Capacity-Building for Career Paths in Public Health and Biomedical Research for Undergraduate Minority Students: A Jackson Heart Study Success Model

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Objective: This article chronicles the building of individual student capacity as well as faculty and institutional capacity, within the context of a population-based, longitudinal study of African Americans and cardiovascular disease. The purpose of this article is to present preliminary data documenting the results of this approach.

Design: The JHS Scholars program is designed, under the organizational structure of the Natural Sciences Division at Tougaloo College, to provide solid preparation in quantitative skills through: good preparation in mathematics and the sciences; a high level of reading comprehension; hands-on learning experiences; and mentoring and counseling to sustain the motivation of the students to pursue further studies.

Setting: This program is on the campus of a private Historically Black College in Mississippi.

Participants: The participants in the program are undergraduate students.

Main Outcome Measures: Data, which included information on major area of study, institution attended, degrees earned and position in the workforce, were analyzed using STATA 14.

Results: Of 167 scholars, 46 are currently enrolled, while 118 have graduated. One half have completed graduate or professional programs, including; medicine, public health, pharmacy, nursing, and biomedical science; approximately one-fourth (25.4 %) are enrolled in graduate or professional programs; and nearly one tenth (9.3%) completed graduate degrees in law, education, business or English.

Conclusions: These data could assist other institutions in understanding the career development process that helps underrepresented minority students in higher education to make career choices on a path toward public health, health professions, biomedical research, and related careers. *Ethn Dis*. 2016;26(3):399-406; doi:10.18865/ed.26.3.399

Keywords: Mentor; Cardiovascular Disease; Undergraduate; Training

Introduction

The purpose of this article is to chronicle 16 years (1999-2015) of the innovative Jackson Heart Study (JHS) Scholars program that successfully encouraged and enabled 167 underrepresented minority undergraduate students at Tougaloo College to pursue or enter careers in public health, biomedical research and related fields. This article documents the building of individual student capacity, as well as, faculty and institutional capacity, within the context of a community-based, longitudinal study of African Americans and cardiovascular disease. Further, the purpose of this article is to present preliminary data on the results of this innovative approach.

The problem facing the planners of the JHS in 1997 was how to address the persistent dearth of African American students in Mississippi who pursue health careers in general and graduate studies in particular. The JHS planners recognized that this could not be accomplished in a short period of time. Thus, an innovative approach was undertaken as a component of the JHS to provide undergraduate students training opportunities and incentives in the public health sciences; these efforts resulted in the establishment of the Undergraduate Training and Education Center (UTEC) at Tougaloo College.

Tougaloo College, a predominantly Black, liberal arts college with a student body of about 1000, had an excellent record of preparing minority students for success in graduate and professional programs. The JHS is a large, community-based observational study whose participants were recruited from urban and rural areas of three counties: Hinds, Madison and Rankin.[1] Jackson is the

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capital of Mississippi, the state with the largest percentage (37.01) of African Americans in the United States.[2]

In 1998, as one of the three sponsoring institutions of the JHS, Tougaloo College (TC) was tasked to address objectives specified by the National Institutes of Health (NIH) National Heart, Lung, and Blood Institute (NHLBI), and the Office of Research on Minority Health (ORMH) to establish the UTEC. The primary goals of UTEC were to: 1) create a pool of well-trained high school students who, upon entering college, could successfully complete undergraduate and graduate professional degrees in health professions and public health; 2) introduce a program of college courses to prepare the students to pursue advanced studies toward public health and epidemiology; and; 3) involve the students in hands-on-experiences to create interest in public health careers. The other two sponsoring institutions of the JHS were Jackson State University (JSU), which was tasked to serve as the Data Coordinating Center, and the University of Mississippi Medical Center (UMMC), tasked to serve as the Examination Center. The three institutions formed a unique partnership for investigating the risk factors of cardiovascular disease (CVD) among the African American population.

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Characteristics of the partnership that made it unique included the setting, in the southern United States, as well as the nature of the partners. The three partnering institutions, two Historically Black, and one historically majority, had differing histories, missions, faculty and student populations. "The building of capacity for research in minority health requires a research infrastructure plus the will of the professional and lay communities to activate it to study health disparities."[3] The partners had the potential to meet these criteria, and to each enhance the capacity of the other in benefiting students, faculty, researchers, and the community. JHS planners envisioned that "the inclusion of minority institutions would increase the diversity of America's scientific workforce, as well as empower minority communities to improve their health status through participation in health research."[4]

Methods

Since the 1980s, multiple approaches to increasing the diversity of America's public health, health professional and biomedical workforce have been implemented. These approaches have included: residential and non-residential summer programs inclusive of classroom experiences in biostatistics, epidemiology, public health, bioethics and health disparities; public health research experiences; and students' written and oral presentations of their research.[5] Students who participated in the Leadership Alliance program between 1993 and 2011 attended a summer research seminar and were provided the opportunity to participate in a Summer Research Early Identification Program.[6] For students at Emory University, it was a 10- week Summer Undergraduate Research Program.[7] Bangera and Brownell[8] strongly advocated an approach that included a Course-Based Undergraduate Research Experience (CURE) as a required introductory course for all students, in order to give students the opportunity to engage in authentic research. Since the early 1980's federal agencies and private organizations have funded programs to increase the number of underrepresented minorities in the workplace in general and in biomedical and health-related careers specifically. These programs featured individual research experience and financial support. The implicit assumption, according to NIH[9] was that "when students are provided the opportunity to engage in state-of-the-art biomedical research with appropriate facilities, support and mentorship, their appetite will be whetted to enter a career in biomedical research."

Under the organizational structure of the Natural Sciences Division (NSD), the JHS Scholars Program is designed to provide solid preparation in quantitative skills through: good

preparation in mathematics and the sciences; a high level of reading comprehension; hands-on learning experiences; and mentoring and counseling to sustain the motivation of the students to pursue further studies. With the Scholars Program, the JHS wanted to create an environment at Tougaloo that supported the academic preparation of natural science and social science students in public health and epidemiology. This environment included: expert faculty and mentors; physical resources such as laboratories; specifically designed courses; and linkages with other institutions through partnerships or collaborations. It also included opportunities for scholars to learn directly from JHS investigators about hypertension and other risk factors for CVD.

The first class of JHS Scholars was selected from the incoming freshmen class of fall 1999. Five scholars were selected. Beginning in the 2000-2001 academic year, 10 scholars were selected near the end of the first semester of their freshman year. Beginning in 2005, 12 scholars were selected each year at the end of their freshman year, so that a maximum of 48 scholars, at various academic levels, could matriculate at one time. Requirements for a student to be selected as a JHS scholar, included: a 3.0 grade point average (GPA); an ACT score at or >20 or its Standardized Admissions Test (SAT) equivalent; two letters of recommendation from TC professors, at least one of which must be from a mathematics or science professor; a copy of his/her midterm grades and a personal statement of his/her professional goals. A selection committee, composed of seven faculty members from TC, JSU, UMMC, and JHS, reviews all applications and determines eligibility of each applicant based upon the selection criteria.[10]

A profile of JHS scholars admitted to the program between 1999-2016 reveals that 28% of the scholars are male, while 72% are female. Most, 88%, are from Mississippi leaving 12% from out-of-state, including; Louisiana, Tennessee, Texas, Georgia, Arkansas and Illinois. The scholars' two most frequently chosen majors are biology (50.8%) and chemistry (28.7%). The remaining 20.4% select other majors such as computer science, English, political science, sociology, mathematics, economics, and mass communications. The scholars' mean age on admission is 19; their mean ACT is 24.35 (Table 1).

Once selected, the scholars are eligible to stay in the program for the duration of their academic matriculation at TC, as long as they meet the criteria for progression, which are based on their attendance, academic performance, research presentations and research mentor's evaluation. Twice a year, program staff review scholars' eligibility to remain in the program. Scholars who do not maintain a 3.0 GPA, or who earn less than a "C" grade in any course are placed on probation for the following semester. If they do not meet the progression criteria at the end of their probation, the student is dropped from the Scholars Program. During the first two years, students who are dropped from the program are replaced by potential scholars who are maintained on a list of students who met eligibility criteria but were not selected. In their freshman year, the newly admitted JHS Scholars participate in a weekly seminar series that includes reading and discussing topics such as: how to read and understand a scientific paper; health disparities; and the background of the JHS. These assignments introduce the scholars to critical thinking, public health, cardiovascular disease and related risk factors, and health disparities. All of the new scholars are required to take part in the Mathematics and Reading Enhancement program to help them overcome any deficiencies they might have had in their high school preparation. During the summer, the scholars work as mathematics and science tutors in the Science, Language Arts and Mathematics (SLAM) Program and learn how to use spreadsheets and statistical software programs.

Tougaloo faculty and staff designed the scholars' academic activities to provide them with a competitive edge in public health, biostatistics, bioethics and epidemiology and to help them be easily

Table 1. Profile of JHS scholars: sex, age, home state, ACT, and major, N=167[a]

Sex, n (%)		Mean age	US state, n (%)		ACT, mean	Major, n(%)		
Male	Female		Miss.	All others		Biology	Chem	Other
47 (28.1)	120 (71.9)	19	147 (88)	20 (12)	24.35	85 (50.8)	48 (28.7)	34 (20.4)

a. 46 are currently enrolled, 118 have graduated, and 3 delayed graduation.

placed in mentored summer undergraduate research programs. The JHS scholars' curriculum is designed to include sequential courses, beginning in the sophomore year and extending through the end of the junior year. The curriculum focuses on research preparation such as: 1) Introduction to Public Health and Epidemiology 2) Biostatistics; 3) Research Methods in Public Health and Epidemiology; and 4) Ethics, Medicine and Technology. Course faculty take every opportunity to invite guest presenters who are often JHS investigators. In the Introduction to Public Health and Epidemiology course, the professor invites JHS investigators who have served as authors or co-authors on recently published articles to present their work and discuss its application to the lay public with the scholars. As an assignment, the scholars are required to write a lay summary of the investigator's article. Over the four-year span of this Lay Summary Project, scholars have read articles by JHS investigators as described in (Table 2). JHS Investigators who have served as guest presenters include Drs. Mario Sims, Herman Taylor, Daniel Sarpong, DeMarc Hickson, Ervin Fox and, Solomon Musani.

Many of our scholars apply for admission to medical schools at participating universities such as Tufts University, Boston University, Brown University and others with an Early Identification Program (EIP) for qualified students. Scholars are also enrolled in medical school at UMMC, Howard University, and Meharry Medical College. Beginning in 2012, selected students who applied and met specific criteria could earn early admission to Brown University's Public Health Program. Scholars are exposed to the Schools of Public Health at Emory University, Jackson State University, University of Southern Mississippi, Johns Hopkins University, Harvard University, University of California at Berkeley, and the University of North Carolina at Chapel Hill through their Summer Mentored Undergraduate Research Experience. The combination of coursework, hands-on internships, learning experiences with JHS investigators, and mentoring gives JHS Scholars a unique educational experience that prepares them to surmount the competitive edge in meeting the criteria for admission to graduate and professional programs leading to their career objective in epidemiology, public health or health-related professions.

The JHS Scholars Program is further enriched by colloquia and Public Health Adventures, field trip excursions. Tougaloo already had a well-established colloquium program through which well-known scientists from across the country were invited to present their work and expose the students to concepts in the field. The UTEC expanded this program by including a public health or epidemiology researcher each semester. Over the years, scholars have experienced unique learning experiences through the Public Health Adventures component; examples include visiting: the Centers for Disease Control and Prevention; Emory University School of Public Health; Morehouse School of Medicine; the Project Imhotep Internship at Morehouse College; and the National Center for Bioethics in Research and Health Care located at Tuskegee Univer-

Table 2: JHS scholars' coursework: articles by JHS investigators on hypertension and metabolic risk factors for cardiovascular disease

Title of Article	Presenting JHS Investigator
Subjective social status and psychosocial and metabolic risk factors for cardiovascular disease among Blacks in the Jackson Heart Study[11]	Sims, M
Dietary patterns, abdominal visceral adipose tissue and cardiometabolic risk factors in African Americans: The Jackson Heart Study[12]	Hickson, D
Social patterning of cumulative biological risk by education and income in Blacks[13]	Sims, M
Perceived discrimination and hypertension among African Americans in the Jackson Heart Study[14]	Sims, M
Association of genetic variation with systolic and diastolic blood pressure among African Americans: The Candidate Gene Association Resource (CARe) study[15]	Fox, ER
Aldosterone, C-reactive protein, and plasma B type natriuretic peptide are associated with the development of metabolic syndrome and longitudinal changes in metabolic syndrome components[16]	Musani, S
C-reactive protein and subclinical cardiovascular disease among African Americans: (The Jackson Heart Study)[17]	Fox, ER
Relation of obesity to circulating B type Natriuretic peptide concentrations in Blacks: The Jackson Heart Study[18]	Fox, ER
Relationships of BMI to cardiovascular risk factors differ by ethnicity[19]	Taylor, H

sity. Beginning in 2004, the scholars have annually visited the NIH campus in Bethesda, Maryland.

The Summer Mentored Undergraduate Research Experience is a significant milestone in the scholars' preparation for admission to, and success in, graduate and professional education. The program coordinator informs the scholars of the summer research internship component early in fall semester of their sophomore year. This includes information on placement opportunities and deadlines. Scholars apply to summer research programs at institutions or programs in the Jackson Area such as: the JHS; UMMC; JSU; TC; and the Veterans Administration Hospital. They also apply for national and international placements such as: the Minority Health International Research Training (MHIRT) Program; NIH; IMHOTEP; the Framingham Heart Study; and more than 36 universities and Health Sciences Centers. At least seven scholars have had the opportunity for international research internships in China, Thailand, Finland, Ghana, and Iceland.

The role of the program coordinator is contacting potential mentors, assisting scholars with the application process, matching mentors and mentees, monitoring scholars' progress; the mentors' evaluation process is a complex task. It requires expert communication and negotiation skills, patience, and persistence in supporting scholars, at varying levels of development, through the application process and the realities of travel, lodging, and mentor expectations. At the end of the summer internship, scholars submit an abstract of the research in which they were involved with their mentor. The program coordinator guides scholars in using their abstracts as frameworks for oral or poster presentations at local, regional, and national conferences such as: UMMC Research Day; JSU Health Disparities Conferences; Mississippi Academy of Sciences (MAS); Annual Biomedical Research Conference for Minority Students (ABRCMS); and American Public Health Association (APHA). Often the scholars have earned awards for their presentations. In some cases, scholars have participated with their mentors on a JHS Writing Group to develop a manuscript that is subsequently published.

Statistics

Data are collected annually on our scholars in a UTEC Research Electronic Data Capture (REDCap) database, inclusive of hometown, ACT score, sex, age, major area of study, institutions attended, degrees earned and position in the workforce. STATA 14 was used to construct our JHS Scholar profile in Table 1, and the status of graduated scholars in Table 3. Additionally, data were collected on graduation honors (eg, cum laude, magna cum laude, etc) from the Registrar's Office and Commencement Exercise Booklets on JHS Scholars and non-JHS Scholars who matriculated through the Natural Sciences Division and graduated with a GPA of >3.0. A Chi-square statistical test was used to examine the association between GPA and JHS Scholars vs non-Scholars.

Results

As of March 2015, 118 scholars have graduated from the JHS Scholars program. Of these, nearly 20% have completed degrees in medicine, dentistry, optometry, nursing and physical therapy. Nearly 6% have complet-

Table 3. Status of graduated scholars, degrees earned, enrolled in graduate/professional education; entered workforce, or lost to follow-up, N=118

Status of Graduated Scholars	n	%
Scholars who have completed degrees in medicine, dentistry, pharmacy, optometry, nursing and physical therapy	23	19.5
Scholars who have completed PhD degrees in biology, chemistry, English, pathobiology, biostatistics, public health or computer science	7	5.9
Scholars who hold dual degrees: MD/MPH; MD/PhD; MPH/DrPH; MPH/PhD or MPH/JD	6	5.1
Scholars who completed master's degree in public health, chemistry, neuroscience, biology, or biomedical science	23	19.5
Scholars who completed graduate degrees in law, education, business or English	11	9.3
Scholars enrolled in graduate/professional education, including medical school	30	25.4
Scholars who have entered the workforce	15	12.7
Scholars lost to follow-up	3	2.5
Total	118	100

Table 4. Number of Natural Sciences Division (NSD) JHS Scholars and non-JHS scholars graduating with <3.0 GPA, with honors, cum laude, magna cum laude and summa cum laude

	<3.0 GPA	With honors (GPA 3-3.19)	Cum laude (GPA 3.2-3.49)	Magna cum laude (GPA 3.5-3.79)	Summa cum laude (GPA 3.80-4.0)	Total
Non-JHS Graduates	75	59	46	28	4	212
JHS Graduates	0	7	29	24	15	75
Total	75	66	75	52	19	286

The academic performance of NSD non-JHS Scholars (n=212) and JHS Scholars (n=75) indicates a strong association; Chi-square=79.1337 (P<.000).

ed PhD degrees in biology, chemistry, biostatistics, public health, or computer science. A quarter (25.4%) are enrolled in graduate or professional programs, including; medicine, public health, nursing, pharmacy, biomedical science, chemistry, physics and mathematics. Scholars who have completed a master's degree in public health, chemistry, neuroscience or biomedical science total 19.5%. Nearly 10 percent (9.3%) have completed a post-baccalaureate degree in law, education, business or English. Approximately 13% have entered the workplace before completing post-baccalaureate education and <3% were lost to follow-up (Table 3).

Sixteen scholar graduates hold a master's degree in public health (MPH). Of these, six also hold MD and/or PhD or DrPH degrees and are working in positions that are related to health inequities and the advancement of health inequities research inclusive of hypertension and related target organ damage. These graduates hold positions including: training core director for the Johns Hopkins CVD Disparities Center; branch chief for Graduate Medical Education in the Health Research and Services Administration (HRSA) Division of Medicine and Dentistry; and, deputy bureau director, Office of Health Promotion and Health Equity, Mississippi State Department of Health. In informal conversations with our graduates in these positions, they credit the JHS UTEC for introducing them to public health, for opportunities to learn about the high rates of cardiovascular disease among African Americans in Mississippi, and for contributing to the foundation they have in public health.

JHS scholars show great proficiency upon graduation from Tougaloo, providing further evidence of the competitive edge they have developed over the three and a half years of their matriculation in the program. In all, the JHS Scholars Program has been responsible for 27% of the 246 Natural Science Division graduates during 2005-2015. All JHS scholars graduated from Tougaloo with a GPA of >3.0. The honors categories bestowed upon graduation are: with honors (GPA 3-3.19); cum laude (GPA 3.2-3.49); magna cum laude (GPA 3.5-3.79); and summa cum laude (GPA 3.80-4.0). Table 4 illustrates the significant statistical difference (P<.05) in the GPA of JHS scholars vs non-JHS scholars. Additional Chi-square statistical test (data not shown) indicated that for the years 2008, 2009, 2011, 2014 and 2015, there was no significant statistical difference in the GPA of JHS scholars and non-JHS scholars (P>.05). For the years 2005, 2006, 2007, 2010, 2012 and 2013 (data not shown), there was a significant statistical difference (P<.05) in the GPA of JHS scholars vs non-JHS scholars. In summary, in comparison with non-JHS scholars (n=212), being a JHS scholar (n=75) was associated with higher academic performance (Chi-square=79.1337, P<.000).

Discussion

The JHS Scholars Program includes features of several components of similar programs including: Summer Undergraduate Research Experiences and Course-Based Research Experiences;[20] Junge et al op.cit.[7]; and Bangera and Brownell.[8] Similar to Project Imhotep, operated at Morehouse College from 1982 to 2010, students participated in an intensive classroom experience that included introductory and intermediate courses in biostatistics, epidemiology, public health, bioethics, and health disparities along with scientific writing and presentation skills.[5] And, similar to the Minority Biomedical Research Support (MBRS) and Minority Access to Research Careers (MARC) Programs,

scholars received a stipend. Unlike Villerejo, Barlow, Kogan, Veazey and Sweeney,[21] we have not yet conducted an analysis of the influence the JHS Scholars Program on the graduates' career choices. Additionally, unlike Ghee, Collins, and Pearson,[6] we did not assess scholars' ratings of usefulness of their experiences in the program nor the impact of the program on their research career trajectories.

We learned valuable lessons over the last 16 years as we encountered challenges to implementing the UTEC. We learned that selecting the scholars during the second semester of their freshman year, rather than the first semester, gave us time to assess their classroom performance potential as indicated by end of semester grades. When we tied the stipend to the scholar's follow-through on presenting his/her research, we observed an increase in scholar presentations. We had to make a concerted effort to increase the number of males that we recruited because, in most years, our ratio of females to males was approximately 3:1. Once we discovered that all scholars benefited from a Mathematics and Reading Enhancement Program, we included it as a program requirement. Helping scholars to meet application deadlines for summer internship placement, and graduate/professional schools including EIP, required persistent reminders, and assistance with the process. We found that our program coordinator was an invaluable asset in addressing these and related scholar needs.

Capacity-building for career paths in Public Health and Biomedical Research for underrepresented minority students is indeed a JHS success model…

Capacity-building for career paths in Public Health and Biomedical Research for underrepresented minority students is indeed a JHS success model because: 1) the methods for selecting and educating scholars are embedded within the largest, single-site, prospective, epidemiological study of African Americans and CVD risk factors; 2) the content of the courses and hands-on-mentored summer research learning experiences include the realities of health inequities, health disparities and CVD risk factors for underrepresented minority populations; 3) graduates from the program choose a career path that leads them to and through graduate/professional programs to the optional acquisition of a PhD degree that assures their trajectory toward positions where they can participate in health inequity research; and 4) the program allows mentors at the summer research training sites opportunities to make a difference by ushering a JHS Scholar into graduate and/or professional school, and onto a career path in public health, health-related professions, biomedical research or related areas.

We attribute the successes of the JHS Scholars Program to: 1) a carefully executed process of selecting scholars who demonstrate the attributes and potential for success in an innovative and rigorous program of study; 2) working closely with the scholars in all aspects of the program; 3) a systematic process of mentoring scholars and monitoring their performance and progress; 4) the mentored Summer Undergraduate Research Experience followed by opportunities for the scholars to present their research; 5) dedicated and expert coordination and teaching provided by a multidisciplinary team; and 6) the awarding of federal funding support from NIH, both the NHLBI and National Institute on Minority Health and Health Disparities (NIMHD).

In terms of future research, we are interested in creating and testing a framework and process for evaluating the effectiveness of the JHS Scholars Programs and the other components of the UTEC. The trajectories that JHS scholars follow as their career interests develop during college and beyond, and how the scholars evaluate the usefulness of their scholar experience is also of great interest to us. These data could assist us in understanding the career development process that help underrepresented minority students in a liberal arts college make career choices on a path toward public health, health professions, biomedical research, and related careers.

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Disclaimer Statement

The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the National Heart, Lung, and Blood Institute; the National Institutes of Health; or the US Department of Health and Human Services.

Conflict of Interest

No conflicts to report.

Author Contributions

Research concept and design: White, Srinivasan, Henderson; Acquisition of data: White, Srinivasan, Fahmy, Henderson; Data analysis and interpretation: White, Srinivasan, Nelson, Fahmy, Henderson; Manuscript draft: White, Srinivasan, Nelson, Henderson; Statistical expertise: Henderson; Administrative: White, Srinivasan, Nelson, Fahmy, Henderson; Supervision: Srinivasan, Henderson

References

1. Taylor HA Jr, Wilson JG, Jones DW, et al. Toward resolution of cardiovascular health disparities in African Americans: design and methods of the Jackson Heart Study. *Ethn Dis*. 2005;15(4)(suppl 6):S6-S4, 17. PMID:16320381.
2. 2010 Census Interactive Population Map. *2010* Census Interactive Population Map. Available at: http://www.census.gov/2010census/popmap/. Accessed April 7, 2016.
3. Pearson TA. Capacity for research in minority health: the need for infrastructure plus will. *Am J Med Sci*. 2001;322(5):279-283. http://dx.doi.org/10.1097/00000441-200111000-00009.
4. Ruffin J, Flagg-Newton JL. Building capacity for health disparity research at minority institutions. *Am J Med Sci*. 2001;322(5):251-256. http://dx.doi.org/10.1097/00000441-200111000-00003. PMID:11721796.
5. Duffus WA, Trawick C, Moonesinghe R, Tola J, Truman BI, Dean HD. Training racial and ethnic minority students for careers in public health sciences. *Am J Prev Med*. 2014;47(5)(suppl 3):S368-S375. http://dx.doi.org/10.1016/j.amepre.2014.07.028. PMID:25439259.
6. Ghee M, Collins D, Wilson V, Pearson W Jr. The Leadership Alliance: twenty years of developing a diverse research workforce. *Peabody J Educ*. 2014;89(3):347-367. http://dx.doi.org/10.1080/0161956X.2014.913448.
7. Junge B, Quiñones C, Kakietek J, Teodorescu D, Marsteller P. Promoting undergraduate interest, preparedness, and professional pursuit in the sciences: an outcomes evaluation of the SURE program at Emory University. *CBE Life Sci Educ*. 2010;9(2):119-132. http://dx.doi.org/10.1187/cbe.09-08-0057. PMID:20516357.
8. Bangera G, Brownell SE. Course-based undergraduate research experiences can make scientific research more inclusive. *CBE Life Sci Educ*. 2014;13(4):602-606. http://dx.doi.org/10.1187/cbe.14-06-0099. PMID:25452483.
9. National Institutes of Health (2007, July 2008) "Research on interventions that promote research careers" (RO1) Department of Health and Human Services. http://grants.nih.gov/grants/guide/rfa-files/RFA-GM-08-005.html. Accessed June 27, 2016.
10. Srinivasan A, Brown J, Fahmy N, et al. Preparing African Americans for careers in health care: the Jackson Heart Study. *Ethn Dis*. 2005;15(4)(suppl 6):S6-S71, 75. PMID:16317988.
11. Subramanyam MA, Diez-Roux AV, Hickson DA, et al. Subjective social status and psychosocial and metabolic risk factors for cardiovascular disease among African Americans in the Jackson Heart Study. *Soc Sci Med*. 2012;74(8):1146-1154. http://dx.doi.org/10.1016/j.socscimed.2011.12.042. PMID:22381684.
12. Liu J, Hickson DA, Musani SK, et al. Dietary patterns, abdominal visceral adipose tissue, and cardiometabolic risk factors in African Americans: the Jackson heart study. *Obesity (Silver Spring)*. 2013;21(3):644-651. http://dx.doi.org/10.1002/oby.20265. PMID:23592674.
13. Hickson DA, Diez Roux AV, Gebreab SY, et al. Social patterning of cumulative biological risk by education and income among African Americans. *Am J Public Health*. 2012;102(7):1362-1369. http://dx.doi.org/10.2105/AJPH.2011.300444. PMID:22594727.
14. Sims M, Diez-Roux AV, Dudley A, et al. Perceived discrimination and hypertension among African Americans in the Jackson Heart Study. *Am J Public Health*. 2012;102(S2)(suppl 2):S258-S265. http://dx.doi.org/10.2105/AJPH.2011.300523. PMID:22401510.
15. Fox ER, Young JH, Li Y, et al; International Consortium for Blood Pressure Genome-wide Association Studies (ICBP-GWAS). Association of genetic variation with systolic and diastolic blood pressure among African Americans: the Candidate Gene Association Resource study. *Hum Mol Genet*. 2011;20(11):2273-2284. http://dx.doi.org/10.1093/hmg/ddr092. PMID:21378095.
16. Musani SK, Vasan RS, Bidulescu A, et al. Aldosterone, C-reactive protein, and plasma B-type natriuretic peptide are associated with the development of metabolic syndrome and longitudinal changes in metabolic syndrome components: findings from the Jackson Heart Study. *Diabetes Care*. 2013;36(10):3084-3092. http://dx.doi.org/10.2337/dc12-2562. PMID:23757435.
17. Sung JH, Lee JE, Samdarshi TE, et al. C-reactive protein and subclinical cardiovascular disease among African-Americans: (the Jackson Heart Study). *J Cardiovasc Med (Hagerstown)*. 2014;15(5):371-376. http://dx.doi.org/10.2459/JCM.0b013e32836411d6. PMID:24751480.
18. Fox ER, Musani SK, Bidulescu A, et al. Relation of obesity to circulating B-type natriuretic peptide concentrations in blacks: the Jackson Heart Study. *Circulation*. 2011;124(9):1021-1027. http://dx.doi.org/10.1161/CIRCULATIONAHA.110.991943. PMID:21824924.
19. Taylor HA Jr, Coady SA, Levy D, et al. Relationships of BMI to cardiovascular risk factors differ by ethnicity. *Obesity (Silver Spring)*. 2010;18(8):1638-1645. http://dx.doi.org/10.1038/oby.2009.407. PMID:19927137.
20. Jones MT, Barlow AEL, Villarejo M. Importance of Undergraduate Research for Minority Persistence and Achievement in Biology. *J Higher Educ*. 2010;81(1):82-115. http://dx.doi.org/10.1353/jhe.0.0082.
21. Villarejo M, Barlow AEL, Kogan D, Veazey BD, Sweeney JK. Encouraging minority undergraduates to choose science careers: career paths survey results. *CBE Life Sci Educ*. 2008;7(4):394-409. http://dx.doi.org/10.1187/cbe.08-04-0018. PMID:19047426.