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Viewpoints

# 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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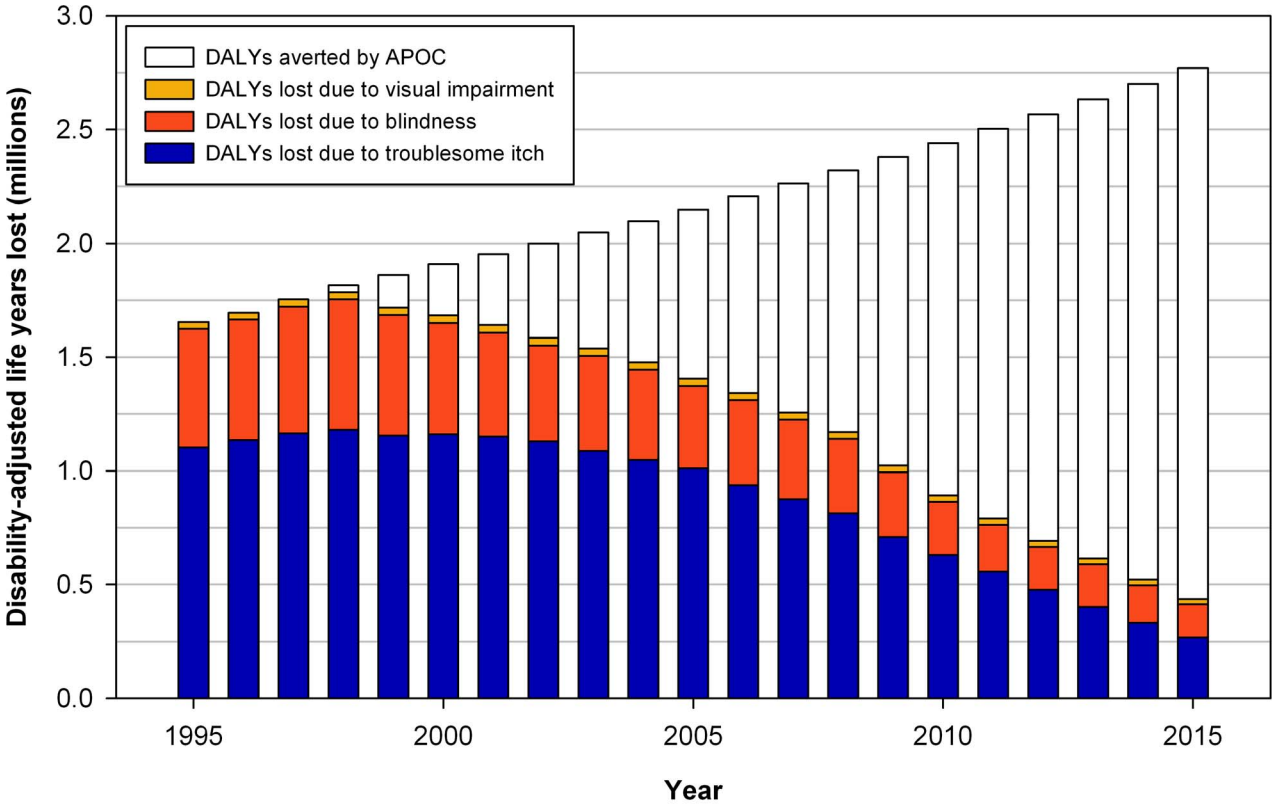


**Figure 1. Disability-adjusted life years (DALYs) lost due to onchocerciasis from 1995 to 2015.** The total height of the bars (colored plus blank) represents the estimated number of DALYs lost in a counterfactual scenario without ivermectin mass treatment (increasing trend due to population growth). 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[a] | Troublesome itch | Visual impairment | Blindness | Troublesome itch | Visual impairment | Blindness | Total | Troublesome itch | Visual impairment | Blindness | Total |
| 1995 | 71,474 | 32,330 | 10,202 | 889 | 404 | 1,102 | 29 | 523 | 1,654 | 0 | 0 | 0 | 0 |
| 1996 | 73,310 | 33,209 | 10,499 | 910 | 410 | 1,134 | 30 | 530 | 1,694 | 0 | 0 | 0 | 0 |
| 1997 | 75,195 | 34,073 | 10,780 | 931 | 418 | 1,164 | 31 | 558 | 1,753 | 0 | 0 | 0 | 0 |
| 1998 | 77,132 | 34,951 | 10,925 | 957 | 427 | 1,180 | 32 | 573 | 1,785 | 9 | 0 | 21 | 30 |
| 1999 | 79,122 | 35,816 | 10,692 | 974 | 430 | 1,155 | 32 | 530 | 1,717 | 65 | 0 | 79 | 144 |
| 2000 | 81,165 | 36,522 | 10,749 | 981 | 427 | 1,161 | 32 | 489 | 1,683 | 90 | 1 | 135 | 226 |
| 2001 | 83,144 | 36,998 | 10,653 | 987 | 420 | 1,151 | 33 | 457 | 1,640 | 131 | 1 | 180 | 312 |
| 2002 | 85,172 | 37,338 | 10,456 | 995 | 410 | 1,129 | 33 | 421 | 1,583 | 183 | 2 | 231 | 416 |
| 2003 | 87,249 | 37,502 | 10,073 | 990 | 402 | 1,088 | 33 | 417 | 1,538 | 256 | 3 | 251 | 510 |
| 2004 | 89,377 | 37,458 | 9,705 | 977 | 391 | 1,048 | 32 | 397 | 1,477 | 329 | 4 | 288 | 621 |
| 2005 | 91,558 | 37,196 | 9,357 | 965 | 379 | 1,011 | 32 | 363 | 1,405 | 400 | 6 | 338 | 744 |
| 2006 | 93,928 | 36,779 | 8,684 | 951 | 369 | 938 | 31 | 373 | 1,342 | 509 | 7 | 349 | 864 |
| 2007 | 96,360 | 36,093 | 8,111 | 931 | 358 | 876 | 31 | 349 | 1,256 | 608 | 9 | 390 | 1,007 |
| 2008 | 98,857 | 35,085 | 7,539 | 910 | 345 | 814 | 30 | 327 | 1,171 | 708 | 10 | 431 | 1,149 |
| 2009 | 101,419 | 33,811 | 6,564 | 885 | 330 | 709 | 29 | 285 | 1,024 | 852 | 12 | 492 | 1,356 |
| 2010 | 104,050 | 32,246 | 5,836 | 854 | 310 | 630 | 28 | 234 | 892 | 971 | 14 | 563 | 1,549 |
| 2011 | 106,750 | 30,355 | 5,157 | 825 | 290 | 557 | 27 | 206 | 790 | 1,086 | 16 | 611 | 1,713 |
| 2012 | 109,521 | 28,244 | 4,417 | 797 | 271 | 477 | 26 | 189 | 692 | 1,208 | 18 | 648 | 1,875 |
| 2013 | 112,366 | 25,979 | 3,724 | 762 | 254 | 402 | 25 | 188 | 615 | 1,327 | 21 | 670 | 2,018 |
| 2014 | 115,287 | 23,591 | 3,074 | 724 | 237 | 332 | 24 | 165 | 521 | 1,442 | 23 | 715 | 2,179 |
| 2015 | 118,285 | 21,115 | 2,478 | 690 | 220 | 268 | 23 | 145 | 435 | 1,552 | 25 | 757 | 2,334 |
| **Subtotal 1995–2010** | | | | | | **16,289** | **498** | **6,827** | **23,614** | **5,110** | **70** | **3,748** | **8,929** |
| **Total 1995–2015** | | | | | | **18,325** | **623** | **7,719** | **26,667** | **11,724** | **174** | **7,149** | **19,048** |

[a]Infection defined as presence of at least one adult female worm.

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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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