The University of Vermont Wellness Environment

Feasibility and Initial Results of a College Undergraduate Health-Promoting Program

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KEYWORDS

• Audit • DAST-10 • PHQ-9 • College students • Wellness • Behavior change • Substance use

KEY POINTS

- The University of Vermont Wellness Environment is a neuroscience-inspired, incentive-based behavioral change program developed to promote well-being and prevent negative outcomes in college age students.
- It is feasible to collect high-quality data including daily surveys on college students in this program related to key outcomes, including drug and alcohol use, health-promoting behaviors, academic performance, and continued enrollment/retention.
- Over the course of an academic year, participation in both periodic and daily surveys were high, suggesting a full evaluation of the Wellness Environment program is a reasonable goal.
- According to institutional data provided by the University of Vermont Student Affairs, students living in the Wellness Environment residential hall during the 2017 to 2018 academic year had 81% fewer alcohol/drug incidents and 46% fewer student conduct violations than students living in typical residence halls.

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Abbreviations	
ASR	adult self report
AUDIT	alcohol use disorders identification test
CIT	comprehensive inventory of thriving
DAST-10	drug abuse screening test
GPA	grade point average
MAAS	mindfulness attention awareness scale'
PHQ-9	patient health questionnaire
UVM WE	university of vermont wellness environment
WE APP	UVM WE mobile application

INTRODUCTION

The development of the adolescent brain has been the focus of a great deal of recent scientific inquiry. A number of scholars have drawn attention to the fact that the transitional age (teenage years to 25 years of age) brain may undergo a second critical period of development.[1] The neuroscience behind this idea is often called the developmental mismatch of adolescence.[2,3] The transitional age brain is undergoing a critical period of organization during which early maturation of subcortical regions (eg, amygdala, nucleus accumbens) are mismatched with still-developing regulatory prefrontal cortical regions.[1] At the same time, that transition-aged youth and their maturing brains need more external regulatory support and lower risk environments, they are often leaving home and entering college, where they have easier access to alcohol and drugs, high-risk social activities, and loss of close parenting and supervision. In contrast with the insufficient scaffolding that characterizes a stereotypical undergraduate experience, the University of Vermont Wellness Environment (UVM WE) program offers a neuroscience inspired, incentive-based behavioral change system designed to increase health-promoting behaviors and decrease substance misuse and abuse, as well as emotional and behavioral problems among transitional age college students with an overarching goal of improving academic performance and seeding life-long healthy habits.

In many ways, the developmental mismatch between cortical and subcortical structures and the pressures of the modern world on developing brains combine to create a perfect storm for negative health outcomes. For instance, national data suggest that adolescence and young adulthood are the developmental periods of greatest risk for developing substance abuse behaviors as well as a broad range of other high-risk behaviors, including criminality and risky sexual behavior.[4–6] These problems often contribute to a wide array of maladaptive behaviors, such as poor school performance, high rates of alcohol and other substance abuse, school dropout, property damage, physical and sexual assault, accidental injury, and suicidal behavior.[7–9] With all of these factors in play, it is not surprising that many teenagers and young adults suffer so mightily when they go to college. Findings from longitudinal studies of changes in the brain structure from childhood to adolescence and throughout the transitional years[10–12] indicate that neurodevelopmental processes, including pruning and increasing specialization, underlie the exquisite sensitivity of the transitional age brain to environmental influences. On one hand, the plasticity—and resulting resilience—of the transitional age brain provide a sensitive period during which the positive effects of health-promoting environmental influences are amplified. On the other hand, the same plasticity makes transitional age brains especially susceptible to harmful

environmental influences. For instance, 5-year graduation rates for undergraduate students hover around 50%, and more than 1 million college students suffer from the sequelae of alcohol and other drug use. Therefore, it is imperative that new models of health promotion and illness prevention be developed for young brains in college.[13]

In response to this challenge, one of the authors (J.H.) designed, developed, implemented, and tested a neuroscience-inspired, incentivized behavioral change program at the UVM called the WE.[13] The goal was relatively straightforward: design a model college experience based on what is known about transitional age brain development, the negative impact of high-risk behaviors in a high-risk environment (eg, free of parental supervision and guidance), and emerging behavioral change and neuroimaging research. By improving decision making; providing knowledge, skills, and attitudes about the impact of one's choices on brain health; and using the power of choosing to engage in health-promoting activities over risky behaviors, the UVM WE program is hypothesized to improve health and academic outcomes by incentivizing behaviors that promote positive brain health and decrease normative risk for alcohol and drug use in college students.

THE UNIVERSITY OF VERMONT WELLNESS ENVIRONMENT DESIGN

The UVM WE program is rooted in the developmental neuroscience literature and rests on 4 pillars: physical fitness, nutrition, mindfulness, and interpersonal relationships (**Fig. 1**). Activities consistent with each pillar are implemented at 3 interrelated levels: didactic, residential, and app-based incentivized participation, guidance, and tracking in health-promoting activities.

The cornerstone of the didactic level of the UVM WE program is the course Healthy Brains, Healthy Bodies: Surviving and Thriving in College, in which students are taught the impact of specific behaviors on genomic (epi) and brain health (neuroplasticity) in a

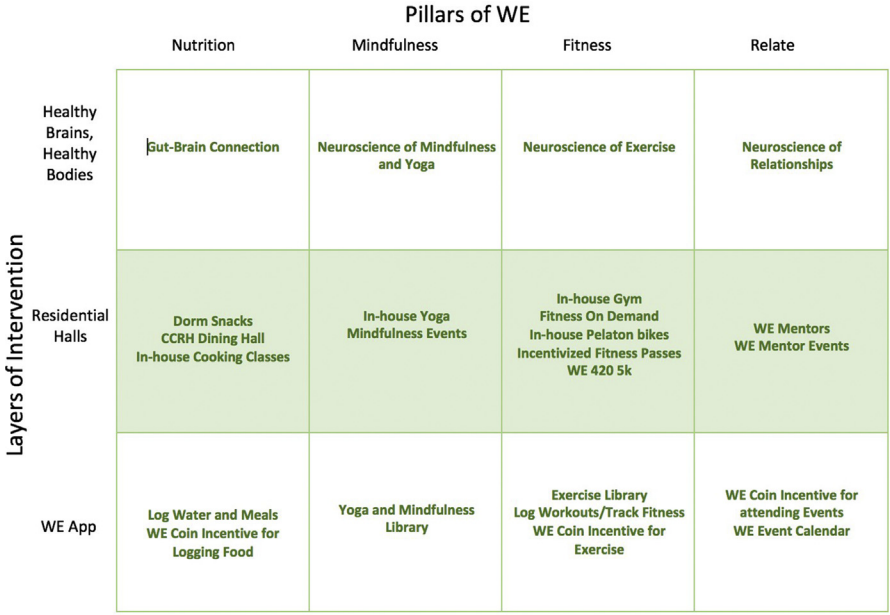

Fig. 1. Wellness Environment (WE) design diagram. (*Courtesy of* J. Hudziak, MD, Burlington, VT.)

nonjudgmental context. The central theme of the course is that an individual's environment and choices impact on the function of the genome through epigenetic modifications, which in turn impact the structure and function of the brain and subsequent thoughts, beliefs, and behaviors. The course is designed to demonstrate that all health, emotional, general medical, cognitive, and academic outcomes are directly influenced by the thoughts, beliefs, and behaviors of the individual. By demonstrating that connection, this course provides the underlying rationale for the UVM WE program. In addition to this course, UVM students have the opportunity to continue studying the impact of health-promoting (and risky) behaviors on both brain development and overall health by completing a minor in Behavioral Change Health Studies. Example courses from the minor include: Your Brain on Drugs, The Science of Happiness, Living Behavioral Change, Family Wellness Coaching, and The Effects of Adversity.

The residential aspect of the WE design is an experiential extension and tangible application of the principles studied in the didactic component (ie, the 4 pillars of wellness). For instance, students in the residential community engage in brain-building wellness activities including incentivized daily exercise with personal trainers, music lessons, mindfulness and yoga with certified instructors, and healthy dietary practices under the guidance of a nutrition coach whose work is informed by recent advances in gut–brain neuroscience. Examples of how these behaviors are incentivized include the following. All WE students group and in house fitness passes are paid for up front (cost per student $260) and remain cost free as long as they use the passes a total of 40 times per year. If the student only uses the facility 20 times, they are required to pay back 50% of the upfront costs. Additionally, and discussed elsewhere in this article, on the WE App is a cryptocurrency, entitled WE Coin, that students earn by participation in wellness activities; for example, each time the student uses the gym they earn 50 WE coins. Thus, through incentivized, first-hand experience, students learn the impacts of hydration, sleep, and learning to play an instrument on their developing brains. Students also participate in WE Relate programming to better understand how to honor themselves, live in an affirmative environment, and engage in acts of kindness and gratitude. As an extension of the WE Relate programming, a mentoring program called WE Mentors was developed (www.wementor.org) to encourage participating undergraduates to provide guidance to local elementary school students and to mentor these children in activities that advance their personal wellness. Students who live in the WE are required to sign a contract that indicates they understand that if they have alcohol, drugs, or paraphernalia, or are grossly intoxicated in the WE, they will be removed from the program (and live elsewhere on campus). During the first full year of the WE App Research Study (2017–18), 15 students were required to transfer from the WE to other campus housing in response to violations of the policy prohibiting alcohol and drugs in the WE. After enthusiastic endorsement from university leadership, the program opened during the 2015 to 2016 school year with 120 students. The program grew to 480 students for the 2016 to 2017 academic year and to 806 for the 2017 to 2018 academic year.

The third aspect of the UVM WE program is the UVM WE mobile application (WE App). The WE App was designed to support student participation in daily health-promoting activities. To that end, students can use the WE app to set goals, check their progress, and receive incentives for engaging in health promotion activities. The WE App includes meditations specifically developed for college students, personalized yoga instruction through video education, and mentored physical fitness training exercises custom-made for college students. In addition, there includes a logging feature for a variety of health-promoting behaviors, including fitness, nutrition,

sleep, and hydration. Most importantly, there is a nightly self-report survey that asks the students about their day by querying 14 items, 7 health-promoting related behaviors, 6 risk-related behaviors, and whether or not they had a happy, okay, or sad day. These data are archived for the student, allowing them at any time to review what their behaviors were on their happy, okay, or sad days and thus inform their personalized health planning. All of the health promoting activities, including the nightly survey are incentivized through a WE cryptocurrency called WE Coin. Each time a student logs engaging in a health-promoting activity, they have the opportunity to earn WE Coin. WE Coin is then stored within the WE App, in the WE Bank. Students can then use the WE Coin in the WE Store to purchase a variety of rewards (eg, outdoor experiences, bike passes, meals at local restaurants, clothing, exercise gear). For the 2017 to 2018 academic year, the approximate cost of providing rewards in the WE Store was $40,000. The current development version of the WE App can be used on both an Apple iPhone and Apple Watch; however, a future version will be compatible with both Apple and Android operating systems.

Finally, the UVM WE program has an aggressive research component built around 3 extensive questionnaire sessions conducted at the beginning (ie, baseline; the focus of this report), middle, and end of the academic year. From the beginning, assessment has been a core feature of the WE program, with information collected at regular intervals (baseline, midyear, and end of year) as well as daily. In addition to the periodic questionnaires, students complete a nightly 14-item health and risk survey on the WE App. The daily survey was developed for use in the WE App Study and can be seen in **Box 1**. To examine the effects of the WE program, typical university aggregate data such as grade point average (GPA), alcohol and drug abuse violations, and school retention are integrated with individual-level data from the periodic questionnaires and daily surveys.

This analysis presents baseline data collected at the beginning of the 2017 to 2018 academic year and focuses specifically on self-reported drug abuse, alcohol abuse, wellness-related behaviors, and emotional health symptoms, as well as university-level data on alcohol- and drug-related incidents and student retention. This analysis also shows that it is possible to collect daily survey data throughout the year on a broad range of health and wellness indicators using an iPhone or Apple Watch app. This article is not a formal evaluation of the entire WE program, but the current findings suggest that such an evaluation can be rigorous and include novel data collection efforts.

SAMPLE

All participants were recruited during the 2017 to 2018 academic year via an institutional review board-approved research protocol to test the impact of the UVM WE program and the WE App on college students' health behaviors and academic achievement. A total of 1941 students consented to participate, but 81 of those students were excluded because they failed to complete the initial battery of questionnaires, which resulted in 1860 students who agreed to participate, including 806 WE students and 1054 college as usual students (non-WE; **Fig. 2**). This sample is best considered a convenience sample of current UVM students. The rapid growth in student participation in the WE (ie, 120 in year 1, 480 in year 2, and 806 in year 3) suggests a strong interest among UVM students. All participants completed an informed consent approved by the UVM Institutional Review Board. All participating students in both conditions received a Series 1 Apple Watch that was used to collect the nightly survey data and encouraged health promotion through daily reminders to exercise and be active.

Box 1
Daily survey

1. How many hours of sleep did you get?
   Answers: 0, 1 to 3, 4 to 7, 8+
2. How many minutes did you exercise?
   Answers: 0, 1 to 30, 31 to 60, 61+
3. How many servings of fruit/vegetables did you eat?
   Answers: 0, 1 to 3, 4+
4. How many bottles of water did you have?
   Answers: 0, 1 to 3, 4 to 6, 7+
5. How many minutes have you practiced mindfulness?
   Answers: 0, 1 to 9, 10 to 30, 31+
6. How many minutes did you play an instrument or sing today?
   Answers: 0, 1 to 30, 31 to 60, 61+
7. How was your day?
   Answers: sad, okay, happy
8. How many hours did you spend non-academic screen time?
   Answers: 0, 1 to 2, 3 to 6, 7+
9. How many drinks did you have?
   Answers: 0, 1 to 2, 3 to 4, 5+
10. How many shots of liquor did you have?
    Answers: 0, 1 to 2, 3 to 4, 5+
11. How many times did you smoke/use marijuana?
    Answers: 0, 1 to 3, 4+
12. How many cigarettes did you smoke?
    Answers: 0, 1 to 3, 4+
13. How many times did you take illicit drugs?
    Answers: 0, 1 to 3, 4+
14. How many prescription pills (not yours) did you take?
    Answers: 0, 1 to 3, 4+

ASSESSMENT

Information on student functioning and relevant outcomes was collected in 2 ways: (1) a periodic battery of questionnaires to assess in-depth functioning and (2) daily surveys administered using the participants' mobile devices (ie, iPhone or Apple Watch) to assess within-individual variability in key outcomes (**Fig. 3**).

Periodic Questionnaires

To remain an active participant in the study, all participants were asked to complete 3 online self-report questionnaires throughout the 2017 to 2018 academic year. These self-report questionnaires were administered at baseline, midyear, and the end of the year through the online platform Campus Labs. The measures included in the questionnaire sets were: The Big Five Inventory,[14] Adult Self Report (ASR),[15] Brief Problem Monitor,[16] Screening Brief Intervention and Referral to Treatment, the WE Inventory of Thriving,[17,18] Mindfulness Attention Awareness Scale (MAAS),[19] Short Form Health Survey,[20] Alcohol Use Disorders Identification Test (AUDIT),[21] Drug Abuse

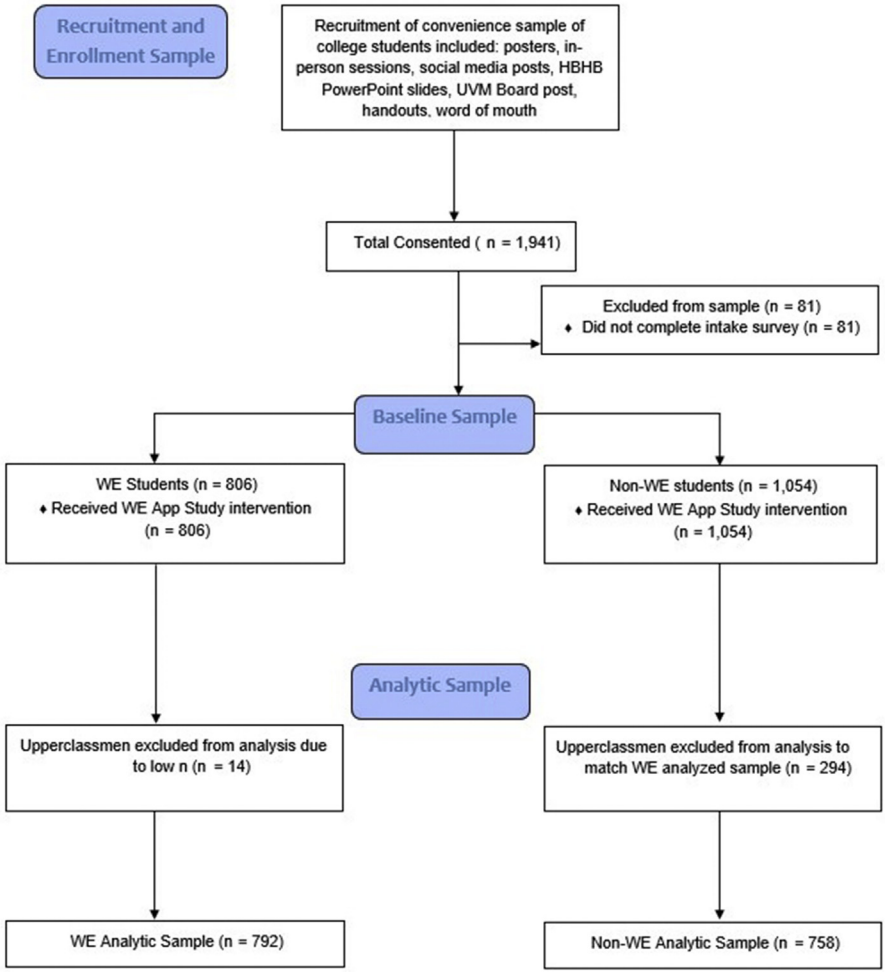

Fig. 2. CONSORT diagram of the Wellness Environment (WE) app study sample. (*Courtesy of* J. Hudziak, MD, Burlington, VT.)

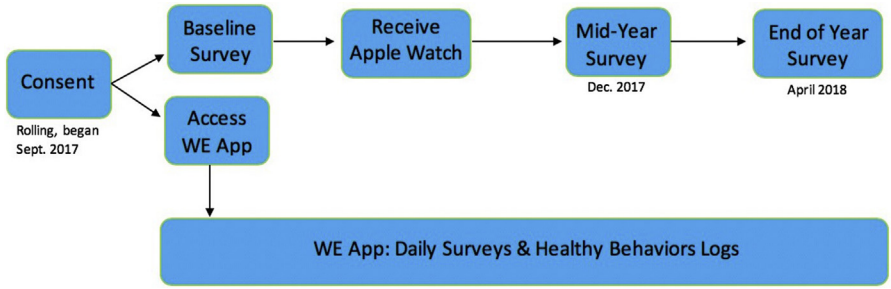

Fig. 3. Wellness Environment (WE) App Study participant flowchart for the 2017 to 2018 academic year. (*Courtesy of* J. Hudziak, MD, Burlington, VT.)

Screening Test (DAST-10)[22], and Patient Health Questionnaire (PHQ-9).[23] The ASR was administered at baseline and at the end of the year, and the Brief Problem Monitor was administered at midyear and the end of the year. All other measurements were collected at all 3 time points. Questionnaire data included information on alcohol and drug use, psychological health, mindfulness, level of thriving, personality, and a self-report measure of overall health (HSQ Short Form Health Survey[20]).

A detailed description of the substance abuse measures, mental health measures (AUDIT, DAST-10 and PHQ-9) and other additional measures is provided herein.

Adult Self Report

The ASR[18] is a nationally normed self-report instrument that provides dimensional information about 6 areas of an individual's level of adaptive function (personal strengths; friends; family; spouse/partner; job; education), symptoms of 8 empirically derived syndromes (anxious/depressed, withdrawn, attention problems, aggressive behavior, rule-breaking behavior, intrusiveness, somatic complaints, thought problems), and symptoms of 6 *Diagnostic and Statistical Manual of Mental Disorders*–oriented scales (eg, depressive problems, avoidant personality problems, antisocial personality problems). This measure yields scores and percentile ranks (with corresponding cutoff scores for clinical significance) on each subscale that are nationally normed by sex, within each of 2 age bands (18–35 or 36–59 years), based on nationally representative samples of adults. Given the close correspondence between the scales of the ASR those of the Child Behavior Checklist,[19] this measure can be particularly useful when examining similarities and differences between individuals within a family system.

The Big Five Index

The Big Five Index[20] is a self-report measure created to capture the dimensions of the Big Five model of personality.[21] This instrument includes 44 affirmative statements, each of which begins "I see myself as someone who. . . ." (eg, ". . . is talkative; is reserved"). Participants are asked to rate each item on a scale of 1 (disagree strongly) to 6 (agree strongly). Between 8 and 10 items are intended to represent each dimension of the Big Five model, and evidence from confirmatory factor models is consistent with this intended structure. Item-scale reliability coefficients range from 0.80 (neuroticism) to 0.92 (extroversion).

Brief Problem Monitor

The Brief Problem Monitor[22] comprises a subset of items from the ASR (described elsewhere in this article) and yields nationally normed, dimensional scores for internalizing, externalizing, attention problems, and total problems. This instrument can be used for self- or other-report. Scores on each scale can be compared with specific norms based on age, gender, and cultural group. Based on each set of norms, T-scores of 65 or greater (corresponding with the 93rd percentile in that individual's reference group) indicate cause for clinical concern.

Health Survey Questionnaire

The Health Survey Questionnaire,[23] the Short Form 36, is a self-report measure of overall health. This instrument comprises 36 questions and is designed for use in community settings. Items are designed to provide information about 8 areas of general health: physical functioning, social functioning, physical problems, emotional problems, pain, mental health, vitality, and general health perception. Scores across these

dimensions are aggregated using an algorithm and scaled from 0 to 100, with higher scores indicating better health states.

Mindful Attention Awareness Scale

The MAAS[24] is a self-report measure of trait mindfulness. This instrument comprises 15 first-person statements (eg, "I could be experiencing some emotion and not be conscious of it until some time later" "I find myself listening to someone with one ear, doing something else at the same time") and provides response options ranging from 1 (almost always) to 6 (almost never) for each item. Total score on this measure is the average rating across all items, with lower scores indicating higher levels of mindfulness. The MAAS was originally tested in 14 independent samples of college students (2277 total participants; mean, 3.83; standard deviation, 0.70). Subsequent evaluations of the MAAS have reported excellent psychometric properties, including a unitary factor structure and high levels of internal consistency (αs of 0.80–0.90[24,25]).

Wellness Environment Inventory of Thriving

The WIT was created as an adaptation of the Comprehensive Inventory of Thriving (CIT[26]) for use with participants in the WE. The CIT is a self-report measure of overall well-being that includes 7 subscales (relationship support, engagement, mastery, autonomy, meaning, optimism, and subjective well-being). The CIT was initially developed with a sample of college students (n = 490) and later cross-validated in a series of 4 independent community samples (2701 total participants). Across samples, the CIT subscales demonstrated adequate to high internal consistency (αs of 0.71–0.96), and results of confirmatory factor models indicated that the proposed 7-factor structure fit the data well. In the original cross-validation sample, the addition of CIT scores to regression models predicting physical health outcomes provided significant incremental value, beyond predictions based on narrower thriving scales and beyond predictions based on anxiety and depression symptoms. In addition to 10 items taken directly or with only word-level edits from the CIT, the WIT includes 9 novel items intended to represent gratitude, mindfulness, exercise, sleep, and nutrition. The WIT comprises 20 declarative statements (eg, "The way I exercise has a positive impact on my well-being") with 3 response options (1 [disagree]; 2 [neither agree nor disagree]; 3 [agree]). Higher scores on the WIT are indicative of higher levels of well-being (**Fig. 4**).

Alcohol Use Disorders Identification Test

The AUDIT is a measure of behaviors associated with increased risk for harmful consequences of alcohol use.[21] Participants are asked to respond to 10 questions that address alcohol consumption, symptoms of dependence, and interpersonal consequences of alcohol use. Although it was originally developed for use with adults, independent research groups in the United States and other countries have reported adequate psychometric properties of the AUDIT when administered to undergraduate students.[24,25] Results of a study that compared AUDIT scores and diagnoses of alcohol use disorders based on semistructured face-to-face interviews in a sample of 251 undergraduate students (mean age, 20.56 years; standard deviation, 1.86 years; 46.8% female) indicated that a cut score of 6 for males or 3 for females was associated with a 97% sensitivity (but only 37% and 17% specificity, respectively).[26] Despite some limitations with regard to specificity, the sensitivity of the AUDIT is consistently high across studies, especially when used with undergraduates who are not seeking treatment for alcohol-related problems.

Please indicate your agreement or disagreement with each of the following statements using the scale below:

	Disagree	Neither Agree nor Disagree	Agree
1. There are people who appreciate me as a person	1	2	3
2. I am achieving most of my goals	1	2	3
3. I can succeed if I put my full effort into something	1	2	3
4. What I do in life matters	1	2	3
5. My life has a clear sense of purpose	1	2	3
6. My life is going well	1	2	3
7. I feel good most of the time	1	2	3
8. My sleep pattern has a positive impact on my life	1	2	3
9. I practice mindfulness in a way that has a positive impact on my well-being	1	2	3
10. The food I eat has a positive impact on my well-being	1	2	3
11. I feel a sense of belonging in my community	1	2	3
12. The way I exercise has a positive impact on my well-being	1	2	3
13. The way I show and experience appreciation for the world have a positive impact on my well-being	1	2	3
14. In most things I do, I feel energized	1	2	3
15. The amount of water I drink has a positive impact on my well-being	1	2	3
16. The way I handle stress has a positive impact on my well-being	1	2	3
17. I am confident that I can handle stressful situations	1	2	3
18. I am able to adjust to changes in my life	1	2	3
19. I am optimistic about my future	1	2	3
20. No matter what kind of person I am, I can always grow and change substantially	1	2	3

Fig. 4. Wellness inventory of thriving. (*Adapted from* Su R, Tay L, Diener E. The development and validation of the comprehensive inventory of thriving (CIT) and the brief inventory of thriving (BIT). Appl Psychol Health Well Being 2014;6(3):278–79; with permission.)

Drug Abuse Screening Test

The DAST is a quantitative self-report instrument designed to measure maladaptive use of psychoactive substances during the past 12 months.[22] Responses on each of 10 yes/no items are scored 1 or 0, yielding a total score between 0 and 10. Although the DAST is a quantitative instrument designed to provide dimensional measurement of substance abuse, findings are consistent with the use of a cut score of 3 on the 10-item version as a predictor of diagnostic status. For instance, compared with diagnoses based on the combination of semistructured interviews and urinalysis, using a cut score of 3, the DAST-10 was found to correctly distinguish between individuals with and without a substance abuse problem in 93% of cases.[27]

Patient Health Questionnaire

The PHQ-9 is a quantitative self-report measure that maps directly onto the 9 *Diagnostic and Statistical Manual of Mental Disorders,* 5th edition, symptoms of a major depressive episode.[23] This instrument allows respondents to report both the number of symptoms present and the severity of each symptom. Each of 9 items (eg, "Little interest or pleasure in doing things," "Poor appetite or overeating") is scored on a 4-point scale ranging from 0 (not at all) to 3 (nearly every day). The possible range

of scores is 0 to 27. This measure shows high internal consistency ($\alpha = 0.89$) and corresponds well with diagnoses made on the basis of a standard diagnostic interview. Scores on the PHQ-9 correspond closely (ie, $r = 0.81$) with scores on the 21-item Beck Depression Inventory-II, especially in community settings.[28]

Daily Surveys

All participants in the study were provided with a Series 1 Apple Watch (as described elsewhere in this article) and asked to download and use the WE App developed by Dr Hudziak. In addition, participants were asked to complete daily surveys administered through the WE App or Apple Watch. The daily survey was open from 7:00 PM to 11:59 PM every evening and prompted participants to consider their health- and wellness-related behaviors throughout the day. Data collected from the WE App included 14 health- and risk-related behaviors (ie, cigarette use, consumption of alcoholic drinks, minutes of exercise, illicit drug use, shots of liquor, minutes of mindfulness, mood, minutes of music played/sang, nutrition, number of prescription pills, hours of sleep, marijuana use, hours of technology, and amount of water consumed). For example, the item used to measure sleep is: "How many hours of sleep did you get?" Response options for this item are 0, 1 to 3, 4 to 7, and 8 hours or more (**Fig. 5**). The full text of this survey can be seen in **Box 1**.

STATISTICAL ANALYSIS

Descriptive statistics for demographic variables including gender, ethnicity, and year in college were computed separately for WE and non-WE students, and baseline group differences (WE vs non-WE) were examined using a χ^2 test. Completion rates for the periodic questionnaires (beginning, middle, end of the year) and daily surveys were also examined. The baseline scores for alcohol abuse, drug abuse, and depression symptoms from the AUDIT, DAST-10, and PHQ-9 were computed separately for WE and non-WE participants, and group mean differences were tested separately by gender, race/ethnicity, and year in school (ie, first- or second-year students). Daily survey data from October 2017 were used as the baseline measure. Participants who completed the survey on a minimum of 5 of 31 days were included in the analysis. The prevalence of health- and risk-related behaviors as reported in the daily surveys was calculated at the individual level first. Group means and group differences were then calculated and tested between WE and non-WE participants. All analyses were conducted with SAS 9.4 (Cary, NC) software. The alpha value for significance testing was set at 0.05.

RESULTS

Sample Description and Compliance

A total of 1941 participants were initially recruited. Eighty-one students who failed to complete baseline assessments were excluded from the current analysis. The resulting sample consists of 1860 participants, 1054 non-WE and 806 WE students who completed the baseline assessment. At the midpoint assessment, a total of 612 WE participants and 751 non-WE participants submitted the wave 2 questionnaires. The completion rate increased to 654 WE students and 833 non-WE students for the wave 3 questionnaires. A total of 745 control students and 602 WE students provided questionnaire data at all 3 time points (baseline, midyear, and end of the year). The characteristics of the participants who completed all baseline questionnaires are summarized in **Table 1**. Overall, more than two-thirds of participants enrolled in the WE App Study were female, regardless of group. Caucasian (88.6% and 85.7% for WE and non-WE participants, respectively) was the most prevalent ethnic group, followed

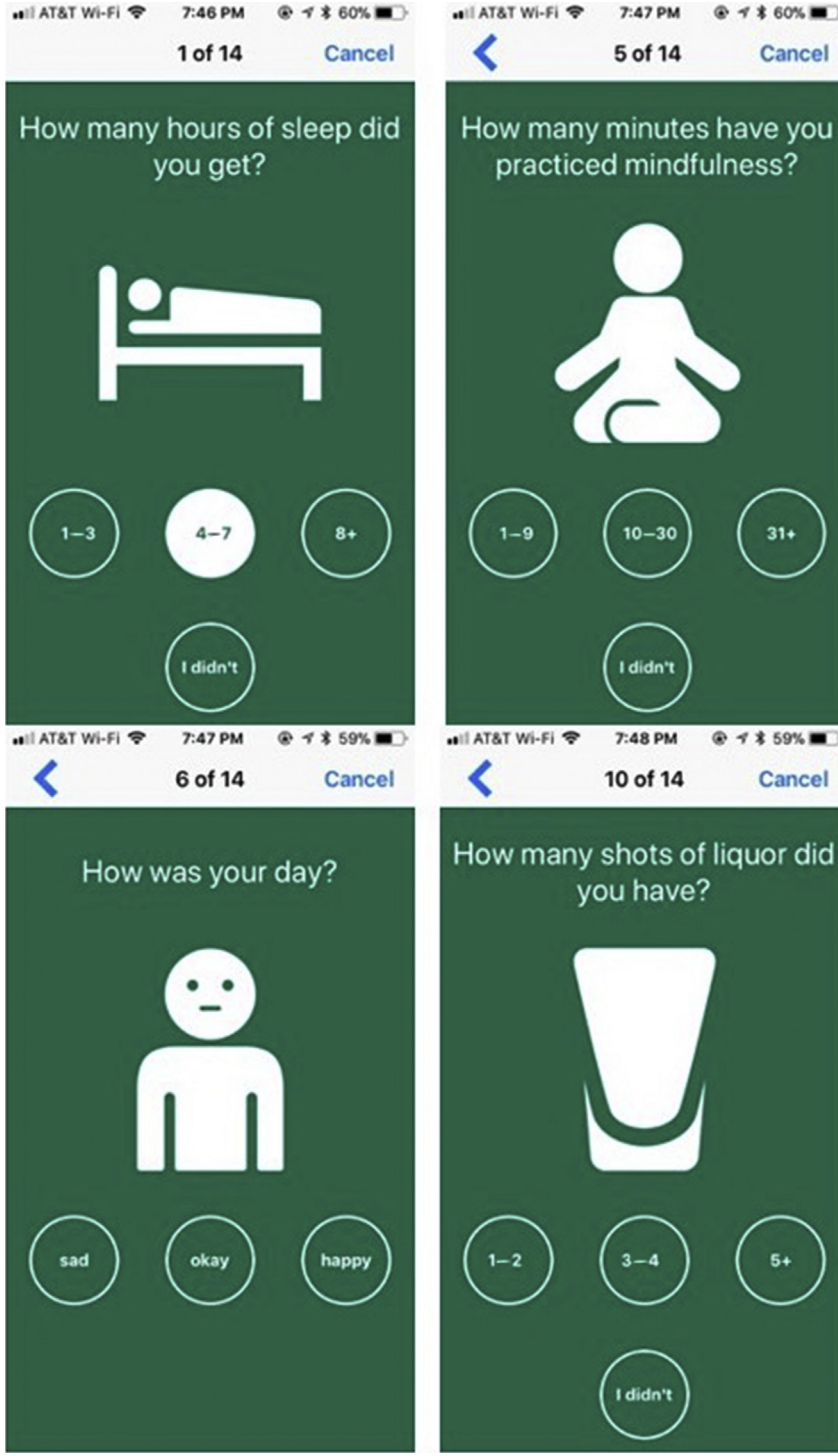

Fig. 5. Screenshot from the Wellness Environment (WE) app. (*Courtesy of* J. Hudziak, MD, Burlington, VT.)

Table 1
Descriptive statistics of sample characteristics

	WE (N = 806)		Non-WE (N = 1054)		
	n	%	n	%	*P*
Gender					
Female	573	71.8	686	65.3	<.05
Male	221	27.7	362	34.4	
Other	4	0.5	3	0.3	
Ethnicity					
African American	10	1.3	20	1.9	>.05
Asian	33	4.2	64	6.2	
Caucasian	702	88.6	890	85.7	
Latina/Latino	23	2.9	28	2.7	
Native American	4	0.5	1	0.1	
Pacific Islander	1	0.1	4	0.4	
Other	19	2.4	31	3.0	
Academic year					
First year of college	666	83.3	429	41.0	<.05
Second year of college	120	15.0	322	30.8	
Third year of college	14	1.8	240	22.9	
Fourth year of college	0	0	56	5.4	

Abbreviation: WE, wellness environment.
The number may not add up to total N owing to missing data in certain demographic questions.

sequentially by Asian, Latino, African American, Native American, Pacific Islander, and others. The Native American, Pacific Islander, and others comprised less than 5% of the sample. Thus, it was not possible to conduct WE versus non-WE comparisons specifically for these participants; however, all WE App Study participants are included in analyses of the full sample and comparisons not based on race/ethnicity (ie, male vs female; first- vs second-year students). Most of the WE participants were first-year college students (83.3%); the control participants were more equally distributed among first- (41%), second- (30.8%) and third-year (22.9%) students. Thus, to match the WE and non-WE participant populations, the subsequent analyses included only first- and second-year students. No group differences were found between WE and non-WE participants by race distribution, but statistically significant differences were found for gender and academic year distribution ($P<.05$).

Periodic Measures

Almost all students enrolled in this protocol provided baseline questionnaire data, and the data from the periodic battery focused on those students. Table 2 shows the raw scores for alcohol abuse, drug abuse, and depression symptoms, computed separately for WE and non-WE participants at baseline. WE participants showed statistically significantly lower baseline scores for alcohol and drug abuse compared with non-WE participants among female, male, Caucasian, and first- and second-year students ($P<.05$). No statistically significant baseline differences were found for depression symptoms ($P>.05$).

Daily Surveys

A total of 850 non-WE and 682 WE participants provided daily survey data. In terms of participation rate, 359 WE participants (52.6%) and 491 non-WE participants (57.8%)

Table 2
The descriptive statistics of alcohol abuse, drug abuse, and depression scores by WE and control at baseline measured by AUDIT, DAST, and PHQ

	AUDIT			DAST			PHQ		
	WE	Non-WE	*P*	WE	Non-WE	*P*	WE	Non-WE	*P*
Gender									
Female	4.7 (4.3)	7.1 (4.5)	<.0001	0.8 (1.4)	1.0 (1.4)	.0041	6.7 (5.2)	6.2 (5.3)	.07
Male	5.6 (4.9)	8.3 (5.8)	<.0001	1.2 (1.9)	1.5 (1.7)	.0083	5.1 (5.1)	4.7 (4.6)	.39
Ethnicity									
African American	6.3 (5.5)	4.6 (5.2)	.35	1.3 (1.4)	0.4 (0.8)	.13	6.8 (6.3)	5.1 (3.9)	.38
Asian	2.5 (2.9)	4.0 (3.5)	.13	1.1 (2.1)	0.8 (1.2)	.46	6.8 (6.0)	5.8 (5.2)	.36
Caucasian	5.1 (4.5)	7.9 (5.0)	.0001	0.9 (1.5)	1.3 (1.6)	<.0001	6.2 (5.2)	5.7 (5.2)	.09
Latina/Latino	4.3 (4.2)	6.4 (5.3)	.05	0.7 (1.0)	1.0 (1.1)	.54	7.2 (4.8)	4.9 (4.0)	.11
Academic year									
Freshman	5.0 (4.5)	7.4 (5.2)	<.0001	0.9 (1.6)	1.3 (1.6)	<.0001	6.3 (5.2)	6.0 (5.3)	.43
Sophomore	4.8 (4.3)	7.5 (4.9)	<.0001	0.8 (1.6)	1.2 (1.5)	.0056	6.3 (5.7)	5.7 (5.0)	.23

Abbreviations: AUDIT, alcohol use disorders identification test; DAST, drug abuse screening test; PHQ, patient health questionnaire; WE, wellness environment. Data are presented as mean (standard deviation).

completed at least 70% of the daily surveys during the 2017 to 2018 school year. A total of 460 WE participants (67.4%) and 628 non-WE participants (73.9%) completed at least 60% of the daily surveys, and 527 WE participants (77.3%) and 695 non-WE participants (81.8%) completed at least 50% of the daily surveys. The average number of total daily surveys completed per participant was 136 (out of a possible 209 days) with similar completion rates between WE and non-WE participants.

Table 3 shows the prevalence of self-reported health- and wellness-related behaviors by WE and non-WE participants in October 2017 as a baseline measure. The 593 WE participants and 499 non-WE participants who had at least 5 days of valid data in October are included in the analyses. WE participants had statistically significantly higher rates of sleeping more than 8 hours a day ($P = .04$), exercising more than 30 minutes per day ($P = .04$), consuming at least 1 serving of fruit or vegetable per day ($P = .0002$), and daily mindfulness practice ($P<.0001$). WE participants also had statistically significantly lower rates of engaging in drug and alcohol use or abuse behaviors including lower rates of (a) having at least 1 drink ($P<.0001$), (b) having at least 1 shot of liquor ($P<.0001$), (c) using marijuana at least once ($P<.0001$), (d) smoking at least 1 cigarette ($P<.0001$), (e) using illicit drugs at least once ($P = .0003$), and (f) taking at least 1 pill prescribed to another person ($P = .0002$) daily. No group differences were found between WE and non-WE students for the probability of playing an instrument, mood state, or having more than 3 hours of screen time ($P>.05$). These data are presented only to demonstrate the feasibility of collecting this type of data as well as potentially understanding the differences between the students who live in the WE and those who do not. We wish it to be clear that no causal comparisons can be made owing to the ascertainment bias inherent in the students' choice to live in or not live in the WE.

Institutional Data

Finally, the university maintains aggregate information on student academic achievement and disciplinary incidents. To maintain student confidentiality, this information is

Table 3
The prevalence of health- and wellness-related behaviors self-reported by WE and non-WE participants at baseline (October) measured by the WE App daily survey

	WE	Non-WE	*P*
Having a happy day	47.7% (26.5%)	45.9% (27.1%)	.26
Sleep >8 h/d	40.0% (26.1%)	36.8% (26.9%)	.04
Exercise >30 min/d	48.6% (28.8%)	45.0% (29.7%)	.04
Consume ≥1 serving of fruit and veggies/day	84.1% (21.4%)	79.0% (24.4%)	.0002
Having ≥4 bottles of water/day	50.89% (36.9%)	48.4% (36.8%)	.29
Having ≥1 drink/day	6.1% (9.7%)	14.3% (16.6%)	<.0001
Having ≥1 shots/d	5.1% (7.9%)	9.3% (13.4%)	<.0001
Having ≥1 marijuana/day	4.2% (12.8%)	12.9% (24.7%)	<.0001
Having ≥1 cigarettes/d	1.1% (6.4%)	4.0% (14.1%)	<.0001
Having ≥1 illicit drugs/d	0.3% (1.7%)	1.3% (6.9%)	.0003
Having ≥1 illicit pills/d	0.7% (4.0%)	2.3% (9.5%)	.0002
Practicing meditation ≥1 time/day	39.3% (26.4%)	28.6% (31.4%)	<.0001
Playing instrument or sing ≥1 time/day	47.2% (37.5%)	49.6% (37.3%)	.30
Spending ≥3 h of screen time/day	39.8% (31.0%)	39.4% (30.7%)	.84

Abbreviation: WE, wellness environment.
Screen time excludes academic screen time.

only available through the UVM Office of Student Affairs. According to findings provided by UVM Student Affairs, the WE residential hall had 0.84% alcohol/drug community standard incidents per student compared with 10.8% in the non-WE residential halls on campus in the 2017 to 2018 academic year. For alcohol/drug conduct violations, 46.0% fewer WE students were determined to be responsible after undergoing a full adjudication process, compared with non-WE students. Academic performance data from fall of 2017 also showed favorable results. WE students had a 90.0% retention rate compared with 85.0% among non-WE students, and WE students had a statistically significantly ($P<.05$) higher average GPA of 3.36 compared with 3.22 among non-WE students. Campus-wide alcohol use by students has decreased by 33.0% since the inception of the WE program, and the number of students requiring medical attention for excessive drinking at UVM has decreased by 50.0%. It must be noted that the dramatic decreases in campus-wide alcohol use and students requiring medical attention for excessive drinking is due to a wide number of initiatives started by the Division of Student Affairs and the Center for Health and Wellbeing at UVM before the creation of the WE program. Although it is possible that the WE program has contributed to these campus-wide reductions, it is impossible to tell.

Dissemination

The WE model has provided a roadmap for how to bring together multiple programs usually run by separate departments on campus. More than 70 different entities have contacted the WE for guidance and on how to further use aspects of the WE model.

Existing infrastructure and on-campus programs within higher education institutions provide the possibility to overcome the negative problems of the current college and university cultures. As our data mature, it may be possible to demonstrate that incentivized health promotion and prevention approaches may lead to improved overall college health and diminished consequences of alcohol and drug use and misuse, as well as the epidemic of emotional behavioral problems in college age students. Although most institutions have some programming in yoga/mindfulness, fitness, and mentoring, it is rarely programmatic and incentivized. One key challenge in replicating the WE model is securing high-level commitment at the university level to deliver resource allocation. The larger operational challenges lie in overcoming barriers between departments that subscribe to their individual norms with different frameworks, visions, and goals (eg, Campus Recreation, Psychiatry services, Student Affairs, class approval committees). Blending together resources and creating new requirements around a neuroscience-based approach requires participation from high levels of campus leadership. Establishing new leadership uniting faculty, residential life and other departments will necessarily give rise to challenges in service of bringing behavior change to a campus culture.

Institutional support and funding

A necessity for success is the need to build relationships through a campus champion, high-level faculty member, or administrator with the will and ability to keep developing and establishing the program foundation from which the WE model can flourish. Because this program has been funded from multiple cost centers, 3 major areas are identified in getting the program off the ground. First, staffing from the WE was funded from multiple sources at its outset, with the UVM Center for Health and Wellbeing, Larner College of Medicine, and Residential Life all contributing to the staff who delivered the program. As of 2017, the WE had 5 full-time staff devoted to programming, along with a number of individuals contributing to research, business operations, and course curriculum for the nearly 1200 students in the WE program. Next,

funding for incentives available in the WE store came from the Residential Life programmatic funding, creating an early arrival program, WEventure, and the Conrad Hilton Fund Grant. Finally, the WE has received a number of donations from alumni and corporations interested in furthering this work. This support has been in the form of programmatic dollars to help fund Apple Watches, Peloton bikes, and incentives such as Burton clothing.

DISCUSSION

A core precis put forward by the creator of UVM WE program is that college students, if given the chance to make healthy decisions, will make healthy decisions. If college and universities are able to surround their students with opportunities and like-minded peers to engage in healthy brain building activities, they will. If, every time a student turns around, they have opportunities to engage in yoga, relationship building, acts of kindness and gratitude, fitness, mindfulness, healthy nutrition, and mentoring activities, they are likely to choose these activities. This fundamental precis is counterbalanced by the fact that, in many university and college residence halls and campuses, the student may turn around and be offered alcohol, cannabis, other drugs and high-risk behaviors, making the choice of wellness more difficult. The UVM WE program, although in its early stages, and only reliably tested in those students who live in the WE, has demonstrated that by offering and incentivizing wellness, students embrace it, and have better academic and behavioral outcomes and far less negative alcohol and conducts behaviors. Results from the 2017 to 2018 year of the WE confirm that the integrated educational, residential, and App-based facets of the WE programming can be implemented at a large scale and integrated with in-depth, multimodal data collection. Preliminary results at the institutional level, including higher GPA and retention as well as dramatically lower rates of alcohol and drug incidents among WE students, are promising but not causal, because the ascertainment bias cannot be ruled out. If longitudinal analyses reveal similar group differences, the WE would represent a promising health promotion and risk reduction intervention for college students. It is also possible that the results regarding group differences over the course of the year may be more modest than the institutional data would suggest. Even in that case, any significant decrease in substance abuse and conduct violations, along with any significant increase in nutrition, sleep, exercise, and GPA, would suggest that the WE can have a meaningful effect on the college environment. This question is the subject of ongoing analyses that will be reported separately.

Limitations

At baseline, there were preexisting differences between students who elected to live in the WE and those who did not, and these differences will be taken into account when examining the trajectory of risk- and health-related behaviors over the course of the 2017 to 2018 academic year. For the data from 2017 to 2018, we acknowledge that no causal, across sample, comparisons can be made. Our current database for the 2018 to 2019 academic year will allow us to test the impact of the WE environment in a more causal manner. There are many more freshmen at UVM this academic year (2018–2019) who selected WE as their primary signature program then could be included in the residential halls of WE. We currently have 760 freshmen who live in WE this year; of that number, 620 are enrolled in the study (the others do not have Apple phones or chose not to participate) and 600 non-WE students also enrolled in the study. At the end of this academic year, we will be able to perform classic comparison analyses between those students who live in WE, those who

selected to live in WE but were placed in a learning community, and those who had no desire to live in WE. As long as some portion of the non-WE sample did not state a preference to live in the WE (ie, self-selection to non-WE), we expect to find similar baseline differences between WE and non-WE students. Going forward, these differences will be quantified and accounted for by implementing broader pretest assessments, collecting retrospective data, and increasing the size of the causally interpretable sample by increasing the use of random selection of WE students from the larger group who stated a preference to live in the WE yet live in a different learning community. In this way, we hope to disentangle program effects from preexisting baseline differences between WE and non-WE participants. Altogether, these data suggest that a full evaluation of the WE program integrating multimodal assessment methods is both feasible and warranted, given the preliminary evidence of improved academic outcomes and negative outcomes in both the WE students and the campus overall.

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