Dear Editor,

Re: Evidence for an "epidemic" of myopia

Park DJ, Congdon NG

In the *Annals* January 2004 theme issue on Myopia, Park and Congdon[1] have disputed the reality of the increases in prevalence of myopia in East Asia for several reasons. In particular, they criticise the 2 best documented sets of cohort data, from Taiwan[2-6] and Singapore,[7-10] on methodological grounds.

In the case of the studies from Taiwan, they argue that there are methodological uncertainties that undermine the validity of the studies. In the same issue of the Annals, Lin et al[3] outline the consistent methodologies and definitions used in their comprehensive set of data, and document increasing prevalence, earlier onset of myopia, and an increasing prevalence of high myopia. While Park and Congdon raise the theoretical possibility that the school sampling framework may have distorted the data, they provide no evidence that this is, in fact, the case. Thus, the data from Taiwan provide strong evidence of a cohort effect.

In relation to the data from Singapore, their methodological criticisms have greater foundation, in that the early data on conscripts rely on measurement of visual acuity rather than actual refraction. However, some of the later data on conscripts have been obtained on samples on which refraction has been carried out, and thus clearly establish the recent high prevalences of myopia.[10]

Park and Congdon suggest that the earlier data may be flawed because some of the low visual acuity may have been associated with hyperopic rather than myopic errors. However, if this was the case, then the prevalence of myopia would have been even lower 40 years ago, and thus the increase since then would have been even greater. Similarly, if their argument, that some of the low visual acuity may be explained by conscripts attempting to escape military service, were valid, this would again lower the real prevalence of myopia in the earlier studies, magnifying the increase that has actually taken place. Thus, neither of their hypotheses actually weakens the case for cohort effects.

On a slightly different tack, Park and Congdon imply that there may be no epidemic of myopia in the sense of a cohort effect in which more recent birth cohorts have a much higher prevalence of myopia. They quote Rasmussen[11] as demonstrating that the prevalence of myopia was as high as 50% to 70% in China, at least since the 1920s.

Unfortunately, this error perpetuates a misinterpretation of the work of Rasmussen made in Curtin's book on myopia.[12] Rasmussen did not report the prevalence of myopia. He actually reported the percentage of refractive prescriptions that were for the correction of myopia, in westernised Chinese hospitals in China in the 1930s. Even though Park and Congdon added the rider "depending on the definition and mode of data acquisition", this measure is obviously so far removed from a population prevalence of myopia that it should never be quoted in that context.

Park and Congdon also contest the suggestion that the prevalence of myopia may be increasing in Caucasian populations, quoting work suggesting that the declining prevalence of myopia in older age groups is due to age-related hypermetropisation, rather than a cohort effect.[13] Park and Congdon point to one strong piece of evidence of the increasing prevalence of myopia in Caucasian populations, the cohort effect demonstrated in the Beaver Dam Eye Study.[14] There is another example. In the Orinda Longitudinal Study on myopia, there has been a clear cohort change in the prevalence of myopia.[15] This has been attributed to an increasing proportion of people of Asian origin in the population studied, but the demographic evidence to back this up has not been presented, and the magnitude of the change makes this explanation unlikely. Park and Congdon also need to explain the high prevalence of myopia in recent cohorts in the Framingham Offspring Eye Study[16] and the Goteborg school district in Sweden.[17]

In the end, Park and Congdon conclude that "both longitudinal changes and cohort effects may be present". They further argue that "their relative contribution may differ in different racial groups". In this area it is important to use current definitions of population groups based on modern molecular classifications.[18,19] Unfortunately, Park and Congdon confuse geographical location with population classification when they describe studies carried out in India as on Asians – for in molecular terms, the population of India is Caucasian in origin, and quite distinct in genetic terms from the populations of East Asia.

In this area, one of Park and Congdon's assertions, that the prevalence of myopia in "other Asian populations" (Indians, on their classification) is higher than those of European populations, is contestable. Several recent studies on European populations[16,17,20,21] show values for the prevalence of myopia significantly higher than those reported from India.[22-25] They also ignore one of the most striking findings in this area – that Indians growing up in Singapore have a much higher prevalence of myopia than Indians in India, with a prevalence quite close to that in Singaporean Chinese.[10] While there is a persistent difference, which could be attributed to racial differences, it seems highly likely that the different environment of Singapore has had the predominant impact on the prevalence of myopia in those of Indian origin.

There is no doubt that if many of the previous studies could be redesigned retrospectively, they would be carried

out with more rigorous protocols, although the studies from Taiwan appear to have been well-designed from the outset. Unfortunately, the phenomenon of the increasing prevalence of myopia was discovered on the run. Now that it has taken place, it cannot be recapitulated, but there are other parts of the world in which the process appears to be at an earlier stage, and in which it will be able to be better documented. To this end, we are currently carrying out the Sydney Myopia Study on over 3000 schoolchildren in Australia, using a stratified random cluster design, and at the same time following the changes in the prevalence of myopia in rural and urban areas of Vietnam using cycloplegic autorefraction and a consistent cut-off for myopia of ≤-0.5D. These studies will systematically document the baseline prevalence of myopia, in 2 racial groups in 3 diverse environments.

While we await the data from these studies, we argue that when the data available is reviewed comprehensively, then the conclusion that the prevalence of myopia is increasing in many parts of the world is inescapable.[26,27] We also argue that, despite the evidence for high correlations in refractive error in twin and other family studies, environmental risk factors are now the predominant determinants of myopia in many parts of the world.[26,27]

Clearly, we do not accept Park and Congdon's conclusion that the evidence in favour of a large cohort effect for myopia in East Asia is weak. Nor do we accept their claim that the evidence that acquired myopia is related to axial elongation is weak. Instead, several papers have documented the link between the 2 parameters in subjects from Singapore and Taiwan, where acquired myopia is common.[4,28-32] It is therefore likely that acquired myopia, and particularly high myopia, will be associated with myopic retinopathy.

But even if the evidence for a cohort effect were as weak as Park and Congdon argue, it is incontestable that in many parts of East Asia today, most notably in the highly developed areas, the prevalence of myopia in school-leavers is extremely high (70% to 90%), and the prevalence of high myopia (<-6D) is also very high (15% to 30%). It is not possible to wait for definitive evidence of the pathological outcomes associated with this high myopia, before taking public health action, for that would leave a substantial proportion of the population vulnerable. It would equally be unwise to wait for perfect studies on cohort effects before recognising the reality of the changes that are taking place in East Asia, and continuing the search for effective and safe preventive measures.

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Dear Editor,

Re: Authors' Reply

We appreciate the thought-provoking letter from Morgan et al, in response to our article. By choosing to call into question whether there is an "epidemic" of myopia in East Asia and elsewhere, our article did not only seek to review skeptically the current data suggesting that myopia prevalence may be increasing. We still maintain that many of these data are complicated by methodological problems, and may also confound cohort effects with longitudinal changes in refractive error with ageing.

More importantly, we also seek to question whether the term "epidemic", which is frequently used to describe the putative changes in myopia prevalence in East Asia, should accurately be applied in this situation. An "epidemic" suggests an acute public health problem requiring appropriate counter-measures to be applied in a timely fashion. Morgan et al's letter explicitly adopts such a paradigm, suggesting that "it is not possible to wait for definitive evidence of the pathologic outcomes associated with this high myopia before taking public health action, for that would leave a substantial proportion of the population vulnerable". We would very much question the current need to take "public health action" against myopia, on 2 important grounds.

In the first place, even assuming that a rising prevalence of myopia in East Asia is a fact, available data give us very little basis for understanding the public health implications of such changes. How might even a significant increase in a relatively rare condition such as rhegmatogenous retinal detachment, or a more modest increase in a comparatively prevalent condition such as posterior subcapsular cataract, both which may be associated with myopia, be balanced against a possible decrease in a very common blinding condition such as angle closure glaucoma, which is generally inversely correlated with the presence of myopia? More importantly, a decade or more of randomized trials of myopia treatments have yielded only fairly modest effects with agents such as pirenzepine. Current data suggest that such effects may be relatively short lived, and of course the long-term effects of such treatments, which would be aimed primarily at children of school age, are completely unknown.

In the face of currently available information, it would seem that reasonable people may disagree about the relative contribution of longitudinal, age-related changes and cohort effects to the cross sectional data, which comprise much of what we now know about refractive error prevalence and distribution. It is much more difficult, however, to accept that the paradigm of an "epidemic" may accurately be applied to myopia prevalence in East Asia or elsewhere. In the absence of "evidence of pathologic outcomes," we cannot even know that the patient is sick, much less whether the medicine will be preferable to the illness.

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Dear Editor,

Re: Guest Editors' Reply

In the Letter to the Editor by Morgan et al in response to the article "Evidence for an Epidemic of Myopia",[1] Morgan and colleagues assert that the increases in the prevalence of myopia in East Asia are real and should not be dismissed lightly. We tend to agree with this view. Though the data from Taiwan and Singapore are both flawed in many aspects and it cannot be concluded with certainty that the rates of myopia have risen in these countries, we believe there is sufficient evidence to believe that the purported increase in myopia prevalence in East Asia could indeed be true. In fact, even in European-derived populations, the evidence for an "epidemic" of myopia is strong. For example, in the Beaver Dam Eye Study, myopia rates were significantly higher in later birth cohorts in the same population.[2]

There are both strengths and weaknesses of the Taiwanese studies. In Taiwan, the majority of children likely attend school and a school-based sampling approach may therefore provide data that are not too different from the population.[3] However, the sampling strategies adopted by the 1986, 1990, 1995 and 2000 studies were not identical and it is possible that children from a certain type of school with its defined socioeconomic and lifestyle characteristics may be selected.[4-6] Nonetheless, the reported rise in rates is remarkable and any selection biases due to school types alone would not have likely cause such a large apparent increase in myopia prevalence. Further surveys in the same schools as the 2000 survey would be useful.

One of the major criticisms of the military studies in Singapore was the fact that myopia was defined using visual acuity measures. Admittedly, there can be other causes of poor vision in young adults, including other refractive errors such as hyperopia and amblyopia. However, in this age group, the main cause of uncorrected low vision is likely myopia. Thus, there will only be substantial bias if the relative contribution of the major causes of uncorrected low vision has changed in the past few decades. It is extremely unlikely that the age change in the population is significant because the age for compulsory enlistment into the military has remained the same.[7] The methods of vision measurement using the Snellen chart in the military have not changed considerably over time and the ethnic distribution of young Singapore adults have remained stable over the past few decades.[1]

Although more cohort studies may provide stronger evidence of whether myopia rates are truly rising, and whether it will continue to rise in Asia, there are already considerable data from well-conducted surveys in children (Refractive Error studies in Children) and adults that reveal high prevalence rates of myopia in East Asia.[8,9] Thus, given that myopia is already a huge public health problem, the lack of data on myopia time trends should not preclude concerted efforts to identify modifiable risk factors for the primary prevention of myopia and a safe, effective intervention to slow myopia progression.

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