Education Research: Online Alzheimer education for high school and college students

A randomized controlled trial

Nabeel Saif, MS, Kellyann Niotis, MD, Moises Dominguez, MD, John F. Hodes, BS, Michael Woodbury, BS, Yasmin Amini, BS, George Sadek, BA, Olivia Scheyer, BA, Emily Caesar, BA, Hollie Hristov, FNP, Newman Knowlton, MS, Paige Lee, Mark McInnis, BA, and Richard S. Isaacson, MD

Correspondence
Dr. Isaacson
rii9004@med.cornell.edu

Neurology® 2020;95:e2305-e2313. doi:10.1212/WNL.0000000000009859

Abstract

Objective

Alzheimer disease (AD) risk factors are present throughout the lifespan. This randomized controlled trial evaluated the effectiveness of various online education strategies concerning AD risk reduction and brain health in younger populations.

Method

High school and college students were recruited via social media (Facebook and Instagram) to join AlzU.org, an evidence-based education portal, and were randomized to 1 of 4 courses: highly interactive webinar lessons narrated by actor Seth Rogen (celebrity webinar) or a physician (doctor webinar), minimally interactive video lessons with Seth Rogen (celebrity video), or minimally interactive video lessons (control). Surveys were administered at baseline and postcourse. The primary outcome was change in knowledge of AD risk reduction assessed by pre vs post lesson quiz scores. Secondary outcomes included change in awareness of AD research, hopefulness about AD, interest in pursuing health care, willingness to volunteer, and likelihood of recommending AlzU.org.

Result

A total of 721 participants joined. A total of 281 (38.9%) completed the course. Among college students, quiz score improvements were greater in celebrity webinar and celebrity video vs doctor webinar and control. Among high school students, no differences were found in quiz scores. In both groups, celebrity webinar, celebrity video, and doctor webinar resulted in greater improvements in awareness that nutrition and exercise may reduce AD risk vs controls. Among college students, celebrity webinar and celebrity video group participants felt more hopeful about the future of AD and more likely to recommend AlzU.org vs doctor webinar and control participants. Among college students, celebrity webinar, celebrity video, and doctor webinar participants were more willing to volunteer for AD causes and pursue health care careers vs controls.

Conclusion

Online education involving a celebrity may be an effective strategy for educating college students about AD risk reduction strategies. Further studies are warranted in high school students.

From the Department of Neurology (N.S., K.N., M.D., G.S., H.H., M.M., R.S.I.), Weill Cornell Medicine & New York-Presbyterian, New York; Pacific Brain Health Center (J.F.H.), Pacific Neuroscience Institute, Los Angeles, CA; Harvard Medical School (M.W.), Boston, MA; Mailman School of Public Health (Y.A.), Columbia University, New York, NY; School of Law (O.S.) and College of Letters and Science (P.L.), University of California Los Angeles; Loyola School of Medicine (E.C.), Chicago, IL; and Biostatistics (N.K.), Pentara Corporation, Salt Lake City, UT.

Go to Neurology.org/N for full disclosures. Funding information and disclosures deemed relevant by the authors, if any, are provided at the end of the article.

Glossary

AD = Alzheimer disease; **MCQ** = multiple choice question.

Alzheimer disease (AD) is one of the greatest global health challenges of this century, as over 47 million people are estimated to have AD or a related dementia.[1] There has been limited progress in developing AD treatments, but modifiable risk factors continue to be identified throughout the lifespan. For example, early-life education (age <18) has been identified as one of the most significant determinants, influencing relative risk by 60%.[2] Population-attributable risk models estimate that managing such risk factors (e.g., hypertension, insulin resistance, physical inactivity) may prevent up to one-third of dementia cases, suggesting that early lifestyle changes involving diet and exercise are key components in AD risk reduction.[2] Nevertheless, studies have shown a distinct knowledge gap in college students about AD risk factors.[3] Considering this, along with the fact that 1 in 6 millennial caregivers cares for a person with dementia, it is essential to educate younger generations about AD as well as risk reduction strategies.[1]

As students grow accustomed to web-based learning, online education may be a useful method to broadly promote healthy behaviors.[4] Studies have shown that similar interventions can improve knowledge of exercise strategies and general nutrition, but an e-learning intervention specifically focused on AD and brain health has not yet been studied.[5,6]

Alzheimer's Universe (AlzU.org) is an online portal providing evidence-based educational resources on AD and multidomain strategies for risk reduction. Although a prior study demonstrated that AlzU.org improved knowledge of AD risk reduction, this study population had a mean age >65 years.[7] To evaluate the effectiveness of various e-learning formats on teaching high school and college students about AD and brain health, AlzU.org partnered with Hilarity for Charity, a nonprofit organization founded by Seth and Lauren Rogen.

Multiple studies have shown that including a celebrity can improve a health campaign's impact on the attitudes and perceptions of adolescents and young adults.[8,9] In turn, this can result in behavioral change as suggested by the theory of planned behavior, which states that an individual's attitudes, perceived behavioral control, and normative beliefs are essential factors in determining behavioral change.[10]

To build upon this prior research, the primary objective of this study was to evaluate whether the inclusion of a celebrity can enhance online learning of AD and AD risk reduction in high school and college students. The secondary aim was to compare the relative effectiveness of highly interactive webinar lessons vs minimally interactive video lessons that included a celebrity.

Methods

Participants

Between October 10, 2018, and February 28, 2019, high school and college students were recruited via social media (Facebook.com and Instagram) to join AlzU.org.[11] Posts were promoted with targeted advertising to ages 14–24 with expressed interest in "Alzheimer disease." A total of 406 users enrolled in the high school course and 315 users enrolled in the college course. Participants aged >24 were excluded from the study.

Study design

In this randomized controlled trial (ClinicalTrials.gov NCT03149380), participants were randomized to 1 of 4 lesson groups using a random number generator: (1) highly interactive webinar lessons narrated by actor Seth Rogen (celebrity webinar), (2) highly interactive webinar lessons narrated by a physician (doctor webinar), (3) minimally interactive video lessons narrated by Seth Rogen (celebrity video), or (4) minimally interactive noncelebrity/nondoctor narrated video lessons (control). Informed consent was obtained (IRB 1311014539).

Curriculum development

The course includes 3 lessons: (1) What is Alzheimer's? (2) Stages of Alzheimer's; and (3) Overview of Brain Health. Lesson content was created by a multidisciplinary team of AD health care professionals, including 4 neurologists (2 AD specialists, 2 with graduate training in medical education), 2 instructional designers, and a professional graphic designer. Each lesson (~1,500 words) was edited by a professional medical writer with experience in lay public education. Lessons were reviewed by focus groups and refined accordingly.

Lessons consisted of 2 possible formats: webinar and video. Webinar lessons were made highly interactive, capitalizing on strengths of the e-learning design software Articulate Studio. These lessons required continuous user engagement to advance through the lesson, and included various interaction styles, along with periodic intracontent quiz questions that require the user to select an answer to proceed.[12] Video lessons required substantially less interaction. Video lessons had the narrator ask intraperiodic quiz questions, but learners did not have the option to select a specific answer. Rather, there was a 5-second pause for learners to consider the options before the narrator would reveal the correct answer. Question examples are included in appendices e-1 and e-2 (links.lww.com/WNL/B129).

Control lessons consisted of time-neutral, noninteractive, noncelebrity/nondoctor video lessons that included congruent imagery and educational content. The control served as an

"active" placebo, rather than a traditional placebo, which would not include any related educational content in an effort to formally study pedagogical effects of specific lesson formats and degree of interactivity.[13]

Study procedures

Immediately after joining AlzU.org, participants were administered a precourse survey (via surveymonkey.com) to collect demographic data and baseline knowledge/beliefs regarding AD. This survey consisted of 29 questions, including 5-point Likert scales and multiple-choice and fill-in questions. After completing the survey, participants were redirected back to AlzU.org to complete the lessons in sequential order (lessons unlocked sequentially upon completion of prior module). Before and after each lesson, a quiz of 3 multiple choice questions (MCQs) was administered. After completing the 3-lesson course, a postcourse survey was administered. To improve lesson completion rates, additional email reminders were sent.

Outcomes

The primary outcome was change in knowledge of AD risk reduction strategies and brain healthy behaviors, assessed by total MCQ correct pre vs post lesson quizzes. Changes in quiz scores were compared across all 4 groups.

Secondary outcomes included (1) change in awareness of prevalent AD research findings (exercise and nutrition may reduce AD risk), (2) hopefulness about the future of AD research, (3) interest in pursuing a career in health care, (4) willingness to volunteer for AD-related causes, and (5) likelihood of recommending the course to others.

Statistical analyses

Paired *t* test procedures were used to compare pre vs post lesson quiz scores and pre vs post course outcomes. One-way analysis of variance was used to compare differences in pre vs post scores among the lesson groups. In cases where change in score differed significantly between the groups ($p < 0.05$), post hoc *t* tests were performed to assess for specific group differences.

Results

Demographic and baseline characteristics

The mean age was 21.2 years (SD 2.9) for college students and 16.4 years (SD 1.8) for high school students. Female respondents comprised 58.7% and 64.5% of the college and high school students, respectively. A majority of college students were Caucasian (58.7%), whereas high school students consisted of larger minority populations (30.8% Hispanic/Latino, 18.6% Asian/Pacific Islander, 32.0% Caucasian). See table 1 for additional information.

Mean total prelesson quiz scores were 3.7 (SD 2.3) and 4.9 (SD 2.9) of 9 for college and high school students, respectively; these did not differ among the 4 groups in college ($p = 0.67$) or high school students ($p = 0.54$). Baseline values for awareness that both nutrition and exercise may reduce AD risk did not differ among the groups in college and high school students.

Lesson completion

Of 315 college students, 109 (34.6%) completed the course/postsurvey. The completion rates were 39.5% (30 of 83), 36.6% (26 of 71), 33.3% (24 of 72), and 32.6% (29 of 89) for the celebrity video, celebrity webinar, doctor webinar, and control, respectively. No differences were found between completion rates.

Of 406 high school students, 172 (42.4%) completed the course/postsurvey. The completion rates were 47.1% (48 of 102), 44.2% (42 of 95), 41.1% (46 of 112), and 37% (36 of 97) for the celebrity video, celebrity webinar, doctor webinar, and control, respectively. No differences were found between completion rates.

Quizzes

In college students, all 4 groups scored higher on the postlesson quizzes (table 2). Difference in quiz score improvement was significant across the 4 groups ($p < 0.01$). Quiz improvements were significantly greater in the celebrity webinar and celebrity video when compared to both the control and the doctor webinar. Improvements did not differ between the doctor webinar and control (table 3).

In high school students, all 4 groups scored higher on the postlesson quizzes (table 2). No differences were found among the groups ($p = 0.24$).

Secondary endpoints

In both high school and college students, the celebrity webinar, celebrity video, and doctor webinar had greater improvements in awareness that both nutrition and exercise may reduce AD risk vs control. No differences were found among the celebrity webinar, celebrity video, and doctor webinar (table 3).

In college students, the celebrity webinar and celebrity video groups felt more hopeful about the future of AD research and were more likely to recommend the course vs both the doctor webinar and control participants. The celebrity webinar, celebrity video, and doctor webinar participants were more willing to volunteer for AD-related causes and pursue a career in health care vs controls (table 3).

Among high school students, there were no differences in hopefulness about the future of AD research ($p = 0.08$), interest in pursuing a career in health care ($p = 0.19$), willingness to volunteer for AD-related causes ($p = 0.35$), and likelihood of recommending the course ($p = 0.18$).

Discussion

To our knowledge, this is the first randomized study to investigate the effectiveness of various online educational strategies to inform college and high school students about AD risk. Although little difference was seen among the courses in high

Table 1 Baseline demographics of college and high school students

Variable	Celebrity webinar	Celebrity video	Doctor webinar	Control	Total
College	n = 26	n = 30	n = 24	n = 29	n = 109
Age, y, mean	21.3	22.0	20.7	21.1	21.3
Year of education					
Freshman	3 (11.5%)	3 (10%)	3 (12.5%)	6 (20.7%)	15 (13.8%)
Sophomore	4 (15.4%)	8 (26.7%)	5 (20.8%)	6 (20.7%)	23 (21.1%)
Junior	6 (23.1%)	6 (20%)	4 (15.4%)	7 (24.1%)	23 (21.1%)
Senior	8 (30.8%)	8 (26.7%)	5 (20.8%)	7 (24.1%)	28 (25.7%)
Other	5 (19.2%)	2 (6.7%)	5 (20.8%)	2 (6.9%)	14 (12.8%)
Sex					
Male	9 (34.6%)	14 (46.7%)	9 (37.5%)	13 (44.8%)	45 (41.3%)
Female	17 (65.4%)	16 (53.3%)	15 (62.5%)	16 (55.2%)	64 (58.7%)
Race					
Caucasian	14 (53.8%)	19 (63.3%)	15 (62.5%)	16 (55.2%)	64 (58.7%)
Hispanic/Latino	4 (15.4%)	1 (3.3%)	3 (12.5%)	3 (10.3%)	11 (10.1%)
African American	4 (15.4%)	3 (10%)	1 (4.2%)	3 (10.3%)	11 (10.1%)
Asian/Pacific Islander	2 (7.7%)	2 (6.7%)	2 (8.3%)	2 (6.9%)	8 (7.3%)
Middle Eastern			1 (4.2%)	2 (6.9%)	3 (2.8%)
Native American		2 (6.7%)			2 (1.8%)
Other/mixed	2 (7.7%)	2 (6.7%)		2 (6.9%)	6 (5.5%)
No response		1 (3.3%)	2 (8.3%)	1 (3.4%)	4 (3.7%)
Relation to AD					
Grandchild of person with AD	11 (42.3%)	11 (36.7%)	7 (29.2%)	10 (34.4%)	39 (35.8%)
Child of person with AD		2 (6.7%)	1 (4.2%)	2 (6.9%)	5 (4.6%)
Other relative with AD	4 (15.4%)	4 (13.3%)	8 (33.3%)	5 (17.2%)	21 (19.2%)
No personal connection	10 (38.5%)	12 (40%)	8 (33.3%)	12 (41.4%)	42 (38.5%)
No response	1 (3.8%)	1 (3.3%)			2 (1.8%)
Referral to AlzU					
Instagram	14 (53.8%)	10 (33.3%)	9 (37.5%)	9 (31.0%)	42 (38.5%)
Facebook	3 (11.5%)	11 (36.7%)	7 (29.2%)	12 (41.4%)	33 (30.2%)
Twitter				1 (3.4%)	1 (0.9%)
Email	2 (7.7%)	1 (3.3%)	1 (4.2%)	3 (10.3%)	7 (6.4%)
TV	1 (3.8%)		1 (4.2%)		2 (1.8%)
YouTube	1 (3.8%)	2 (6.7%)		1 (3.4%)	4 (3.7%)
***Parade* magazine**					
Newspaper					
Lecture		2 (6.7%)			2 (1.8%)
Website	2 (7.7%)	1 (3.3%)	2 (8.3%)	1 (3.4%)	6 (5.5%)
No response	3 (11.5%)	3 (10%)	4 (15.4%)	2 (6.9%)	12 (11.0%)

Continued

Table 1 Baseline demographics of college and high school students *(continued)*

Variable	Celebrity webinar	Celebrity video	Doctor webinar	Control	Total
High school	n = 42	n = 48	n = 46	n = 36	n = 172
Age, y, mean	16.2	16.7	16.1	16.5	16.4
Year of education					
Freshman	4 (9.5%)	11 (22.9%)	12 (26.1%)	3 (8.3%)	30 (17.4%)
Sophomore	6 (14.3%)		2 (4.3%)	1 (2.8%)	9 (5.2%)
Junior	16 (38.1%)	17 (40.5%)	20 (43.5%)	11 (30.6%)	64 (37.2%)
Senior	16 (38.1%)	17 (40.5%)	12 (26.1%)	19 (52.8%)	64 (37.2%)
No response		3 (6.3%)		2 (5.6%)	5 (29.1%)
Sex					
Male	19 (45.2%)	14 (29.2%)	18 (39.1%)	10 (27.8%)	61 (35.5%)
Female	23 (54.8%)	34 (70.9%)	28 (60.1%)	26 (72.2%)	111 (64.5%)
Race					
Caucasian	13 (30.9%)	17 (40.5%)	15 (32.6%)	10 (27.8%)	55 (32.0%)
Hispanic/Latino	16 (38.1%)	12 (25.0%)	14 (30.4%)	11 (30.6%)	53 (30.8%)
African American	2 (4.8%)	1 (2.1%)	2 (4.3%)	2 (5.6%)	7 (4.1%)
Asian/Pacific Islander	5 (11.9%)	8 (16.7%)	9 (19.6%)	10 (27.8%)	32 (18.6%)
Middle Eastern/Arabic	2 (4.8%)	2 (4.2%)			4 (2.3%)
Native American					
Other/mixed	4 (9.5%)	4 (8.3%)	5 (10.9%)	3 (8.3%)	16 (9.3%)
No response		2 (4.2%)	1 (2.2%)		3 (1.7%)
Relation to AD					
Grandchild of person with AD	12 (28.6%)	10 (20.8%)	6 (13.0%)	4 (11.1%)	32 (18.6%)
Child of person with AD					
Other relative with AD	5 (11.9%)	5 (10.4%)	13 (28.2%)	2 (5.6%)	25 (14.5%)
No personal connection	24 (57.1%)	31 (64.6%)	25 (54.3%)	30 (83.3%)	110 (63.9%)
No response	1 (2.4%)	2 (4.2%)	2 (4.3%)		5 (29.1%)
Referral to AlzU					
Instagram	18 (42.9%)	14 (29.2%)	18 (39.1%)	12 (33.3%)	62 (36.0%)
Facebook	9 (21.4%)	8 (16.7%)	6 (13.0%)	8 (22.2%)	31 (18.1%)
Twitter	1 (2.4%)	1 (2.1%)			2 (1.2%)
Email	2 (4.8%)	3 (6.3%)	4 (8.7%)	3 (8.3%)	12 (6.9%)
TV		3 (6.3%)			3 (1.7%)
YouTube		1 (2.1%)	1 (2.2%)	1 (2.8%)	3 (1.7%)
***Parade* magazine**					
Newspaper		1 (2.1%)			1 (0.6%)
Lecture	8 (19.0%)	13 (27.1%)	13 (28.2%)	10 (27.8%)	44 (25.6%)
Website	2 (4.8%)	4 (8.3%)	1 (2.2%)		7 (4.1%)
No response	2 (4.8%)		3 (6.5%)	2 (5.6%)	7 (4.1%)

Abbreviation: AD = Alzheimer disease.
Values are n (%) unless noted otherwise.

Table 2 Change in quiz performance in college and high school users

Measure	Celebrity webinar	Celebrity video	Doctor webinar	Control
College	n = 26	n = 30	n = 24	n = 29
Prelesson quiz total score (SD)	3.54 (2.61)	3.37 (2.88)	3.92 (3.36)	4.24 (2.83)
Postlesson quiz total (SD)	7.12 (0.82)	7.23 (1.28)	5.79 (3.09)	5.66 (2.58)
Change in score (95% CI)	3.58 (2.43–4.73)	3.87 (2.61–5.13)	1.88 (0.68–3.07)	1.41 (0.78–2.04)
***p* Value**	<0.01	<0.01	<0.01	<0.01
High school	n = 42	n = 48	n = 46	n = 36
Prelesson quiz total score (SD)	4.62 (2.46)	5.29 (2.62)	4.80 (2.09)	5.03 (1.89)
Postlesson quiz total (SD)	6.12 (1.92)	6.48 (1.57)	6.46 (1.57)	5.78 (1.66)
Change in score (95% CI)	1.50 (0.77–2.23)	1.19 (0.51–1.86)	1.65 (0.99–2.31)	0.75 (0.33–1.17)
***p* Value**	<0.01	<0.01	<0.01	<0.01

Abbreviation: CI = confidence interval.

school students, we found that college students saw greater improvements across multiple outcomes when the courses involved a celebrity. Ultimately, this study builds upon the growing body of evidence demonstrating that e-learning may be effective for education focused on general nutrition and exercise in younger populations, and particularly college students.

The celebrity video was more effective than the doctor webinar across multiple outcomes in college students, suggesting that celebrity voiceovers may enhance online learning formats greater than increasing lesson interactivity in this group. However, this result was not found in in high school students, suggesting that this effect may depend on various factors, such as familiarity with the celebrity among target audiences.[14] Future studies are warranted to further understand these factors in an attempt to develop online education better suited for high school age students.

The overall baseline scores for the college and high school students are noteworthy. A prior study found that only ~35% of college students correctly answered questions regarding AD risk factors.[3] This gap in initial knowledge was also found in our study population, as the mean baseline scores for college (mean, 3.76; SD, 2.87) and high school students (mean, 4.94; SD, 2.30) were considerably low—this further demonstrates the importance of educating younger populations about AD and risk reduction, as there exists a distinct knowledge gap in this topic.

Our study has several limitations. AlzU.org offers 6 different courses (e.g., for physicians, medical students, etc.) While safeguards were in place to ensure users signed up for the correct course during the enrollment process, it is possible that the study populations did not include only currently enrolled high school and college students, and this may bias the results. Furthermore, study recruitment, as well as the entirety of study participation, was conducted online and may serve as a potential source of selection bias. While high school and college students may be more likely to have access to online platforms, this study is limited in its potential exclusion of participants who lack routine computer access or experience.

The course completion rates serve as another limitation, as 34.6% of college students and 42.4% of high school students completed the course. These participants may have been more motivated to complete the course than the general population, and may introduce bias to our results.

While the primary outcome was difference in pre vs post quiz scores, all demographics and secondary outcomes were collected via self-reported online surveys and are subject to reporting bias. Nevertheless, all such outcomes were compared against the control group in an attempt to mitigate this potential bias.

Given the overall postlesson quiz performances in both college (mean, 6.49; SD, 2.32) and high school (mean, 6.24; SD, 1.69), quiz difficulty may serve as a potential limitation. These questions were written by a team of health care professionals with prior experience in medical education, and were beta-tested in high school and college students. Nevertheless, these relatively low postlesson scores may suggest a degree of difficulty higher than we wished to achieve. Finally, given that completed lessons were followed immediately by the post-quizzes, it is not yet clear whether the beneficial effects and knowledge gained by joining AlzU.org will persist with time. Future studies should examine the long-term effect of online education programs to better understand their effectiveness.

Our study suggests that online education involving a celebrity can be a useful strategy to educate younger populations about AD and risk reduction. As several studies have found that morphologic AD-related changes begin in the brain decades

Table 3 Comparison of lesson groups within college and high school students

	College students		High school students	
Between-group comparisons	**Estimated difference (95% confidence interval)**	***p* Value**	**Estimated difference (95% confidence interval)**	***p* Value**
Change in pre vs post quiz scores				
Celebrity webinar vs control	2.17 (0.87 to 3.46)	<0.01	TNP	TNP
Celebrity video vs control	2.46 (1.06 to 3.85)	<0.01	TNP	TNP
Doctor webinar vs control	0.465 (−0.87 to 1.80)	0.49	TNP	TNP
Celebrity webinar vs celebrity video	−0.29 (−1.95 to 1.38)	0.73	TNP	TNP
Celebrity webinar vs doctor webinar	1.70 (0.09 to 3.31)	<0.01	TNP	TNP
Celebrity video vs doctor webinar	2.00 (0.30 to 3.70)	0.02	TNP	TNP
"There are studies that prove exercise may reduce AD risk"				
Celebrity webinar vs control	1.44 (0.97 to 1.91)	<0.01	0.66 (0.14 to 1.18)	<0.01
Celebrity video vs control	1.525 (1.03 to 2.02)	<0.01	0.71 (0.24 to 1.18)	<0.01
Doctor webinar vs control	0.88 (0.3 to 1.46)	<0.01	0.81 (0.35 to 1.27)	<0.01
Celebrity webinar vs celebrity video	−0.085 (−0.65 to 0.48)	0.76	−0.045 (−0.51 to 0.42)	0.50
Celebrity webinar vs doctor webinar	0.555 (−0.08 to 1.19)	0.08	−0.145 (−0.6 to 0.31)	0.44
Celebrity video vs doctor webinar	0.645 (−0.01 to 1.3)	0.06	−0.1 (−0.49 to 0.29)	0.89
"Studies have shown that diet may help with AD and memory loss"				
Celebrity webinar vs control	1.375 (0.88 to 1.87)	<0.01	0.51 (−0.02 to 1.04)	0.01
Celebrity video vs control	1.225 (0.7 to 1.75)	<0.01	0.675 (0.19 to 1.16)	<0.01
Doctor webinar vs control	0.82 (0.26 to 1.38)	<0.01	0.705 (0.2 to 1.21)	<0.01
Celebrity webinar vs celebrity video	0.155 (−0.47 to 0.78)	0.63	−0.165 (−0.65 to 0.32)	0.84
Celebrity webinar vs doctor webinar	0.555 (−0.1 to 1.21)	0.10	−0.19 (−0.69 to 0.31)	0.52
Celebrity video vs doctor webinar	0.4 (−0.27 to 1.07)	0.24	−0.03 (−0.48 to 0.42)	0.62
Hopeful about the future of AD research				
Celebrity webinar vs control	1.26 (0.73 to 1.79)	<0.01	TNP	TNP
Celebrity video vs control	1.125 (0.58 to 1.67)	<0.01	TNP	TNP
Doctor webinar vs control	0.475 (−0.21 to 1.16)	0.17	TNP	TNP
Celebrity webinar vs celebrity video	0.14 (−0.16 to 0.44)	0.36	TNP	TNP
Celebrity webinar vs doctor webinar	0.785 (0.25 to 1.32)	<0.01	TNP	TNP
Celebrity video vs doctor webinar	0.65 (0.1 to 1.2)	0.02	TNP	TNP
"I am likely to pursue a career in health care"				
Celebrity webinar vs control	0.955 (0.47 to 1.44)	<0.01	TNP	TNP
Celebrity video vs control	0.98 (0.52 to 1.44)	<0.01	TNP	TNP
Doctor webinar vs control	0.515 (−0.07 to 1.1)	0.09	TNP	TNP
Celebrity webinar vs celebrity video	−0.025 (−0.36 to 0.31)	0.87	TNP	TNP
Celebrity webinar vs doctor webinar	0.24 (−0.46 to 0.94)	0.8	TNP	TNP
Celebrity video vs doctor webinar	0.465 (−0.007 to 0.94)	0.04	TNP	TNP

Continued

Table 3 Comparison of lesson groups within college and high school students *(continued)*

Between-group comparisons	College students		High school students	
	Estimated difference (95% confidence interval)	*p* Value	Estimated difference (95% confidence interval)	*p* Value
"I am likely to promote awareness and raise money for AD"				
Celebrity webinar vs control	1.12 (0.49 to 1.75)	<0.01	TNP	TNP
Celebrity video vs control	0.98 (0.43 to 1.53)	<0.01	TNP	TNP
Doctor webinar vs control	0.525 (−0.17 to 1.22)	0.14	TNP	TNP
Celebrity webinar vs celebrity video	0.14 (−0.44 to 0.72)	0.63	TNP	TNP
Celebrity webinar vs doctor webinar	0.6 (−0.12 to 1.32)	0.10	TNP	TNP
Celebrity video vs doctor webinar	0.46 (−0.19 to 1.11)	0.16	TNP	TNP
"I plan to recommend the course to family & friends"				
Celebrity webinar vs control	−0.38 (−0.57 to −0.19)	<0.01	TNP	TNP
Celebrity video vs control	−0.315 (−0.52 to −0.11)	<0.01	TNP	TNP
Doctor webinar vs control	−0.05 (−0.32 to 0.22)	0.74	TNP	TNP
Celebrity webinar vs celebrity video	−0.065 (−0.16 to 0.03)	0.16	TNP	TNP
Celebrity webinar vs doctor webinar	−0.335 (−0.54 to −0.13)	<0.01	TNP	TNP
Celebrity video vs doctor webinar	−0.27 (−0.49 to −0.05)	0.02	TNP	TNP

Abbreviations: AD = Alzheimer disease; TNP = test not performed.
One-way analysis of variance (ANOVA) was used to compare differences pre vs post among the lesson groups. In cases where change in score differed significantly between the groups ($p < 0.05$), post hoc *t* tests were performed to assess for specific group differences. Outcomes that did not have significant differences found via ANOVA have post hoc *t* test values reported as TNP.

before onset of neurodegenerative symptoms, it is essential to educate high school and college students on brain-healthy lifestyles that may reduce AD risk.[1]

Study funding

This research was funded by philanthropic support by Hilarity for Charity; proceeds from the Annual Memories for Mary fundraiser organized by David Twardock; Zuckerman Family Foundation; Women's Alzheimer's Movement; contributions from patients of the Alzheimer's Prevention Clinic, Weill Cornell Memory Disorders Program; and grant funding by the Weill Cornell Medicine Clinical and Translational Science Center (NIH/NCATS #UL1TR002384).

Disclosure

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

Appendix Authors

Name	Location	Contribution
Nabeel Saif, MS	Weill Cornell Medicine, New York	Study design, data collection, drafting of the manuscript, data interpretation

Appendix *(continued)*

Name	Location	Contribution
Kellyann Niotis, MD	Weill Cornell Medicine, New York	Study design, data collection, data interpretation, critical revision of the manuscript
Moises Dominguez, MD	Weill Cornell Medicine, New York	Study design, data interpretation, critical revision of the manuscript
John F. Hodes	Pacific Neuroscience Institute, Los Angeles	Data interpretation and revision of the manuscript
Michael Woodbury	Harvard Medical School, Boston	Data interpretation and revision of the manuscript
Yasmin Amini	Columbia University, New York	Data interpretation and revision of the manuscript
George Sadek, BA	Weill Cornell Medicine, New York	Revision of the manuscript
Olivia Scheyer, BA	School of Law, University of California Los Angeles, Los Angeles	Data collection and measurement of the sample
Emily Caesar, BA	Loyola School of Medicine, Chicago	Data collection and measurement of the sample
Hollie Hristov, FNP	Weill Cornell Medicine, New York	Revision of the manuscript

Appendix *(continued)*

Name	Location	Contribution
Newman Knowlton, MS	Biostatistics, Pentara Corporation, Salt Lake City	Statistical analyses
Paige Lee	University of California Los Angeles, Los Angeles	Revision of the manuscript
Mark McInnis, BA	Weill Cornell Medicine, New York	Study design and measurement of the sample
Richard Isaacson, MD	Weill Cornell Medicine, New York	Study design, data collection, data interpretation, drafting, revision of the manuscript

References

1. 2019 Alzheimer's disease facts and figures. Alzheimers Demen 2019;15:321–387.
2. Livingston G, Sommerlad A, Orgeta V, et al. Dementia prevention, intervention, and care. Lancet 2017;390:2673–2734.
3. Eshbaugh EM. Gaps in Alzheimer's knowledge among college students. Educ Gerontol 2014;40:655–665.
4. Escoffery C, Miner KR, Adame DD, Butler S, McCormick L, Mendell E. Internet use for health information among college students. J Am Coll Health 2005;53:183–188.
5. Suminski RR, Petosa R. Web-assisted instruction for changing social cognitive variables related to physical activity. J Am Coll Health 2006;54:219–226.
6. LaChausse RG. My student body: effects of an internet-based prevention program to decrease obesity among college students. J Am Coll Health 2012;60:324–330.
7. Isaacson RS, Haynes N, Seifan A, et al. Alzheimer's prevention education: if we build it, will they come? J Prev Alzheimers Dis 2014;1:91–98.
8. Newcomb MD, Antoine Mercurio C, Wollard CA. Rock stars in anti-drug-abuse commercials: an experimental study of adolescents' reactions. J Appl Soc Psychol 2000;30:1160–1185.
9. Keys TR, Morant KM, Stroman CA. Black youth's personal involvement in the HIV/AIDS issue: does the public service announcement still work? J Health Commun 2009;14:189–202.
10. de Leeuw A, Valois P, Ajzen I, Schmidt P. Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: implications for educational interventions. J Environ Psychol 2015;42:128–138.
11. Isaacson RS, Seifan A, Haddox CL, et al. Using social media to disseminate education about Alzheimer's prevention & treatment: a pilot study on Alzheimer's Universe. J Commun Healthc 2018;11:106–113.
12. Larsen DP, Butler AC, Aung WY, Corboy JR, Friedman DI, Sperling MR. The effects of test-enhanced learning on long-term retention in AAN annual meeting courses. Neurology 2015;84:748–754.
13. Kanner RM, Alcauskas M. Is the medium the message, or is more better? Neurology 2011;76:115–116.
14. Hoffman SJ, Mansoor Y, Natt N, et al. Celebrities' impact on health-related knowledge, attitudes, behaviors, and status outcomes: protocol for a systematic review, meta-analysis, and meta-regression analysis. Syst Rev 2017;6:13.