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Assessing Psychometric Predictors of Academic and Life Success for High School Students in a STEM-Based Program in Rural Alabama

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ABSTRACT: The Health Sciences and Technology Academy of Alabama (HSTA-AL) is an academic program focused on health sciences enrichment offered through the College of Nursing at the University of Alabama to address the state's nursing and biomedical professionals shortage (i.e., a 10:1,000 nursing to population ratio). This paper examines outcomes addressing social, academic, and life success from the participants' perspective. The one-sample-pretest-posttest designed study evaluated whether there was a difference between baseline and year 1 levels of community engagement and academic intentions for the 23 students for which paired data were obtained. Analyses show promising outcomes from baseline to year one matched responses with preliminary evidence of program goals being realized.

INTRODUCTION

Nurses and other biomedical professionals are integral members of the health care workforce and in short supply in Alabama (Alabama Board of Nursing, 2023). In a recent analysis of a survey of chief nurses in Alabama, 68% reported that they had difficulty meeting their agency's need for acute care nurses and 80% reported that they needed experienced nurses (Dick et al., 2023; Juraschek et al., 2019) forecasted that in 2030 Alabama would move to a grade of "D" from their 2009 grade of "C+" for its RN shortage ratio. The National Academies of Science, Engineering and Medicine conducted a regional STEMM meeting to address workforce needs in the Wake of COVID-19. Given the high percentage of African Americans in Birmingham, Alabama, 67.5% in the city of Birmingham and 30.6% in the Birmingham-Hoover Metro area, this area was a region of focus. Josh Carpenter, director of economic development for the city of Birmingham noted that COVID-19 along with the Black Lives Matter movement illuminated the need to restructure and rebuild the workforce culture through "…intentional actions to root out racism and create inclusive conditions to support diversity and equity in all job sectors...(a)s we continue these conversations, we want to make sure that piece of this struggle is front and center." (National Academies of Sciences, Engineering, and Medicine, 2021).

Underrepresentation of marginalized persons (i.e., Persons of Color, Rural-dwelling, Economically Disadvantaged, and First-Generation College) in academia and the health care professions continue to persist (Dent et al, 2021; Temming, 2021). Despite the resounding call of political voices and program implementations, the inclusion landscape for underrepresented persons remains bleak (Fry, 2021; National Academies of Sciences, Engineering, and Medicine, 2023). To change the workforce outlook for underrepresented groups, club-based, academic, health sciences/science, technology, engineering, and mathematics (STEM) enrichment programs are a way to address this lack

of representation (Kitchen et al., 2022). Given its rural composition and higher African American population than the United States (i.e., 26.8% vs. 13.6%), Alabama's residents are more susceptible to experiencing a shortage of health care professionals of color in their communities (United States government, n.d.). Alabama is also vulnerable to the nursing shortage and turnover epidemic the nation is experiencing as there are 9.73 nurses per 1,000 persons in the state compared to a 9.22:1,000 ratio nationally (Nurse Journal Staff, 2023; Dick et al., 2023). According to results from a 2021 survey released by the Alabama State Nurses Association, 80% ($N \geq 2,600$) of respondents "strongly agreed" or "agreed" that there was a nursing shortage in their facility, whereas, the previous year (2020), 46% had this perception (Shepard, 2021).

The Health Sciences and Technology Academy of Alabama (HSTA-AL) is a health sciences academic enrichment program created in 2021 through a National Institute of Health Science Education Partnership Award (NIH-SEPA). The program is an adaptation of the West Virginia Health Sciences and Technology Academy (WV HSTA). For three decades, WV HSTA has supported underrepresented and underserved youth (i.e., African American, financially impacted, first generation college, and rural) who desire to pursue health sciences/STEM disciplines in college. The WV HSTA program was created to address the lack of health care practitioners in rural Appalachian communities through community-driven, grass roots efforts (Chester et al., 2020). The founding premises of WV HSTA were that lack of opportunity, low academic expectations, and non-access to higher education—not lack of academic ability—created barriers to achievement in these areas of study for underrepresented students (Cooper, 2023; Stafford, 2020; Sullivan and Chanoff, 2014; Washington, 2019). WV HSTA participants have opportunities to interact with community health care providers, scientists, and academicians during the academic school year through weekly teacher-led community-based club meetings and in the summer months via summer camps held at WV higher education institutions. HSTA-WV has over 3,400 graduates. To date 1,964 of the graduates are college completers, and 523 are advanced degree. Of the WV HSTA graduates, 61% have attained or are still pursuing health sciences/STEM related majors. Approximately 81% of WV HSTA students who completed college degrees indicated having a WV home address at their last reporting, and 89% of current WV HSTA college attendees are pursuing their degrees in WV. Clearly, the WV HSTA program is supporting students to obtain advanced biomedical degrees and to remain in West Virginia to work.

Through current federal funding, the University of Alabama implemented a tailored version of WV HSTA to address the shortage of nurses, nurse scientists, nurse faculty, and other biomedical professionals in Alabama. Although the programs are similar in their goal to increase the number of underrepresented students to pursue college degrees by providing academic enrichment and life skills support, the WV HSTA model focuses on increasing health care/STEM practitioners throughout the health care workforce (e.g., doctors, physical therapists, pharmacists, etc.); whereas, HSTA-AL is designed to increase the number of nurses, nurse practitioners, nurse faculty, and nursing and other biomedical researchers in Alabama among those who are African-American and underrepresented in these fields. HSTA-AL also adopted the community-based club meetings and summer camp models of WV HSTA since these programmatic components have successfully heightened WV HSTA participants' interests in health sciences areas of study.

HSTA-AL participants complete psychosocial scales addressing academic work, community intentions, mattering, community engagement, social support, etc. designed to measure retention in the program, academic trajectories, and interest in health sciences/STEM areas with specific emphasis on nursing and biomedical professions. Participants completed the scales prior to receiving any intervention (i.e., baseline) and yearly. Although HSTA-AL participants completed several scales, this paper focused on scales related to community engagement, also known as participatory community citizenship, intentions also known as the validated AWHSCI scale created by WV HSTA (i.e., academic, pursuit of health careers, and serving their community), and the HSTA-AL scale, Alabama-Intentions, measuring pursuit of nursing, STEM and other health degrees/careers. The research question for this analysis was:

> *Are there significant differences between the paired baseline and year 1 reported levels of Community Engagement (scales A and B), AWHSCI (i.e., academic, pursuit of health careers, and serving their community), and Alabama-Intentions (i.e., pursuit of nursing, STEM, and other health degrees/careers for HSTA-AL participants)?*

Analysis was also performed to determine if there were differences based on demographics variables, specifically race and gender. In summary, the analyses presented in this paper are intended to measure changes in HSTA-AL participants' levels of community engagement, academic pursuit of health careers, and pursuit of nursing/STEM and other health degrees as they progress through the program, which may correlate with pursuit of, and success in health sciences/STEM areas (Thacker et al., 2022; Gutman and Midgley, 2000).

Literature Review. Creating an equitable workforce in the nursing and biomedical professional industry has become a national endeavor as there is an overall shortage of nurses,

along with a shortage of African American nurses (Smiley et al., 2021). According to the 2022 population estimates, African Americans comprised 13.6% of the United States (U.S.) population; however, African Americans make up only 6.3% of the population of registered nurses (RN), which took a down-turn from 6.7% in 2020 (Smiley et al., 2021; United States government, n.d.). Henderson (2021) reported that persons of color represent 40 percent of the population, yet they comprise only 20 percent of the nursing workforce. It is important for persons to receive care from those who understand their cultural experiences and their encounters within the health care system to address inequities in health service. So, it is not only crucial to increase the number of nurses available to provide care, but to increase the number of African American nurses, especially in a state like Alabama with higher populations of African Americans in combination with surmounting health inequities.

In 2019, Salsberg et al. (2021) examined data from the American Community Survey and the Integrated Postsecondary Education Data System to estimate and compare the representation of African American, Hispanic, and Native American persons in 10 health care professional areas. Their analyses also examined those who were in the educational pipeline. The findings showed that these groups were underrepresented in all 10 areas and although the educational pipeline showed limited improvement, underrepresentation persisted. This trend was shown in workforce surveys disseminated by the Alabama Board of Nursing (ABN) in 2021 and 2022, in which demographic data showed that 70% of the respondents (N= 84,779) were White females, 17% were African American females, and 8% were White Males (Alabama Board of Nursing, 2023). The report concludes that with a decreasing Alabama nursing workforce due to retirements, critical healthcare service implications are expected. This phenomenon is playing out across the U.S., as the American Association of Colleges of Nursing recently reported that enrollment trends for prelicensure BSN programs fell by 1.4%. The enrollment declines are the first to occur in 20 years with the RN to BSN programs showing 4 years of declining enrollment dropping to 16.9% in 2022. (Sanborn, 2023). An untapped pool of potential nurses in underrepresented populations (e.g., African Americans, males, and other persons of color) of Alabama and the U.S. may be cultivated to address this shortage. As such, HSTA-AL was developed to address nurse and biomedical workforce shortages, especially shortages of African Americans in these fields.

In Fall 2021, the National Center for Education Statistics (NCES) reported that there were 1.5 million faculty (e.g., professors, associate professors, instructors, interim professors, adjunct professors, etc.) working at postsecondary, degree-granting institutions, with 56% working full time and 44% part time. When considering only the full-time faculty, the racial/ethnic breakdown is such that 73% were White, 12% were Asian, 6% were African American, 6% Hispanic, 1% identified as two or more races, and less than one-half of 1% identified as American Indian/Alaska Native, and Pacific Islander. A further breakdown of these data revealed that the representation of full-time faculty by race and gender was: 35% White females; 38% White males; 5% Asian females; 7% Asian Males; 4% African American females; 3% African American males; 3% Hispanic females and 3% Hispanic males. As educators in higher education institutions, faculty of color may find themselves isolated and without support systems (Hassouneh, 2018; Doležal, 2022; Okahana, 2023). NIH recognized the need to address this problem in the biomedical professional arena. The HSTA-AL program has as one of its foci to increase the number of people of color who become educators and scientists, especially among those from rural and low-income populations, and those who will be first generation to go to college in their families.

To promote diversity, equity, and inclusion, NIH established the UNITE initiative in February 2021 with a goal "to identify and address structural racism with the NIH-supported and greater biomedical research community" (NIH, 2022, p. 8). To gain viable data on the biomedical research workforce and to advance health disparities and health equity research, the committee issued a request for information (RFI) (U.S. Department of Health and Human Services 2021). Researchers and professionals from various areas responded to the RFI (e.g., academia, NIH Staff, health professionals, student/postdoc researchers, etc.), with the majority from higher education institutions (i.e., 46%). The report focused on several themes (e.g., grants process, biomedical research workforce, etc.) for diversifying biomedical professions; with one of the focus areas being community partnerships and outreach. The respondents recommended that NIH pre-graduate STEM education programs are developed and funded which target diverse groups of scholars. Further recommendations are increased outreach to pre-graduate students by members of the biomedical research community and supporting diversity bridge programs and opportunities to engage in research (NIH, 2022, p. 16). The UNITE initiative is a necessary step in bridging the biomedical equity gap since biomedical professionals are integral to the advancement of medical breakthroughs via research, and NIH recognizes the critical need to grow, train, and diversify the biomedical professional workforce to include persons of color (i.e., African Americans, Hispanic and Native Americans), rural, and citizens from lower socio-economic backgrounds (U.S. Department of Health and Human Services n.d.; Mckinley et al., 2023).

Population increases dictate the need for maintaining or increasing the health care workforce of which nurses and biomedical professionals are a crucial component of insuring health care equity for disadvantaged populations.

HSTA-AL aspires to inspire the next generation of diverse nursing and biomedical professionals in the state. Connecting future nurse practitioners and nurse researchers as well as other biomedical researchers from diverse backgrounds to their local communities through community engagement (CE) is essential (Chuisano et al., 2023). If marginalized persons do not believe they are important members of their community, they are less likely to feel a connection and will find it unnecessary to help sustain and/or re-vitalize their local community (Anderson, 2010). Such connections are achieved through engaging students with their local communities through community-based research projects and volunteer opportunities. Established research has shown that the intersection between family, community and school is essential to fostering students' academic success and yielding community viability in diversifying the health care workforce and closing the health equity gap (Mid-Atlantic Equity Consortium, 2018; Rocha et al., 2022; Kilpatrick et al., 2023). A thriving community is predicated on an equitable health care industry in which quality care is available to mitigate long-term health care issues and costs for its citizenry. For HSTA-AL, building the future nursing and other biomedical professional workforces through experiential learning and mentoring opportunities for local high school students is an important step to obtaining quality health care for its community. Likewise, a cornerstone of community engagement involves creating partnerships with academic researchers who will foster a sense of belonging and self-efficacy among high school students from underrepresented and diverse backgrounds. According to a recent study, undergraduate nursing students are influenced by being involved in their communities, through the guidance of nurse academicians, which promotes attaining nursing values and improving their delivery of care to the community, which is also applicable to those with the potential to join the future nursing workforce (Shannon, 2023). Biomedical researchers are equally important to assisting underrepresented students in developing their identities as research scientists, creating a "sense of belonging" in the biomedicine arena and bolstering "their confidence in their ability to succeed" (Vannier et al., 2023).

Increasing high school students' interest in nursing and other biomedical professions involves providing opportunities for community-based participatory research (CBPR) promoting community engagement. The CBPR initiative seeks to equitably integrate local community stakeholders and academic partners in the active discovery of solutions, through engaging research, to solve community problems (Brush et al., 2020). Community engagement is the desire and active involvement by community stakeholders to participate in improving the social and health dynamics of their local community (Sanders Thompson et al., 2021). Academic stakeholders are key to reaching out to community members to foster and nurture CE. The community/academic relationship is paramount to effectively implementing CBPR and CE. The HSTA-AL program provides a unique opportunity for its participants to become future health care practitioners and scientists with specific focus on nursing or other biomedical professions as potential career paths.

PROGRAM DESCRIPTION

In July of 2022 the HSTA-AL program was launched with 48 rising 9th graders from two counties in rural western Alabama with the primary goal of providing academic and life enrichment programming to promote nursing/biomedical careers. Students were recruited from the county schools with interested participants submitting an online application. The participants were selected through a blind review by an elected local governing board (LGB) comprising residents from their home counties. The LGB model is a concept adopted from HSTA-WV in which local citizens, representing the demographic makeup of the community, serve as the connection between the university and community. HSTA-AL students were accepted based on review of the criteria including living in a rural location, African American descent, low economic status, and being the first in their family to go to college. Other criteria included students having a 2.5 or greater GPA upon admission and submitting a brief essay detailing their future aspirations/interest. The LGB members reviewed the applications and collaboratively determined who would be invited to join HSTA-AL, wait-listed, or not selected. Upon completion of this process, HSTA-AL staff notified applicants of the decisions. The demographic makeup of the first cohort was as follows: African American (n=39); first generation (n=36); low income (n=30); rural (n=48); male (n=11) and female (n=37). The first cohort participated in a 1-week summer program hosted by the University of Alabama. During the summer camp, participants were exposed to campus life, nurses, nursing faculty, biomedical scientists and their work, and mentoring opportunities designed to instill aspirations and encouragement to pursue a college degree in a biomedical field, particularly nursing. The students participated in interactive learning experiences related to infectious and chronic diseases within their communities. The campers also learned in the College of Nursing's interactive, state of the art, simulation labs guided by nursing academicians and students.

The program also recruited and hired five teachers, who participated in the first summer camp as well. The camp experience focuses on a different topic each year. While year 1 camp focused on infectious diseases, year 2 camp focused on childhood obesity and its sequelae with camp activities exposing students to elements of the research process that they will further explore in their community-based club meetings during the academic year. The HSTA-AL high school teach-

ers also attend professional development workshops, during the academic year, designed to provide training on the established curriculum to present in their clubs along with activities to assist students in learning the research process. For example, in their community-based clubs, students explore the concept of ethics in research and learn about conducting research in communities. In addition, students are exposed to the elements of a good research question, the variables involved, formulating hypotheses, data gathering techniques, data management tools, etc. The weekly club activities, throughout the academic year, help to prepare the students to conduct their own research projects each spring semester. During this process, students are guided by teachers with support from university faculty members. Ultimately, the intended outcome or expectation is that students will come away with an understanding of how to develop and conduct individualized or small group projects addressing health issues in their local communities.

PSYCHOMETRIC MEASURES

In 2013, WV HSTA embarked on a journey to determine which psychological concepts were important in measuring participants' academic, emotional, and social development. WV HSTA partnered with the West Virginia University School of Public Health Faculty to secure a grant through the Annie E. Casey Foundation to create and research validated psychometric scales measuring academic and life success from the students' perspective (Anderson, 2010; Button et al., 1996; Carver, 1997; Elliot et al., 2004; Huebner et al., 2006b; Hurtado et al., n.d.; McKendall et al., 2023; Midgley et al., 2000; Pearlin and Schooler, 1978; Snyder et al., 1991; Zimet et al., 1988; Wilson et al., 2005). The first step in the process was to conduct focus groups of key WV HSTA stakeholders (i.e., current participants, graduated participants, community leaders, and WV HSTA leadership) develop a detailed program logic model. After the logic model was created, WV HSTA examined the literature for validated psychometric scales for use in a longitudinal study of WV HSTA students (i.e., experimental) and a comparable control group (i.e., non-HSTA students attending schools where there are HSTA students). Afterwards, a quasi-experimental, mixed methods study was conducted from 2016 through 2018 of HSTA students and the comparison group measuring theorized variables from the logic model and the literature for reliability and validation across the three years. The surveys that HSTA students and comparison group students took included 15 validated measures on various aspects of identity, learning abilities, values, social support, community, and academic intentions (Chester et al., 2020).

HSTA-AL adopted these measurements for evaluating the success of their program as participants progress through the program. These scales are used to determine if there are increases/decreases among these scales as participants progress through the program. Although HSTA-AL participants completed 16 psychometric measures at their baseline and year 1 data collections, the focus of this paper is on four key scales examining community engagement and academic intentions, two critical elements of the HSTA program. The first is the Academic, Work/Health Science, and Community Intentions (AWHSCI) scale measuring participants' willingness to live in and contribute to their local community (McKendall et al., 2023). It is a validated, HSTA-WV scale containing 13-items measured on a 5-point Likert continuum. The initial five items measure high school intentions, specifically to complete HSTA, earn As and Bs in their classes for college acceptance, prepare for college entrance exams, and graduate from high school. The next four items examine intention to enroll in college, major in a health science or a related subject, attend medical or other health science graduate professional program, and have a career in a health service area or as a health scientist. The final four items query on intentions to live in Alabama after completing college, improve their community as a high schooler/college student and as a working adult. See Table A1 in the appendix for all 13 items in this scale.

The Participatory Community Citizenship or Community Engagement Scale (CES) is also a 13-item, 5-point Likert scale. This scale is a WV HSTA scale that has undergone test-re-test reliability testing with an R^2=.22 indicating a significant prediction of student intentions to pursue a career in the health sciences (Litwin, 1999; Chester, 2015; Kristjansson and Mann, 2018). The CES-A subscale includes the first seven items which query participants' beliefs of how important it is for them to be involved in improving their community and if it is their responsibility to be involved in community issues. This scale also taps into if they deeply care about problems in their community, seek to make their community a better place, and their level of commitment to building a better community. The CES-B subscale, which is comprised of the last six items, examines participants' confidence in their ability to conduct research, to identify problems in the community, convince others to care about a community problem, and employ various leadership skills to address community concerns. See Tables A2 and A3 in the appendix for all 13 items in these subscales.

The Alabama Intentions Scale (AIS) contains nine items and is a on a 5-point Likert scale as well. The AIS was created by HSTA-AL leadership and WV HSTA evaluators to measure participants' perceptions that are specifically related to HSTA-AL program implementation. Measuring intent to go to college, the scale also queries intent to major in nursing, STEM, health sciences, or biomedical research, as well as pursuit of a career in these areas. This scale has not undergone validation as this is the first time it is used in research, and the number of participants here was not suffi-

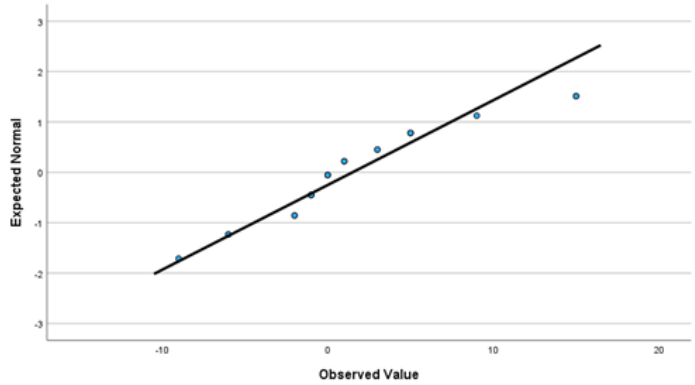

Figure 1. Normal Q-Q plot of difference between baseline and Year 1 for AWHSCI scale.

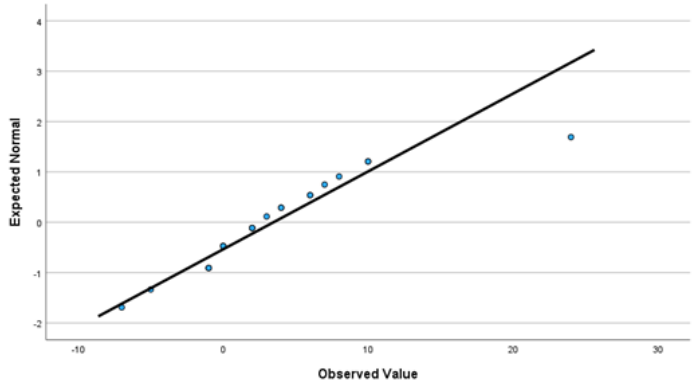

Figure 2. Normal Q-Q plot of difference between baseline and Year 1 for CES-A scale.

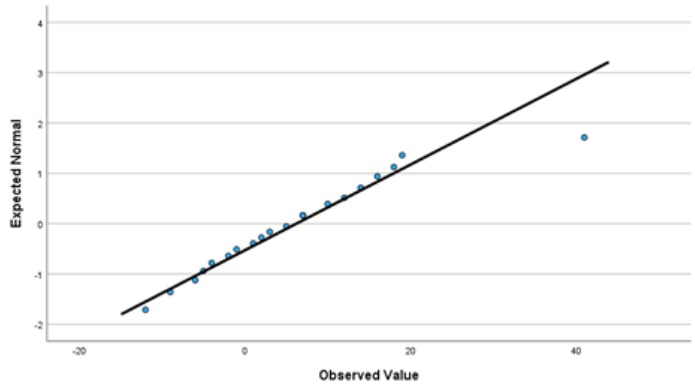

Figure 3. Normal Q-Q plot of difference between baseline and Year 1 for CES-B scale.

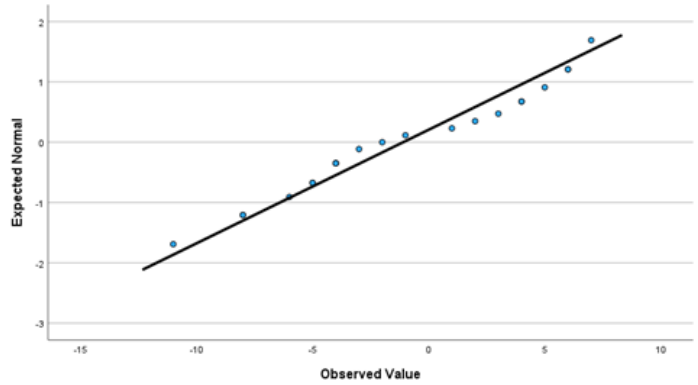

Figure 4. Normal Q-Q plot of difference between baseline and Year 1 for AIS scale.

cient for scale validation. See Table 4A in the appendix for all nine items in this scale.

METHODS

As previously stated, prior to receiving intervention, participants completed the scales from May through October of 2022 (baseline) and in May of 2023 at the completion of year 1 (year 1). A total of 39 students took the baseline survey with five providing an incorrect tracking number making a match to their baseline data impossible. In year 1, 31 students completed the baseline surveys; however, the data matched for only 23 students, such that 58.97% were tracked from baseline to year 1 completion.

Participant data, including self-reported demographics, were electronically captured and managed by the Research Electronic Data Capture (REDCap) system through the West Virginia Clinical and Translational Science Institute NIH grant located at West Virginia University (Harris et al., 2019). As a secure, web-based platform, the REDCap system is designed to efficiently collect and manage on-line surveys and databases to conduct human subjects' research. Data analyses were performed using Matlab and the IBM SPSS® Statistics (Version 29) software package. To track the students longitudinally, each student signs into the RedCap system using their unique number. After the data capture, normality tests were performed. Since n < 50, the Shapiro-Wilk test and Q-Q plots were used to test for normality of the distributions of the students' mean differences (m_1-m_b) between baseline and year 1 on the four psychometric scaled scores (Mishra et al., 2018). The Q-Q Plot figures are presented in Figures 1-4. Changes in participants' responses on the psychometric scales from baseline (2022) to completion of year 1 (2023) were analyzed using a one-group pretest-posttest design. Both parametric and non-parametric tests were utilized, namely the paired *t*-test, independent *t*-test, the Wilcoxon Signed-Rank Test, and the Mann Whitney U test for scaled paired differences showing normality and non-normality, respectively. Cohen's d effect size benchmarks were also employed for interpretation purposes (i.e., small (.20); medium (.50), and large (.80) (Ellis, 2010).

RESULTS

Descriptive Statistics. A total of 22, 21, 22, and 21 participants' data were matched using the student number across baseline and completion of year 1 for the AWHSCI, CES-A, CES-B, and AIS scales, respectively. Self-reported demographics are presented in Table 1 for a total of 23 participants for which both baseline and year 1 data were available. The CES-A was the only scale with a non-normal distribution exhibited in the significant *p*-value. See Table 2 for the Shapiro-Wilk results. After obtaining demographics and testing for normality, reliability analyses were performed to deter-

Table 1. *Self-Reported Demographics of Program Participants.*

Demographic Characteristics	N	%
Race		
African-American/Bi-Racial/Multi-Racial	17	73.9%
White	6	26.1%
Gender		
Male	4	17.4%
Female	19	82.6%
Race By Gender		
African-American Males	4	18.2%
African-American Females	12	54.5%
White Males	0	0%
White Females	6	27.3%
County		
County 1	12	52.2%
County 2	11	47.8%
Parents Completed College		
Yes	10	43.5%
No	12	52.2%
Free/Reduced Lunch Recipient		
Yes	21	91.3%
No	2	8.7%

mine internal consistency at baseline and year 1. The reliability coefficient or Cronbach's alpha levels range from 0 to 1, with higher values reflecting greater internal consistency. Table 3 provides the overall statistics for each of the scales showing "excellent," "good," or "acceptable" reliability coefficients.

***T*-Tests and Wilcoxon Signed-Rank Test Results**. The paired *t*-test on the CES-B scale showed a significant difference between baseline (M=27.77, S.D.=10.68) and year 1 (M=34.00, S.D.=8.76), ($t(21) = 2.49$), $p = .02$), showing an increase in the score from baseline to year 1 (Table 4). As a result, it is determined that there is a correlation between participation in the HSTA-AL intervention and an increase in participants' CES-B scores from baseline to year 1. Medium effect was also obtained with the Cohen's $d = .53$, 95% CI [0.08, 0.97]. Independent t-tests were conducted on race and gender to determine if there were differences between the groups after one year of intervention. See Table 5 for results. Group analysis comparing African American and White participants' CES-B scores revealed the mean difference between the scores at baseline and year 1 as 2.38 and 8.63, respectively. The baseline scores were not significantly different; however, the year 1 scores were approaching significance. The mean differences for males and females on the CES-B scale at baseline and year 1 were -1.95 and 1.53, respectively. There were no significant differences at baseline or year 1 between male and female scores.

Table 2. *Normality Tests on Differences Between Baseline and Year 1 for all Scales.*

Scale	Shapiro-Wilk test
AWHSCI	.067
CES-A	.021*
CES-B	.158
AIS	.315

**Significant*

The paired *t*-test on the AIS scale did not show a significant difference between baseline (M=35.19, S.D.=6.01) and year 1 (M=34.10, S.D.=6.43), ($t(20) = 0.95$, $p = .36$) with the baseline score 1.10 units higher than the year 1 score. Referring to Table 5, the AIS independent t-test results for African American and White participants revealed the mean difference between the scores at baseline and year 1 as 2.14 and 4.21, respectively. There was no significant difference found between the baseline and year 1 scores by race, but a small and medium *Cohen's d* effect size was shown in baseline and year 1, respectively. In other words, the magnitude of the difference between the mean response of African American and White participants on the AIS scale was small at baseline, but at year 1, there was a medium difference between the groups. The mean differences for males and females on the AIS score at baseline and year 1 was -5.79 and 0.51, respectively, with no significant differences. Nevertheless, at baseline, *Cohen's d* showed a large difference between the mean responses of males and females on the AIS scale. However, in year 1, the difference between the groups is narrowed to a less than small effect with a nearly 1-point (i.e., 0.945) difference between baseline and year 1 *Cohen's d* effect sizes.

The paired *t*-test results for the AWHSCI scale from baseline (M= 45.23, S.D.=5.96) to year 1 (M=46.73, S.D.=5.97) showed no significant difference with the baseline score 1.50 units lower than the year 1 score ($t(21) = 1.18$, $p = .25$). Referring to Table 5, the AWHSCI independent t-test results for African American and White participants revealed the

Table 3. *Overall Reliability of Scales.*

	Baseline										Year 1							
	N Items	Span	N	Mean	SD	Min	Max	Skew	Kurt	Alpha	n	Mean	SD	Min	Max	Skew	Kurt	Alpha
AWHSCI	13	0-52	22	45.23	5.96	32.00	52.00	-1.03	-.008	.90***	23	46.96	5.94	26.00	52.00	-2.31	6.54	.85**
CES-A	7	0-28	21	19.76	5.07	4.00	28.00	-1.17	3.86	.90***	22	23.32	4.87	10.00	28.00	-1.14	1.36	.95***
CES-B	12	0-48	23	27.61	10.46	5.00	48.00	-.24	-.21	.94***	22	34.00	8.76	16.00	47.00	-.24	-.94	.91***
AIS	9	0-45	21	35.19	6.01	24.00	45.00	-.50	-.44	.78*	23	33.83	6.77	21.00	45.00	-.59	-.61	.85**

*Note: ***α Excellent; **α Good; *α Acceptable; SD: Standard deviation*

Table 4. *Descriptive Statistics of Paired T-Test.*

	Baseline				Year 1					Paired Differences				Paired T-Test		
	N	Mean	SD	σM	Mean	SD	σM	Paired Samples Correlation	p	Mean	SD	Lower	Upper	t	df	p
AWHSCI	22	45.23	5.96	1.27	46.73	5.97	1.27	.50	.02*	-1.50	5.94	-4.14	1.14	1.18	21	.25
CES-B	22	27.77	10.68	2.28	34.00	8.76	1.87	.28	.20	-6.23	11.75	-11.44	-1.02	2.49	21	.02*
AIS	21	35.19	6.01	1.31	34.10	6.43	1.40	.64	.00*	1.09	5.31	-1.32	3.51	.95	20	.36

Note: σM = Standard Error of the Mean

mean difference between the scores at baseline and year 1 as 2.33 and 2.79, respectively. There was no significant difference found between the baseline and year 1 scores by race, but there was a small effect for both baseline and year 1. As was the case with the AIS scale, the magnitude of the difference between the mean response of African American and White participants on the AWHSCI scale was small at baseline, however, unlike the AIS scale, the AWHSCI effect size difference between the groups remained small. The mean differences for males and females on the AWHSCI score at baseline and year 1 was -3.74 and 4.59, respectively, with no significant differences. Nevertheless, the magnitude of the difference between the mean response of males and females on the AWSHSCI scale was approaching a large effect for year 1 with a medium effect at baseline.

Correlation coefficient analyses were conducted to measure the strength and direction of a relationship between the baseline and year 1 scores for each of the scales. For the CES-B scale, the results revealed a non-significant relationship between baseline and year 1 scores (Table 4). On the other hand, the AWHSCI and AIS scales showed sufficient evidence to conclude that there was a significant linear relationship between the baseline and year 1 scores. The correlation coefficient for these scales between baseline and year 1 was significantly different from zero. Several guides have been presented for interpreting Pearsons's and Spearman's correlation coefficients; however, Geher and Hall (2014) provide a general rule of thumb, considering -/+ sign as between 0 and .3 (weak), .3 and .7 (moderate) and .7 and 1.0 (strong). Results for these analyses are shown in Table 4. Descriptive statistics showing the intersection between race and gender for all 4 scales is shown in Table 6. Despite having such a small sample size, the year 1 AWHSCI score (M=50.75) for African American males is quite impressive with a standard error of the mean as 0.75. The standard error of the mean explains the accuracy of the estimated mean, in other words, how close are the sample means to the parametric mean, with the value usually decreasing as the sample size increases; nevertheless, in this case, the standard error of the mean for the year 1 AWHSCI scaled score for African American males is less than 1.

Since the sample sizes (i.e., n < 30) are quite small, the Wilcoxon signed-ranks test was also performed on all scales, to determine if the parametric and non-parametric tests would produce similar results. This test is non-parametric and investigates the "relationship between a quantitative

Table 5. *Descriptive Statistics of Independent T-Tests by Race and Gender.*

	Independent T-Tests (Baseline)							Independent T-Tests (Year 1)						
Scale (Demographics)	N	Baseline Mean (SD)	t	df	*p*	Cohen's d	95% Confidence Interval	N	Year 1 Mean (SD)	t	df	*p*	Cohen's d	95% Confidence Interval
CES-B														
(African American)	16	27.88 (11.24)	0.46	20	0.65	0.22	[-0.72,1.16]	16	35.63 (8.29)	2.08	19	0.051*	1.07	[-0.01,2.11]
(White)	6	25.50 (9.09)						5	27.00 (7.28)					
(Male)	4	26.00 (13.04)	0.33	21	0.74	-0.18	[-1.26, 0.90]	4	35.25 (8.96)	0.31	20	0.76	0.17	[-0.92, 1.25]
(Female)	19	27.95 (10.23)						18	33.72 (8.95)					
AIS														
(African American)	14	35.64 (6.27)	0.71	18	0.49	0.35	[-0.62, 1.31]	16	34.88 (6.38)	1.29	20	0.21	0.62	[-0.35, 1.57]
(White)	6	33.50 (5.96)						6	30.67 (7.94)					
(Males)	4	30.50 (8.27)	1.83	19	0.08	-1.02	[-2.14, 0.13]	4	34.25 (8.54)	0.14	21	0.89	0.07	[-1.01, 1.15]
(Females)	17	36.29 (5.06)						10	33.74 (6.62)					
AWHSCI														
(African American)	15	45.67 (6.38)	0.80	19	0.44	0.39	[-0.58, 1.33]	16	47.63 (6.48)	0.96	20	0.35	0.46	[-0.94, 1.40]
(White)	6	43.33 (5.09)						6	44.83 (4.62)					
(Males)	3	42.00 (6.56)	1.01	20	0.33	-0.63	[-1.85, 0.61]	4	50.75 (1.50)	1.44	21	0.16	0.79	[-0.32, 1.89]
(Females)	19	45.74 (5.89)						19	46.16 (6.23)					

**Approaching significance*

Table 6. *Descriptive Statistics intersecting Race and Gender (Baseline to Year 1).*

	African American Males				African American Females				White Females			
	N	Mean	SD	σM	N	Mean	SD	σM	N	Mean	SD	σM
CES-A												
Baseline	3	17.67	1.16	0.67	11	20.00	6.80	2.05	6	20.00	2.45	1.00
Year 1	4	23.00	2.31	1.16	11	22.91	6.22	1.88	6	23.50	3.78	1.54
CES-B												
Baseline	4	26.00	13.04	6.52	12	28.50	11.15	3.22	6	25.50	9.09	3.71
Year 1	4	35.25	8.96	4.48	12	35.75	8.47	2.44	5	27.00	7.28	3.26
AIS												
Baseline	4	30.50	8.27	4.13	10	37.70	4.12	1.33	6	33.50	5.96	2.43
Year 1	4	34.25	8.54	4.27	12	35.08	5.95	1.72	6	30.67	7.94	3.24
AWHSCI												
Baseline	3	42.00	6.56	3.79	12	46.58	6.27	1.81	6	43.33	5.09	2.08
Year 1	4	50.75	1.50	0.75	12	46.58	7.20	2.08	6	44.83	4.62	1.89

Note: σM = Standard Error of the Mean

variable and a two dependent-level qualitative variable (before-after) ...and is appropriate if the data is low (less than 20) or the distribution of errors in the quantitative variable does not follow the normal distribution" (Chenani and Madadizadeh, 2020). First, the CES-A scale data are analyzed using the Wilcoxon signed-ranks test due to non-normality.

A Wilcoxon Signed Ranks Test for related samples as presented in Table 7 indicated that the CES-A Year 1 (mean rank = 5.90) was statistically significantly higher than the CES-A Baseline (mean rank = 10.88) ranks Z = -2.4, p =.015. The median CES-A baseline score was 19.00, and the year 1 median score was 24.50, which shows an increase of 5.5 (Figure 5). Table 8 provides descriptive statistics for the Mann-Whitney U Test results by race and gender for Year 1, and it showed a non-significant difference on the CES-A scale for males and females (Z = -.53, p = .60), and for race (Z = -.28, p = .78) for year 1.

Results for the paired t-test on the CES-B, AIS, and AWHSCI scales were the same for the Wilcoxon signed-rank tests. The tests showed a statistically significant change for the CES-B scale (Z = -2.29, p = .022), with the median scores as 27.00 and 35.50 for the baseline and year 1, respectively. Both the AWHSCI (Z = -.829, p = .407) and AIS scores (Z = -.836, p = .403) were not statistically significant. The AWHSCI median baseline and year 1 scores were 48.00 and 49.00, respectively. The AIS median baseline and year 1 scores were 37.00 and 36.00, respectively.

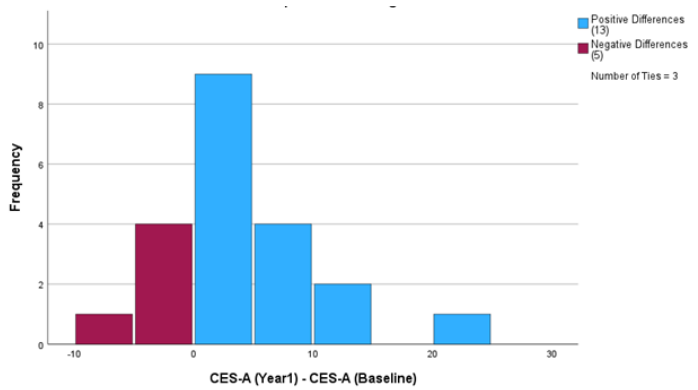

Figure 5. Related-samples Wilcoxon signed rank test.

DISCUSSION

HSTA-AL's primary goal is to increase academic success thereby influencing life success for students historically underrepresented in the healthcare and STEM workforces with a focus on nursing and biomedical research. The program's partnership with local community members and WV HSTA has created a foundation for social support by monitoring and guiding participants through community engagement and educational activities. This alliance was a labor built on reciprocal respect and trust between the community and university, allowing rural Alabama students to receive academic interventions (e.g., work on research projects, campus-based experiences, etc.) and teachers to receive professional development (i.e., workshops/trainings) relevant to and promoting positive health outcomes in their communities (Greenhalgh, 2022).

The plight of African Americans/Blacks and in particular Black males in the U.S. with regards to economic and education outcomes have been examined in numerous studies and reports (Allen, 2022; Irwin et al., 2023; Teasley, 2019). The 2020 Condition of Education report produced disturbing trends in that among students whose parents obtained less than a high school diploma and lived in poverty, 64% were African American compared to 46% of the whole U.S. student population. The key takeaways from this report illustrating extreme economic and educational inequities for African American communities were higher poverty rates, lack of home internet access, higher percentage of Black students attending high-poverty schools, higher percentage of Black students with disabilities receiving services for emo-

Table 7. *Related-Samples Wilcoxon Signed Rank Test.*

	Total N		N	Mean Rank	Sum of Ranks	Z	Asymp. *p*	Exact *p*	Baseline N	Baseline Median	BL Min	BL Max	Year 1 N	Year 1 Median	Y1 Min	Y1 Max
CES-A	21	Negative Ranks	5[a]	5.90	29.50	-2.44[d]	0.02*	0.01*	21	19.00	4.00	28.00	22	24.50	10.00	28.00
		Positive Ranks	13[b]	10.88	141.50											
		Ties	3[c]													
CES-B	22	Negative Ranks	7[a]	8.00	56.00	-2.29[d]	0.02*	0.02*	23	27.00	5.00	48.00	22	35.50	16.00	47.00
		Positive Ranks	15[b]	13.13	197.00											
		Ties	0[c]													
AIS	21	Negative Ranks	12[a]	11.63	139.50	-0.84[d]	0.40	0.42	21	37.00	24.00	45.00	23	36.00	21.00	45.00
		Positive Ranks	9[b]	10.17	91.50											
		Ties	0[c]													
AWHSCI	22	Negative Ranks	9[a]	8.28	74.50	-0.83[d]	0.41	0.42	22	48.00	32.00	52.00	23	49.00	26.00	52.00
		Positive Ranks	10[b]	11.55	115.50											
		Ties	3[c]													

[a]*Year 1 < Baseline;* [b]*Year 1 > Baseline;* [c]*Year 1 = Baseline;* [d]*Based on negative rank*
**. p <.05; BL=Baseline; Y1= Year 1*

tional disturbances, low ratio of Black teachers to Black students, continual achievement gaps between Black and White students; Black students having the highest school dropout rates, and graduation and college enrollment rates remaining low for Black students (Cai, 2020). The recent 2023 Supreme Court's decision to end affirmative action in college/university's ability to consider race as a deciding factor for qualified student applicants will have a ripple-down impact in further narrowing the inequity divide between communities of color and non-color. According to Barlow et al. (2023), when Proposition 209 was passed in 1996 banning California public universities from considering race, sex, or ethnicity in selecting students for admission, NPR reported that in the first year after the law went into effect, Black and Latino students' enrollment at UCLA and UC Berkely fell by 40%. Thus, the die has been cast in that African Americans and other underrepresented persons of color may well experience increased gaps in economic, education, and health outcomes (Herder, 2023). Despite such a setback, programs like HSTA-AL could maintain a gateway for African American and other underrepresented students to persist to college.

Several factors influencing academic motivation among low-socio economic (SES) and African American youth have been studied, including individual, family, school, and social factors which may be influenced by intervention strategies (Isik et al., 2018; St. Mary et al., 2018). A recent longitudinal study by Browman et al. (2022) hypothesized that there is a relationship between the beliefs of youth from low socioeconomic (SES) backgrounds that their future education identity is related to higher social/economic mobility.

Table 8. *Mann-Whitney Rank Test-(Race and Gender).*

Variable			Baseline						Year 1					
			N	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. p	Exact P	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. p	Exact P
CES-A	Race	African American	14	10.29	144.00	36.00	0.80	0.83	15	11.23	168.50	41.50	0.78	0.80
		White	6	11.00	66.00				6	10.42	62.50			
	Gender	Male	3	6.17	18.50	12.50	0.14	0.15	4	10.00	40.00	30.00	0.60	0.63
		Female	18	11.81	212.50				18	11.83	213.00			
CES-B	Race	African American	16	11.88	190.00	42.00	0.66	0.68	16	12.31	197.00	16.00	0.08	0.093
		White	6	10.50	63.00				5	6.80	34.00			
	Gender	Male	4	11.25	45.00	35.00	0.81	0.83	4	12.00	48.00	34.00	0.87	0.89
		Female	19	12.16	231.00				18	11.39	205.00			
AWHSCI	Race	African American	15	12.07	181.00	29.00	0.21	0.22	16	13.03	208.50	23.50	0.07	0.07
		White	6	8.33	50.00				6	7.42	44.50			
	Gender	Male	3	7.17	21.50	15.50	0.21	0.24	4	18.13	72.50	13.50	0.05*	0.051
		Female	19	12.18	231.50				19	10.71	203.50			
AIS	Race	African American	15	12.07	181.00	29.00	0.21	0.22	16	12.59	201.50	30.50	0.20	0.21
		White	6	8.33	50.00				6	8.58	51.50			
	Gender	Male	4	7.13	28.50	18.50	0.16	0.18	4	12.25	49.00	37.00	0.94	0.95
		Female	17	11.91	202.50				19	11.95	227.00			

**Significant at .05*

The authors found causal evidence that education-dependent identity proximally contributes to academic outcomes for low-SES youth. Findings also suggested that providing awareness of viable post-secondary pathways as means to financial success for low-SES youth increased their academic intentions. The authors state that the study was conducted within the context of an intervention; however, there was not information provided on the type or length of the intervention. Although this study does not consider SES status as a variable, over 90% of HSTA-AL participants reported receipt of free/reduced priced lunch in school, a proximal indicator of low-SES status; thus, the Browman et al. study may have implications for this study as there seems to be a pattern of association between participation in HSTA-AL and increased academic engagement. Reed et al. (2024) conducted a review of college readiness programs for Black high school students to determine the role of school nurses in impacting educational outcomes. Using the Framework for the 21st Century School Nursing Practice the authors set forth that school nurses can advocate for anti-racist college readiness programs positioning youth for success in college; however, neither of the programs reviewed in the study (N=18) implemented school nurse advocates. Although HSTA-AL does not utilize school nurses; nurse academicians are a key component to the program intervention strategies.

Research has shown that students who have not shown college-readiness attributes by the 8th grade, could reach those benchmarks if they are equipped with college aspiration and college prep coursework (Royster et al., 2015). Furthermore, African American students, particularly males, connote academic success with having a strong support person, leadership experience and realistic self-appraisal (Pickett, 2020; Powell, 2018). The educational programming of HSTA-AL is designed to expose participants to nursing/biomedical concepts and mentoring opportunities from nursing/biomedical academicians and researchers. These opportunities produce a university/community partnership that is essential to addressing the education and health barriers in local communities (Minnick et al., 2022).

The primary aim of this study was to evaluate participants' levels of community engagement and academic intentions prior to and after receiving a year of HSTA-AL intervention. The major finding of this study revealed significant increases in participants' community engagement (A and B) scales, and although not significant, there was a decrease in the mean responses on the AIS scale by 1.09 from baseline to year 1. The analysis also showed differences between African American and White participants' academic intentions as approaching significance. African American participants' mean rank scores on the AWHSCI scale increased; whereas, White participants' scores decreased. Of the male participants who were tracked from baseline to year 1, 100% (n=4) were African American. The male participants showed a significant difference in their academic intention pursuits whereas females did not, with their mean rank scores increasing compared to females' mean rank scores decreasing. Essentially, the Mann-Whitney U test showed a significant difference between the paired mean rank scores by gender, further supporting this finding.

An association between participation in HSTA-AL and students' beliefs in the importance of community involvement, the responsibility of being involved in issues impacting their community and working to make their community a better place was shown. Furthermore, associated with an increase in confidence to conduct research, to identify problems in the community, to convince others to care about a community problem as well as to employ leadership skills was identified from baseline to year 1. Although the AWHSCI and AIS scales did not show significant differences from baseline to year 1, one may infer an associated increase in participation in WV HSTA with academic intentions as shown in the *Cohen's d* in that magnitude of the difference in the mean scores for African American compared to White participants showed a large effect. Further, given the magnitude of the correlations, it may be inferred that the correlations are moderate in size.

This preliminary study of this health sciences/STEM program shows promising results for replicating the WV HSTA program in another locale and for achieving success in introducing participants to nursing and other STEM areas as potential college majors and career paths. Although the data seems to show a correlation between participating in HSTA-AL with an associated increase in community engagement or participatory community citizenship, other confounding variables may have a greater association with this increase from baseline to year 1 (Geher and Hall, 2014).

Limitations. Since this study is not an experimental design (randomized selection of participants to the program and to a control group of students), the observed relationship between receipt of the HSTA-AL intervention and community engagement may be attributed to other variables (e.g., self-motivation). Furthermore, there is a selection bias into the program as HSTA-AL participants are required to have a 2.5 or greater GPA as well as submit an essay for admittance. Thus, one may argue that the participants are self-motivated with the HSTA-AL interventions having minimal if any association with increased levels of academic intention and community engagement. Finally, the small number of participants

Implications. The potential implication of this study suggests there is an association between participation in HSTA-AL with an increase in AWHSCI scores, particularly for African American males. Furthermore, African American male and females' CES-B scores also suggest an associa-

tion between participation in the program with an increase in scores from baseline to year 1. As such, the findings suggest that efforts to provide African American and other underrepresented students with opportunities like HSTA-AL could have the potential to lead to an upward trajectory in participants' academic intentions and community engagement which are viable for diversifying the health sciences workforce and ameliorating educational and economical barriers for persons of color.

CONCLUSION

The HSTA-AL model promotes academic and community awareness in participants with the intent of increasing health equity in rural and disadvantaged communities in the future when these graduates return to their communities to help address health disparities. HSTA-AL is modeled after the successful WV HSTA program that has been in effect since the 1990s with many successful graduates. The "home grown" ideology of raising up nursing faculty, researchers, and practitioners from Alabama local communities is a pivotal program goal. This preliminary study of some of the psychometric scales examining academic intention and community engagement from baseline to year 1 shows promise that HSTA-AL students are on track for similar successes that have been seen in the WV HSTA students related to pursuit of health sciences/STEM areas of study. Continued receipt of the HSTA-AL intervention could help to address health inequalities in rural Alabama by instilling a desire in participants to attain a college degree, and to live in and work in their local communities as a nurse or other health care worker/advocate into the future.

For future research, the evaluation team intends to conduct a comparative analysis of the other psychometric scales and outcomes (e.g., grades, college enrollment, etc.) of HSTA-AL and HSTA-WV students from baseline to program completion. Other potential future studies include enrolling a control group in Alabama for further analyses to determine if there are differences between HSTA-AL and a comparison group.

ASSOCIATED CONTENT

Supplemental material mentioned in this manuscript can be found uploaded to the same webpage as this manuscript.

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ABBREVIATIONS

ABN: Alabama Board of Nursing; AIS: Alabama Intentions Scale; AWHSCI: Academic, Work/Health Science, and Community Intentions; CBPR: Community-Based Participatory Research; CE: Community Engagement; CES: Community Engagement Scale; HSTA-AL: Health Sciences and Technology Academy of Alabama; LGB: Local Governing Board; NCES: National Center for Education Statistics; REDCap: Research Electronic Data Capture; RFI: Request for Information; RN: Registered Nurses; SES: Socioeconomic; STEM: Health Sciences/Science, Technology, Engineering, and Mathematics; U.S.: United States; WV HSTA: West Virginia Health Sciences and Technology Academy

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