

A pilot educational intervention for headache and concussion

The headache and arts program

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Neurology® 2018;90:e1799-e1804. doi:10.1212/WNL.0000000000005521

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Abstract

Objective

Using a science, technology, engineering, arts, and mathematics (STEAM) curriculum, we developed, piloted, and tested the Headache and Arts Program. This program seeks to increase knowledge and awareness of migraine and concussion among high school students through a visual arts–based curriculum.

Methods

We developed a 2-week Headache and Arts Program with lesson plans and art assignments for high school visual arts classes and an age-appropriate assessment to assess students' knowledge of migraine and concussion. We assessed students' knowledge through (1) the creation of artwork that depicted the experience of a migraine or concussion, (2) the conception and implementation of methods to transfer knowledge gained through the program, and (3) preassessment and postassessment results. The assessment was distributed to all students prior to the Headache and Arts Program. In a smaller sample, we distributed the assessment 3 months after the program to assess longitudinal effects. Descriptive analyses and *p* values were calculated using SPSS V.24 and Microsoft Excel.

Results

Forty-eight students participated in the research program. Students created artwork that integrated STEAM knowledge learned through the program and applied creative methods to teach others about migraine and concussion. At baseline, students' total scores averaged 67.6% correct. Total scores for the longitudinal preassessment, immediate postassessment, and delayed 3-month postassessment averaged 69.4%, 72.8%, and 80.0% correct, respectively.

Conclusion

The use of a visual arts–based curriculum may be effective for migraine and concussion education among high school students.

Migraine and concussion are highly disabling conditions that are underrecognized and undertreated.^{1,2} WHO defines migraine as the sixth most disabling condition.³ Children and adolescents experience adverse physical and mental health outcomes, hindrances on school performance, and negative effects on quality of life.⁴⁻⁶ In adolescent girls and boys, the mean prevalence of migraine is 10.5% and 7.6%, respectively, whereas in adulthood, prevalence is 18% of women and 6% of men.^{7,8} Despite its prevalence, migraine remains substantially underdiagnosed and undertreated in youths due to knowledge gaps among students and parents.⁹

Similar complications exist for concussion, as most students lack the basic awareness needed to recognize and respond to concussion injuries. Further concussion education is thus essential.¹⁰ Currently, few studies assess the effect of concussion education programs, and existing programs are generally limited to student athlete groups; no high school-based programs address migraine education.¹¹⁻¹⁴ Broader, school-based education programs have proven effective for disseminating important various health concepts.¹⁵⁻¹⁸

Using the science, technology, engineering, arts, and mathematics initiative, which integrates the traditional science, technology, engineering, and mathematics curriculum with art and design, we developed and piloted the Headache and Arts Program to increase high school students' knowledge and awareness of migraine and concussion through the visual arts. Since adolescence is a period of peak incidence for migraine and concussion relative to other age groups, we chose to target high school students. We assessed students' knowledge through (1) the creation of artwork that depicted the experience of a migraine or concussion, (2) the conception and implementation of innovative methods to transfer knowledge gained through the program, and (3) preassessment and postassessment results.

Methods

Curriculum development

In preparation for this pilot and to gauge interest, a shorter, informal version of the current curriculum was taught to 9th-grade visual art students in one school during the 2014–2015 school year. This included lessons developed and taught by an

art teacher, a presentation by a board-certified neurologist in headache medicine, and creation of artwork displayed at our Medical Center. Next, a formal curriculum was developed, including daily lesson plans, PowerPoint presentations, and an informative headache manual for art teachers (concept diagram: figure 1). Through a series of qualitative 1:1 interviews, detailed input from 3 current high school teachers and 4 high school students was obtained and incorporated into the curriculum through an iterative approach.

Assessment development

A board-certified neurologist with United Council of Neurologic Subspecialty Certification in Headache Medicine drafted an assessment designed to capture students' basic knowledge about migraine and concussion. To assess content validity, we distributed the assessment on the pediatric headache listserv of the American Headache Society. We received feedback from 5 pediatric headache specialists across the United States and adapted the assessment accordingly to ensure that we captured what they felt were the most important pieces of information and to ensure that they felt that the wording on the assessment was age-appropriate. We then conducted qualitative 1:1 interviews with 4 art teachers, 2 science teachers, and 5 high school students to ensure the use of age-appropriate vocabulary, language comprehension, and understanding of measured health concepts. Using an iterative, psychometric approach, we adapted the assessment following feedback from each student and teacher.

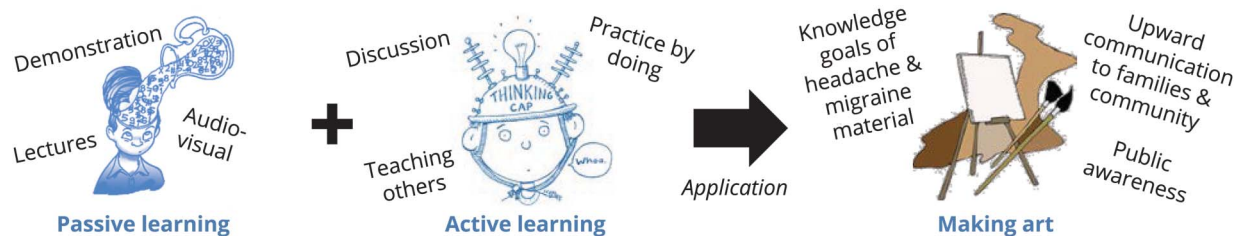
Population

Art teachers or school administrators of select New York City private schools were emailed program invitations during the 2016–2017 academic year. Public and private schools with a visual arts program and visual arts faculty were invited to participate. Upon New York City Department of Education institutional review board approval, select New York City public schools were emailed program invitations. Two private schools and 2 public schools opted to participate, including three 9th-grade classes, two 10th-grade classes, and one mixed 9th- and 10th-grade class. Two classes of 10th-grade students were used to assess the longitudinal effects of the program.

Program run

Consent and assent forms were sent home with the students in all participating art classes. Only students and parents who

Figure 1 Concept diagram



consented were involved in the research portion of the 2-week program. Publication permissions were obtained from some students. In week 1, students learned to draw a model of the brain, create textures with line patterns, and critique and research famous works of op art (optical illusion art). The neurologist taught one interactive lesson on migraine and concussion, during which students learned about the symptoms of migraine and concussion, prevention and treatment options, and the public health burden of these conditions. In week 2, all art students generated a work of op art that depicted the experience of a migraine or concussion using their own ideas synthesized from knowledge gained from the curriculum lesson. The works of art were displayed at the New York University Concussion Symposium and the New York University Neurology Research Symposium. Participating students and their families were invited to attend receptions to view the art displays.

All students were assessed through a knowledge transference project, by which they were required to teach family or community members through a mechanism of their choice. As part of the research program, students were asked to complete a cross-sectional assessment immediately before and after the program. Students at one school were also asked to complete an assessment 3 months after the program. The purpose of the assessment was to assess what students know about migraine and concussion to aid in future program development.

Outcomes

The first 2 outcomes were qualitative: artwork was required to depict the experience of a migraine or concussion and was assessed accordingly by each art teacher, and students were required to write a paragraph about their knowledge transference project in which they described their project and the success to which they were able to transfer their knowledge. Teachers assessed the assignments for completion. The third outcome was quantitative and was based on the scores on the assessments. The same assessment was delivered at each of the 3 assessment periods. Questions were grouped into 5 categories, including general concussion knowledge, concussion symptoms, general migraine knowledge, migraine symptoms, and migraine protective factors. Students were assessed on mean improvement within each category. Of note, the students were not given a sheet indicating the correct answers after each assessment period.

Data analysis

Data were analyzed using descriptive statistics in SPSS and paired 2-sample *t* tests (with $p \leq 0.05$ significant) in Microsoft Excel. We collected baseline assessment results for all schools. Preassessment and postassessment analyses were conducted for one school only due to limitations of the academic year. Results were compared for preassessment vs postassessment and postassessment vs delayed 3-month postassessment. Assessments were scored on the basis of correctness, and answers that were left blank were marked as incorrect.

Data availability

Anonymized data will be shared by request from any qualified investigator.

Results

Of all 4 participating schools, 48 students elected to enroll in the research program.

Artwork is displayed in figure 2. As part of the knowledge transference project, students developed unique methods of teaching their families, friends, classmates, local community, and the general public about migraine and concussion (table 1). One student wrote a poem that was submitted to a national poetry contest (figure 2). Another student created posts on Facebook to inform people about concussion. Posts included the following:

"Did you know: In children's cases, migraines are a problem and occur 1–2 hours shorter than in adults?"

"Did you know: One of the main causes for concussions is due to sports? Be sure to wear helmets."

"Did you know: At least one person in every 4 households suffers from migraines?"

We later sought feedback from the participating teachers. Comments included the following:

"So many parents commented on the program at parent teacher night."

"There was a ripple effect [in the excitement]. I was pleasantly surprised that there was a ripple effect."

Comments from parents included the following:

"I'm so glad that my child had the unique opportunity to be a part of this program."

"My child appreciates art so much more since completing this program."

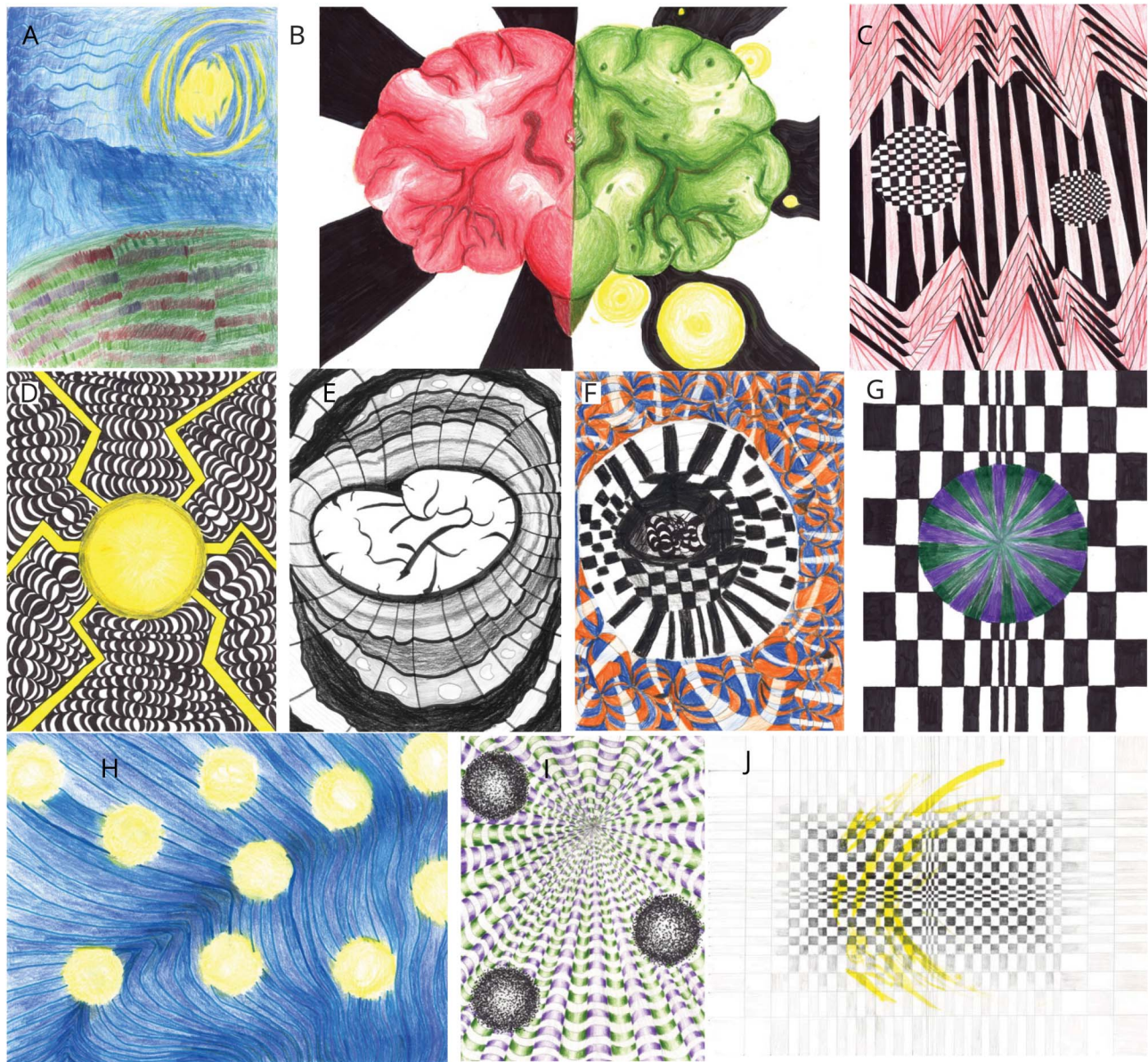
"It was such a thrill to see my child's work in the culminating exhibition."

Sixty-two percent ($n = 30$) of students completed 2 or more assessments to test their knowledge of migraine and concussion. Thirty-one percent ($n = 15$) completed one assessment. Three students did not complete any assessments. Table 2 shows a summary of assessment questions and the results by question category and format. At baseline, students' scores averaged 67.6% correct. Students' total scores for the longitudinal preassessment, immediate postassessment, and delayed postassessment averaged 69.4%, 72.8%, and 80.0% correct, respectively. These improvements generally appeared to be sustained in the group in which a 3-month postassessment was also conducted.

Discussion

The use of a visual arts-based curriculum may be an effective medium for headache and concussion education among high school students. The artwork created demonstrated

Figure 2 Student artwork from the headache and arts program



Of Mind and Heart by Ashley Milone

The perils of both mind and heart selfsame
 Most people will have felt its hellish wrath
 Source less pain brings profitless work and shame
 Over three hundred types lead to one path

Headache and Heartbreak masquerade as light
 Beware of bright Auras and fair lover
 Misleading beauties bring omens of plight
 Yet sport near halts chances to recover

Senses divert into meaningless blurts
 Reality intensifies yet blurs
 Outwardly perfect yet scarlessly hurts
 Beware the signs before it reoccurs

Beware the disasters deceive the eyes
 Beware for Headache and Heartbreak arise

Artist credits: (A) Alexander Alvarez, (B) Ashley Milone, (C) Katie Nakano, (D) Morgan Turner, (E) Steven Morris, (F) Richard Karnabi, (G) Jack Foulsham, (H) Sarah Marie Axiak, (I) Katherine Buttigieg, (J) Christian Conte.

knowledge about the brain and how perception can be affected by brain disorders such as migraine and concussion, and the transfer of knowledge assignment generated innovative ideas, thereby indicating that students spread knowledge gained from the program. Our results from this assignment show that the Headache and Arts Program

sparked conversations within families, sports teams, and friend groups, and led to public service announcements on social media (e.g., Facebook). Dissemination of the scientific knowledge about concussion and migraine enables more people to seek treatment when it may be needed. This is noteworthy given the stigma associated with concussion

Table 1 Educational outreach project

For my educational outreach project, I talked with my family and with other people that I am close with about migraines. I talked about the symptoms of it such as the headaches, sound sensitivity, light sensitivity, etc. They all were informed, and it made them rethink whether or not they had a migraines or just a headache.

For my outreach, I created a poem, sharing it with my English class in order to educate them on the problems that surround headaches and migraines as well as signs of them. In addition, I sent the poem to a poetry contest in an attempt to get it showcased to a larger audience.

I helped others learn and expand their information of migraines and headaches by talking about it to my family. During a dinner, I was talking to my parents and sister about how migraines and headaches can turn out to be small but have a larger impact. For example, I talked about how there are different kinds of migraines which can effect vision and the way we go about our everyday lives. Overall, I think that my family learned something new, which can help them understand more about migraines and headaches.

I posted a picture of me playing basketball on social media and in the caption I talked about concussions and migraines that are effects of sports. I briefly stated some of the symptoms, like seeing auras and feeling dizzy, and talked about ways to prevent it like always wearing a helmet in contact sports.

For my outreach, I went out and spoke to my family about the topics. My mother, who studied psychology and the brain for many years, was especially interested in the topic. I gave her and the rest of my family helpful information on how to prevent concussions and the effects of migraines. As an added bonus, my mother had even taught me a little about the brain to further my learning.

For the educational outreach project, I spoke with my mom and a few of my neighborhood friends. I spoke with my mom about how statistics show that there are more than double the percent of women in America that suffer from migraine compared to men. With my friends, I discussed the symptoms of migraine with aura and facts about headaches, including that about 99% of people have a headache at some point in their lives.

For the educational portion of my project, I sat my family down and spoke to them about the definition of migraine and concussion, as well as how to prevent concussions with helmets. I answered as many questions as I could to properly inform them.

For my project, I talked to my little brother and his football team about concussions. I talked about the risks of not using a helmet and the signs of a concussion. Now they know about the risks of not playing safely.

For my outreach, I told my friends about the risks of concussions in high school sports and how important it is to look out for symptoms in yourself and others. My friends all play multiple sports, so it is important for them to be able to recognize the causes, signs, and long-term effects of a concussion.

For my educational outreach project, I talked to my parents and my older brother about debilitating migraines with aura. I told them about how migraines can be much more than a temporary nuisance. Surprisingly enough, I learned that my mother used to get migraines with aura as a child.

Methods of teaching that students developed to teach their families, friends, classmates, local community, and the general public about migraine and concussion. Listed here in no particular order, the texts are not linked to an artist's name, per the students' request.

reporting among students and student-athletes for fear of consequences from athletic coaches or teachers due to the requirement for evaluation and possible removal from play or class.¹⁹⁻²¹ These data are also important given that there is concern about migraine and stigma, and because patients report decreased quality of life compared to their peers.²²⁻²⁴ Increased education and awareness among students and spread of this knowledge to their families could lead to increased diagnosis and treatment for migraine and concussion, thereby decreasing the time of onset to diagnosis for these conditions. Finally, despite our small sample size, there appeared to be improvement in knowledge based on differences in the preassessment and subsequent assessments.

A limitation of this study includes potential differences in baseline knowledge. We do not have these data available. In addition, since we administered the same assessment 3 times, there may have been testing effects, including practice effect bias and maturation bias. Therefore, some improvement may have been expected. Given academic year limitations, it is difficult to conduct a 3-month postprogram assessment within the classrooms if the program is not begun at the start of the year. Our small sample size may have limited our ability to detect additional significant findings on the assessment. However, the program has great potential given the transfer of knowledge

activities done as a result of the program and the creative works of art created by students who participated in the program.

We have several ideas for future development of the Headache and Arts Program. To increase consent and assessment-return adherence among students, new versions of the program will include a student participation-based grading scheme for teachers. Based upon input from teachers and students, the program may be adapted to different teaching styles, including flipped classroom learning, and may be expanded beyond visual arts classes. A program website will be developed that will provide resources, such as a link for teachers and students to submit input about the program. Further study is needed in other settings to verify our findings. Interestingly, there appeared to be a high rate of baseline knowledge of concussion symptoms. This could be explored further to examine how it varies among schools. To assess the full potential effect of the program, additional studies must determine whether high school students can act as effective conduits of headache and concussion education in their families and communities and whether these efforts can translate into reduced public burden of these conditions.

Author contributions

Mia Minen: study concept and design, acquisition of data, interpretation of data, critical revision of manuscript, study

Table 2 Assessment questions and the results by question category and format \leq

Question concept	Baseline preassessment (n [students] = 45) (all schools)	Longitudinal preassessment (n [students] = 21) (pre-pilot only)	Longitudinal immediate postassessment (n [students] = 21) (pre-pilot only)	Longitudinal preassessment to immediate postassessment <i>p</i> values	Longitudinal delayed 3-month postassessment (n [students] = 18) (pre-pilot only)	Longitudinal immediate postassessment to delayed 3-month postassessment <i>p</i> values
General concussion knowledge	78.6	77.6	84.9	0.00 ^a	91.0	0.31
Concussion symptoms	66.6	75.6	80.7	0.00 ^a	83.6	0.18
General migraine knowledge	74.3	62.7	66.3	0.29	72.2	0.17
Migraine symptoms	67.3	70.0	78.6	0.05 ^a	76.1	0.05 ^a
Migraine protective factors	67.7	72.7	70.0	0.62	82.3	0.02 ^a
Total	67.6	69.4	72.8	0.05^a	80.0	0.05^a

Average percent correct is denoted per assessment category and question concept.

^a $p \leq 0.05$ according to paired 2-sample *t* test.

supervision. Alexandra Boubour: study concept and design, acquisition of data, analysis and interpretation of data.

Acknowledgment

The authors thank Judith Kaplan and Rachel Meuler for help with program development; and the Pediatric Section of the American Headache Society for their members' suggestions for the program assessment.

Study funding

This study was not funded. However, Dr. Mia Minen is a recipient of the American Academy of Neurology/American Brain Foundation Practice Research Training Fellowship, which provides salary support to allow her time to conduct research. In addition, Dr. Mia Minen is part of the Empire Clinical Research Investigator Program, which provides salary support to allow her time to conduct research.

Disclosure

The authors report no disclosures relevant to the manuscript. Go to Neurology.org/N for full disclosures.

Received October 5, 2017. Accepted in final form February 26, 2018.

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Cite as: *Neurology*® 2018;90:e1799-e1804. doi:10.1212/WNL.0000000000005521

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Study question

Can a visual arts-based program be used to increase knowledge and awareness of migraine and concussion among high school students?

Summary answer

In addition to improving assessment scores, the Headache and Arts Program resulted in the creation of meaningful works of art and a variety of methods for disseminating knowledge about migraine and concussion.

What is known and what this paper adds

Despite their prevalence, migraine and concussion remain substantially under-diagnosed and under-treated in adolescents due to knowledge gaps among students, parents, and the general medical community. The artwork created by students who participated in the program portrayed the effects of migraine and concussion on the brain, and the transfer-of-knowledge assignment allowed students to generate innovative ideas for spreading the knowledge gained from the program.

Participants and setting

Two private schools and 2 public schools from New York City opted to participate in the study. This included 3 9th grade classes, 2 10th grade classes, and one mixed 9th and 10th grade class. Two classes of 10th grade students were used to assess the longitudinal effects of the program. A total of 48 students elected to participate.

Design, size, and duration

In week one, students learned to draw a model of the brain, create textures with line patterns, and critique and research famous works of optical illusion art. A neurologist taught one interactive lesson on migraine and concussion, during which students learned about the symptoms, prevention and treatment options, and the public health burden of these conditions. In week 2, the students created artwork that depicted the experience of a migraine or concussion. The artworks were displayed at the NYU Concussion Symposium/NYU Neurology Research Symposium. Through the knowledge transference project, students were required to teach what they learnt to family/friends, community members, or the general public using methods of their choice.



Main results and the role of chance

The artwork created (figure 2) demonstrated knowledge about the brain and how perception can be affected by brain disorders such as migraine and concussion. The transfer of knowledge assignments (table 1) were varied, ranging from the submission of a poem to a national poetry contest to “public service announcements” on social media (e.g., Facebook). Mean total scores on the longitudinal pre-assessment, immediate postassessment, and delayed postassessment were 69.4%, 72.8%, and 80.0%, respectively, indicating an improvement in the knowledge of migraine and concussion. These improvements generally appeared to be sustained at the three-month assessment.

Bias, confounding, and other reasons for caution

The authors did not account for potential differences in baseline knowledge.

Generalizability to other populations

This program may be adapted to other high schools throughout NYC and the country.

Study funding/potential competing interests

No funding was received for this study. Go to Neurology.org/N for full disclosures.

A draft of the short-form article was written by D. Drobish, a writer with Editage, a division of Cactus Communications. The authors of the full-length article and the journal editors edited and approved the final version.