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ORIGINAL ARTICLE

National and sub national prevalence of Amblyopia and its trends from 1990 to 2018 in Iran

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KEYWORDS
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Abstract
Purpose: To determine the national and subnational prevalence of amblyopia and the respective provincial distribution and trend during 1990–2018 in Iran.
Methods: Amblyopia data retrieved from 26 original studies, systematic reviews, Data has been cleaned by STATA and a linear mixed effect spatio-temporal model was used to calculate Gaussian process regression mean functions. Using a Bayesian approach, by pooling empirical data based on the assumed prior, a posterior distribution obtained for age and sex specific prevalence prediction nationally during the study time and provincially.
Results: The overall age-adjusted prevalence of Amblyopia was 0.03 (95% CI, 0.022–0.035). The prevalence was comparable in boys and girls (p = 0.85), highest prevalence was in >30 years old (p = 0.038). Our extrapolation revealed a stable trend of prevalence of Amblyopia in Iran during 1990–2018 (national screening program has been active from 1990 onwards). While Amblyopia prevalence suggested a declining trend in three provinces of Hormozgan, Qom and Tehran and it went up in 13 other provinces.
Conclusion: Amblyopia prevalence seems unchanged despite the concurrent screening program. It is noteworthy that the coverage of the program has been improved and has reached more than 85% in 2018. Our finding mandates a formal evaluation on the program.

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PALABRASCLAVE
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Prevalencia nacional y provincial de la ambliopía y tendencias de 1990 a 2018 en Irán

Resumen
Objetivo: Determinar la prevalencia nacional y provincial de la ambliopía, así como la distribución y tendencia provincial respectivas de 1990 a 2018 en Irán.
Métodos: Datos sobre ambliopía recabados de 26 estudios originales y revisiones sistemáticas. Dichos datos fueron depurados con STATA, utilizándose un modelo espacio-temporal de efecto mixto lineal para calcular las funciones medias de regresión del proceso de Gauss. Utilizando un enfoque Bayesiano, agrupando los datos empíricos basados en el previo asumido, se obtuvo una distribución posterior de la predicción de prevalencia específica por edad y sexo, a nivel nacional y provincial durante el periodo de estudio.
Resultados: La prevalencia global de la ambliopía ajustada por edad fue de 0,03 (95% IC, 0,022–0,035). Dicha prevalencia fue comparable en chicos y chicas (p = 0,85), con una mayor prevalencia en >30 años de edad (p = 0,038). Nuestra extrapolación reveló una tendencia estable de la prevalencia de ambliopía en Irán de 1990 a 2018 (el programa nacional de cribado estuvo activo de 1990 en adelante). Mientras que la prevalencia de ambliopía sugirió un descenso de la tendencia en tres provincias de Hormozgan, Qom y Teherán, y se incrementó en otras 13 provincias.
Conclusión: La prevalencia de ambliopía parece no haberse modificado, a pesar del programa de cribado concurrente. Cabe resaltar que la cobertura del programa ha sido mejorada, alcanzando a más de un 85% de la población en 2018. Nuestro hallazgo exige una evaluación formal del programa.

Introduction

Amblyopia is the most common cause of monocular visual impairment in both children and adults[1,2] Unilateral Amblyopia induces a lifetime risk for bilateral blindness and has a potentially profound effect on the individual life.

The prevalence of Amblyopia has been estimated in many countries.[3–6] Global prevalence of Amblyopia has been reported in a systematic review that showed the pooled prevalence estimate of Amblyopia was 1.75% (95% CI: 1.62–1.88).[7] In Iran, there also have been some studies national and also from discrete regions, which reported a prevalence of Amblyopia ranged from 0.5% to 6.9%.[8,9]

Screening and treating Amblyopia is a cost effective and well-accepted public health policy in most developed countries.[10,11] The National Vision Screening Program has been conducted in Iran for over 20 years, in order to identify cases in a timely manner. [12] and it seems that reduced the ocular diseases in some studies. This program has been started in Iran since 1995 using E chart board in three examination levels by kindergarten teachers, optometrist, and ophthalmologist in urban and rural areas.

In this screening program, 11,000,000 children have been screened and 300,000 children have been suspected and finally, 89,000 amblyopic children have been recognized and treated.

The sensitivity and specificity of this program was reported 38.15% and 93.11% respectively.[13] In this program, uncorrected visual acuity was evaluated to identify visual problems by a teacher or health supervisor.

The impact of the screening and treatment on the actual prevalence of Amblyopia is hard to quantify.[14,15] Nonetheless, recent official reports fail to show any considerable change in the prevalence of Amblyopia.

Differences in diagnostic methods, definitions of Amblyopia, sampling methods and sample sizes, restrict our ability to judge the current status of Amblyopia in Iran properly. Some studies claim that they have done reporting the national Amblyopia prevalence in Iran by collecting the samples from a single city.

For these reasons, we designed a study to estimate the, prevalence and the trend of Amblyopia during the years 1990–2018 at the national and sub-national levels and assess the impact of national vision screening program on its magnitude.

Methods

Systematic review

Published literature between January 1980 and December 2018 in Medline (PubMed), ISI Web of Science, Scopus, Iranian Digital databases of SID (http://www.sid.ir), Barakat knowledge net-work system (http://health.barakatkns.com), and Irandoc as well as Google Scholar and national ophthalmic literature by Noor Ophthalmology Research Center (http://iraneyedoc.com) and manual search by medical research journals are included. Additionally titles in the abstract books of the Iranian ophthalmology annual congresses from 2008 through 2010. More details about study selection criteria and critical appraisal have been described elsewhere(protocol paper).[16]

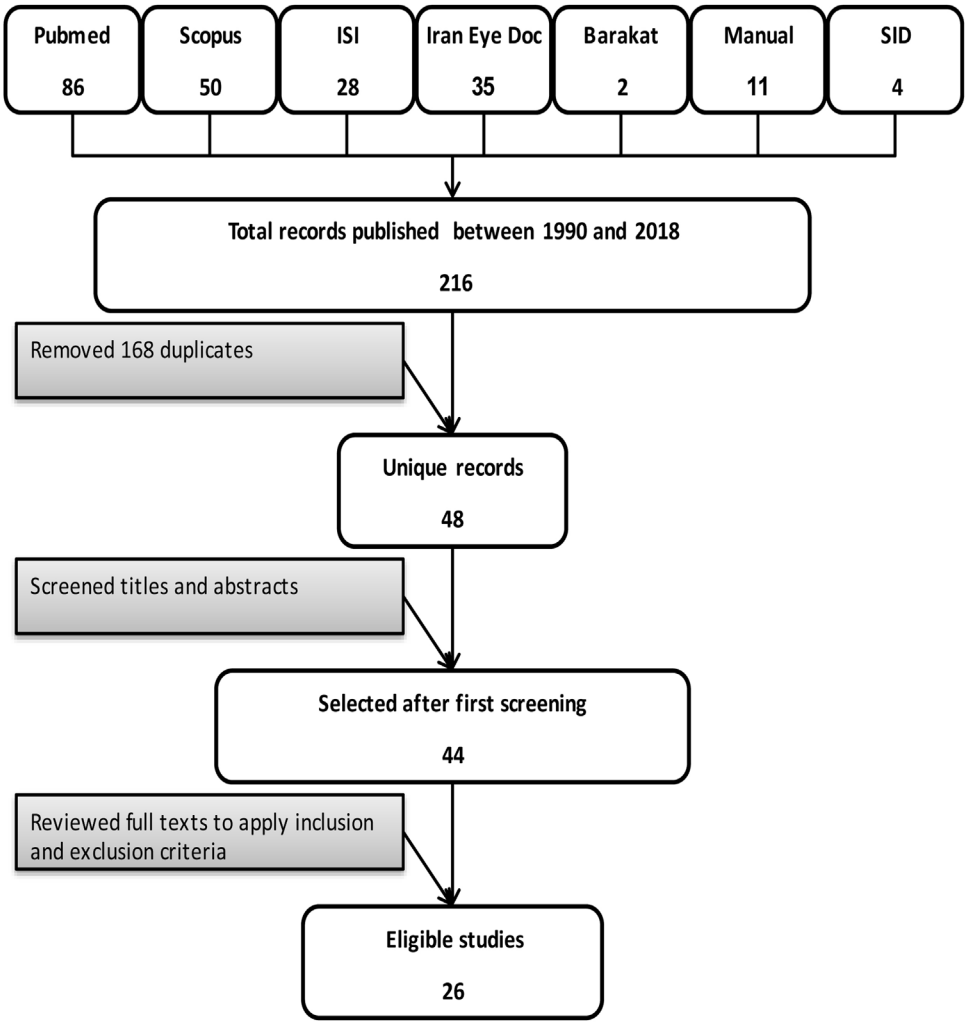

Fig. 1 Flow chart of the systematic search and review.

Data extraction and quality assessment

The study quality has been assessed by using the tool described by the Critical Appraisal Skills Program (CASP) by two independents reviewers. Studies with poor quality scores were excluded. In this study, the age has been divided into five subgroups: less than 6, 6–12, 12–18, 18–30 and more than 30. All retrieved records were screened and reviewed by two independent reviewers (SJD and EA). Uncertainties were resolved by consensus with a third reviewer (SFM). Data collected from each study included (1) study information including year of publication, province of study, age range of participants, definition of Amblyopia, sample sizes; (2) prevalence of Amblyopia reported unadjusted and adjusted ORs and 95% CIs (or standard errors), and adjusted co-variables.

Statistical analysis for data imputation in 31 provinces

The aim of this project was estimating the prevalence of Amblyopia of different ages, among two sexes from 1990 to 2018 and 31 provinces. For this reason, Generalized Linear Mixed Model (GLMM) was applied to impute missing values during these combinations and have reliable predictions of prevalence. In this model the rates of Amblyopia has been predicted by fixed covariates including: years of schooling, wealth index and urbanization and a random effects of provinces. In order to have robust estimates with uncertainty we employed Gaussian Process Regression (GPR) which is a Bayesian technique using the information of estimated rates and defines a flexible model with hierarchical priors for its parameters. Gaussian Process has a mean and covariance function. In this study, these functions were defined as AST model and Matérn covariance function respectively. GPR was drawn samples from posterior distribution by Markov Chain Monte Carlo method and we got the median as final estimates of prevalence and the 2.5 and 97.5 percentile for its uncertainty.

Results

Summary of included studies

The detailed steps were given as a flowchart (Fig. 1). A total of 216 articles were identified. After removal

Table 1 Description of the extracted studies included in pooled estimation.

province of study	year of publication	Median age of participants	sample sizes	Prevalence
Charmahlo bakhtiari	1996	7	2000	1.35%
Kerman	1996	7.5	1726	2.00%
Kordestan	1996	8.5	16185	1.80%
Zanjan	1996	9.5	1275	1.65%
kermanshah	2000	9.5	4533	5.80%
Fars	2000	9.5	1224	2.28%
Ghazvin	2000	7.5	20000	4.30%
Ardabil	2001	4.5	8427	1.42%
Khouzestan	2002	4.5	1151	2.70%
Ardabil	2004	12.7	913	1.90%
Azarbayejan gharbi	2004	8	2955	2.20%
Tehran	2005	27.8	11975	1.00%
Sistan- Blaouchestan	2005	27.7	5446	0.70%
Iran	2005	6	1433540	1.25%
Khouzestan	2007	24.7	6960	0.91%
Fars	2008	12.5	2683	2.24%
Khorasan razavi	2008	13.5	2150	1.90%
Yazd	2008	26.1	974	1.20%
Semnan	2009	6	815	1.70%
Tehran	2010	16.3	1133	2.10%
Tehran	2010	30.89	600	2.30%
Mazandaran	2011	64.7	937	3.20%
Semnan	2012	50.9	5190	5.90%
North Khorasan	2011	11.2	1551	2.50%
Hormozgan	2012	4	16599	1.01%
Tehran	2013	9.4	2417	2.30%

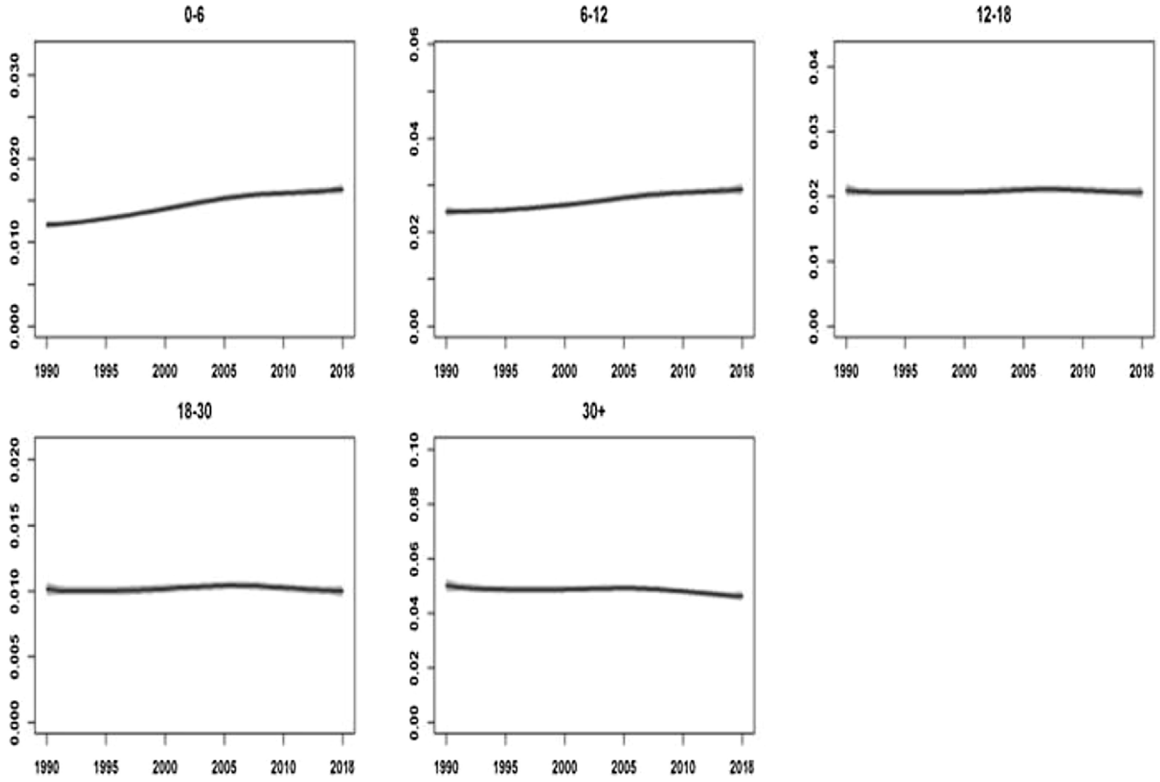

Fig. 2 National prevalence of Amblyopia in both sexes in different age groups and years. Age group separated by boxes. Vertical line represents provenances and Horizontal line represents years.

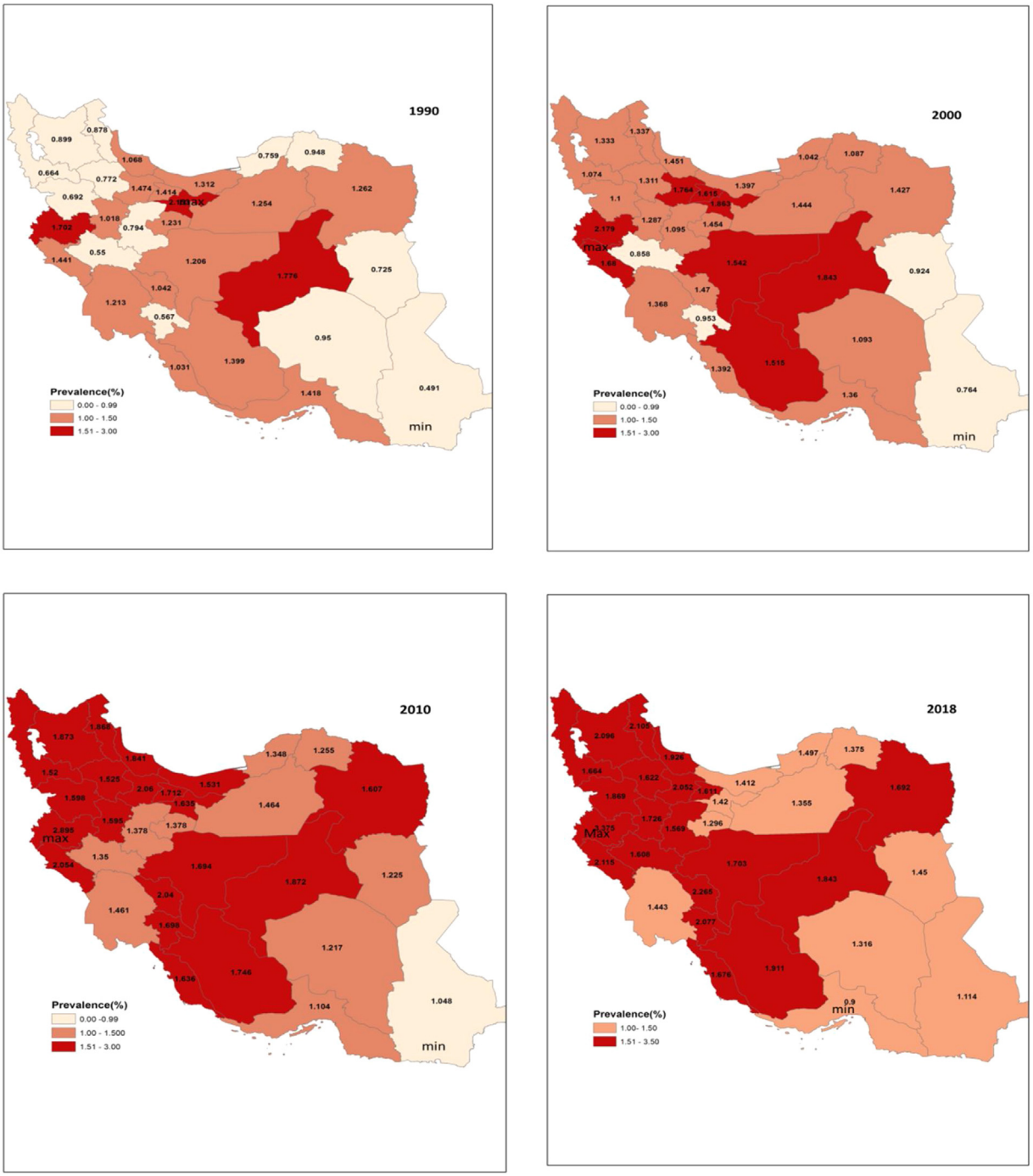

Fig. 3 The age adjusted Amblyopia for different province and different years.

of duplicates and non-relevant studies, the abstracts of the remaining articles were reviewed. 48 articles with potentially relevant studies were further identified in full. Overall, 26 published studies were considered eligible for Amblyopia.[8,9,16–39] (Table 1)

Prevalence of Amblyopia

In our study, the overall age-adjusted prevalence of Amblyopia was 0.03 (95% CI, 0.022–0.035). The prevalence was comparable in males (0.0310) and females (0.0293) ($p = 0.85$). Our extrapolation revealed a stable trend of prevalence of Amblyopia in Iran during 1990–2018 (national screening program has been active from 1990 onwards). The details of prevalence trend have been summarizing in Table 1.

The prevalence of Amblyopia in women and men increases with age with a highest prevalence among more than 30 years ($P = 0.18$) and the prevalence of Amblyopia in 18–30 years was significantly lower than other age groups

(P = 0.04). The prevalence was 0.01, 0.02, 0.02, 0.01 and 0.04 in <6, 6–12, 12–18, 18–30 and >30 respectively.

The Most prevalence rise in different years could be seen in ages under 12 years (Fig. 2).

Geographic distribution

The age adjusted Amblyopia for different province been reported in Fig. 3.

It showed only four provinces (Tehran, Alborz, Hormozgan and Qom) have had decrescendo trend and 11 provinces did not show any significant changes in trend of prevalence of Amblyopia.

The highest prevalence was seen in Kermanshah 3.37% and the lowest prevalence was in Hormozgan .0.9% in 2018.

Discussion

Adjusted sex and age Prevalence of Amblyopia was about 3% in this study which is comparable to the European countries (3.67%, 95% CI: 2.89–4.45) and higher than the prevalence in Africa (0.51%, 95% CI: 0.24–0.78).[7]

Amblyopia prevalence in different age groups showed downward trend probably due to the Amblyopia screening program in recent 24 years (in 18–30 years versus in >30 years old) (p = 0.028) but to our surprise, we did not observe a significant decrescendo trend in other age groups. The prevalence was comparable in males and females (P = 0.85).

Based on National vision screening program, the frequency of positive Amblyopia screening in the population under coverage from 1990 to 2018 has decreased generally. This is attributed to decreasing likelihood of false positive screening and improved experience and skill in the program.

However, as shown in Fig. 2, during 1996–2000 we had an up rise. It should be noted that this was co-incident with adoption of a new photoscreening technology in the program[12] We know that the photoscreeners screen amblyopia risk factors like strabismus, ametropia, and optical deprivation and not the amblyopia and it is clear that the risk factors have quite higher frequency in the population than the condition itself.

There are some evidences that Amblyopia incidence is increasing generally.[17,18] This has been attributed to higher incidence of premature birth and survival which almost in all cases is accompanied by Amblyopia and this new success (pool of Amblyopia cases) counter act the influence by current Amblyopia screening program.

The authors can attribute this lack of observing national vision screening program welfare screening impact to the following reasons: Dilutional anisometropic Amblyopia prevalence decline in the total pool of Amblyopia for different causes. (Such as ametropic and refractive) and also we cannot truly treat Amblyopia successfully; itis expected the severity reduction instead of the prevalence of Amblyopia.

It is known truly that even in some diagrams we observed an unexpected paradoxical upward trend but tracking index in population under national vision screening program welfare screening coverage from 1995 to 2018 was fluctuated between 50% and 70% and it just increased a little in 2018.

There are difficulties in assessing Amblyopia prevalence in older populations. It is possible that early treatment may alter the prevalence of Amblyopia. Eye diseases such as cataract or age-related macular degeneration may mask Amblyopia, particularly in the oldest age groups.

The variability in prevalence is partly due to differences in the VA criterion used and the age group sampled. In populations with high rates of prior Amblyopia treatment, using current visual acuity may underestimate the overall burden. On the other hand, including treated Amblyopia in the numerator by history is problematic too. Another source for heterogeneity, in our study, was the mix of population- and school-based studies and the sampling effect.

Conclusion

We reached to a pooled estimate of 3% (95% CI: 2.4–3.8) for amblyopia in Iran in the past 24 years by Markov Chain Monte Carlo method Despite a concurrent national amblyopia screening program, and to our surprise, our data revealed a stable status and this put shadows on the impact of the national screening program. However, ecologic nature of our data and the associated uncertainty makes a definite conclusion impossible.

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Conflicts of interest

The author has no conflicts of interest to declare.

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