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

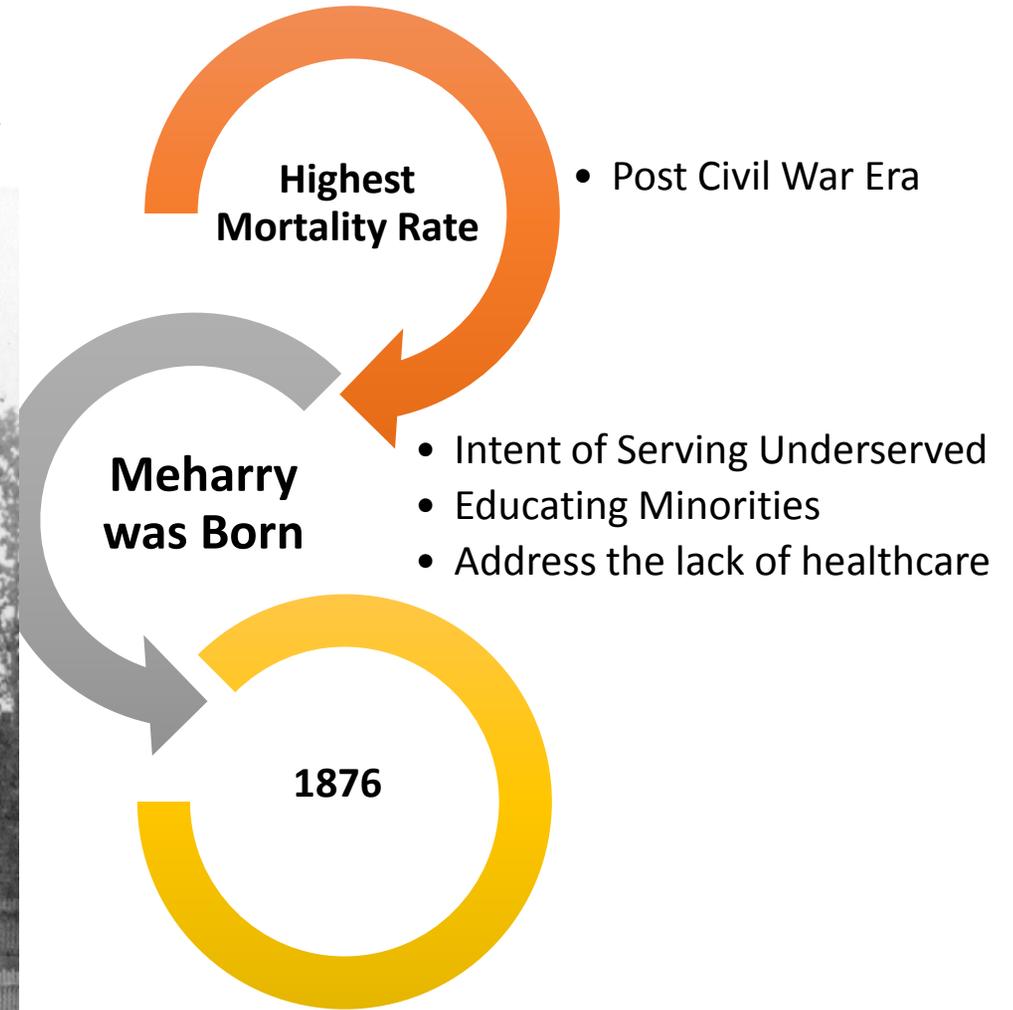
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Background Information



Courtesy Meharry Medical College Archives



Meharry Medical College

Committed to our motto:
“Worship of God Through Service to Mankind”
as a United Methodist Church related institution



Meharry Medical College...

- Three schools: the School of Medicine, the School of Dentistry, and the School of Graduate Studies and Research
- Approximately 800 students enrolled in all three schools combined; predominantly African American, inclusive of Caucasian, Asian, Hispanic, and Native American students

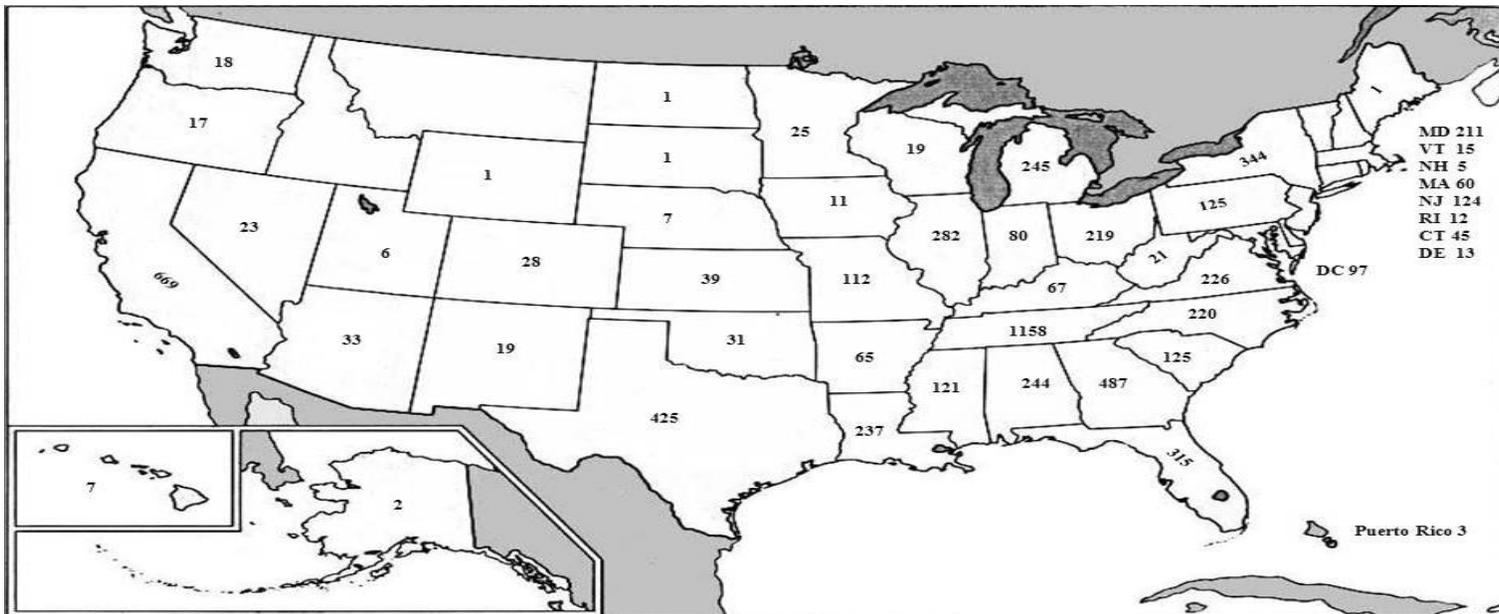


Meharry Medical College...

- Employs nearly 1,000 faculty, staff and residents
- Total endowment, approximately \$125 million, is the second highest among Nashville-area colleges and universities

Meharry Medical College

Nearly 7,000 alumni nationwide



Mission Statement

Meharry Medical College is an academic health center that exists to improve the health and health care of minority and underserved communities by offering excellent education and training programs in the health sciences. True to its heritage, Meharry places special emphasis on providing opportunities for people of color, individuals from disadvantaged backgrounds, and others regardless of race or ethnicity; delivering high quality health services; and conducting research that fosters the elimination of health disparities.

Study Objectives

- To quantify the impact of socioeconomic status and adverse health outcomes on primary care professionals serving disadvantaged communities.
- To assess if Meharry accomplished its mission:
 - to train primary care physicians and dentists to serve underserved communities
 - to improve the health and health care of minority and underserved communities.

Statement of the Problem (1 of 2)

Physician Shortage

- In 2020, there will be a deficit of 55,000 to 200,000 physicians in the United States.
- Only 9% of physicians practice in rural and underserved areas--a shortage of primary care physicians practicing in disadvantaged and underserved communities.
- Only 7% to 10% of physicians are minorities while 20% to 25% of the U.S. population are minorities.

- Cooper et al., 2012
- Murkowski, 2007; Chen, 2009

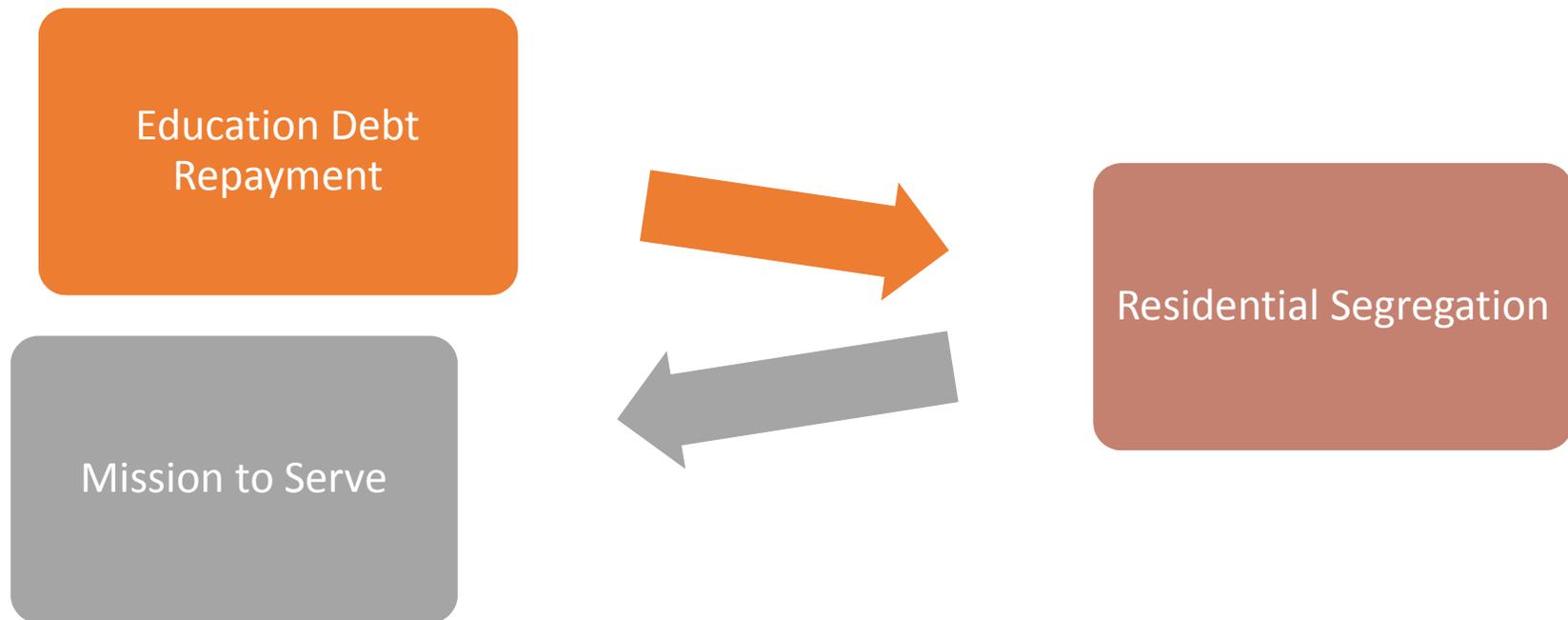
Statement of the Problem (2 of 2)

Dentist Shortage

- Dentist shortage and uneven geographic distribution are major concerns when decreasing the oral health inequality of disadvantaged communities.
- Of the 14,700 health professional shortage areas, 4,813 (33%) are related to dental care, which are industrialized, over-crowded, and households of more individuals live below the poverty line.

U.S. Department of Health & Human Services, 2014

Factors Influencing Primary Care Professionals To Practice in Underserved Communities



Education Debt Repayment

- Medical graduates from private schools - \$250,000 in debt.
- Primary care physician (PCP) debts over \$200,000
 - IBR (Income Based Repayment)
 - NHSC (National Health Service Corps)
- PCPs can live comfortably while practicing in underserved areas.

(Youngclaus et al., 2013)

Residential Segregation

- Residential segregation refers to geographical locations where minorities or people of similar ethnic backgrounds reside.
 - segregated communities may experience PCP shortages.
- African Americans have less geographic access to PCPs in segregated communities.
- The odds of being a PCP shortage area were 67% higher for majority African American zip codes compared to all other zip codes.

(Gaskin et. al, 2012)

Mission to Serve

- More than 80 percent of medical and dental students at Meharry Medical College come from environmentally disadvantaged communities.

(Colette Davis, Chau-Kuang Chen, Juanita Buford, and Vanisha L. Brown, 2014)

- A top producer of primary care physicians; ranked second among 141 academic health science centers in the “social mission” of medical education.

(Meharry Facts at a Glance, 2014)

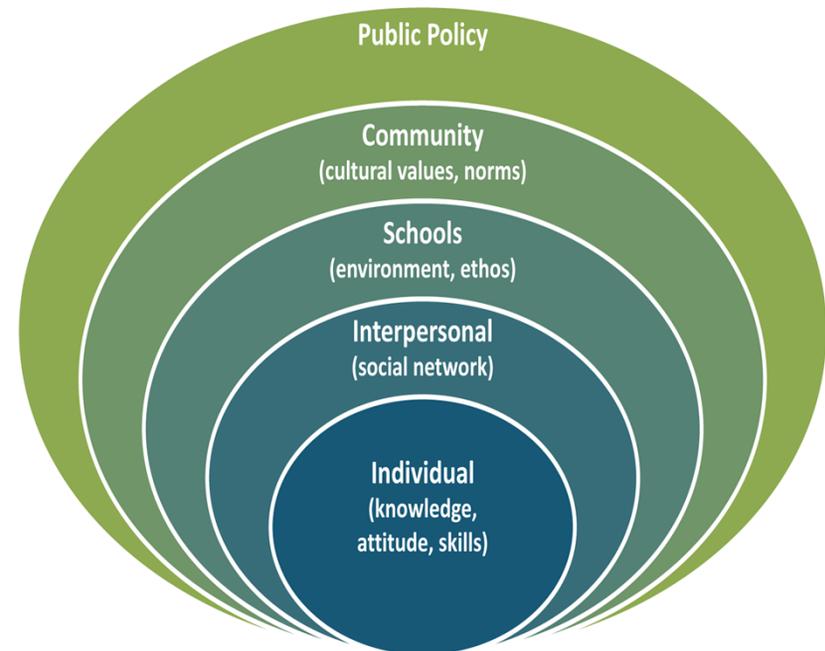
- Studies have shown students from environmentally disadvantaged backgrounds are more likely to provide care to underserved populations when compared to other health professions students.

(John Hopkins Medicine, What are disadvantaged students, 2013, Retrieved from <http://www.hopkinsmedicine.org/geneticmedicine/residency/Disadvantaged.html>)

Social Ecological Model (1 of 2)

The social ecological model provides a framework for examining and understanding decisions for an individual to practice medicine or provide care to medically disadvantaged and underserved or racial/ethnic minority populations.

(Elder et al, 2006)



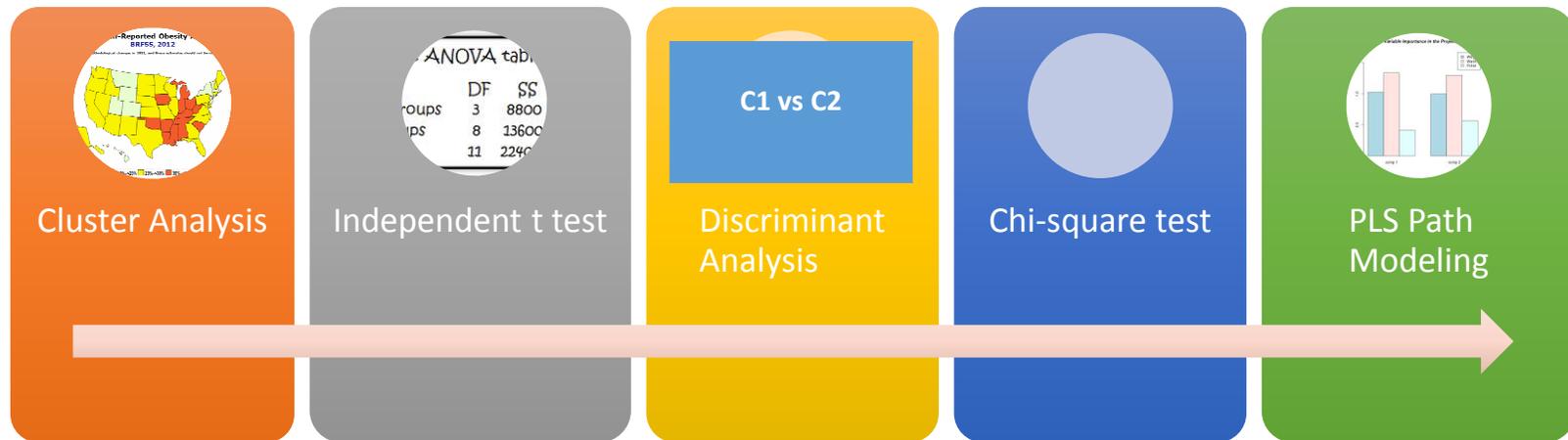
Social Ecological Model (2 of 2)

It was hypothesized:

The impact of socioeconomic status and adverse health outcomes on primary care professionals serving disadvantaged communities could be quantified.

Primary care professionals serving disadvantaged communities related to a health professional shortage score can be measured.

Statistical Methods



Statistical Methods (1 of 5)

K-means Cluster Analysis:

To group medical and dental graduates' locations of practice in two clusters (disadvantaged and non-disadvantaged communities)

Statistical Methods (2 of 5)

Independent t test:

To demonstrate the “content validity” of cluster analysis by comparing mean differences of clustering variables (socioeconomic status) and criterion variables (adverse health outcomes) between two clusters, respectively

Statistical Methods (3 of 5)

Discriminant analysis:

To verify the “classification accuracy” of cluster analysis

Statistical Methods (4 of 5)

Chi-square test:

To test 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

Statistical Methods (5 of 5)

PLS Path Modeling:

To explore the “construct validity” of cluster analysis by providing the effects of socioeconomic status and adverse health outcomes on primary care professionals serving disadvantaged communities

Census Tract

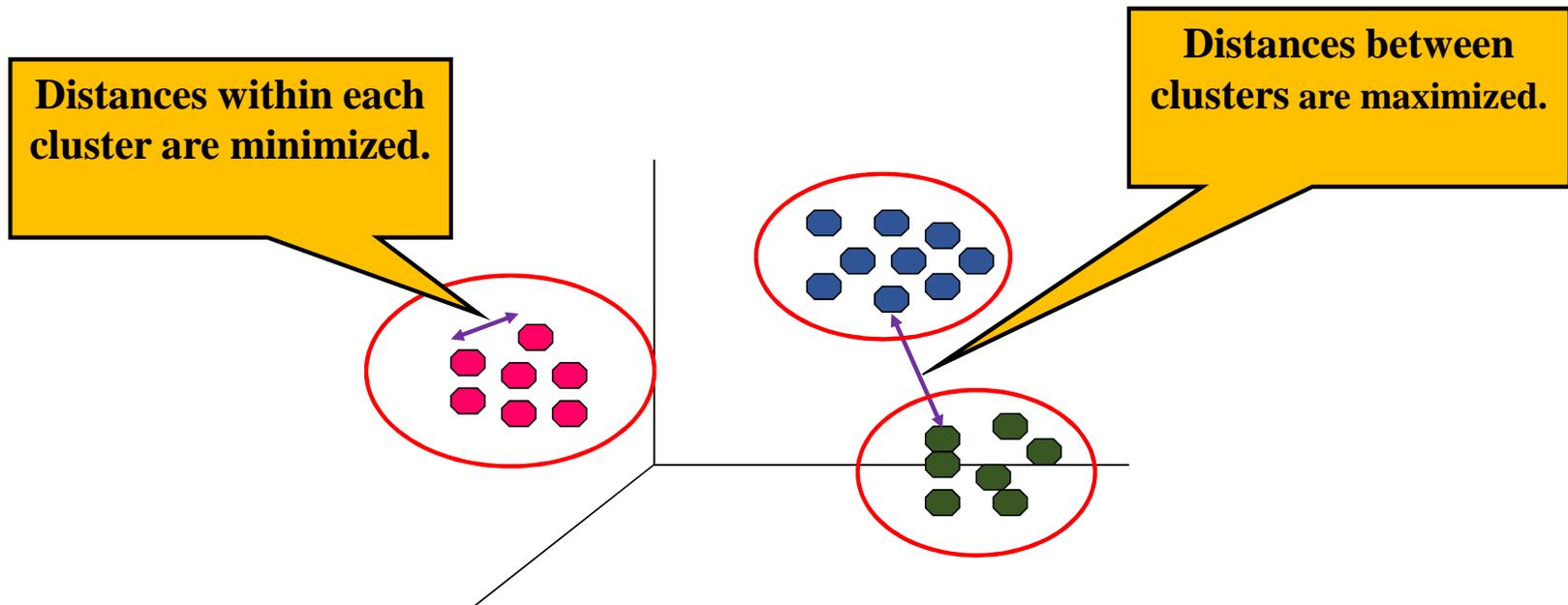
(U.S. Census Bureau Definition)

A census tract or census area is a geographic region defined for the purpose of taking a census.

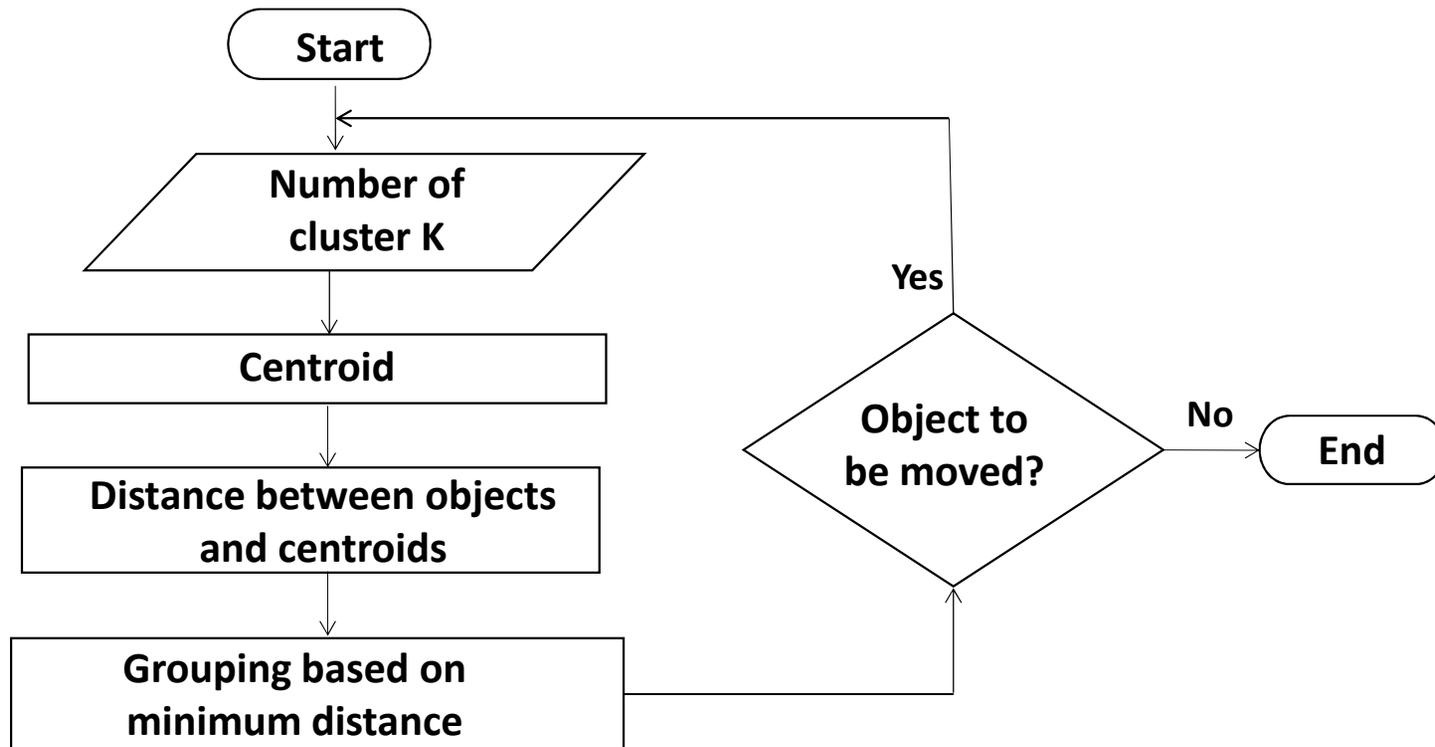
Census tracts are “Designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions, census tracts average about 4,000 inhabitants”.

Cluster Analysis

- A method of identifying homogenous groups of data points called cluster analysis
- A grouping of data points such that the points within a group are similar (or related) to one another and different from (or unrelated to) the points in other groups



K-Means Cluster Analysis



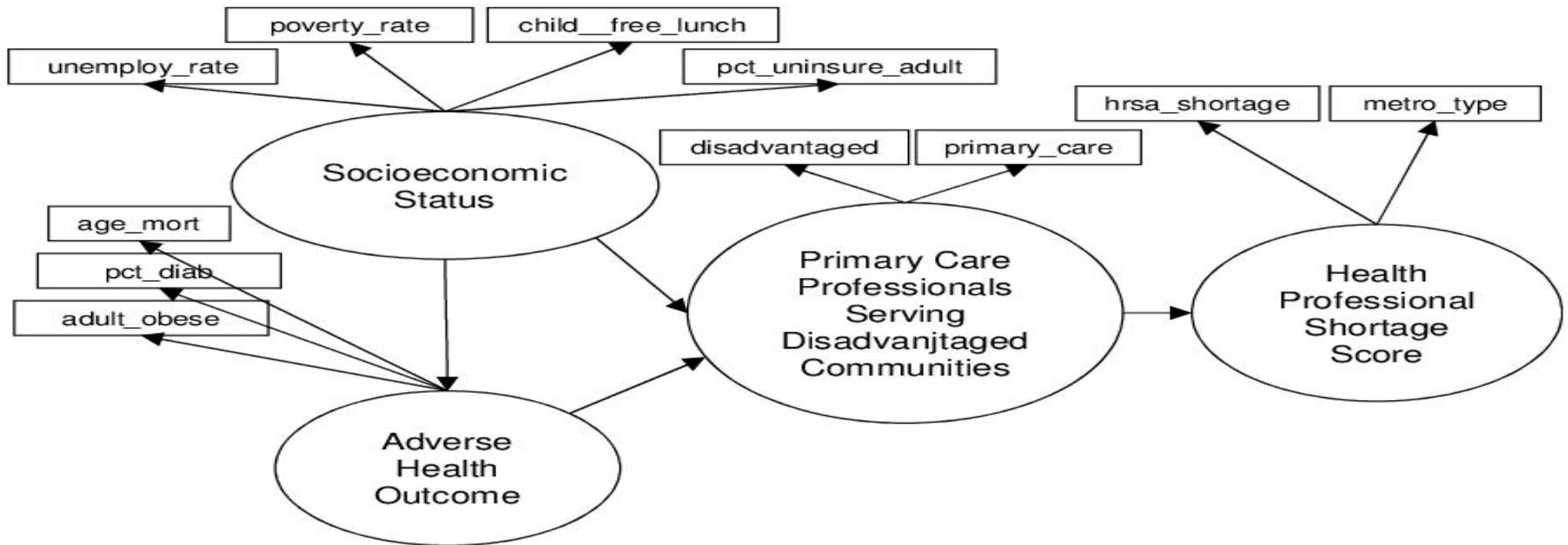
PLS Path Modeling (1 of 7)

It is a “soft” modeling approach imposing less stringent assumptions:

- Distributions of manifest, latent variables, and error terms
- Sample size
- Measurement scale

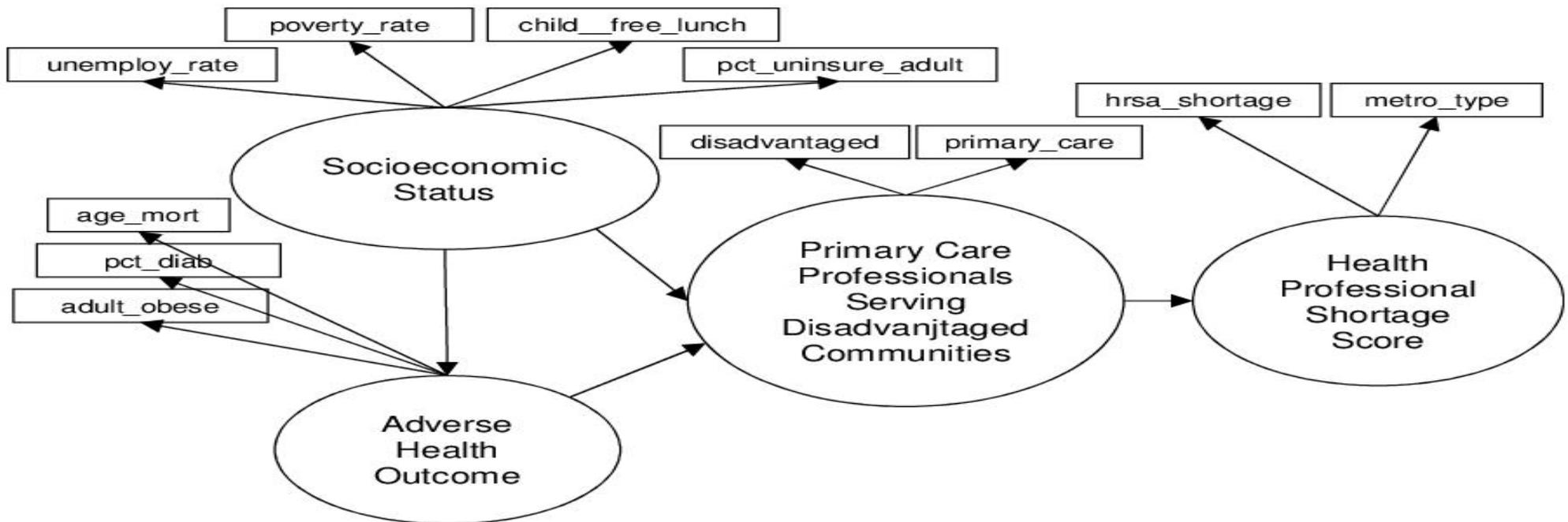
PLS Path Modeling (2 of 7)

It can be used to estimate a network of causal relationships linking latent variables that are measured through a number of manifest variables.



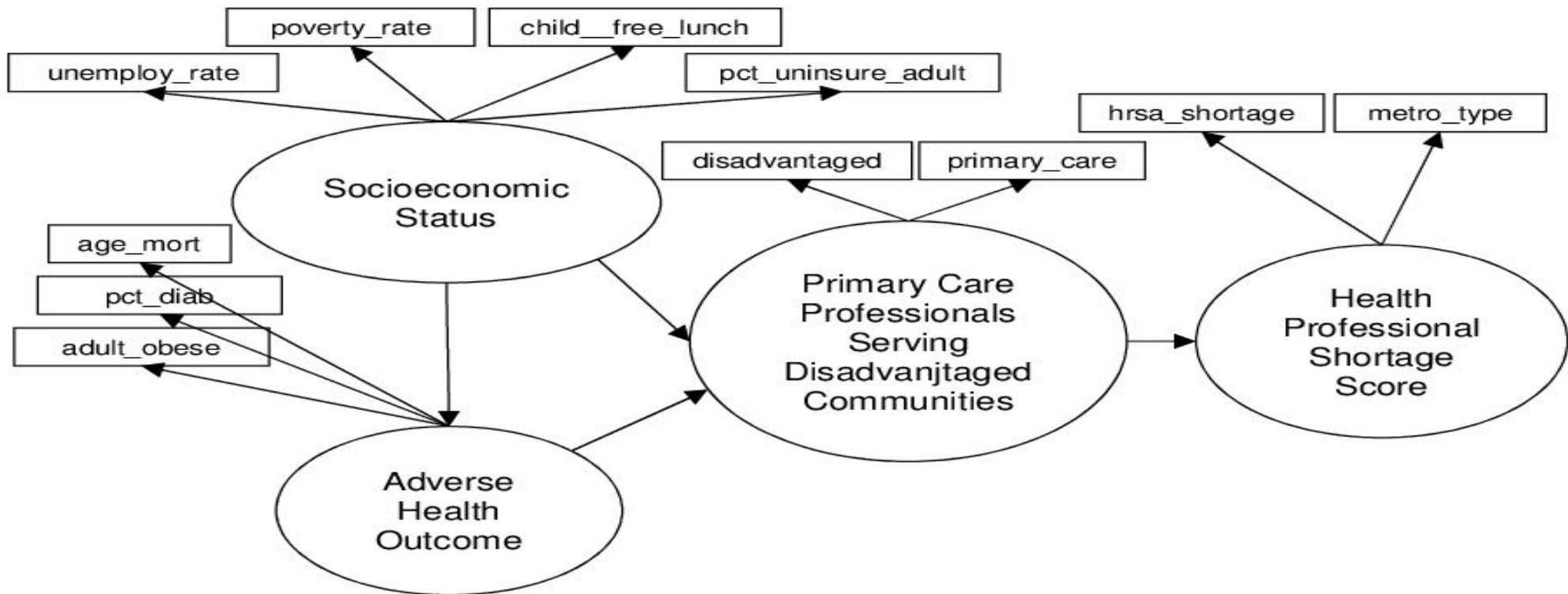
PLS Path Modeling (3 of 7)

It is an iterative algorithm of performing factor analysis and least squares regression until the change of R squared values is non-significant.



PLS Path Modeling (4 of 7)

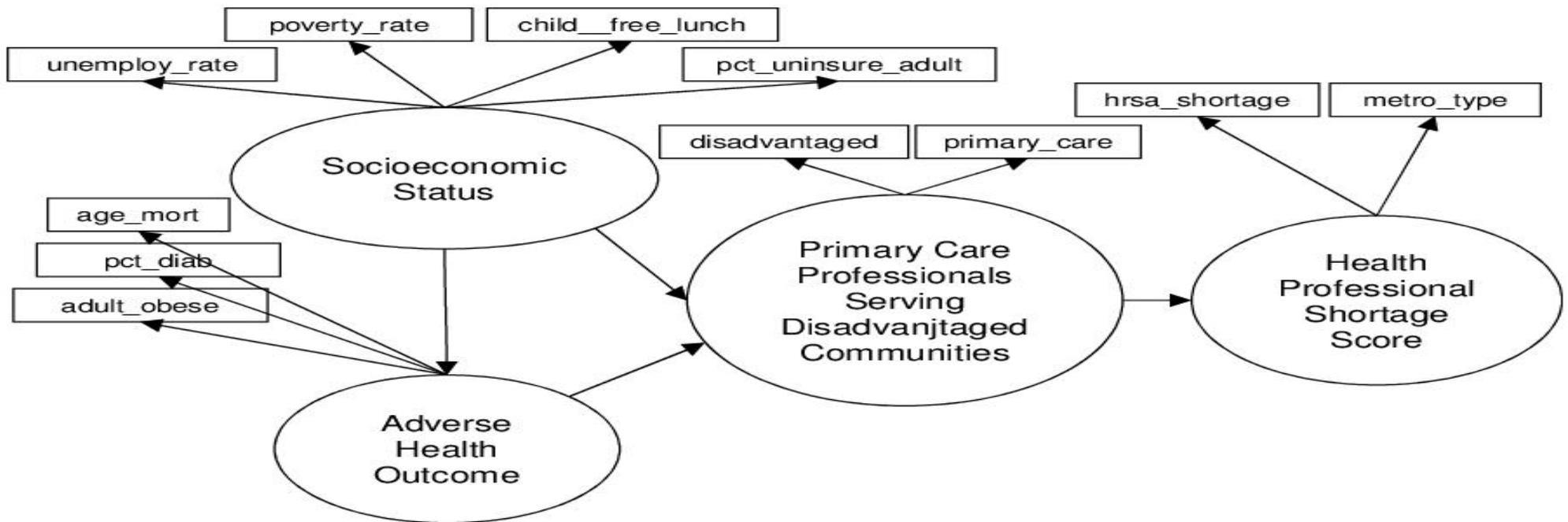
It yields magnitude interrelation by separating blocks of the measurement model (**outer model**), followed by estimating the path coefficients in the structural model (**inner model**).



PLS Path Modeling (5 of 7)

Measurement Model (Outer Model):

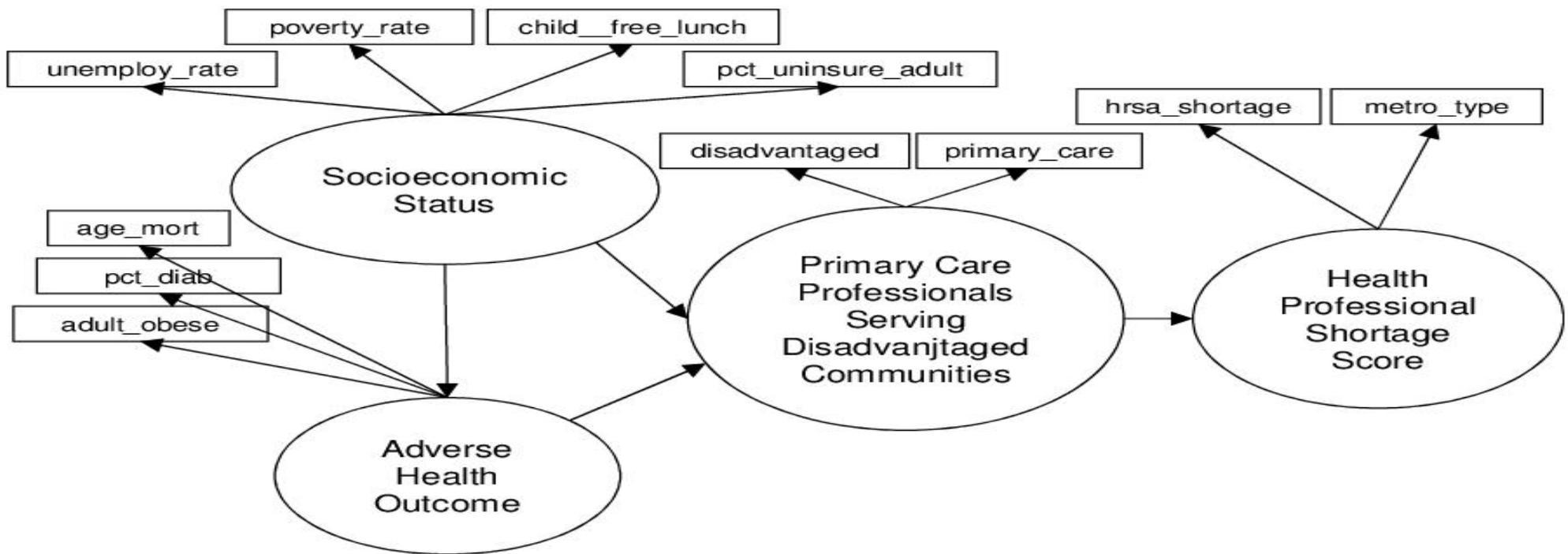
Manifest variables are linearly connected to the corresponding latent variables according to a reflective scheme: the direction of causality is from the latent variable to its manifest variables; thus, observed measures are assumed to reflect variation in the latent variable.



PLS Path Modeling (6 of 7)

Structural Model (Inner Model):

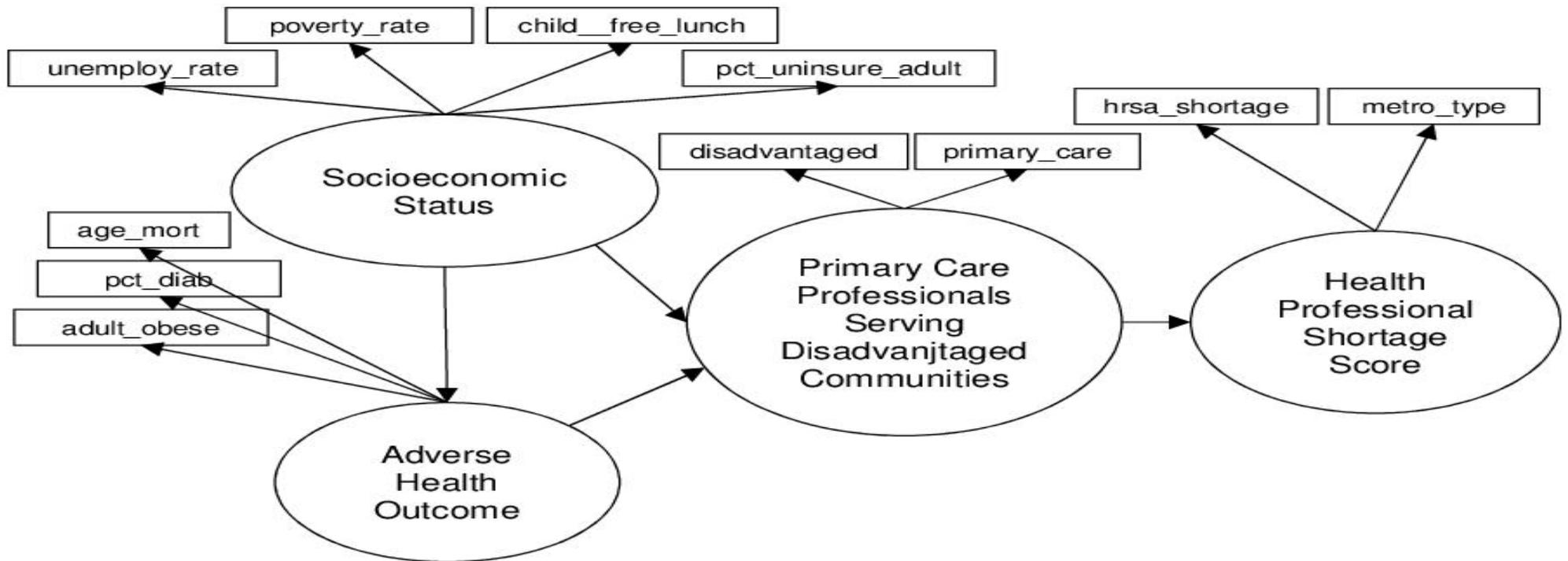
The latent variable (endogenous variable) can be explained by all other latent variables (exogenous and other endogenous variables).



PLS Path Modeling (7 of 7)

Measurement Model (Outer Model):

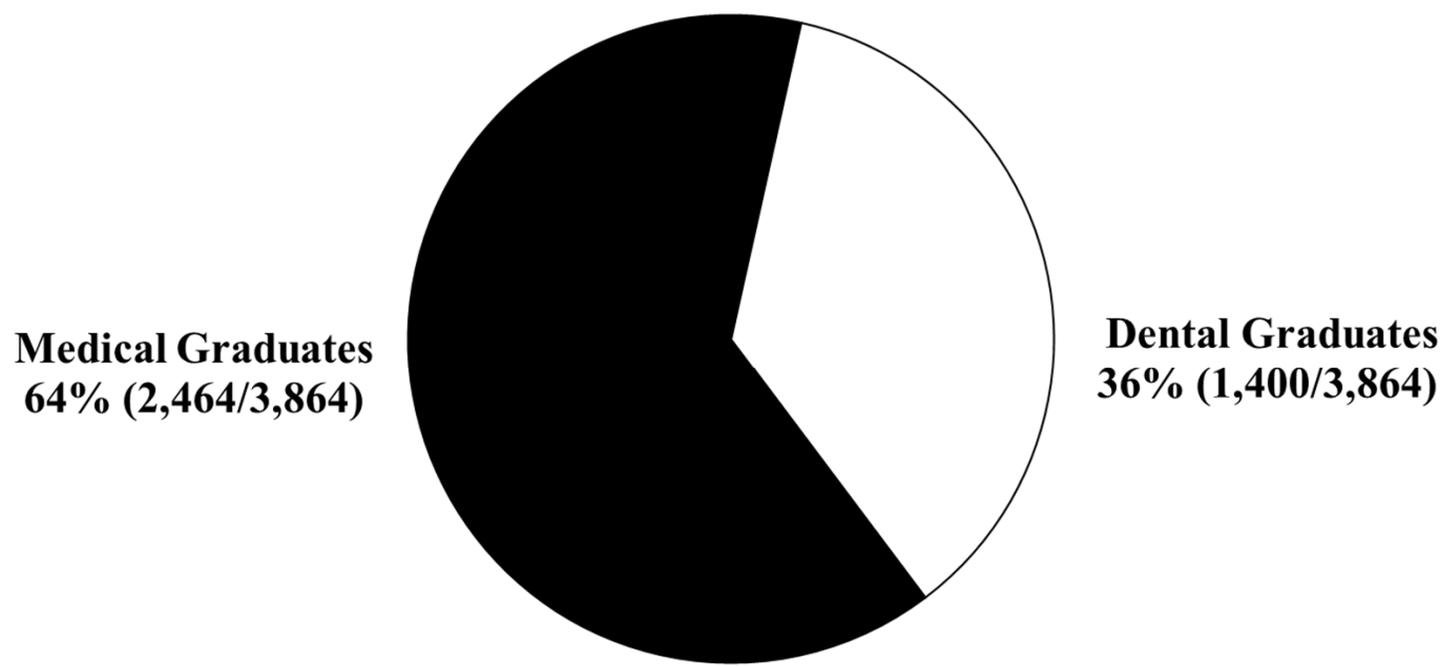
It can be used to construct both reflective and formative measurement models.



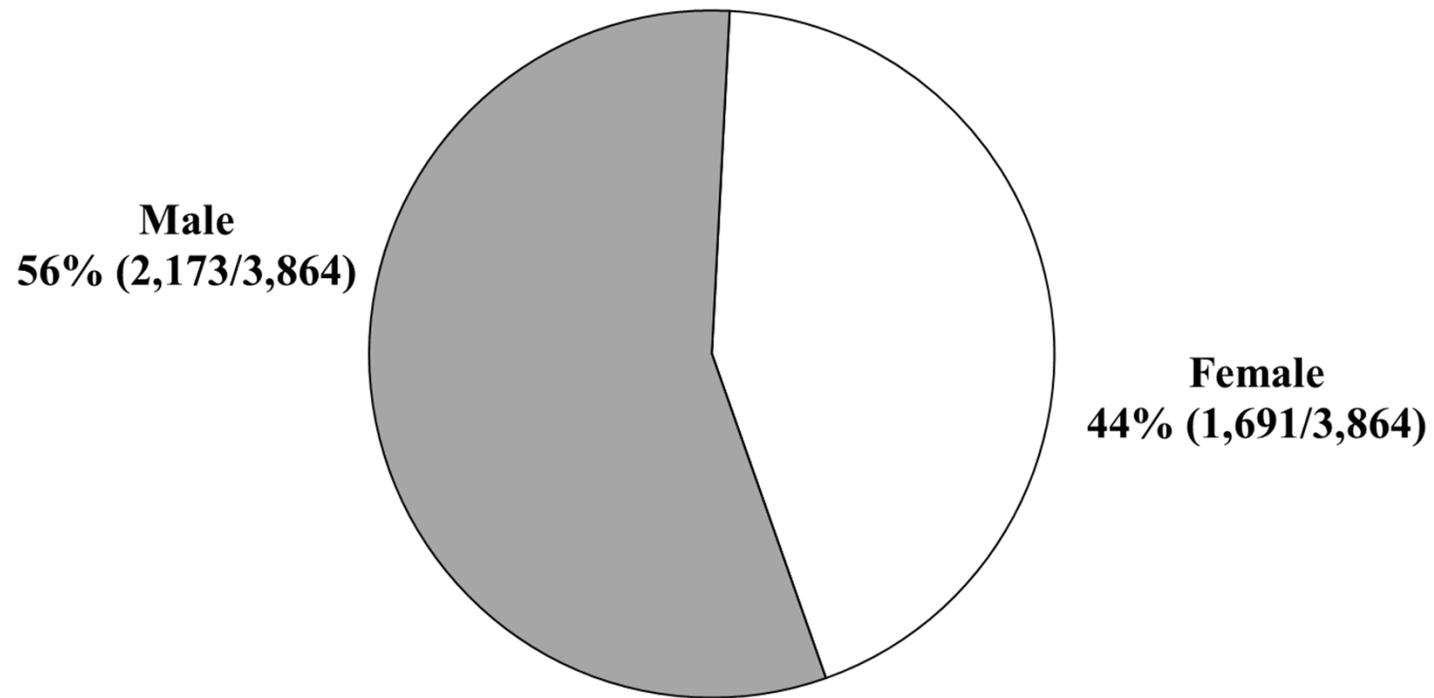
Study Sample

- Secondary data was extracted from Meharry alumni tracking system which contains alumni specialties and practicing locations from 1975 to 2013.
- Meharry alumni tracking system was created and maintained by the Office of Institutional Research.

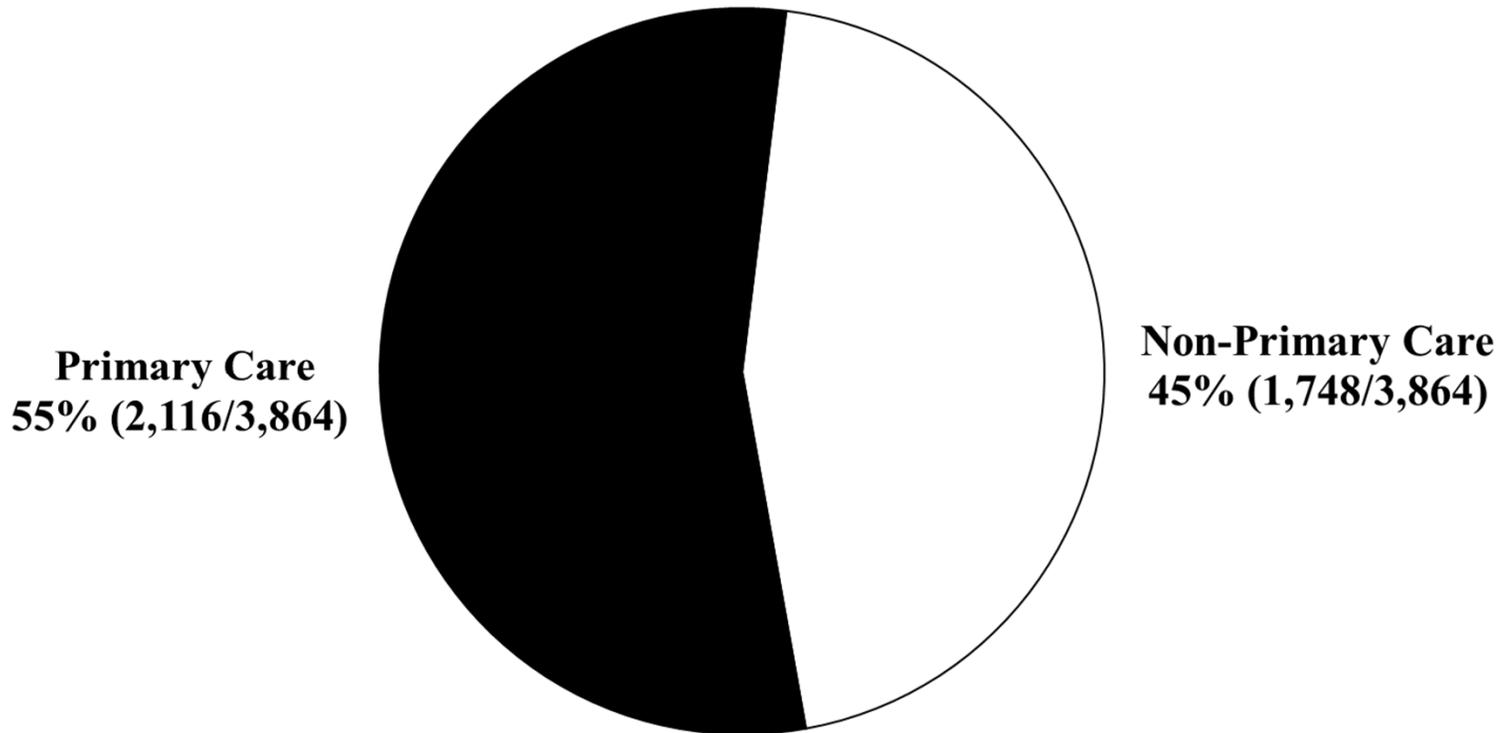
Study Sample (1 of 3)



Study Sample (2 of 3)



Study Sample (3 of 3)



Primary Care (43%) vs. Non-primary Care (57%)--U.S. physicians and dentists combined

Study Variables and Data Sources (1 of 4)

Variable		Measurement scales
Name	Description	
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

Study Variables and Data Sources (2 of 4)

Variable		Measurement scales
Name	Description	
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.	
adult_obese	A measure of the percentage of adults that report a BMI \geq 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).	

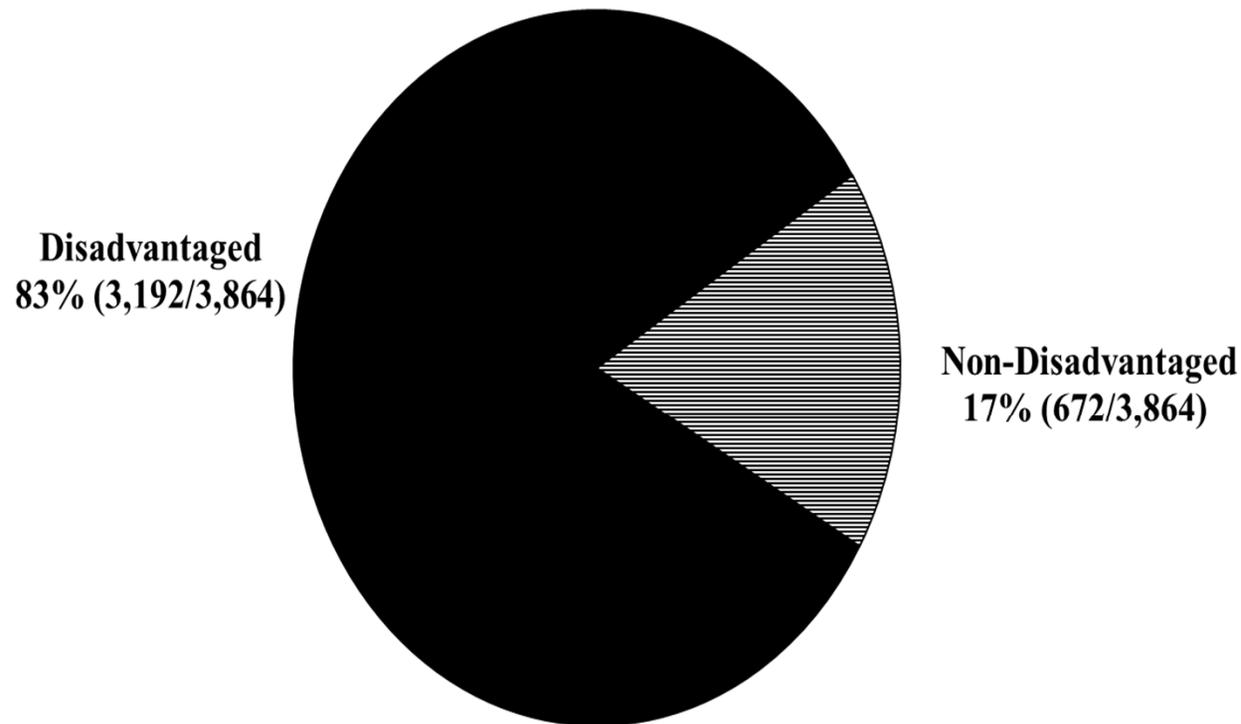
Study Variables and Data Sources (3 of 4)

Variable		Measurement scales
Name	Description	
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

Study Variables and Data Sources (4 of 4)

Variable		Measurement scales
Name	Description	
hrsa_shortage	<p>Health Professional Shortage Area (HPSA) Scores range from 1 to 25 for primary care and 1 to 26 for dental. 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.</p>	National Health Service Corps

Percent of Medical and Dental Graduates in Disadvantaged and Non-disadvantaged Communities Based on K-means Cluster Analysis



Classification Accuracy*

Number of Cases (Discriminant Analysis)

		1	2	Total
Original Counts	1	3160	32	3192
		(99%)		
(Cluster Analysis)	2	34	638	672
			(95%)	
	Total	3194	670	3864

***98% ((3160+638)/(3864)) of original grouped cases from cluster analysis correctly classified by discriminant analysis.**

Practicing Community Characteristics **(Male vs. Female)**

Cluster	Male	Female
Disadvantaged (N=3,192)	1,797 (56%)	1,395 (44%)
Non-Disadvantaged (N=672)	376 (56%)	296 (44%)

HPSA⁺ Practicing Community Characteristics (Metropolitan vs. Non-Metropolitan)

Cluster	Metropolitan	Non-Metropolitan	Non-HPSA*
Disadvantaged (N=3,192)	2,586 (81%)	531 (17%)	75 (2%)
Non-Disadvantaged (N=672)	521 (78%)	44 (6%)	107 (16%)

⁺ Health professional shortage area (HPSA) designated by U.S. Department of Health and Human Services

* 5% ((75+107)/3864) unmatched with HPSA, indicating that 95% matched with HPSA

HPSA+ Practicing Health Service Sites (Disadvantaged vs. Non-disadvantaged)

Health Service Site	Disadvantaged	Non-Disadvantaged
Comprehensive Health Center	456 (84%)	87 (16%)
Correctional Facility	176 (75%)	60 (25%)
Federally Qualified Health Center	46 (54%)	39 (46%)
Indian Health Service	37 (60%)	25 (40%)
Rural Health Clinic	35 (100%)	0 (0%)
Low Income Population Group	720 (85%)	129 (15%)
Other Facilities	1,647 (88%)	225 (12%)

Mean Values of Clustering Variables (1 of 2)

Community	Median Household Income	Unemploy Rate	Poverty Rate	% of Children in Free Lunch Program	% Uninsured	
					Adult	Child
Disadvantaged* (N=3,192)	43,568	9.5	19.3	52.48	24.6	8.8
Non-disadvantaged* (N=672)	72,739	7.6	10.4	30.70	16.2	6.3
U.S. National Average (As of date)	53,981 (June 2014)	6.1 (June 2014)	16.0 (Nov. 2012)	62.00 (2013-2014 School Year)	15.4 (2012)	8.9 (2012)

* Significant difference at $p < .05$ based on independent t test

Mean Values of Criterion Variables (2 of 2)

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

* Significant difference at $p < .05$ based on independent t test

PLS Path Modeling Results

- 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.
- The composite reliability for primary care professionals serving disadvantaged communities (0.673) was close to 0.7 and satisfactory.

Absolute Goodness of Fit Values for Structural and Measurement Sub-Models

- **Measurement model:** Outer model specifies the relationships between individual latent variable with its manifest variables. **Absolute Goodness of fit value = 0.737**
- **Structural model:** Inner model specifies the relationships among latent variables. **Absolute Goodness of Fit value = 0.944**
- Both absolute goodness of fit values were significant (95% confidence intervals of GoF value not containing zero), and yielded large contribution variations in PLS path model

Cross Loadings

Manifest Variables	Socio Economic Status	Adverse Health Outcome	Health Professional Shortage Score	Primary Care Professionals Serving Disadvantaged Communities
unemploy_rate	0.454	0.289	0.061	0.351
poverty_rate	0.876	0.675	0.119	0.613
child__free_lunch	0.994	0.634	0.171	0.525
pct_uninsure_adult	0.570	0.173	0.097	0.519
adult_obese	0.364	0.738	0.024	0.425
pct_diab	0.390	0.721	0.055	0.355
age_mort	0.637	1.000	0.122	0.521
hrsa_shortage	0.164	0.116	1.000	0.088
metro_type	0.225	0.273	0.197	0.214
disadvantaged	0.580	0.529	0.077	0.976
primary_care	0.022	0.050	0.084	0.268

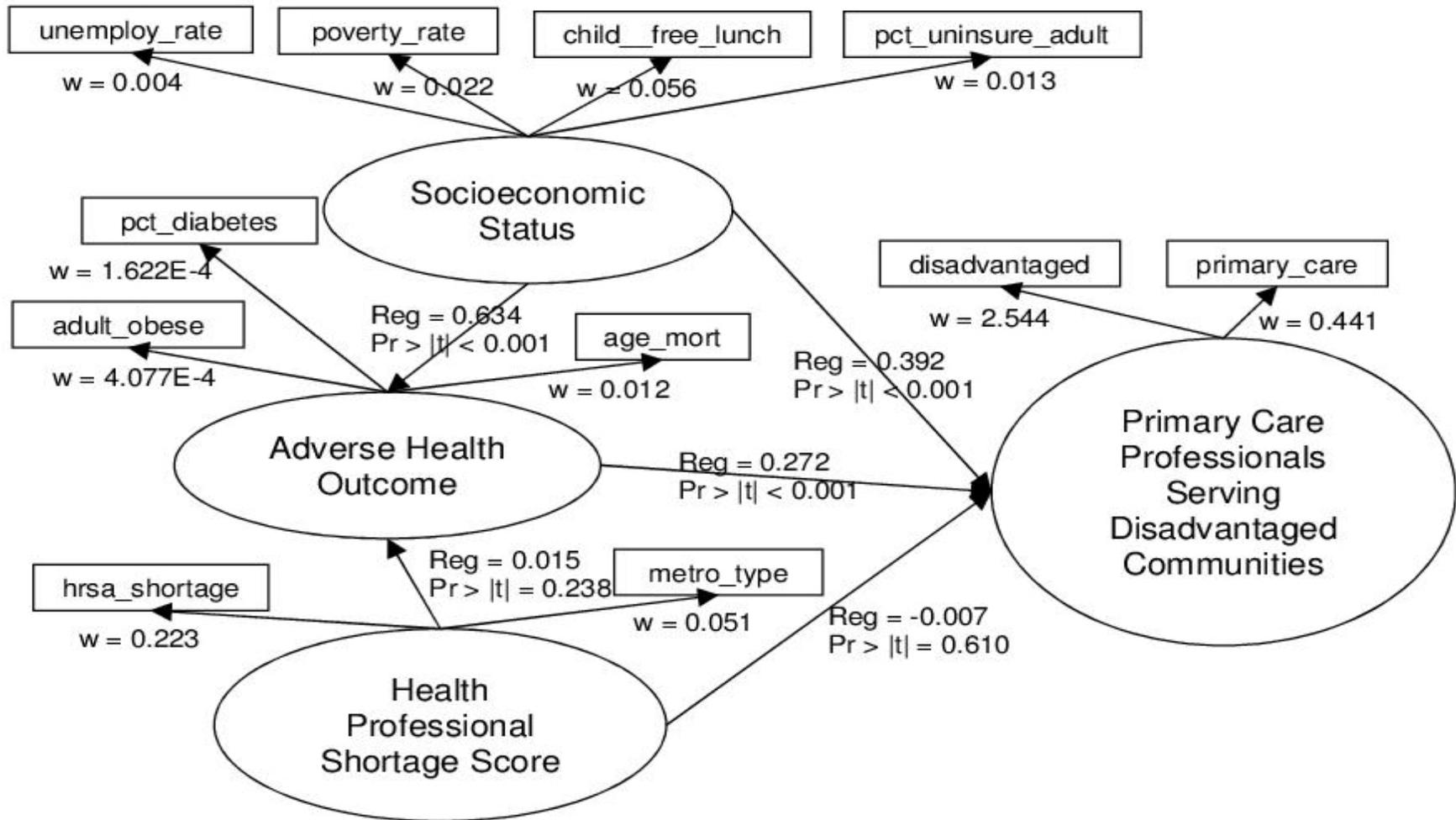
Significant Outer Weights of the Manifest Variables (1 of 2)

Latent Variable	Manifest Variable	Outer Weight	95% Confidence Interval	
			Lower Limit	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

Significant Outer Weights of the Manifest Variables (2 of 2)

Latent Variable	Manifest Variable	Outer Weight	95% Confidence Interval	
			Lower Limit	Upper Limit
Primary Care Professionals Serving Disadvantaged Communities	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

PLS Path Modeling Diagram



Impact and Contribution of Latent Variables to Primary Care Professionals Serving Disadvantaged Communities

Latent variable	Path coefficient	Standard error	t	p value
Socioeconomic Status	0.391	0.00	0.00	< 0.001
Adverse Health Outcome	0.272	0.00	0.00	< 0.001

Impact and Contribution of Latent Variables to Health Professional Shortage Score

Latent variable	Path coefficient	Standard error	t	p value
Primary Care Professionals Serving Disadvantaged Communities	0.093	0.00	0.00	< 0.001

Impact and Contribution of Latent Variables to Adverse Health Outcome

Latent variable	Path coefficient	Standard error	t	p value
Socioeconomic Status	0.391	0.00	0.00	< 0.001

R Square Values for Latent Variables with Respective Manifest Variables

The mean communalities index (average variance extracted) was higher than 0.5 for all four latent variables. Therefore, these variables explained their own manifest variables well.

Dillon-Goldstein (D.G.) rho values for socioeconomic status and adverse health outcome were greater than 0.7 indicating the existence of the homogeneity. (Note: DG rho is based on the results from the loadings of the model).

Primary care professionals serving disadvantaged communities and health professional shortage score were almost 0.7 to indicate that the homogeneity somewhat exists.

Model Assessment

Latent variable	Type	R ²	Mean communalities (AVE*)	D.G. rho
Socioeconomic Status	Exogenous		0.572	0.830
Health Professional Shortage Score	Exogenous		0.519	0.598
Adverse Health Outcome	Endogenous	0.405	0.688	0.866
Primary Care Professionals Serving Disadvantaged Communities	Endogenous	0.363	0.512	0.613

* AVE – average variance extracted

Summaries (1 of 3)

- Of the 3,864 medical and dental graduates in years of 1975 - 2013, 83% were practicing in a disadvantaged community.
- Medical and dental students from disadvantaged communities were more likely to practice in primary care specialty than non-primary care specialty (56% vs 44%).

Summaries (2 of 3)

- Meharry Medical College had a higher percentage (56%) of medical and dental graduates practicing in primary care than the national figure of 43%.
- Approximately 95% of medical and dental graduates served in health professional shortage areas designated by the U.S. Department of Health and Human Services.

Summaries (3 of 3)

- These research findings indicated that the medical and dental graduates from the 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.

Final Thoughts (1 of 2)

- PLS path modeling demonstrated that medical and dental graduates as primary care professionals serving disadvantaged communities were significantly affected by two latent variables (socioeconomic status and adverse health outcome).
- PLS path modeling exhibited the meaningful interrelationship between primary care practicing communities and surrounding environments (socioeconomic statuses and adverse health outcome), which yielded model reliability, validity, and applicability.

Final Thoughts (2 of 2)

- The researchers may not only be interested in the direct effect of the relationship between primary care professionals serving disadvantaged communities and their surrounding environments (socioeconomic status and adverse health outcome), but also the moderating (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).

References

- Epps, A. C. & Hammock, P. M. (2009). *An Act of Grace: The Right Side of the Story*. Nashville, TN: Privately Printed.
- Johnson, C. W. (2000). *The Spirit of a Place Called Meharry. (The Strength of Its Past and The Shape of the Future)*. Nashville, TN: Hillsboro Press.
- Meharry Medical College. (2014). *Mission and Vision*. Retrieved from <http://www.mmc.edu/about/mission-vision.html>
- Riley, W. J. (2008). Diversity in the Health Professions Matter. The Untold Story of Meharry Medical College. *Journal of Health Care for the Poor and Underserved*, 19, 331-342.
- Chen, C. K. (2009). Nationwide Physician Shortages Likely to Occur Beyond 2015 Based on Grey Forecasting Model. *Journal of Education, Informatics, and Cybernetics*, 1, 14-18.
- Cooper, R. A., Getzen, T. E., McKee, H. J., & Laud, P. Economic and Demographic Trends Signal and Impending Physician Shortage. *Health Affairs*. 21, 140-154.

References cont.

- Council on Graduate Medical Education (COGME). (2005). *Physician Workforce Policy Guidelines for the U.S. for 2000-2020*. Rockville, MD: U.S. Department of Health and Human Services.
- Hawkins, J., Mcrittt, J., & Miller, P. B. (2004). *Will the last physician in America Please Turn off the lights? A Look at America's Looming Doctor Shortage*. Irving, TX: Practice Support Resources, Inc.
- Murkowski, L. (2007). *Murkowski Urges Senate to Address Physician Shortage Crisis Facing the Nation*. Retrieved from <http://murkoski.senate.gov/pressapp/record.cfm?id=269414>.
- Katz, J. N. (2001). Patient Preferences and Health Disparities. *Jama*, 286, 1506-1509.
- Smedley, B. D., Butler, A. S. Bristow, LR. (2004) *In the Nation's Compelling Interest: Ensuring Diversity in the Health-care Workforce*. Washington, DC: The National Academies Press.
- AAMC. (2007) *Medical School Expansion Plans: Results of the 2006 AAMC Survey*.

References cont.

- Colette Davis, Chau-Kuang Chen, Juanita Buford, and Vanisha L. Brown (2014). *A Case Study: Determining the Relationship between Socioeconomic Backgrounds of Matriculants and Their Environment of Medical Practice after Graduation*. *European International Journal of Science and Technology*, Vol. 3 No. 5 June, 2014
- John Hopkins Medicine (2013). *What are disadvantaged students*, Retrieved from <http://www.hopkinsmedicine.org/geneticmedicine/residency/Disadvantaged.html>)

That's All Folks!!!

