How Does Race Affect Health Outcomes? New Analysis with Different Statistical Methods Comes Up with New Answers

Reanalyzing datasets using path analysis and structured equation modeling to reduce racial and ethnic health care disparity

**SUMMARY**

Researchers at the Henry Ford Health System applied the path analysis and structural equation modeling statistical technique to four datasets—breast cancer, lung cancer, colorectal cancer screening and lipid testing and control—previously analyzed using regression methods.

They wanted to determine whether path analysis and structural equation modeling resulted in the estimation of different effects of race and ethnicity on clinical outcomes than did those found through regression analysis.

**Key Findings**

Researchers found that path analysis and structural equation modeling did lead to differences in estimations of the effects of race on health outcome, compared with estimations derived from regression analysis:

- Reanalysis of a breast cancer dataset identified two significant paths by which Black race has a negative influence on survival from breast cancer: having lower income and having more advanced cancer at time of diagnosis.

- Reanalysis of a lung cancer dataset identified paths by which Black race has a negative influence on survival:
  - For Blacks with early stage lung cancer, one path was through the likelihood of having relatively more advanced cancer at time of diagnosis and, as a result, being less likely to have surgery. Another path was through a relatively lower income for Blacks, lower income being associated with a lower likelihood of surgery. Having surgery carried a lower risk of death than did not having surgery.
— For Blacks with later stage lung cancer, the path was through the lower likelihood of being married, not being married leading to a lower likelihood of receiving chemotherapy treatment. Having chemotherapy is associated with a lower risk of death.

● Reanalysis of a colorectal screening dataset identified two significant paths by which Black race has a positive influence on receiving colorectal screening: greater use of health maintenance visits and more chronic illnesses.

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**THE PROJECT**

Researchers at the Henry Ford Health System Center for Health Services Research believe "that most indicators of disparity in health and health care are the results of [complex] causal networks…. That is, there are proximal [near] causal factors, distal [far] causal factors, and factors in between. If this is so, then we believe that statistical methods more suited to analysis of complex causal networks should be employed whenever possible."

Researchers applied path analysis and structural equation modeling to three datasets previously analyzed using regression methods to determine whether use of this technique resulted in the estimation of different effects of race and ethnicity on clinical outcomes.

Original regression analyses of the datasets concluded that race and ethnicity were not significant predictors of clinical outcomes once other factors (such as socioeconomic status or primary language) were taken into account.

The datasets were:

● Data related to survival rates of 886 women with breast cancer, who were diagnosed at the Henry Ford Health System between 1986 and 1996.

● Data related to survival rates of 1,154 lung cancer patients, who were diagnosed at the Henry Ford Health System between 1995 and 1998. Researchers analyzed data from two groups of primary lung cancer patients (patients whose cancer did not spread to the lungs from other parts of the body):
  — Stages I and II non-small cell lung cancer (NSCLC) patients.
  — Stages III and IV NSCLC and all stages of small cell lung cancer (SCLC) patients.
NSCLC accounts for the majority of lung cancers. Late-stage survival rates are low, but patients diagnosed in the early stages have a 70 percent five-year survival rate.

Small cell lung cancer is less common but more aggressive than NSCLC. At diagnosis, the disease usually has spread to another part of the body.

- Data from a study of factors influencing receipt of colorectal cancer screening in a sample of 8,256 adults seen at the Henry Ford Health System between 1998 and 2002.

Several published papers had previously reported results of regression analyses of these datasets. Principal investigators of the original studies were involved in this project—reviewing the new analyses, comparing them to the original regression analyses and ensuring that comparisons were fair.

Researchers first reanalyzed the datasets using regression methods, in order to replicate earlier results and confirm that they were using exactly the same datasets as in the published papers. Then they analyzed the datasets using path analysis and structural equation modeling.

**FINDINGS**

Researchers reported key findings of the reanalysis of the breast and lung cancer datasets in a report to RWJF:

- **Path analysis and structural equation modeling identified influences on cancer survival and colorectal screening not identified, or at least not reported, by previous regression analyses.**

- **The reanalysis of the breast cancer dataset yielded two significant paths through which Black race influences breast cancer survival:**
  - Being Black is associated with lower income, and more income is associated with a lower risk of death from breast cancer. Thus, being Black and, therefore, more likely to have lower income, would be associated with a higher risk of death from breast cancer.
  - Being Black is associated with a more advanced stage of cancer at diagnosis, which is associated with a higher risk of death. So here, also, being Black and more likely to be diagnosed at an advanced stage would be associated with a higher risk of death from breast cancer.

Analysis of the percentage of women surviving at seven years after diagnosis of breast cancer supported findings that race influences survival through these paths:

- A group of women of all races but with income and stage at diagnosis typical of White women had a seven-year survival rate of about 90 percent.
— A group of women of all races but with income and stage at diagnosis typical of Black women had a seven-year survival rate of less than 75 percent.

- **The reanalysis of the lung cancer dataset yielded several paths through which being Black either increases or decreases risk of survival.**

For Stages I and II NSCLC patients:

— Being Black is associated with a more advanced stage at diagnosis, which is associated with a lower likelihood of surgery. Having surgery, in turn, has a lower risk of death from lung cancer than does not having surgery. Thus, according to researchers "there is a significant effect of race on risk of death, mediated through stage at diagnosis and subsequent decision about surgery."

— At the same time, being Black is directly associated with a lower risk of death from lung cancer for Stages I and II NSCLC patients. This direct effect was not identified with the original regression analysis.

For Stages III and IV NSCLC and all SCLC lung cancer patients:

— Being Black is associated with a lower likelihood of being married. Married patients are more likely than unmarried patients to receive chemotherapy treatment, which is associated with lower risk of death from lung cancer. According to researchers, "the entire chain of events creates a higher risk of death among Black patients, with the effect mediated through both marital status and use of chemotherapy."

— Income does not influence actions related to survival risk from lung cancer and Blacks’ generally lower income level does not affect their survival rates.

— With these later-stage patients, there is no direct effect of race on survival. Also, a direct effect was not identified with the original regression analysis.

Researchers reported key findings of the reanalysis of the colorectal screening dataset in an interview.

- **The reanalysis of the colorectal screening data identified two significant, indirect paths to more screening for Blacks:**

  — Black patients are more likely than non-Black patients to have health maintenance visits. Patients who have health maintenance visits are more likely to have colorectal screening.

  — Black patients are more likely than non-Black patients to have more chronic illnesses, which lead to more health maintenance visits and, eventually, more screening.
CONCLUSIONS

Researchers offered the following conclusion in a report to RWJF:

- "In both [cancer] data sets, we were able to identify influences of race on cancer survival that were not identified … in the original published papers…. [A]n effect of race on survival identified in regression analyses as 'not statistically significant' was significant in the path analysis approach. Path analysis was also able to identify variables originally considered to be 'confounders' (e.g., income, marital status) as parts of a causal pathway linking race to cancer survival. We believe that path analysis provides not only a more accurate depiction of important relationships between race and health care outcomes, but also provides insight into mediating variables that may be important targets for quality improvement interventions."

The project director offered the following conclusion in an interview:

- "This more detailed look at intervening variables allows us to do a better job of planning and carrying out disparity-reduction interventions. If we know, for example, that health maintenance exams [HMEs] are a proximal 'cause' of colorectal screening, and we know that Black patients are more likely on average to have these exams in a particular period of time, we may decide to try to enhance screening, not by promoting screening itself, but by promoting more HME visits among Black patients who aren't getting them now."

LESSONS LEARNED

1. **Allow more time than would seem necessary to create "ready for analysis" versions of datasets when planning projects that involve reanalysis of existing datasets.** In this project, researchers found that previous investigators had made minor updates to datasets as they moved through stages of analysis, documenting these changes in a way that would be clear to someone involved in the original project, but not sufficiently clear to someone using the datasets several years later for new analyses. This experience confirmed the value of careful documentation of research datasets when projects are completed. (Project Director)

AFTERWARD

As of March 2009, researchers plan to submit a manuscript detailing the analysis of the three datasets reported here for publication in a peer-reviewed journal. During summer 2009, they plan to analyze a fourth dataset on disparities in diabetes care using path analysis and structural equation modeling, supported by internal funding.

Researchers also hope to identify other datasets that lend themselves to path analysis and can extend this work.
BIBLIOGRAPHY

(Current as of date of the report; as provided by the grantee organization; not verified by RWJF; items not available from RWJF.)

Articles


Presentations and Testimony