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Follicle size in trachoma: assessment of a well-known trachoma grading diagram

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Keywords

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Introduction

Trachoma remains the world's leading infectious cause of blindness.[1] Trachoma control programs determine when to start and stop mass antibiotic treatments based on the prevalence of follicular trachoma (TF) in children aged 1–9 years, as assessed by examination of the upper tarsal conjunctiva using the World Health Organization (WHO) simplified grading system.[2] According to the WHO classification, TF is defined as the presence of 5 follicles at least 0.5mm in diameter. The original paper describing the WHO simplified grading system included a diagram of the everted conjunctiva with examples of follicles that were 0.5mm in diameter.[2] However, in our clinical experience, the follicles in this diagram seem to be less than 0.5mm when considered relative to the size of the conjunctiva. In this paper, we measured the size of the follicles on the WHO diagram relative to photographs of everted conjunctivae from clinical trials in Niger and Ethiopia in order to determine whether the follicles in the diagram meet the WHO threshold of 0.5mm.

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Competing Interests

No competing interests.

Methods

Trained photographers used Nikon D-series digital SLR cameras with Micro-Nikkor 105mm f/2.8 lenses to photograph the everted upper conjunctiva of children aged 1–5 years in Niger and children aged 1–9 years in Ethiopia.[3] From these photographs, we identified a random set of 5 well-focused photographs per year of age (i.e., 25 photographs from Niger and 45 from Ethiopia). We used Adobe Photoshop to superimpose the WHO follicle diagram over each photograph, adjusting the size of the WHO diagram until the vertical aspect of the everted conjunctiva matched that of the conjunctival photograph.[2] The WHO diagram contains 5 follicles; we measured the height and width of each follicle in pixels and subsequently converted this length to millimeters using a conversion factor. We calculated the conversion factor as the average number of pixels per millimeter from 20 well-focused photographs of a ruler using the same camera, lens, and aperture setting (f/57 in Niger and f/40 in Ethiopia) as the conjunctival photographs. We summarized the diameter of each follicle as the geometric mean of its height and width.

Results

Relative to the size of the conjunctivae of Nigerien and Ethiopian children, the average follicle on the WHO diagram had a diameter of 0.39mm (95%CI 0.38 to 0.40). As shown in Figure 1, the average diameter for each of the follicles ranged from 0.35mm (95%CI 0.34 to 0.37mm, third follicle measured against the Ethiopian photographs) to 0.41mm (95%CI 0.39 to 0.43mm, second follicle measured against the Nigerien photographs). The calculated follicle size, as estimated by the average diameter of the 5 follicles on the diagram, was smaller for the 1–4 year-olds compared to those 5 years and older ($P=0.002$ for Nigerien population and $P<0.001$ for Ethiopian population; Figure 2).

Discussion

When standardized to conjunctival images of Nigerien and Ethiopian children, the follicles on the WHO reference diagram were approximately 0.4mm in diameter rather than the minimum 0.5mm size that is included in the definition of TF. This finding was similar in two ethnically diverse populations of children. We have noticed that many experienced trachoma graders tend to diagnose TF in eyes that have follicles that are slightly smaller than 0.5mm in diameter. In practice, this may be appropriate, since in our clinical experience the 0.4mm threshold may in fact be a better representation of the minimum follicle size required for a case of TF—though this would need to be confirmed in further studies. Refining the optimal threshold for follicle size will be important for trachoma elimination, since different thresholds could change the estimates of trachoma prevalence and hence the classification of elimination.

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Figure 1.

Estimated diameter of each of the 5 follicles on the WHO trachoma grading diagram, as standardized against conjunctival photographs of Ethiopian children aged 1–9 years and Nigerien children aged 1–5 years. Follicles are numbered in the order that they appear on the diagram, from the furthest left (follicle 1) to the furthest right (follicle 5). Error bars indicate 95% confidence intervals. Size markers corresponding to 0.1, 0.2, 0.3, 0.4, and 0.5mm are shown to the right of the chart.

Figure 2.

Average follicle diameter from the WHO trachoma grading diagram, as standardized against the conjunctiva of children of different ages. Error bars indicate 95% confidence intervals.