



# African Programme for Onchocerciasis Control 1995–2015: Updated Health Impact Estimates Based on New Disability Weights

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## Viewpoint

Since 1995, the African Programme for Onchocerciasis Control (APOC) has coordinated mass treatment with ivermectin in 16 sub-Saharan countries (Angola, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Ethiopia, Liberia, Malawi, Nigeria, North Sudan, South Sudan, Uganda, and the United Republic of Tanzania) with the aim to control morbidity due to infection with *Onchocerca volvulus*, a filarial nematode. Recently, we predicted trends in prevalence of infection, visual impairment, blindness, and troublesome itch due to onchocerciasis in APOC countries for the period 1995–2015, based on extensive data on pre-control infection levels, population coverage of ivermectin mass treatment, and the association between infection and morbidity [1]. We also estimated the associated health impact, expressed in disability-adjusted life years (DALYs). However, the estimated health impact was based on disability weights from the 2004 update of the Global Burden of Disease (GBD) study [2], which have been criticized for being based solely on the opinions of health professionals [3,4]. The recently published GBD 2010 study addressed this criticism by providing updated disability weights based on household surveys in Bangladesh, Indonesia, Peru, and Tanzania, an open internet survey, and a telephone survey in the United States [5]. As a result of this population-based approach, the disability weights for visual impairment, blindness, and troublesome itch have changed considerably and should better reflect our ideas and beliefs as a society of what constitutes health. For future reference, we provide an updated estimate of the health impact of APOC activities, based on previously predicted trends in averted number of cases with

infection and morbidity, but using updated disability weights for visual impairment, blindness, and troublesome itch.

Identical to previously used methods [1], we calculated the health impact of APOC for each year between 1995 and 2015, expressed in DALYs averted. The DALY metric is the sum of years of life lost (YLL) due to premature mortality (from blindness) and years lived in disability (YLD), weighted by a disability weight representing the loss of quality of life [5]. DALYs averted were calculated as the difference between two scenarios: a factual scenario in which APOC activities have taken place as documented, and a counterfactual scenario in which APOC activities have not taken place at all, effectively translating to  $DALY_{averted} = \Delta YLL_{blindness} + \Delta YLD_{blindness} + \Delta YLD_{visual\ impairment} + \Delta YLD_{itch}$ . Here,  $\Delta YLL_{blindness}$  is the averted number of YLL related to premature mortality from blindness (as previously estimated [1]), and  $\Delta YLD_x$  is the averted number of YLD due to symptom

$x$ . Averted YLD were calculated as  $\Delta YLD_x = \Delta N_x \cdot dw_x$ , where  $\Delta N_x$  is the averted number of person-years of symptom  $x$  (i.e., difference in annually prevalent cases between the factual and counterfactual scenarios, as previously estimated [1]), and  $dw_x$  is the associated updated disability weight, derived from the GBD 2010 study [5].

Compared to previous disability weights [2], updated weights were considerably lower for visual impairment (0.033, previously 0.282) and blindness (0.195, previously 0.594), reflecting that the loss in quality of life because of these manifestations is considerably lower than previously assumed. On the contrary, the disability weight for troublesome itch has increased (0.108, previously 0.068). The disability weight for visual impairment represents “moderate visual impairment” in the GBD 2010 study. The updated disability weights do not include a category for itch alone. Hence the disability weight for troublesome itch was derived from a

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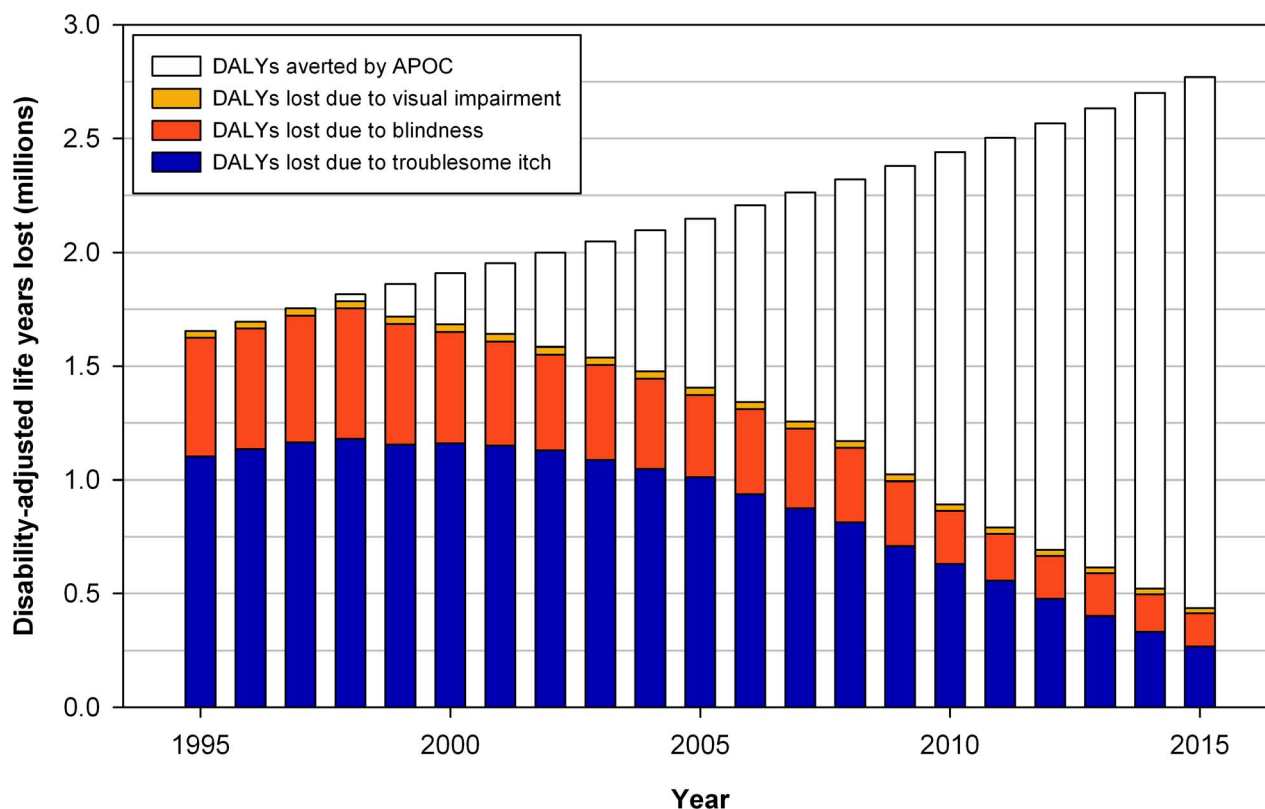
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**Figure 1. Disability-adjusted life years (DALYs) lost due to onchocerciasis from 1995 to 2015.** The total height of the bars (colored plus blank) represents the estimated number of DALYs lost in a counterfactual scenario without ivermectin mass treatment (increasing trend due to population growth). The colored part of each bar represents the estimated actual number of DALYs lost (declining trend due to ivermectin mass treatment). The blank part of each bar therefore represents the annual number of DALYs averted by ivermectin mass treatment in the total APOC population.

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generic class of disability weights for “disfigurement with itch or pain.” This class consists of three severity levels, characterized as “causing some worry and discomfort” (disability weight 0.029), “a person having trouble concentrating and sleeping” (disability weight 0.187), and “causing a person to avoid social contact, feel worried, sleep poorly, and think about suicide” (disability weight 0.562). Based on original precontrol data from a previously published, multicountry study [6] (excluding data from Ghana and Cameroon, which were collected based on convenience sampling rather than household surveys), we assumed that onchocercal itch regularly causes insomnia in about half of the cases and, therefore, calculated YLD due to itch using the mean of the disability weights for the first two severity levels (0.108). We assumed that this disability weight also applies during ivermectin mass treatment, even though the fraction of insomniacs among cases of itch might decrease with repeated mass treatments (due to lower infection loads and consequent lower severity of itch). Unfortunately, previous studies on trends of

onchocercal itch during ivermectin mass treatment do not report on insomnia [7,8]. Therefore, if anything, we may be underestimating the impact of ivermectin mass treatment on the burden of itch (and the associated DALYs averted).

Figure 1 illustrates trends in DALYs lost due to troublesome itch, visual impairment, and blindness, and DALYs averted by APOC. Table 1 gives more detailed information on the number of prevalent cases (according to the factual scenario) and DALYs lost and averted per year. For onchocercal visual impairment and blindness, the updated estimates of the averted burden turned out lower than the previous estimates. In contrast, for troublesome itch, the updated estimate of the burden averted turned out higher than the previous estimate. For visual impairment and troublesome itch, the difference between previous and updated estimates was proportional to the change in values of the associated disability weights. For blindness, however, this difference was not proportional, as the burden of blindness also included years of life lost due to premature mortality (which

is exactly the same for previous and updated estimates).

Overall, we estimated that APOC has cumulatively averted 8.9 million DALYs due to onchocerciasis through 2010, and will avert another 10.1 million DALYs between 2011 and 2015, adding up to a total of 19.0 million DALYs averted through 2015. These updated estimates do not differ much from previous estimates (8.2 million DALYs averted through 2010, and another 9.2 million between 2011 and 2025). In relative terms, the burden of onchocerciasis in APOC areas has decreased from 23.1 DALYs per 1,000 persons in 1995 to 8.6 DALYs per 1,000 persons in 2010, and is expected to further decrease to 3.7 DALYs per 1,000 persons in 2015.

The updated disability weights provided by the GBD 2010 study are based on population surveys rather than expert opinion. Therefore, they are presumably less subjective and should better reflect our ideas and beliefs as a society of what constitutes health than previous disability weights [5]. However, it has been argued that the disability weights for visual impair-

**Table 1.** Population at risk, number of cases, and disability-adjusted life years lost and averted due to onchocerciasis in areas covered by APOC.

Year	Population size and number of cases of infection and disease in APOC areas (thousands)					Disability-adjusted life years lost (thousands)					Disability-adjusted life years averted (thousands)					
	Population (At risk of infection)	Infected <sup>a</sup>	Troublesome itch	Visual impairment	Blindness	Troublesome itch	Visual impairment	Blindness	Total	Troublesome itch	Visual impairment	Blindness	Total	Troublesome itch	Visual impairment	Blindness
1995	71,474	32,330	10,202	889	404	1,102	29	523	1,654	0	0	0	0	0	0	0
1996	73,310	33,209	10,499	910	410	1,134	30	530	1,694	0	0	0	0	0	0	0
1997	75,195	34,073	10,780	931	418	1,164	31	558	1,753	0	0	0	0	0	0	0
1998	77,132	34,951	10,925	957	427	1,180	32	573	1,785	9	0	21	30	0	0	0
1999	79,122	35,816	10,692	974	430	1,155	32	530	1,717	65	0	79	144	0	0	0
2000	81,165	36,522	10,749	981	427	1,161	32	489	1,683	90	1	135	226	1	1	180
2001	83,144	36,998	10,653	987	420	1,151	33	457	1,640	131	1	180	312	1	1	231
2002	85,172	37,338	10,456	995	410	1,129	33	421	1,583	183	2	231	416	2	2	251
2003	87,249	37,502	10,073	990	402	1,088	33	417	1,538	256	3	288	621	3	3	338
2004	89,377	37,458	9,705	977	391	1,048	32	397	1,477	329	4	288	621	4	4	349
2005	91,558	37,196	9,357	965	379	1,011	32	363	1,405	400	6	338	744	6	6	390
2006	93,928	36,779	8,684	951	369	938	31	373	1,342	509	7	349	864	7	7	390
2007	96,360	36,093	8,111	931	358	876	31	349	1,256	608	9	390	1,007	9	9	431
2008	98,857	35,085	7,539	910	345	814	30	327	1,171	708	10	431	1,149	10	10	492
2009	101,419	33,811	6,564	885	330	709	29	285	1,024	852	12	492	1,356	12	12	563
2010	104,050	32,246	5,836	854	310	630	28	234	892	971	14	563	1,549	14	14	611
2011	106,750	30,355	5,157	825	290	557	27	206	790	1,086	16	611	1,713	16	16	648
2012	109,521	28,244	4,417	797	271	477	26	189	692	1,208	18	648	1,875	18	18	670
2013	112,366	25,979	3,724	762	254	402	25	188	615	1,327	21	670	2,018	21	21	715
2014	115,287	23,591	3,074	724	237	332	24	165	521	1,442	23	715	2,179	23	23	757
2015	118,285	21,115	2,478	690	220	268	23	145	435	1,552	25	757	2,334	25	25	2,334
<b>Subtotal 1995–2010</b>						<b>16,289</b>	<b>498</b>	<b>6,827</b>	<b>23,614</b>	<b>5,110</b>	<b>70</b>	<b>3,748</b>	<b>8,929</b>	<b>70</b>	<b>70</b>	<b>8,929</b>
<b>Total 1995–2015</b>						<b>18,325</b>	<b>623</b>	<b>7,719</b>	<b>26,667</b>	<b>11,724</b>	<b>174</b>	<b>7,149</b>	<b>19,048</b>	<b>174</b>	<b>174</b>	<b>19,048</b>

<sup>a</sup>Infection defined as presence of at least one adult female worm. doi:10.1371/journal.pntd.0002759.t001

ment and blindness underestimate the burden of vision loss in rural Africa [9,10]. One of the main arguments is that the surveys used to establish new disability weights did not adequately cover rural Africa (Tanzania only). Furthermore, being strictly a metric of health loss rather than wellbeing [5], DALYs do not capture the effects of vision loss and skin disease on socioeconomic status [11] and productivity [12,13]. Therefore, the impact of APOC most likely encompasses more than what we report here in terms of health impact.

According to our updated estimates, skin disease is now the most important

contributor to the burden of onchocerciasis, rather than eye disease. Moreover, the true disease burden of onchocercal skin disease (and the burden averted by APOC) is still larger than we estimate here, as our updated estimates do not include disfiguring skin disease, or other sequelae potentially associated with onchocerciasis, such as epilepsy [14] and head-nodding syndrome [15]. The additional burden of disfiguring skin disease is probably considerable, given the relatively high values of the updated disability weights for disfiguring skin disease and the high

precontrol prevalence of disfiguring skin disease in areas endemic for onchocerciasis [6]. This underlines the importance of onchocercal skin disease, especially in forest areas where vision loss is relatively rare [16].

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