016. All GTMP programme countries were invited to submit their trachoma data for this analysis. GTMP was a standardized population-based baseline trachoma prevalence survey and GTMP data was collected using the World Health Organization–recommended population based prevalence survey methodology. (Solomon, A.W, et al., 2015: 214 – 225). Briefly, trachoma suspect districts were identified for inclusion and multi-stage random sampling was used in all study sites. Districts which had previously been surveyed were not included in this analysis. For each evaluation unit (EU), generally an administrative district of around 100,000-250,000 people, between 20-30 clusters (villages) were randomly selected using population proportional to size sampling. In each cluster approximately 30 households (depending on household size) were randomly selected, either using household lists or using compact segment sampling, when household lists were not available. The estimated sample size requirement per EU was based on an expected TF prevalence of 10% in children aged 1–9 years, a design effect of 2.65, and a desire to be 95% confident of estimating the TF prevalence with 3% absolute precision. (Solomon, A.W, et al., 2015: 214 – 225).

Study participant enrollment was done door-to-door with all residents in a sampled household age 1 year and above invited for examination after informed consent was requested. Examination entailed assessment, by a trained and certified grader, of the

presence of TF, trachomatous inflammation: intense (TI), and trichiasis. Trichiasis was defined as one or more lash touching the globe or evidence of recent epilation. No assessment of trachomatous conjunctival scarring was undertaken as part of GTMP until 2015. For the purpose of our study, we defined trichiasis as with or without conjunctival scarring. Data was collected on android phones using a purpose-built app through a LINKS application. Data was uploaded to the server, checked for accuracy and standard reporting files were prepared.

To obtain data for this analysis, GTMP requested authorization from all participating national Ministries of Health. Data from countries agreeing to participate was received in a CSV format.

Sex specific age adjusted prevalence of trichiasis was calculated for all EUs as each EU is an independent data set. RevMan 5, meta-analysis software (RevMan V5, 2014) was used to conduct the overall assessment of female excess of trichiasis. Findings were generated using Mantel-Haenszel (M-H) pooled random effect odds ratios (OR) and 95% confidence intervals (CI). A measure of heterogeneity of the data is also generated. RevMan 5 also generated forest plots, a graphic display of the findings. Data was then pooled by country and similar odds ratios and 95% CI calculated.

As the WHO threshold for elimination of trichiasis as a public health problem in an EU is a prevalence of unmanaged trachomatous trichiasis of <0.2% among the age group 15 years and above (WHO Progress report on elimination of trachoma 2014 -2016; 359) we undertook an additional assessment of EUs with a prevalence of trichiasis ≥0.2%. This decision was made as public health interventions are only recommended when trichiasis is ≥0.2% in the adult population. When the prevalence is below this threshold, it is expected

that routine clinical services will be responsible for management of the rare condition. Given the size of the data sets from Ethiopia and Nigeria, data was pooled by region/state to assess heterogeneity within the countries.

Finally, we also used the data to explore whether the relationship between men and women (the odds ratios) were similar in different bands of trichiasis endemicity (age and sex adjusted EU level trichiasis prevalence). Age and sex adjusted trichiasis prevalence bands of 0.20% were generated from the data, starting with the prevalence of 0.20-0.39%. and mean OR for each band was calculated to assess if there was an association between the prevalence of trichiasis and gender-specific excess.

Ethical approval for GTMP was provided by the London School for Hygiene & Tropical Medicine (reference 6319) and the national level ethics committee in each country. Ethical approval for this secondary analysis was obtained by the Human Research Committee of the University of Cape Town. (HREC; 2015/115)

Results

Among the 693 EUs in 16 countries for which data was received (Table 1) there were 498,317 men and 645,425 women examined. There were 503 EUs (72.6%) that had trichiasis prevalence above the WHO threshold for elimination.

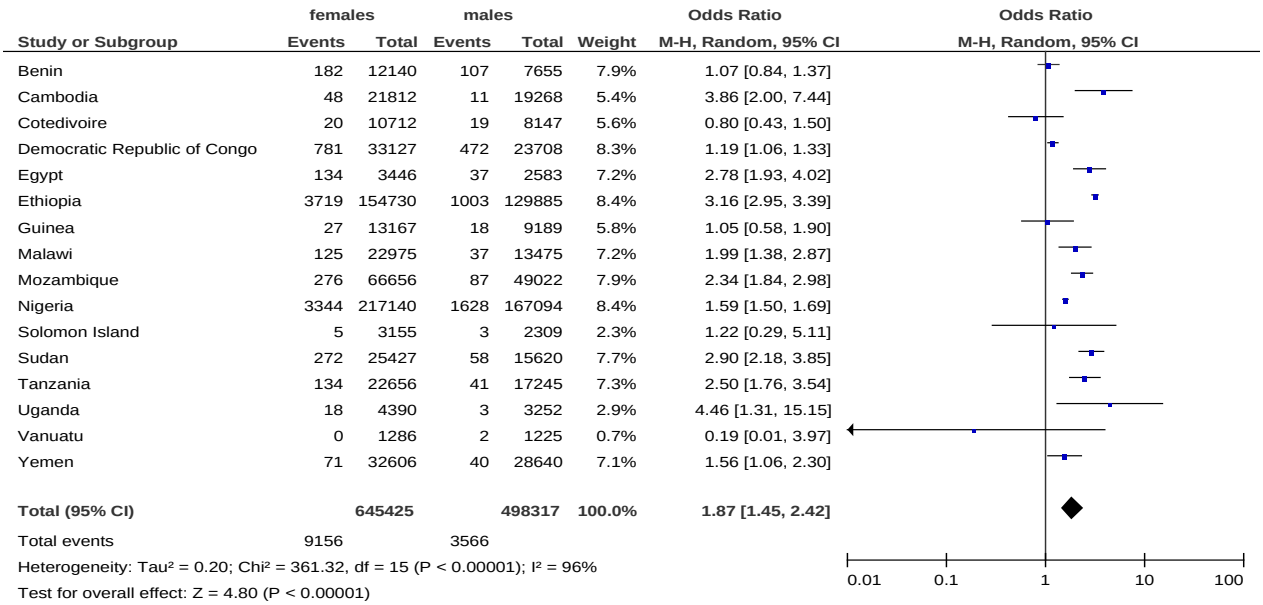
Table 1: Summary of the # of evaluation Units EU per country and its adult population

COUNTRY	#EUs Contributed	#Males ≥15yrs	#Females ≥15yrs	#total ≥15yrs	#EU with a trichiasis prevalence≥0.2%. (% of total EU)
Benin	11	7655	12140	19795	7 (63.6)
Cambodia	14	19268	21812	41080	3 (21.4)
Cote d'Ivoire	10	8147	10712	18859	3 (30.0)
DR Congo	44	23708	33127	56835	42 (95.5)
Egypt	4	2583	3446	6029	4 (100)
Ethiopia	170	129885	154730	284615	164 (96.5)
Guinea	14	9189	13167	22356	6 (42.9)
Malawi	24	13475	22975	36450	17 (70.8)
Mozambique	82	49022	66656	115678	40 (48.8)
Nigeria	220	167094	217140	384234	168 (76.4)
Solomon Islands	3	2309	3155	5464	1 (33.3)
Sudan	32	15620	25427	41047	21(65.6)
Tanzania	19	17245	22656	39901	14 (73.7)
Uganda	4	3252	4390	7642	2 (50.0)
Vanuatu	1	1225	1286	2511	0 (0)
Yemen	41	28640	32606	61246	11 (26.8)
Total	693	498317	645425	1143742	503 (72.6)

The 16 countries in this analysis were primarily from sub-Saharan African (SSA); the five countries from outside of SSA (Yemen, Vanuatu, Solomon Islands, Egypt and Cambodia) contributed 10.27% of the study population. Ethiopia contributed 24.9% of the study population and Nigeria contributed 33.6% of the study population.

There were 12,722 people (9,156 women and 3,566 men) with trichiasis. Pooling all data from the 693 EU the overall M-H OR of females to males with trichiasis was 1.99 (95% CI: 1.54, 2.89) [forest plot too large to present]. Pooling all data at country level and creating a forest plot for the data at the country-level provides an M-H OR of 1.87 (95% CI 1.45, 2.42). [Figure 1]

Figure 1; Forest Plot presenting global M - H Odds ratio for trichiasis by country



Among the 16 countries represented 11 (68.8%) had a M-H OR and CI that exceeded 1; the other five countries (Vanuatu, Solomon Islands, Guinea, Cote d'Ivoire, and Benin) only

contributed 383 (3%) trichiasis cases to the analysis. The M-H OR for Nigeria was 1.59 (95% CI 1.50-1.69), significantly less than the M-H OR for Ethiopia (OR 3.16, 95% CI 2.95, 3.39). Heterogeneity was significant (p<0.001)

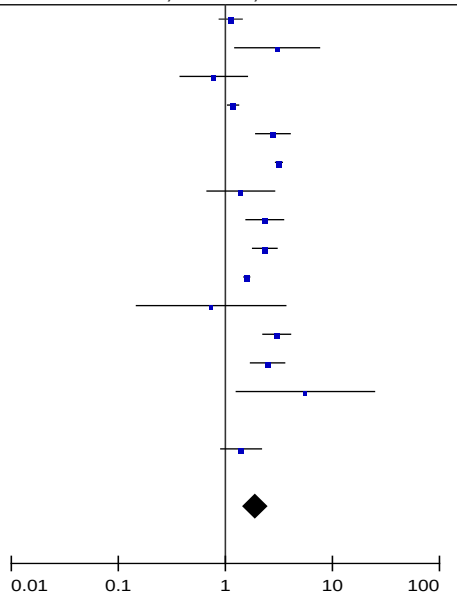
There were 503 EU with a trichiasis prevalence ≥0.2% and the M-H pooled OR in these EU was 2.01 (95% CI: 1.58 , 2.55) . Removing EU with trichiasis <0.2% reduced the survey population of women from 645,425 to 466,812 (72.3%) and of men from 498,317 to 358,698 (72.0%) while only reducing the number of women with trichiasis from 9,156 to 9,007 (98.4%) and of men with trichiasis from 3,566 to 3,494 (98.0%). Country level grouping of OR revealed an M-H OR of 1.91 (95% CI 1.46-2.48). (Figure 2) Heterogenity of data remained significant. (p<0.001)

Figure 2: Forest plot presenting the M - H Odds ratios for the 15 Countries with trichiasis EU prevalence ≥0.2%

Study or Subgroup	females Events	females Total	males Events	males Total	Weight	Odds Ratio M-H, Random, 95% CI
Benin	181	7874	105	5113	8.3%	1.12 [0.88, 1.43]
Cambodia	21	4634	6	4023	4.3%	3.05 [1.23, 7.56]
Cotedivoire	16	3199	14	2187	5.3%	0.78 [0.38, 1.60]
Democratic Republic of Congo	780	31509	470	22320	8.7%	1.18 [1.05, 1.32]
Egypt	134	3446	37	2583	7.6%	2.78 [1.93, 4.02]
Ethiopia	3709	149318	1000	125384	8.8%	3.17 [2.95, 3.40]
Guinea	22	5866	11	4088	5.3%	1.40 [0.68, 2.88]
Malawi	121	17291	30	9967	7.4%	2.33 [1.56, 3.48]
Mozambique	243	33729	75	24231	8.2%	2.34 [1.80, 3.03]
Nigeria	3322	165286	1617	126695	8.9%	1.59 [1.49, 1.68]
Solomon Island	3	967	3	712	2.1%	0.74 [0.15, 3.65]
Sudan	262	15802	54	9724	8.0%	3.02 [2.25, 4.05]
Tanzania	122	16700	38	12845	7.6%	2.48 [1.72, 3.57]
Uganda	14	2035	2	1618	2.3%	5.60 [1.27, 24.66]
Vanuatu	0	0	0	0		Not estimable
Yemen	57	9158	32	7208	7.2%	1.40 [0.91, 2.17]
Total (95% CI)		**466814**		**358698**	**100.0%**	**1.91 [1.46, 2.48]**
Total events	9007		3494			

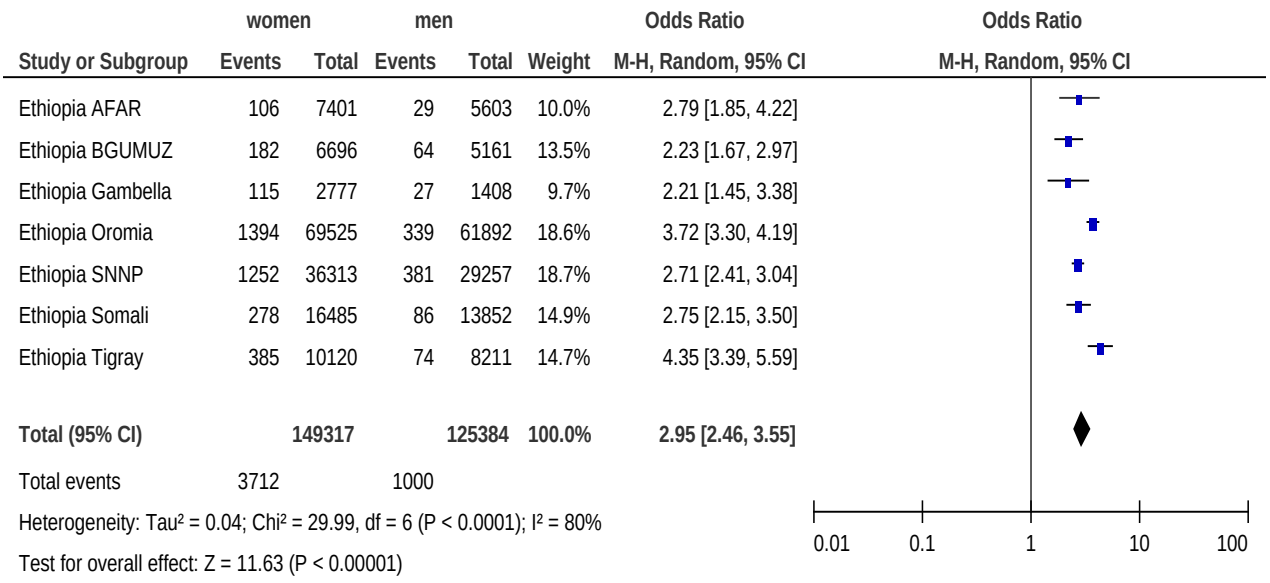
Heterogeneity: Tau² = 0.20; Chi² = 352.97, df = 14 (P < 0.00001); I² = 96%

Test for overall effect: Z = 4.79 (P < 0.00001)



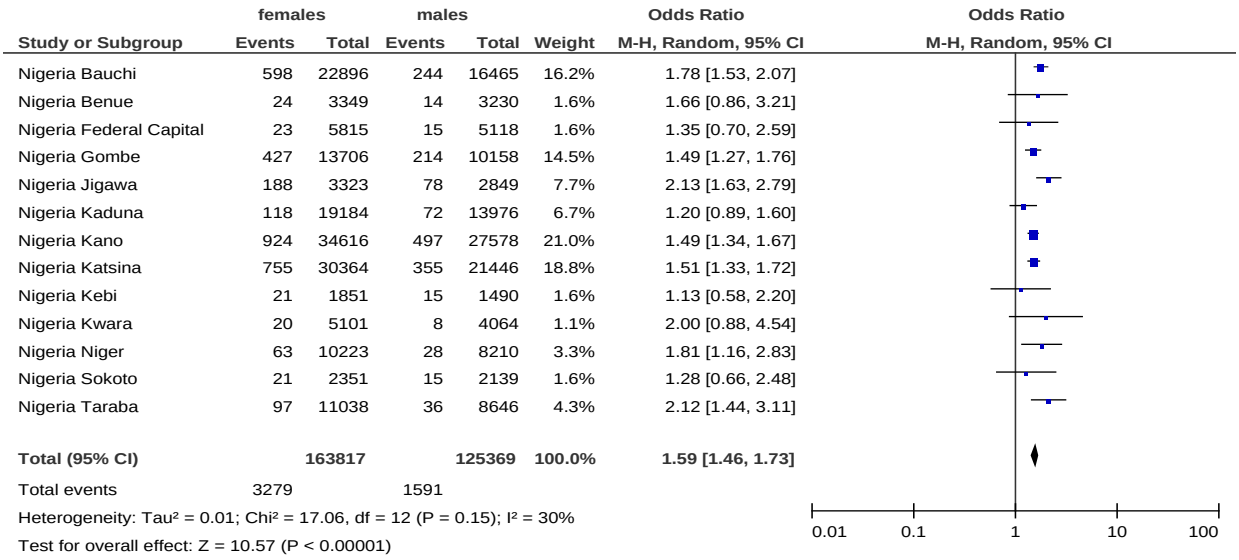
The size of the data sets from Nigeria and Ethiopia as well as the significant difference in their respective M-H OR led to a sub-analysis of state/regional level data from both countries. We limited the sub-analysis to EU with a trichiasis prevalence ≥0.2%. The overall M-H OR for Ethiopia was 3.17 (95% CI 2.95-3.40). Compiling the data region by region provided a M-H OR of 2.95 (95% CI: 2.46, 3.55); all 7 regions in Ethiopia showed M-H OR above 2.2 and there was overlap in all of the confidence intervals. (Figure 3) Even with all regions having a relatively high OR, there was considerable heterogeneity of findings.

Figure 3; Forest plot presenting the M- H Odds ratio for all the 7 regions of Ethiopia



One hundred and sixty eight EUs in Nigeria had a trichiasis prevalence ≥0.2% and the overall excess M-H OR of trichiasis in women to men was 1.59 (95% CI: 1.49-1.68). Compiling the OR at the state level revealed the same M-H OR of 1.59 (95% CI: 1.46-1.73). (Fig. 4). There was little heterogeneity in the findings summarized at the state level.

Figure 4; Forest Plot for all the GTMP Evaluation Units with WHO prevalence threshold in Nigeria



Study or Subgroup	females Events	females Total	males Events	males Total	Weight	Odds Ratio M-H, Random, 95% CI
Nigeria Bauchi	598	22896	244	16465	16.2%	1.78 [1.53, 2.07]
Nigeria Benue	24	3349	14	3230	1.6%	1.66 [0.86, 3.21]
Nigeria Federal Capital	23	5815	15	5118	1.6%	1.35 [0.70, 2.59]
Nigeria Gombe	427	13706	214	10158	14.5%	1.49 [1.27, 1.76]
Nigeria Jigawa	188	3323	78	2849	7.7%	2.13 [1.63, 2.79]
Nigeria Kaduna	118	19184	72	13976	6.7%	1.20 [0.89, 1.60]
Nigeria Kano	924	34616	497	27578	21.0%	1.49 [1.34, 1.67]
Nigeria Katsina	755	30364	355	21446	18.8%	1.51 [1.33, 1.72]
Nigeria Kebi	21	1851	15	1490	1.6%	1.13 [0.58, 2.20]
Nigeria Kwara	20	5101	8	4064	1.1%	2.00 [0.88, 4.54]
Nigeria Niger	63	10223	28	8210	3.3%	1.81 [1.16, 2.83]
Nigeria Sokoto	21	2351	15	2139	1.6%	1.28 [0.66, 2.48]
Nigeria Taraba	97	11038	36	8646	4.3%	2.12 [1.44, 3.11]
Total (95% CI)		**163817**		**125369**	**100.0%**	**1.59 [1.46, 1.73]**
Total events	3279		1591			

Heterogeneity: Tau² = 0.01; Chi² = 17.06, df = 12 (P = 0.15); I² = 30%

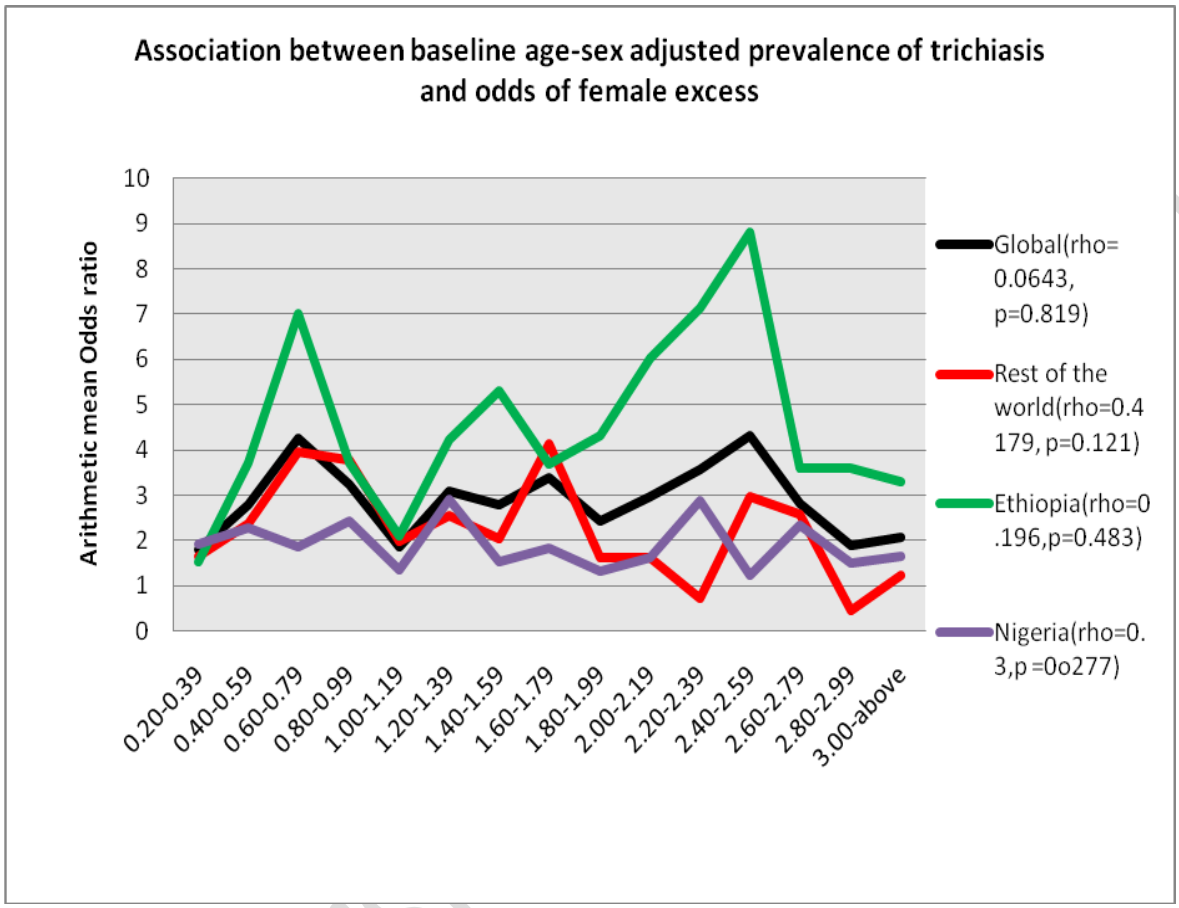
Test for overall effect: Z = 10.57 (P < 0.00001)

There were 15 age and sex adjusted trichiasis prevalence bands of 0.20%, starting with the prevalence of 0.20-0.39% and ending with a prevalence of 3.0% or more. In 254 of the 503 EU (50.5%) the age-sex adjusted prevalence of trichiasis was <1% and in only 72 EU (14.3%) was it 3% or more. There was no relationship between the age and sex- adjusted prevalence of trichiasis and the OR within each prevalence bands. (Table 2) The association remained insignificant regardless of the sub-group used. (Figure 5)

Table 2: Association between baseline age-sex adjusted prevalence of trichiasis and mean odds of female excess

Trichiasis prevalence category	Global mean odds ratio	Rest of the World mean odds ratio	Ethiopia mean odds ratio	Nigeria Mean odds ratio
0.20-0.39	1.79	1.64	1.52	1.93
0.40-0.59	2.78	2.37	3.71	2.27
0.60-0.79	4.26	3.95	7.00	1.85
0.80-0.99	3.23	3.79	3.73	2.43
1.00-1.19	1.85	1.98	2.10	1.36
1.20-1.39	3.08	2.54	4.23	2.92
1.40-1.59	2.79	2.03	5.30	1.52
1.60-1.79	3.40	4.15	3.69	1.82
1.80-1.99	2.44	1.61	4.32	1.31
2.00-2.19	2.97	1.63	6.03	1.63
2.20-2.39	3.58	0.72	7.14	2.88
2.40-2.59	4.33	2.97	8.81	1.23
2.60-2.79	2.82	2.58	3.61	2.33
2.80-2.99	1.88	0.46	3.6	1.51
3.00-above	2.08	1.24	3.31	1.65

Figure 5: Association between age-sex adjusted trichiasis prevalence and odds of women.



Discussion

Trichiasis remains a public health problem in many countries of sub-Saharan Africa and the Middle East and over 2.5 million people will need management of trichiasis to prevent corneal opacities and vision loss. In 2009 it was estimated that the excess burden of trichiasis in women compared to men of 1.82 (95% CI 1.61—2.07). (Cromwell, E.A., et al 2009: 985-992) Due to limited data available, the systematic review could not be used to conduct further sub analysis. The findings from the GTMP data are similar to the earlier results, with an excess prevalence slightly higher than the previous work. Limiting our analysis to only EU with trichiasis prevalence above the WHO threshold for elimination made little change to the overall findings.

Country-specific analyses revealed that there was considerable variation in the OR country by country. The number of EU included for each country varied hugely limiting our ability to compare findings from a number of the countries. Nevertheless, the findings from the two largest countries in the analysis, Nigeria and Ethiopia suggest that there may be country-specific reasons for the gender differences. We can provide no explanation, at the present time, why Ethiopian EUs would have higher female to male OR compared to the Nigerian EUs. Possible explanations that deserve investigation include the potential contribution of household family size, clustering of trachoma within households and communities, cultural factors (e.g., difference in interactions between adult women and children), and religious factors (e.g., how well do women mix with men at household and at community level). It appears, however, that trichiasis prevalence is not a predictor for female excess of trichiasis.

Whether including data from all countries or limiting the analysis to Nigeria or Ethiopia we found no association between the prevalence of trichiasis in an EU and the excess burden of trichiasis in women as expressed by the M-H OR. This is contrary to findings, recently reported from GTMP surveys in Chad in which a higher prevalence of trichiasis was associated to the excess burden of trichiasis in women. (Dezoumbe, et al., 2018) Further investigation is warranted.

While the GTMP data used in this analysis is large, the rarity of trichiasis in each of the survey units means that the variation around the prevalence estimate, generally expressed as a standard error, is quite large. This implies that the analysis of mean OR for each of the prevalence bands can also have significant variation around the OR. The M-H OR generated by RevMan accounts for small sample sizes, generating a robust overall estimate of female excess of trichiasis compared to men. While this analysis includes many trachoma endemic countries, it does not include all trachoma endemic countries. It is possible that the findings from countries, not included in this analysis, would be substantially different.

From a programmatic perspective, the findings indicate that countries would be well-placed to assess the excess of trichiasis in women compared to men and ensure that all of those with trichiasis are receiving access to trichiasis management. Programmes should monitor the gender-specific uptake of trichiasis surgery to ensure that no group is particularly disadvantaged. As impact and surveillance surveys become more commonplace it would be important to assess if gender specific excess remains the norm or if programmes have successfully reached women. Past work in Egypt (MousaA, courtright, P, Kazanjian, A & basset, K2014; 190 - 196) showed that women were still less likely to access trichiasis surgery compared to men while research in Tanzania (West, S, et al

2004;88:1368- 1371) suggested that there was no difference in gender-specific access. Additional research on gender-specific access of trichiasis services is needed.

Finally, the results, when compared against programme services (country by country) may help governments and NGO partners to assess whether they are reaching gender equity in terms of their services.

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APPENDICES

Appendix 2: Expression of Interest (EoI) to tender

PROJECT TITLE: Global Trachoma Mapping Project: secondary analyses

Expression of Interest (EoI) to tender

Part A: Organisation and contact details

1. ORGANISATION DETAILS	
1a Enter the full name of the organisation submitting EoI.	Kilimanjaro Centre for Community Ophthalmology, University of Cape Town
1b Registered office address	Rm 25, H-53, OMB Groote Schuur Hospital Observatory, 7925 South Africa
1c If this is a consortium submission, please enter the names of the other organisations here.	

2. CONTACT PERSON	
Contact details for enquiries (one contact point only)	
2a Name	Paul Courtright

2b Address	Rm 25, H-53, OMB Groote Schuur Hospital Observatory, 7925 South Africa
2c Daytime phone number	+27-21-6712266
2d Mobile number	+27-726772762
2e Email	pcourtright@kcco.net

(You may expand the boxes for Parts B and C so that they occupy no more than 2 A4 pages).

PART B – Project description

3a Research question	What is the excess burden of TT in women compared to men? • Does the ratio of women to men vary at different prevalences of TT? • Is the ratio the same in all trachoma endemic countries? If not, what might explain the differences? • This question was addressed in the paper by Cromwell et al. using existing TT data. This should be repeated with the large and varied data set available from GTMP.
3b Methodology	All data will be compiled in 5 year age groups prior to calculating differences between men and women; as women often live longer than men data will also be standardized to the age distribution of men and women in the country. All baseline GTMP data will be requested. Impact assessment data will not be used as there may be differences in utilization between men and women. A pooled age-adjusted gender-excess will be calculated. Sub-group analyses will include assessment of gender-excess at different levels of TT prevalence as well as regions or countries in the world. Stata (12) statistical software will be used for analytic

	purposes. This project will be carried out by George Moyo, a Malawian MPH student at UCT as part of his dissertation. He will be supervised by Paul Courtright, Robert Geneau, and his UCT faculty.
3c Expected outcomes	The expected outcomes of this work will include a publication of the findings and dissemination to all national programmes. The information generated by this work will be of value for advocacy at the national and the global level.

PART C – Experience and financial standing

4a Experience	KCCO has experience in data analysis, research planning, supervision of students, and all aspects of trichiasis. The student, Mr. Moyo is taking courses in epidemiology and biostatistics, including the use of Stata. He will be supported throughout the research process.
4b Resources available to undertake the work	Research supervision by Paul Courtright and Robert Geneau. There is no need for travel costs, space, or equipment for this work. KCCO will provide costs associated with internet access, secretarial support, and office supplies
4c Resources requested (please note that only limited resources for publication and dissemination of project results can be requested)	Resources required only for publication and dissemination of project.

Appendix 3: Data sharing Agreement