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7

8   Neck pain, dry eye and Sjögren's syndrome in Latin American students during the first
9   wave of COVID-19: Frequencies and associated factors

10

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31

32

33

Abstract

Introduction: Virtual classes brought many changes to the lives of students, not only the fact of being more exposed to screens, but also because of the repercussions. **Aim:** To determine the factors associated with suffering from neck pain, dry eye and Sjögren's syndrome in students in Latin America during the first wave of COVID-19. **Methodology:** Analytical cross-sectional study, using the COM and DEQ-5 scales, neck pain and dry eye/Sjögren's syndrome, respectively, were measured; socio-educational variables were associated with them. **Discussion:** Of the 3939 students, those who lived in Panama, Chile and Bolivia were the ones who suffered the most from these pathologies. These pathologies were associated with the greater number of hours of computer use (all values p<0,001) and sex (all values p<0,002), medical students had more frequent dry eye and Sjögren's syndrome (both p<0,031), Graduate students had more neck pain (p<0.001), but college students had less dry eye (p=0.025) and those at private universities had more neck pain (p=0.024). **Discussion:** Important results of these three pathologies were found, this serves so that students can be evaluated in depth in each university, for a specialized diagnosis and try to avoid medium and long-term consequences for the constant use of electronic devices. **Conclusion**: Neck pain, dry eye and Sjögren's syndrome in students were associated with more hours of computer use and female sex, medical students had more frequent dry eye and Sjögren's syndrome, graduate students had more neck pain, university students had less dry eye and those from private universities had more neck pain.

Keywords: Education, Neck Pain, Dry Eye, Sjögren's Syndrome, Students.

Introduction

The pandemic generated a sudden change in education worldwide, according to UNESCO, the crisis affected about 363 million students worldwide, including 57.8 million students in higher education, in addition, a large percentage of these moved away from the classroom (1). All due to the quarantine, curfews and other social restrictions, which prevented him from going to the classrooms in person (2). In all this context, it was necessary to give an unexpected impulse to new forms of teaching. (3). Although, prior to the pandemic, some universities, schools, undergraduate and graduate programs had already opted for online learning, this never happened on such a large scale. (4, 5).

Therefore, educational institutions had to adapt quickly and, although at first, some institutions found it difficult to enter the world of online learning, after a while almost all had to resort to platforms and other virtual means for the dictation of their classes; thus opting for a comprehensive system of digital education (6, 7). This new model of education reduced the learning loss, but also generated some problems, including distraction, poor internet signal, equipment not suitable for receiving virtual classes, disinterest on the part of students, the large amount of plagiarism / copy or other bad practices in exams, among many others; which generated an incomplete learning process (8, 9).

As a result of this new form of teaching-learning, physio-ergonomic problems have been reported, due to the use of study environments that were not prepared or correctly set to receive classes virtually (10, 11). Since, the students had to have an appropriate computer, screen filters, ergonomic mice, seats that can be graduated according to the physiognomy of the student, an optimal lighting system, pauses / breaks from time to time; those that together avoid or reduce

80 health problems (11, 12). Although there were not many reports in students, previous problems
81 had already been reported in workplaces, such as body aches, backaches, dry eyes, low back pain,
82 carpal tunnel syndrome; among those who were for a long time in front of screens (12, 13).
83

84 For example, neck pain was reported between 10.4-21.3%, with a higher incidence in
85 office and computer workers, neck pain between 0.4-86.8% (mean: 23.1%); being higher in
86 women, high-income countries and urban areas (14). This situation has been little studied among
87 university students, who were exposed the first 6 months of the pandemic to this radical change,
88 especially in a population as diverse and varied as the Latin American region (15, 16). Therefore,
89 the objective of the research was to determine the factors associated with suffering from neck
90 pain, dry eye and Sjögren's syndrome in Latin American students during the first wave of COVID-
91 19.

92 **Methodology**

93 Analytical cross-sectional research was conducted. The surveyed population were
94 students from the countries of Peru, Chile, Paraguay, Mexico, Bolivia, Panama, Ecuador, Costa
95 Rica, El Salvador, and Honduras; These were recruited during the months of June, July and
96 August of the year 2020. Participants who agreed to be part of the research, who said they lived
97 in some of these countries at the precise time the respondent was conducted, were included. Fewer
98 than 300 students were excluded because they did not provide answers for the main tests (for the
99 assessment of neck pain, dry eye or Sjögren's syndrome).

100 Non-random sampling was used. The statistical power of the association of each of the
101 factors was obtained, the power was not enough for neck pain versus having technical studies
102 (3%), or university (8%), or for studying medicine (76%); likewise, an adequate power was not
103 obtained for the crossing of having dry eye or Sjögren's syndrome versus having university studies
104 (67% and 64%, respectively); Therefore, these unique crossovers should be taken with caution
105 for the discussion of results. The information was obtained, a quality control of the data was
106 carried out and statistical analysis was carried out. All this was done in a sheet of the Microsoft
107 Excel program, then the information was exported to a sheet of the Stata version 16 program
108 (licensed by the group's statistician).

109

110 **Test**
111 Non-random sampling was used. The statistical power of the association of each of the
112 factors was obtained, the power was not enough for neck pain versus having technical studies
113 (3%), or university (8%), or for studying medicine (76%); likewise, an adequate power was not
114 obtained for the crossing of having dry eye or Sjögren's syndrome versus having university studies
115 (67% and 64%, respectively); Therefore, these unique crossovers should be taken with caution
116 for the discussion of results. The information was obtained, a quality control of the data was
117 carried out and statistical analysis was carried out. All this was done in a sheet of the Microsoft
118 Excel program, then the information was exported to a sheet of the Stata version 16 program
119 (licensed by the group's statistician) (17, 18).

120

121 For the results of dry eye and Sjögren's syndrome, the DEQ-5 questionnaire was used,
122 where through 5 questions it was possible to evaluate the suffering of these two pathologies,
123 through this questionnaire that was validated in the Mexican population and in other places (19,

124 20). To obtain dry eye, one had to have a score greater than 6 and to determine that one had
125 Sjögren's syndrome a score greater than 12; This as a result of the total sum of each of the
126 questions (21).

127 In addition, the variables of the country of residence, the sex of the respondents, the age,
128 the degree of maximum education with which they had or were studying, the type of university
129 in which they were enrolled, the number of years of study they had to date, if they studied human
130 medicine, the number of hours they used the cell phone and the computer per day were counted.
131 All these variables first went through a descriptive statistical analysis, where the frequency of
132 presentation of each of the three pathologies according to the countries was obtained, with this it
133 was possible to build a first figure. Then we proceeded to construct the tables of the crosses,
134 where the crossing versus the socio-educational variables was obtained for each of the
135 pathologies; This is where the frequency and percentage for the categorical variables were
136 obtained, as well as the median and the interquartile range for the independent quantitative
137 variables (this due to their condition of non-normality, evaluated through the Shapiro-Wilk
138 statistical test).

139 Bivariate and multivariate analyses were also obtained for the crossing of each pathology
140 according to the variables, this generated with the use of generalized linear models, where the
141 Poisson family was used, the log link function, the adjustment for robust variants and by the
142 country of residence; with this, the prevalence ratios were obtained (crude for the bivariate models
143 and adjusted for the multivariate model), their 95% confidence intervals (95% CI) and their P
144 values; for a variable to move from the bivariate to the multivariate model, it had to have a $p<0.05$
145 value. At all times the significance value of 0.05 was considered and we always worked with a
146 confidence level of 95%.

147 **Ethics**

148 Ethics were always respected, surveys were anonymous, and participants were free to
149 participate or not participate in the research. The research was approved by the Bioethics
150 Committee of the Antenor Orrego Private University, with Resolution No. 0013-2022-UPAO.

151 **Results**

152 Of the 3939 students surveyed in some Latin American countries, the countries that had
153 the highest percentages of neck pain were Panama, Chile, and Peru (with ranges 20-40%), for dry
154 eye were Chile, Bolivia, and Costa Rica (with ranges 29-65%) and for dry eye, Sjögren's
155 syndrome were Chile, Bolivia and Panama (with ranges 16-35%). **Fig 1.**

156 **Figure 1.** Percentages of neck pain, dry eye and Sjögren's syndrome by country of residence
157 during the first wave of the pandemic.
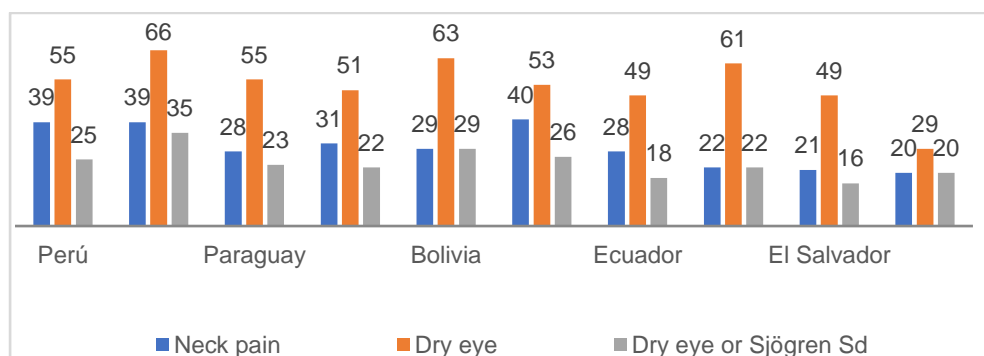
158

159 When analyzing the factors associated with neck pain, there was more frequency among those
160 with postgraduate studies (RPa: 1,75, IC95%: 1,31-2,33; value p<0,001), among those who were
161 from private universities (RPa: 1,16; IC95%: 1,02-1,33; value p=0,024) and according to the use
162 of more hours a day the computer (RPa: 1,05; IC95%: 1,04-1,05; value p<0,001), Men had less
163 frequency of neck pain (RPa: 0,67; IC95%: 0,59-0,76; value p<0,001), adjusted for year of study,
164 hours of cell phone use and country of residence. **Table 1**

165 **Tabla 1.** Descriptive and bivariate analysis of factors associated with neck pain among students
166 in Latin America in the first wave of COVID-19.

Variable	Neck pain n (%)		RPc (IC95%) value p	RPa (IC95%) value p
	No	Si		
Sex				
Woman	1139 (59,5)	776 (40,5)	Comparison category	Comparison category
Male	908 (73,2)	332 (26,8)	0,66 (0,61-0,72) <0,001	0,67 (0,59-0,76) <0,001
Age (years)*	20 (19-22)	20 (18-22)	0,97 (0,95-1,00) 0,069	did not enter the final mode
Maximum instruction				
Secondary/high school or <	616 (65,4)	326 (34,6)	Comparison category	Comparison category
Technical studies	64 (65,3)	34 (34,7)	1,00 (0,87-1,15) 0,961	1,01 (0,80-1,27) 0,931
University studies	1362 (64,8)	741 (35,2)	1,02 (0,95-1,09) 0,599	0,99 (0,92-1,05) 0,680
Studies of posgrado	11 (52,4)	10 (47,6)	1,38 (1,03-1,84) 0,030	1,75 (1,31-2,33) <0,001
Type of university				
Public or state	773 (69,3)	343 (30,7)	Comparison category	Comparison category
Private or private	1244 (62,3)	753 (37,7)	1,23 (1,06-1,43) 0,007	1,16 (1,02-1,33) 0,024
Year of studies*	2 (1-4)	2 (1-3)	0,96 (0,93-0,99) 0,012	0,98 (0,95-1,01) 0,209
Study medicine				

No	1166 (65,9)	603 (34,1)	Comparison category	did not enter the final mode
Yes	866 (63,0)	508 (37,0)	1,08 (0,90-1,31) 0,413	did not enter the final mode
Cell phone use*	8 (5-12)	9 (6-14)	1,02 (1,02-1,03) <0,001	1,00 (0,99-1,01) 0,619
Computer use*	7 (4-10)	10 (6-14)	1,05 (1,04-1,05) <0,001	1,05 (1,04-1,05) <0,001

167 *Variable taken quantitatively. Shours per day on average. The reasons for crude prevalence
168 (RPc), Adjusted (RPa), the confidence intervals at 95% (IC95%) and p-values were obtained with
169 generalized linear models (Poisson family, log link function, fit for robust variances and by
170 country of residence).

171 For factors associated with dry eye, there was more dry eye among those studying medicine (RPa:
172 1,09, IC95%: 1,01-1,17; valor p=0,030) and according to the use of more hours a day the
173 computer (RPa: 1,02; IC95%: 1,02-1,03; valor p<0,001), In contrast, there was less frequency of
174 dry eye among men (RPa: 0,76; IC95%: 0,69-0,85; valor p<0,001) and university students (RPa:
175 0,93; IC95%: 0,88-0,99; valor p=0,025); adjusted for age, hours of cell phone use and country of
176 residence. **Table 2**

177 **Table 2.** Descriptive and bivariate analysis of factors associated with dry eye among students in
178 Latin America in the first wave of COVID-19.
179

Variable	Dry eye n (%)		RPc (IC95%) Yes p	RPa (IC95%) value p
	No	**Yes**		
Sex				
Woman	811 (38,6)	1291 (61,4)	Comparison category	Comparison category
Male	747 (54,2)	632 (45,8)	0,75 (0,67-0,83) <0,001	0,76 (0,69-0,85) <0,001
Age (years)*	20 (19-22)	20 (19-22)	0,98 (0,97-0,99) 0,004	0,99 (0,97-1,01) 0,466
Maximum instruction				
Secondary/high school or <	446 (42,6)	600 (57,4)	Comparison category	Comparison category

	No	Yes	RPc (IC95%) value p	RPa (IC95%) value p
Technical studies	53 (49,5)	54 (50,5)	0,88 (0,72-1,06) 0,187	0,97 (0,82-1,16) 0,764
University studies	1048 (45,3)	1267 (54,7)	0,95 (0,92-0,99) 0,011	0,93 (0,88-0,99) 0,025
Postgraduate studies	14 (63,6)	8 (36,4)	0,63 (0,38-1,05) 0,075	0,67 (0,41-1,07) 0,095
Type of university				
Public or state	594 (47,1)	668 (52,9)	Comparison category	Did not enter the final model
Private or private	947 (43,3)	1239 (56,7)	1,07 (0,99-1,15) 0,077	Did not enter the final model
Year of studies*	2 (1-4)	2 (1-4)	1,00 (0,97-1,03) 0,769	Did not enter the final model
Study medicine				
No	930 (47,7)	1019 (52,3)	Comparison category	Comparison category
Yes	615 (40,6)	900 (59,4)	1,14 (1,06-1,22) 0,001	1,09 (1,01-1,17) 0,030
Cell phone use*	8 (5-12)	8 (5-12)	1,01 (1,00-1,02) 0,001	1,00 (0,99-1,01) 0,603
Computer use*	8 (4-10)	8 (5-12)	1,02 (1,02-1,03) <0,001	1,02 (1,02-1,03) <0,001

180 *Variable taken quantitatively. $hours per day on average. The reasons for crude prevalence
181 (RPc), Adjusted (RPa), the confidence intervals at 95% (IC95%) and p-values were obtained with
182 generalized linear models (Poisson family, log link function, fit for robust variances and by
183 country of residence).

184 There was a higher frequency of Sjögren's syndrome among those studying medicine (RPa: 1,22;
185 IC95%: 1,05-1,41; valor p=0,008) and according to the use of more hours a day the computer
186 (RPa: 1,05; IC95%: 1,04-1,07; valor p<0,001), in contrast, men had less Sjögren's syndrome
187 (RPa: 0,70; IC95%: 0,56-0,87; valor p=0,001); **Table 3**

188

189 **Table 3.** Descriptive and bivariate analysis of factors associated with Sjögren's syndrome
190 among students in Latin America in the first wave of COVID-19.

Variable	Sjögren's syndrome n (%)		RPc (IC95%) value p	RPa (IC95%) value p
	No	**Yes**		
Sex				

Woman	1492 (71,0)	610 (29,0)	Comparison category	Comparison category
Male	1116 (80,9)	263 (19,1)	0,66 (0,55-0,78) <0,001	0,70 (0,56-0,87) 0,001
Age (years)*	20 (19-22)	20 (18-22)	0,97 (0,94-1,01) 0,142	Did not enter the final model
Maximum instruction				
Secondary/ high school or <	766 (73,2)	280 (26,8)	Comparison category	Did not enter the final model
Technical studies	82 (76,6)	25 (23,4)	0,87 (0,60-1,26) 0,460	Did not enter the final model
University studies	1748 (75,5)	567 (24,5)	0,91 (0,76-1,09) 0,314	Did not enter the final model
Studies of posgrado	19 (86,4)	3 (13,6)	0,51 (0,22-1,18) 0,116	Did not enter the final model
Type of university				
Public or state	987 (78,2)	275 (21,8)	Comparison category	Comparison category
Private or private	1594 (72,9)	592 (27,1)	1,24 (1,04-1,48) 0,015	1,09 (0,93-1,28) 0,286
Year of studies*	2 (1-4)	2 (1-4)	0,97 (0,93-1,02) 0,214	Did not enter the final model
Study medicine				
No	1523 (78,1)	426 (21,9)	Comparison category	Comparison category
Yes	1066 (70,4)	449 (29,6)	1,36 (1,14-1,62) 0,001	1,22 (1,05-1,41) 0,008
Cell phone use*	8 (5-12)	9 (6-14)	1,02 (1,01-1,04) 0,002	1,00 (0,99-1,02) 0,700
Computer use*	7 (4-10)	10 (6-14)	1,05 (1,04-1,07) <0,001	1,05 (1,04-1,07) <0,001

191   *Variable taken quantitatively. Shours per day on average. The reasons for crude prevalence
192   (RPc), Adjusted (RPa), the confidence intervals at 95% (IC95%) and p-values were obtained
193   with generalized linear models (Poisson family, log link function, fit for robust variances and by
194   country of residence).

195   **Discussion**

196   The objective was to determine the factors associated with suffering from neck pain, dry
197   eye and Sjögren's syndrome in Latin American students during the first wave of COVID-19.
198   Many of the Latin American countries had to incorporate online learning into their education

199 system, which caused many alterations in the health of the student population, either at the school
200 level or at the university level.

201 Our study reported that more hours on the computer were associated with a higher
202 frequency of neck pain, dry eye and Sjögren's syndrome; students who reported dry eye used the
203 computer on average 8 hours a day, students who had neck pain and Sjögren's syndrome spent
204 more hours a day in front of the computer (10 hours average and range of 6-14 hours). This is
205 consistent with the research carried out by Espinoza, who evaluated students at the primary level
206 and reported that of the total number of students, 40% spent 3-6 hours and 62% did not use the
207 screen protector; therefore, he concluded that computer use had an impact on the visual acuity of
208 schoolchildren. (22). Another study mentions that even before receiving a virtual education, there
209 were already pathologies / ailments that were related to prolonged time in front of a computer
210 (13).

211 Neck pain was more prevalent among women (13% more compared to men), as well as
212 a higher prevalence of dry eye (15% more compared to men) and Sjögren's syndrome (10% more
213 compared to men), in a study among university students on head-neck pain and the degree of
214 disability in relation to computer use, It was reported that the female population was the most
215 affected, in addition, the statistical analysis showed a high prevalence (57% with neck pain and
216 43% with neck pain plus headache); having a relationship according to the number of hours that
217 the computer was used and the practice of sport, however, that no relationship was found between
218 headache and computer use (23). Female gender also had higher risk in Asian study (p= 0,026),
219 stating that women had more negative effects (24). This could be because hormonal changes
220 occur in women during the reproductive cycle and many students use hormonal contraceptives,
221 which could cause a variation in the lipids and proteins of the meibomian glands, which would
222 condition dry eye (25). This needs further research, because if so, women should be instructed to
223 protect themselves more carefully, which could lead to significant long-term pathologies.

224 Medical students had more frequent dry eye and Sjögren's syndrome. A fact that was also
225 demonstrated in a Peruvian study, where male medicine students between the ages of 16-23 years
226 had worse visual health, who spent more than 6 hours a day in front of the computer and more
227 than 5 hours in front of the cell phone (26). In Thailand a study was associated with studying
228 medicine or to be paramedics with Dry Eye Syndrome, which could be due to the great
229 psychological stress experienced in the pandemic (24), In addition, students diagnosed with
230 Sjögren's syndrome use the computer between 4-10 hours a day, as well as the cell phone between
231 6-14 hours; so, we can say that the greater the number of hours on the cell phone and computer
232 there is a greater probability of suffering from Sjögren's syndrome. It is known that the
233 coronavirus pandemic led people to opt for teleworking, as well as online education, allowing
234 workers and students to continue their work remotely; however, excessive use of some devices
235 can lead to visual problems (27). It is recommended to evaluate other careers, to expand this work,
236 since there was an important access to medical students, this because the main authors are doctors,
237 however, this limitation was partial, because there was also a significant number of respondents
238 from other careers, which would be a starting point for other researchers to measure these realities
239 in other areas, professions, or occupations.

240 As for the degree of instruction, graduate students had more neck pain, but high school
241 students had a higher frequency of dry eye, there may be different causes that condition this
242 pathology and affect a certain group, especially this may be related to the longer time of use of
243 the computer or cell phone, as well as, bad postures in front of these devices (27, 28). High school
244 students compared to other students of different grade/instruction reported having dry eye

245 symptoms in 45%, this unlike university students, who presented more dry eye or Sjögren's
246 syndrome; as reported in another study, where high school students reported headaches, neck pain
247 and also visual problems (29). This is related to what was reported in Saudi Arabia, where 50%
248 of the participants of students were not able to have control over their emotions, overvaluing their
249 link with cell phones, using them even before doing any other activity, which increased their
250 possibility of developing Dry Eye Syndrome and also generates a distortion of body mechanics;
251 causing muscle aches in the neck, shoulders, back and whole body (30).

252   In private universities a higher percentage of neck pain was found, although this
253 difference was only 7% with respect to those of public universities, this was statistically
254 significant when adjusted with other variables in the final model. There are still not many results
255 of this type, which find differences between the presentation of neck pain according to whether
256 they belonged to a public or private school, but if it has been reported that there are differences
257 between workers of private companies according to their time of exposure to screens, so more
258 research should be done according to the type of context in which students and even professionals
259 are, since, it is known that institutions vary in their way of providing protection mechanisms,
260 training and even the motivation to protect themselves (12, 13). There are descriptive reports that
261 show this reality in only one type of population, for example, in a private Peruvian university
262 musculoskeletal pain and postural load due to work were evidenced; being the most affected area
263 located at the cervical level (79%); with a pain time greater than 7 days, inadequate postures in
264 66% of respondents and 45% with a high risk level (31). These differences may have been
265 generated by the conditions offered by private universities, since, according to a study, it showed
266 that these institutions had good coverage and access to virtual education, in addition, to perceive
267 that their teachers were more qualified in front of information technologies (32), which would
268 facilitate the adequate teaching of virtual classes and, therefore, with less repercussions than those
269 of public universities. Future research is expected to help find more answers among these groups
270 of respondents.

271   The results found are very interesting, since they show a reality six months after the
272 beginning of the most disastrous stage for many Latin American countries during the pandemic,
273 although there are limitations that the results cannot be extrapolated to all the students, countries
274 or study centers from which the data came (this because that objective was not met, but if the
275 power to find important associations), many of the respondents were from medicine (or health
276 sciences) and could not have many other variables that could influence the presentation of these
277 pathologies (such as the use of ergonomic elements, if their university gave them training, the
278 way of using the elements, among others). Despite all the limitations, it was possible to survey
279 more than three thousand students throughout Latin America, and the vast majority of crossings
280 had a very good power, so these results can give new policies for the management of this problem,
281 which post pandemic would continue to be generated, since, wearer facing A new reality,
282 especially because many schools have incorporated virtuality as part of teaching. For this reason,
283 it is recommended that more studies be carried out on the subject, in specific populations, with
284 diverse interventions and with varied methodological designs, so that new forms of intervention
285 are available to minimize this problem among the student community and other populations that
286 present it.

287 **Conclusion**

288   For all the above, it is concluded that the three pathologies / ailments were associated
289 with the greatest number of hours of computer use and sex, medical students had more frequencies

290 of dry eye and Sjögren's syndrome, graduate students had more neck pain, but university students
291 had less dry eye and those from private universities had more neck pain.

301 **Institutional Review Board Statement:** The study was conducted under the Declaration of
302 Helsinki. This research's preparation and execution fully complied with the fundamental ethical
303 principles of autonomy, justice, beneficence, and non-maleficence. The Act Number (0013-2022-
304 UPAO), approved by the Bioethics Committee of the Universidad Privada Antenor Orrego.

305 **Data Availability Statement:** The data presented in this study are available on request from the
306 corresponding author.

310 **Conflicts of Interest:** The authors declare no conflict of interest.

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