



Original article

Impact of a Neuroscience-Based Health Education Course on High School Students' Health Knowledge, Beliefs, and Behaviors

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A B S T R A C T

Purpose: The purpose of this pilot study was to evaluate the potential of an innovative high school neuroscience-based health course for implementation feasibility and impact on student outcomes.

Methods: Thirteen teachers from two high schools participated in this quasi-experimental pilot study including 395 students (202 in the intervention classes and 193 in the comparison classes). Students completed pre/post online surveys assessing their knowledge, beliefs, and behaviors. Our analysis strategy for multi-item measures was to estimate the effects of the intervention on latent change scores in structural equation models.

Results: Students in the neuroscience health classes showed a significant increase in neuroscience knowledge as compared to students in the comparison group (difference estimate in proportion correct metric, adjusted for covariates = .04; 95% confidence interval [.01, .06]). However, none of the other primary outcomes showed a significant difference between conditions. Teachers in the intervention group were observed implementing the neuroscience and health components more often than the self-regulation and growth mindset components. Students in the neuroscience group were more likely to mention the importance of caring for their brain and its link to health behaviors.

Conclusions: Findings demonstrate that information about the link between health behaviors and brain functioning can be successfully integrated into a high school health education course, although effects on student health beliefs and behaviors were not observed. Additional development work should focus on clarifying the theoretical mechanisms of change, integrating the neuroscience content with self-regulation and growth mindset, and providing additional professional development for teachers.

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**IMPLICATIONS AND
 CONTRIBUTION**

This pilot study demonstrated the feasibility of integrating information about the link between health behaviors and brain functioning into a high school course, although additional development work is needed to realize the potential of this approach with regard to student outcomes. Such work should consider additional professional development for teachers and stronger methods to help students apply knowledge to their health decision-making and behaviors. A thorough examination of recent developments in theoretical models for adolescent health decision-making processes may be helpful in strengthening the curriculum

Conflicts of interest: The authors have no conflicts of interest to disclose. During the implementation of this study.

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Recent advances in developmental neuroscience hold potential for strengthening health education programs for youth. Studies have demonstrated the link between brain functioning and health behaviors such as sleep [1], exercise [2], healthy eating [3], and stress [4]. However, high school health education courses rarely focus on the link between health behaviors and the brain, and research in this area is limited. This is a missed opportunity since adolescence is a unique developmental period for both the promotion of healthy behaviors and prevention of risky behaviors [6,7]. Adolescents are beginning to exert control over their own health decisions, in both positive and negative ways. For example, the mean age at first use for many illegal drugs, alcohol, and cigarettes is during the teen years [8]. Adolescents are also adopting lifelong health-promoting behaviors such as regular physical activity and healthy eating [9].

Developmental neuroscience also provides a framework for thinking about how adolescents make decisions about their health behaviors. Steinberg argues that adolescent risk-taking depends on both logical reasoning and psychosocial capacities [10]. The adolescent brain is especially sensitive to social and emotional conditions related to processing information about rewards [10]. In addition, cognitive-control abilities continue to develop throughout adolescence including executive function abilities such as planning and self-regulation [10] and may be leveraged to support healthy decision-making.

While earlier models of risk-taking suggested that interventions should focus on getting adolescents to simply avoid all risks given their less well-developed prefrontal cortex (e.g., *Just Say No*), current developmental models also focus on adopting healthy behaviors. One such curriculum that integrates neuroscience and the promotion of positive health behaviors is the National Institute of Health curriculum called *The Brain: Understanding Neurobiology through the Study of Addiction* [5]. Researchers compared student outcomes for the five-lesson brain curriculum in two urban high

schools, one that received the new curriculum and one that received the usual curriculum. An evaluation of the program found it to be a promising strategy for preventing substance use among adolescents, particularly for cigarette and marijuana use, although all differences between the groups were extinguished by the follow-up 6–8 months post intervention. The small sample and brief program suggest need for further research on this approach.

Capitalizing on recent research that links brain functioning and health behaviors and building on the extensive literature supporting social-cognitive approaches to behavior change, we developed a neuroscience-based health education class. This course is centered on an emerging new field of health neuroscience [11, p. 447] that aims to “characterize the bidirectional and dynamic brain-behavior and brain-physiology relationships that are the determinants, markers, and consequences of physical health states.” This approach is consistent with calls for applied research that examines the impact of developmental neuroscience in school-based prevention programs [12]. However, new programs also need careful evaluation to ensure that they can be implemented by school staff, and so that any limitations can be identified and addressed before large-scale dissemination.

The present study

Our study objectives were to assess the feasibility of integrating neuroscience into high school health education and to evaluate the promise of a neuroscience-based health course as compared to the standard health education course for a range of student outcomes using a quasi-experimental design. Primary outcomes focus on students' awareness of the links between health behaviors and the brain, core neuroscience knowledge, growth mindset, self-monitoring and self-control, and self-efficacy for academic planning and academic focus. Secondary outcomes examined include beliefs about the impacts of positive health behaviors and

Table 1
Teacher and student demographics

		Comparison	Neuroscience	Total/average
Teachers n		7	6	13
	Gender n (%)			
	Male	6 (85.7)	4 (66.7)	10
	Female	1 (14.3)	2 (33.3)	3
	Race/Eth n (%)			
	Afr-Amer	1 (14.3)	0 (0)	1
	White	6 (85.7)	6 (100)	12
	Yrs exp in educ M (SD)	10.3 (4.9)	16.2 (7.9)	13 (6.9)
Students n		193	202	395
Student-reported variables				
	Gender n (%)			
	Male	109 (56.5)	92 (45.5)	201 (51)*
	Female	84 (43.5)	110 (54.5)	194 (49)
	Grade n (%)			
	Ninth graders	171 (89)	188 (93)	359 (91)
	Age in months M (SD)	175.5	175.2	175.4
	Race/ethnicity n (%)			
	Latino	27 (14)	35 (17)	62 (16)*
	Afr-Amer	33 (17)	55 (27)	88 (22)
	White	115 (60)	87 (43)	225 (57)
	Other	18 (9)	25 (12)	43 (11)
	Days of curr prior to pretest	2	2.7	2.3*
District-reported variables				
	Weighted GPA M (SD)	3.32	3.28	3.3
	Days absent M (SD)	2.57	2.78	2.7
	Students with disabilities n (%)	16 (8)	13 (6)	29 (7)
	Free or reduced lunch n (%)	47 (24)	54 (27)	101 (26)
	Limited Eng proficiency n (%)	6 (3)	12 (6)	18 (5)

* t test or chi square ($p < .05$).

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