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A Study on the Relation among Primary Care Professionals Serving the Disadvantaged Community, Socioeconomic Status, and Adverse Health Outcome

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***Abstract*—**During the post-Civil War era, the city of Nashville, Tennessee, had the highest mortality rate in the United States. The elevated death and disease rates among former slaves were attributable to lack of quality healthcare. To address the paucity of healthcare services, Meharry Medical College, an institution with the mission of educating minority professionals and serving the underserved population, was established in 1876.

Purpose: The social ecological framework and partial least squares (PLS) path modeling were used to quantify the impact of socioeconomic status and adverse health outcome on primary care professionals serving the disadvantaged community. Thus, the study results could demonstrate the accomplishment of the College's mission of training primary care professionals to serve in underserved areas.

Methods: Various statistical methods were used to analyze alumni data from 1975 – 2013. K-means cluster analysis was utilized to identify individual medical and dental graduates in the cluster groups of the practice communities (Disadvantaged or Non-disadvantaged Communities). Discriminant analysis was implemented to verify the classification accuracy of cluster analysis. The independent t-test was performed to detect the significant mean differences of respective clustering and criterion variables. Chi-square test was used to test if the proportions of primary care and non-primary care specialists are consistent with those of medical and dental graduates practicing in the designated community clusters. Finally, the PLS path model was constructed to explore the construct validity of analytic model by providing the magnitude effects of socioeconomic status and adverse health outcome on primary care professionals serving the disadvantaged community.

Results: Approximately 83% (3,192/3,864) of Meharry Medical College's medical and dental graduates from 1975 to 2013 were practicing in disadvantaged communities. Independent t-test confirmed the content validity of the cluster analysis model. Also, the PLS path modeling demonstrated that alumni served as primary care professionals in communities with significantly lower socioeconomic status and higher adverse health outcome ($p < .001$). The PLS path modeling exhibited the meaningful interrelation between primary care professionals practicing communities and surrounding environments (socioeconomic statues and adverse health outcome), which yielded model reliability, validity, and applicability.

Conclusion: This study applied social ecological theory and analytic modeling approaches to assess the attainment of Meharry Medical College's mission of training primary care professionals to serve in underserved areas, particularly in communities with low socioeconomic status and high rates of adverse health outcomes. In summary, the majority of medical and dental graduates from Meharry Medical College provided primary care services to disadvantaged communities with low socioeconomic status and high adverse health outcome, which demonstrated that Meharry Medical College has fulfilled its mission. The high reliability, validity, and applicability of this model imply that it could be replicated for comparable universities and colleges elsewhere.

***Keywords*—**Disadvantaged Community, K-means Cluster Analysis, PLS Path Modeling, Primary care

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I. Introduction

MEHARRY Medical College is the nation's largest private historically black institution for the education of health professionals. Medical students at Meharry Medical College are trained from a unique perspective of medical education and urban population research [1]. Dedicated to eliminating health disparities through education, research and patient care, Meharry Medical College is consistently recognized as a top producer of primary care medical specialists. Meharry Medical College's School of Dentistry program has also trained numerous healthcare professionals dedicated to providing care for underserved populations [2]. Historically, nearly three-quarters of Meharry Medical College's graduates practiced in the communities where they originated as well as rural areas and the inner city, where the greatest unmet health needs of the nation are found [3].

II. Factors Related to Health Professional Shortage

Educational costs and related debt are contributing factors to the U.S. physician shortage in underserved communities. Approximately 85 percent of medical school graduates in America had an education debt averaging $161,290. Medical graduates from private schools acquired an average of more than $250,000 in school debt. In 2011, medical school debt was 3.5 times higher than in 1978 [4]. Research suggests that debt influences on a physician's specialty choice, including demographics, personal interest in a specialty's content, patient care, and choice of lifestyle.

If the estimated debts are more than $200,000, primary care physicians have an opportunity to enroll in an extended repayment plan or federal loan repayment program such as Income-Based Repayment (IBR) or National Health Service Corps (NSHSC) to settle loans within an earlier time frame. Likewise, the more medical students borrow, the more likely they are to evaluate loan repayment options [4]. Research has shown that primary care physicians can make a comfortable living while practicing medicine in underserved communities. Therefore, a career as a primary care physician is economically viable in today's society.

The amount of student debt can also be a major factor for dental graduates' decisions regarding desired postgraduate workplace communities. Students with debt from $168,000 to $350,000 were three times less likely to pursue public service opportunities than those with debt less than $70,000. In addition, loan repayment program-participants were almost ten times more likely to plan public service careers than those not participating [5]. However, educational scholarship and loan repayment incentives alone cannot correct the misdistribution of the U.S. health care workforce [6]. Studies have shown that recruiting underrepresented minority (URM) students leads to a higher percentage of graduating students with intentions to serves in a disadvantaged community.

III. Statement of the Problem

As the active physician population continues to grow, the overall population will grow even faster, resulting in a decrease of physicians per capita [7]. The ratio of 280 physicians per 100,000 of population is predicted for the year 2020, a decrease from the 283 per 100,000 of population ten years earlier [7]. A deficit of 55,000 to 200,000 physicians is also projected to occur during the same period [7]-[10]. Compared to the U.S. minority population of 20 percent to 25 percent (Blacks, Latinos, Native Americans), only 7 to 10 percent of physicians are minorities [10]-[12]. Although Meharry Medical College is graduating a significant number of physicians who serve in disadvantaged and underserved communities, still there is a shortage of primary care physicians practicing in these communities.

Dental shortages and uneven geographic distribution are major concerns when decreasing the oral health inequality of disadvantaged communities [13]. Of the 14,700 shortage areas, 4,813 (33%) are related to dental care health professional shortage areas that are industrialized, over-crowded, and that accommodate more households with individuals living below the poverty line [13].

IV. Purpose of the Study

A retrospective study was designed to determine if Meharry Medical College's medical and dental graduates practice in environmentally disadvantaged areas that exhibit low socioeconomic status, high adverse health outcomes, and inadequate numbers of health care providers. Many of Meharry Medical College's students come from environmentally disadvantaged communities. Studies have shown these students are more likely to provide care to underserved populations when compared to other health professions students [14]. The purpose of this study was to quantify the impact of socioeconomic status and adverse health outcome on primary care professionals serving the disadvantaged community.

V. Population and Sample

Secondary data were extracted from Meharry Medical College's alumni tracking system which contained practicing specialties and locations from 1950 to 2013. All datasets were de-identified before being obtained for the study to protect the privacy of the graduates. A sample of 3,864 college graduates (2,464 medical and 1,400 dental) in years 1975 – 2013 was selected from a total of 6,896 college graduates (4,682 medical and 2,214 dental) in years 1950 – 2013 (See Fig. 1).

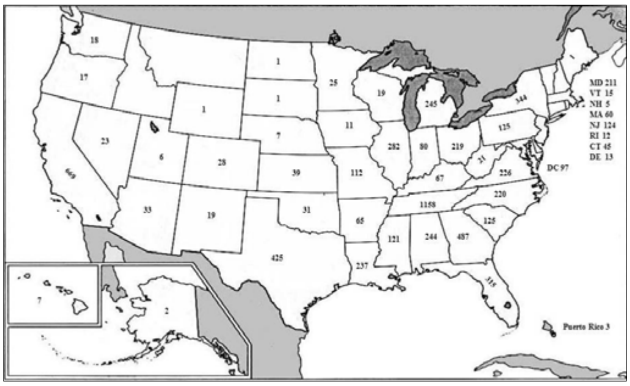

Fig. 1 Distribution of Medical and Dental Graduates in 1950-2013

VI. Statistical Methods

Five statistical methods were used in this study: K-means cluster analysis, discriminant analysis, independent t-test, chi-square test, and PLS path modeling. K-means cluster analysis [15], [16] was used to identify cluster groups for the graduates' practice communities (Disadvantaged and Non-disadvantaged Community). Discriminant analysis was implemented to verify the classification accuracy of cluster analysis. The independent t-test was applied to detect the significant mean differences of respective clustering and criterion variables between Disadvantaged and Non-disadvantaged Communities, which confirms the content validity of cluster analysis model. Chi-square test measured if the proportions of primary care and non-primary care specialties are consistent with those of medical and dental graduates practice in Disadvantaged and Non-disadvantaged Communities. Finally, the PLS path modeling approach explored the construct validity of analytics model by providing the magnitude effects of socioeconomic status and adverse health outcome on primary care professionals serving the disadvantaged community.

A. Brief Description of PLS Path Modeling

PLS path modeling is considered a soft rather than hard modeling approach when it imposes less stringent assumptions regarding the normal distributions of manifest and latent variables, the sample size, and the measurement scale [17].

PLS path model is constructed to estimate a network of causal relationships linking latent variables, each measured through a number of manifest variables. It is an iterative algorithm of performing factor analysis and least squares regression until R squared change is non-significant [18]. PLS path modeling yields magnitude interrelation by separating blocks of the measurement model (outer model) (relationship between each latent variable and its manifest variables), followed by estimating the path coefficients in the structural model (inner model) (relationships among latent variables).

In the measurement model, manifest variables are linearly connected to the corresponding latent variables according to a reflective scheme: the direction of causality is from the latent variable to its manifest variables; thus, observed measures are assumed to reflect variation in the latent variable [19]. In the structural model, the latent variable (endogenous variable) can be explained by all other latent variables (exogenous and other endogenous variables).

B. Social Ecological Theory

The social ecological theory and PLS path modeling approach were used to establish the interrelation between alumni primary care professionals serving the disadvantaged community and their social environments (socioeconomic status, adverse health outcome, and health professional shortage score). Based on social ecological theory, it was hypothesized that the impact of socioeconomic status and adverse health outcome on primary care professionals serving the disadvantaged community could be quantified. Also, primary care professionals serving the disadvantaged community related to a health professional shortage score could be measured. Adverse health outcome (adult obesity rate, age-adjusted premature mortality rate, and percent of people diagnosed with diabetes) could be affected by the latent variable, socioeconomic status (unemployment rate, poverty rate, percent of children who were in free lunch programs, and percent of uninsured adults), which, in turn, could influence alumni primary care professionals serving the disadvantaged community. Additionally, the health professional shortage score (health professional shortage scores from the Health Resources and Services Administration (HRSA) and type of metropolitan vs. rural area) could be attributed to primary care professionals serving the disadvantaged community.

VII. Study Variables

As shown in Table I, the cluster variables used for this study were median household income; unemployment rate; poverty rate; percent of children in free lunch program; percent of uninsured adults; and percent of uninsured children in the census tract where medical and dental graduates practice medical and dental care. Additionally, in Table I, the criterion variables for this study were adverse health outcomes such as adult obesity rate; percentage of people diagnosed with diabetes; and age-adjusted (< 75 years old) premature mortality rate.

TABLE I
STUDY VARIABLES AND DATA SOURCES

Variable Names	Variable Descriptions	Data Sources
median_hh_ income	The amount which divides the income distribution into two equal groups, half having income above that amount, and half having income below that amount.	United States Census Bureau
unemploy_ rate	A measure of prevalence of unemployment; it is calculated as a percentage by dividing the number of unemployed individuals by all individuals currently in the labor force.	United States of Labor, Bureau of Labor Statistics
poverty_rate	A measure of the percentage of households in poverty; It is calculated by using the sum of family income divided by the sum of poverty thresholds.	United States Census Bureau
child_free_ lunch	A measure of the percentage of children who participate in a federally assisted meal program.	United States Department of Agriculture
pct_uninsured_ adult	A measure of the percentage of adults who are without health insurance.	Small Area Health Insurance Estimates
pct_uninsured_ child	A measure of the percentages of children who without health insurance.	Small Area Health Insurance Estimates
adult_obese	A measure of the percentage of adults that report a BMI>=30.	Center for Disease Control and Prevention
age_mort	A measure of years of potential life lost before age 75 per 100,000 population (age-adjusted).	Center for Disease Control and Prevention
pct_diab	A measure of the percentage of adults diagnosed with diabetes. The data is taken from the Behavioral Risk Factor Surveillance System (BRFSS) Survey.	Center for Disease Control and Prevention
Disadvantaged (disadvantaged community = 1; non-disadvantaged community = 0)	Disadvantaged and Non-disadvantaged Communities were identified by K-mean cluster analysis based on clustering variables such as median household income and unemployment rate.	Small Area Health Insurance Estimates and Meharry Alumni Tracking System
primary_care (yes=1; no=0)	Primary care physicians and/or dentists provide comprehensive care to people, while those who in non-primary care provide specialized care to people.	Meharry Alumni Tracking System
hrsa_shortage	Health Professional Shortage Area (HPSA) Scores range from 1 to 25 for primary care. The higher the score, the greater the priority that needs the most healthcare services. HPSA scores are calculated by: score for population-to-full-time-equivalent primary care physician ratio + score for percent of population below poverty level + infant health index + score for travel distance/time to the nearest source of accessible healthcare outside the HPSA areas.	National Health Service Corps

VIII. Study Results

A. Results of K-mean Cluster Analysis

Approximately 83 percent (3,192/3,864) of medical and dental graduates in 1975-2013 were practicing in

Disadvantaged Communities while the remaining 17 percent (672/3,864) were working in Non-disadvantaged Communities.

B. Results of Discriminant Analysis

The results of cluster and discriminant analyses showed the classification accuracy. The first two cells (upper left cell and lower right cell) denoted the correctly classified numbers of medical and dental graduates. Specifically, the upper left cell, 99 percent, denoted the percent of graduates classified as health professionals serving a disadvantaged community in cluster analysis who were actually serving a disadvantaged community in discriminant analysis, and the lower right cell, 95 percent, denoted the percent of graduates classified as health professionals serving non-disadvantaged in cluster analysis who were actually serving non-advantaged in discriminant analysis. The overall classification accuracy was 98 percent, demonstrating the accuracy of the cluster analysis.

C. Independent t-Test Results for Clustering Variables

As shown in Table II, the independent t-test result indicated that the Disadvantaged Community had a significantly lower average median household income than the Non-disadvantaged Community ($p < .05$). Compared to the U.S. median household income of $53,981 [20], the Disadvantaged Community had a lower average median household income while the Non-disadvantaged Community had a higher average median household income.

For the unemployment and poverty rates, the independent t-test results showed that the Disadvantaged Community had significantly higher rates than the Non-disadvantaged Community ($p < .05$). Both communities had higher unemployment rates than the national statistic of 6.1 [21]. Although the national statistic for poverty rate of 16.0 [22] was lower than the Disadvantaged Community, it was higher than the Non-disadvantaged Community.

For the percent of children in the free lunch program, the independent t-test result revealed that the Disadvantaged Community had a significantly higher average percentage than the Non-disadvantaged Community ($p < .05$). However, both communities were lower than the national statistic of 62 [23].

By using an independent t-test, the results demonstrated that the Disadvantaged Community had a significantly higher average percentage of uninsured adults and children than the Non-disadvantaged Community ($p < .05$). Both communities had higher average percentages of uninsured adults and children than the national statistic of 15.4 [24]. However, the national statistic of 8.9 for uninsured children [24] was higher than both communities.

Overall, the Disadvantaged Community had higher mean values than the Non-disadvantaged Community in five clustering variables—unemployment rate, poverty rate, percent of children in free lunch program, percent of uninsured children, and percent of uninsured adults. However, the average median household income of the Non-disadvantaged Community was higher than that of the Disadvantaged Community. These findings met common sense expectations and demonstrated that the results of the cluster analysis were valid.

TABLE II
MEAN VALUES OF CLUSTERING VARIABLES

Community	Median Household Income/ (Unemploy Rate)	Poverty Rate	% of Children in Free Lunch Program	% Uninsured Adults (Children)
Disadvantaged [a] (N=3,192)	$43,568 (9.5)	19.3	52.5	24.6 (8.8)
Non-disadvantaged [a] (N=672)	$72,739 (7.6)	10.4	30.7	16.2 (6.3)
U.S. National Average *(As of date)*	$53,981 (6.1) *(June 2014)*	16.0 *(Nov. 2012)*	62.0 *(2013-2014 School Year)*	15.4 (8.9) *in 2012*

[a] $p < .05$ using independent t-test

TABLE III
MEAN VALUES OF CRITERION VARIABLES

Community	Adult Obesity Rate	Percent of People Diagnosed with Diabetes	Age-adjusted Premature Mortality Rate
Disadvantaged[a] (N=3,192)	29.5	10.1	401.0
Non-disadvantaged[a] (N=672)	24.4	8.4	282.9
U.S. National Average *(As of date)*	27.1 *(2013)*	9.3 *(2012)*	346.0 *(2009)*

[a] $p < .05$ using independent t-test

D. Independent t-test Results for Criterion Variables

As shown in Table III, the independent t-test result indicated that the Disadvantaged Community had a significantly higher average adult obesity rate than the Non-disadvantaged Community ($p < .05$). Compared to the national statistic of 27.1 [25], the Disadvantaged Community had a higher average percentage while the average percentage was lower in the Non-disadvantaged Community.

Of the percent of people diagnosed with diabetes, the independent t-test result showed that the Disadvantaged Community had a significantly higher average percentage than those from the Non-disadvantaged Community ($p < .05$). The national statistic of 9.3 [26] was lower than the Disadvantaged Community, yet higher than the Non-disadvantaged

Community.

Using independent t-test resulted in the Disadvantaged Community having a significantly higher average age-adjusted premature mortality rate than the Non-disadvantaged Community (p < .05). Although the national statistic for age-adjusted premature mortality rate of 346.0 [27] was lower than the Disadvantaged Community, it was higher than the Non-disadvantaged Community.

Overall, the Disadvantaged Community was higher than the Non-disadvantaged Community in average adult obesity rate, average percent of people diagnosed with diabetes, and average age-adjusted premature mortality rate. These findings also met common sense expectations and demonstrated that the cluster analysis yielded high criterion validity.

E. Chi-square Test Results for Pattern Differences

The chi-square test results (p < .05) for primary and non-primary care specialties in both communities showed that the Disadvantaged Community had a significantly higher percentage of medical and dental graduates practicing in primary care than that of the Non-disadvantaged Community (56 percent vs. 49 percent). In contrast, the Non-disadvantaged Community had a significantly lower percentage of medical and dental graduates practicing in primary care than that of the Disadvantaged Community (44 percent vs. 51 percent). Both communities had a higher percentage 55 percent ((1,785+331) / (3,192+672)) of medical and dental graduates practicing in primary care than the national figure of 39 percent ((204,210 + 125,800) / (691,400 + 146,800)) [28].

F. Results of PLS Path Modeling

The depiction of outer weights in Table IV demonstrated that among all 11 manifest variables (unemployment rate, poverty rate, percent of children in free lunch program, percent of uninsured adults; adult obesity rate, percent of people diagnosed with diabetes, age-adjusted premature mortality rate, disadvantaged/non-disadvantaged community, primary care/non-primary care, health resource shortage area, metropolitan/non-metropolitan) in the outer model, outer weights were positively and significantly associated with four latent variables based on 95% confidence intervals not containing the null value of zero.

As shown in Fig. 2, the primary care serving the disadvantaged community significantly depended on socioeconomic status (path coefficients = 0.391 with p < 0.001) and adverse health outcome (path coefficients = 0.272 with p < 0.001). Thus, the impact and contribution of both socioeconomic status and adverse health outcome to primary care professionals serving the disadvantaged community can be written in the following model equation: Primary Care Professionals Serving Disadvantaged Community = 0.391*Socioeconomic Status + 0.272*Adverse Health Outcome. The R squared value of 0.363 shown in Table VI indicated that approximately 36 percent of the variation in primary care professionals serving the disadvantaged community can be explained by socioeconomic status and adverse health outcome.

TABLE IV
SIGNIFICANT OUTER WEIGHTS OF THE MANIFEST VARIABLES

Latent Variable	Manifest Variable	Outer Weight	95% Confidence Interval Lower Limit	95% Confidence Interval Upper Limit
Socioeconomic Status	unemploy_ rate	0.00415	0.00383	0.00446
	poverty_ rate	0.02191	0.02119	0.02279
	child__ free_lunch	0.05574	0.05449	0.05720
	pct_uninsure_ adult	0.01318	0.01234	0.01402
Adverse Health Outcome	adult_ obese	0.00044	0.00041	0.00046
	pct_diab	0.00017	0.00016	0.00018
	age_mort	0.01179	0.01147	0.01207
Primary Care Professionals Serving Disadvantaged Community	disadvantaged	2.54430	2.42915	2.66153
	primary_ care	0.44061	0.17340	0.63790
Health Professional Shortage Score	hrsa_ shortage	0.22290	0.21358	0.23983
	metro_ type	0.05212	0.03986	0.08286

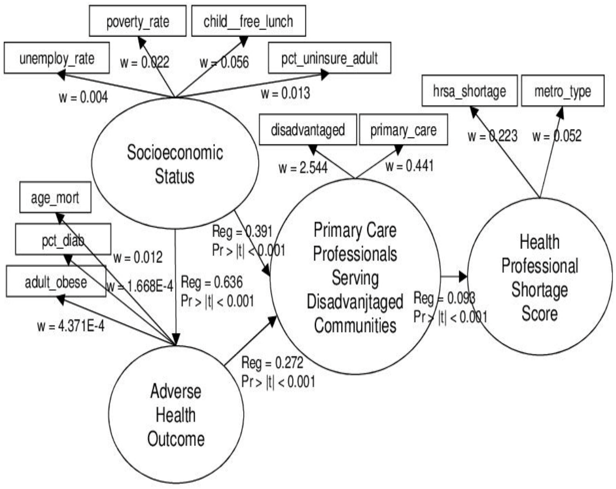

Fig. 2 PLS Path Model Diagram

As displayed in Fig. 2, socioeconomic status was significantly related to adverse health outcome (path coefficients = 0.634 with p < 0.001). Thus, the model equation can be written as Adverse Health Outcome = 0.636*Socioeconomic Status with the R squared value of 0.405 (Table VI) indicating that approximately 41 percent of the variation in adverse health outcome can be explained by socioeconomic status. Also, the study results showed that health professional shortage score was significantly affected by primary care professionals serving the disadvantaged community (path coefficient = 0.093 with p < 0.001) although the impact was very small with R squared value of approximately 1%.

XLSTAT software [29] was used to perform PLS path modeling analysis involving only reflective indicators and the centroid scheme for the inner estimation. A preliminary analysis for verifying the composite reliability of blocks is required because each reflective block represents only one latent construct (one dimension). The composite reliabilities (D.G. rho) for socioeconomic status (0.940), adverse health outcome (0.999), and health professional shortage score (0.991) were greater than 0.7 and very satisfactory demonstrating that individual reflective block was one-dimensional latent variable. Also, the composite reliability for primary care professionals serving the disadvantaged community (0.673) was close to 0.7 and satisfactory.

Also, the goodness of fit (GoF) indices for both the structural sub-model (i.e., inner model specifies the relationships among latent variables) and measurement sub-model (i.e., outer model specifies the relationships between individual latent variable with its manifest variables) were significant (95% confidence intervals of GoF value not containing zero) and very satisfactory with absolute GoF values of 0.944 and 0.737, respectively, which yielded large contribution of variations in PLS path model.

TABLE V
CROSS-LOADINGS

Manifest Variables	Socio-economic Status	Adverse Health Outcome	Primary Care Professionals Serving Disadvantaged Community	Health Professional Shortage Score
unemploy_rate	***0.454***	0.289	0.351	0.061
poverty_ rate	***0.876***	0.675	0.613	0.119
child__ free_ lunch	***0.994***	0.634	0.525	0.171
pct_ uninsure_ adult	***0.570***	0.173	0.519	0.097
adult_ obese	0.364	***0.738***	0.425	0.024
pct_diab	0.390	***0.721***	0.355	0.055
age_mort	0.637	***1.000***	0.521	0.122
disadvantaged	0.580	0.529	***0.976***	0.077
primary_ care	0.022	0.050	***0.268***	0.084
hrsa_ shortage	0.164	0.116	0.088	***1.000***
metro_ type	0.225	0.273	0.214	***0.197***

In addition, the results of the bootstrap estimation of the standardized loadings (correlation coefficients) of manifest variables are listed in Table V. These cross-loadings are capable of validating discriminant validity [19]. PLS path model might be appropriate for this study because the study results indicated that all manifest variables had a higher correlation with its respective latent variable than with other latent variables with the exception of metro type. For example, the first four manifest variables (unemploy_rate, poverty_rate, child_free_lunch, and pct_unisure_adult) had higher association (correlation coefficients being 0.454, 0.876, 0.994, and 0.570, respectively) with the socioeconomic status than the other latent variables (adverse health outcome, primary care professionals serving disadvantaged community, and health professional shortage score). Therefore, they were grouped and labeled together as socioeconomic status. The second factor, adverse health outcomes, was related to three manifest variables (adult_obese, pct_diab, and age_mort). These variables had higher correlation coefficients of 0.738, 0.721, and 1.000, respectively, as compared to the other latent variables (socioeconomic status, primary care professionals serving disadvantaged community, and health professional shortage score). Therefore, they were grouped and labeled together as adverse health outcome. Primary care professionals serving the disadvantaged community seemed to be the theme of the third component, which included disadvantaged community (correlation coefficient=0.976) and primary care specialty (correlation coefficient=0.268). The correlation coefficients were higher in relation to the third latent variable as compared to other latent variables (socioeconomic status, adverse health outcome, and health professional shortage score). Therefore, they were grouped and labeled together as primary care professionals serving the disadvantaged community.

Table VI displays the R squared values for latent variables with their respective manifest variables, together with the mean communality index and Dillon-Goldstein (D.G.) rho [30]. The R squared value measures the model fittings, indicating that the R squared value represents the percentage (41%, 36%, and 1%, respectively) of variances in manifest variables explained by individual latent variables such as adverse health outcome, primary care professionals serving disadvantaged community, and health professional shortage score. The mean communality index shows the ability of each latent variable to explain its own manifest variables. The latent variables explained their own manifest variables well since the mean communalities index (average variance extracted) was higher than 0.5 for all four latent variables. D.G. rho values for socioeconomic status and adverse health outcome were greater than 0.7 indicating the existence of the homogeneity [30]. Also, D.G. rho values for primary care professionals serving the disadvantaged community and health professional shortage score were almost 0.7 to indicate that the homogeneity somewhat exists (Note: The latent variable was considered homogeneous due to D.G. rho being greater than 0.7).

TABLE VI
PLS PATH MODEL ASSESSMENT

Latent Variable	Type	R^2	Mean Communalities (AVE[a])	D.G. rho
Socioeconomic Status	Exogenous		0.572	0.830
Adverse Health Outcome	Endogenous	0.405	0.688	0.866
Primary Care Professionals Serving Disadvantaged Community	Endogenous	0.363	0.512	0.613
Health Professional Shortage Score	Endogenous	0.009	0.519	0.598

[a]AVE – Average Variance Extracted

IX. CONCLUSIONS, IMPLICATIONS, AND ALTERNATIVES

Although there has been an increase in the number of medical and dental graduates nationwide, many are not practicing in disadvantaged communities. Educating and motivating medical and dental students on the importance of serving the underserved after graduation contributes to the health professional workforce development in the United States. Increasing the number of health professionals in the disadvantaged communities might not only decreases health disparities, but might also increase the quality of health in the nation.

Of the 3,864 medical and dental graduates in years 1975 - 2013, 83% were practicing in a disadvantaged community. Also, medical and dental students from disadvantaged communities were more likely to practice in primary care specialty than non-primary care specialty (56% vs 44%). In addition, Meharry Medical College had a higher percentage (55%) of medical and dental graduates practicing in primary care than the national figure of 39%. Furthermore, approximately 95% of medical and dental graduates served in health professional shortage areas designated by the U.S. Department of Health and Human Services. These important findings indicated that the medical and dental graduates from Meharry Medical College were upholding the College's mission of training primary care professionals to serve disadvantaged communities, including communities with higher adult obesity rates, percentages of people diagnosed with diabetes; and age-adjusted (< 75 years old) premature mortality rates. Finally, PLS path modeling demonstrated that medical and dental graduates as primary care professionals serving the disadvantaged community were significantly affected by two latent variables (socioeconomic status and adverse health outcome). These latent variables had a higher impact (path coefficient) on primary care professionals serving the disadvantaged community.

This study accomplished its primary purpose by applying social ecological theory to assess the impact of socioeconomic status and adverse health outcome on primary care professionals serving the disadvantaged community. Moreover, the study demonstrated the success of Meharry Medical College's mission of training primary care professionals to serve in underserved areas. More importantly, a great deal of effort was involved in verifying the model reliability and validity, and assuring the model fittings, enabling the model to be applied to comparable colleges and universities elsewhere.

However, there is an alternative in the foreseeable future. The researchers may not only be interested in the direct effect of the relationship between primary care professionals serving the disadvantaged community and their surrounding environments, but also the moderating effect (interaction effect between socioeconomic status and adverse health outcome) that could influence the strength and direction of relationships among latent variables (exogenous and endogenous variables).

Moreover, in order to achieve the highest degree of the validity in this study, researchers need to include more theoretically relevant variables, such as the level of environmental disadvantage of students prior to their matriculation and the indebtedness of Meharry Medical College's graduates. In previous literature, health professionals from an underserved background were more likely to practice in such an environment, and were more than likely to remain in this environment from four to sixteen years after graduation [31]. Additionally, participants in financial-incentive program were more likely to work in underserved areas in the long run, even though they may not stay at the sight of their original placement [32]. These two variables were not available for individual students and graduates at the time of this study, however future studies may include these factors in the analysis.

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