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Examining Associations between Adult Health and Literacy, Numeracy, Technological Problem-Solving Skills, and Post-Initial Learning in the U.S.

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Abstract: This paper uses data from the Program for the International Assessment of Adult Competencies (PIAAC) to analyze the relationship between self-reported health and (a) literacy, numeracy, and technological problem-solving skills, and (b) post-initial learning for U.S. respondents, and to determine whether those relationships vary by race/ethnicity and educational degree attainment. The main independent variables were scores on the PIAAC literacy, numeracy, and problem solving in technology-rich environments (PS-TRE) scales, and five types of post-initial learning during the previous 12 months: open or distance learning courses, workplace training, seminars or workshops, courses or private lessons, and participation in formal education. The results of ordinal logistic regression analyses showed that after controlling for respondents' sociodemographic characteristics, literacy is a stronger predictor of self-rated health than numeracy or PS-TRE scores. However, literacy matters far less than other factors

such as disability, educational attainment, health insurance, English proficiency, and nativity. Second, of the five post-initial learning activities, only participation in courses/private lessons was significantly related to health, after controlling for other variables. Third, there was no variation in the relationship between self-rated health and literacy, numeracy, and PS-TRE skills or post-initial learning by race/ethnicity. The relationship between health and PS-TRE skills differed by educational attainment: only the most highly educated respondents accrued health advantages from stronger technological problem-solving skills. Implications for research and policy are discussed.

Executive Summary

Higher educational attainment is strongly associated with better health, but we know far less about how other social determinants—namely, literacy and numeracy proficiency, technological problem-solving skillsⁱ, and continuing participation in formal and non-formal education—shape health outcomes. This paper uses data from the Program for the International Assessment of Adult Competencies (PIAAC) to identify whether these proficiencies and learning activities are associated with adult health status, and how those relationships vary across racial/ethnic and educational attainment groups. That is, do people across different racial/ethnic groups and levels of formal schooling accrue similar health advantages from these proficiencies and learning activities?

The study answers the following research questions: (1a) Are literacy, numeracy, and technological problem-solving skills associated with self-rated health, after controlling for race/ethnicity, socioeconomic status (SES), and other respondent characteristics? (1b) Does the relationship between skills in these areas and self-rated health vary across racial/ethnic groups? (1c) Does the relationship between skills in these areas and self-rated health vary across levels of formal educational attainment? (2a) Which types of post-initial learning activities are most strongly associated with self-rated health? (2b) Which types of post-initial learning matter most for the health statuses of different racial/ethnic groups? (2c) Which types of post-initial learning matter most for the health statuses of people at different levels of formal educational attainment? Post-initial learning includes the pursuit of formal and non-formal education and training beyond the respondent's highest level of completed schooling.¹

The dependent variable is self-rated health (excellent, very good, good, fair, or poor). The independent variables are scores on the literacy, numeracy, and problem solving in technology-rich environments (PS-TRE) scales and participation in post-initial learning activities during the past year: open or distance learning courses, workplace training, seminars or workshops, courses or private lessons, and formal education. Racial/ethnic groups were non-Hispanic white, non-Hispanic black, Hispanic/Latino, Asian, and other (American Indian/Alaska Native, Native Hawaiian/Pacific Islander). There were six educational attainment levels: less than high school diploma, high school graduate, certificate from trade school or other, associate degree, bachelor's degree, and master's degree or higher. Ordinal logistic regression was used to analyze the data, and we accounted for demographic characteristics that are known to influence health (e.g., sex, age, marital status, nativity, employment status, disability). This allowed us to examine the unique contribution of literacy, numeracy, technological problem-solving skills, and post-initial learning to health status—above and beyond respondents' other characteristics.

We found that literacy, numeracy, and technological problem-solving skills are positively associated with self-rated health. Ten-point increases on these scales are associated with 10.5%, 8.5%, and 7.6% greater odds, respectively, of being in a better self-rated health category. However, after controlling for respondent characteristics, numeracy and PS-TRE were no longer significant. The effect size for literacy was reduced, but it remained significant. After introducing control variables, a 10-point increase on the literacy scale was associated with 2.6% greater odds

ⁱ The term “problem solving in technology-rich environments” (PS-TRE) was coined by PIAAC and is not used in scholarly literature. To make our paper more accessible to a lay audience and to situate it within the scholarly literature, we use “technological problem-solving skills” to signify the subset of skills measured by the PS-TRE scale. We use “PS-TRE” specifically when referring to PIAAC scores or the PS-TRE scale.

of being in a better health category. This suggests that U.S. adults may accrue greater health benefits from developing literacy than numeracy or technological problem-solving abilities, after accounting for other individual characteristics.

The results show although literacy is important, it is not among the strongest predictors of self-rated health. Several control variables, including disability, formal educational attainment, health insurance, English proficiency, and nativity (being born foreign born vs. US born), have much stronger relationships with health status. This suggests that to improve U.S. residents' health, literacy instruction needs to be accompanied by efforts to increase college attainment, access to health insurance, and English proficiency.

The relationships between self-reported health and literacy, numeracy, and PS-TRE scores did not differ across racial/ethnic groups. In other words, people of color and whites gain equal health advantages from strengthening their *literacy* proficiency (neither numeracy nor PS-TRE scores were significantly related to self-rated health after controlling for demographic variables). This indicates that the “diminishing returns hypothesis,” whereby racial/ethnic minorities accumulate fewer health rewards than whites from increasing levels of educational attainment, does not apply to literacy, numeracy, and technological problem-solving skills.

Of the three PIAAC scales, only the relationship between PS-TRE and self-rated health differed by formal educational attainment. Respondents who had at least a master's degree gained more health benefits from technological problem-solving proficiency than people who had not completed high school. Thus, only the most highly educated U.S. adults experience improved health (although very modest) with better PS-TRE skills.

Regarding the relationship between post-initial learning and self-rated health, we found that participation in workplace training, seminars/workshops, courses/private lessons, and formal education in the past 12 months are all associated with better health, but open/distance education is not. However, after adjusting for sociodemographic characteristics, only courses/private lessons remained significantly associated with improved self-rated health. Further research is needed to understand what these activities entail and how they enhance health (e.g., through cognitive or skill development, information acquisition, social network formation, access to and mobilization of psychosocial or material resources). Since blacks and people with less schooling were the least likely to participate in these activities, increasing their involvement could yield health benefits for those disadvantaged groups.

The relationship between self-rated health and post-initial learning activities did not differ across racial/ethnic or educational attainment groups. Of all the learning activities, participation in courses/private lessons was most strongly associated with self-rated health, regardless of respondents' race/ethnicity or educational attainment. This suggests that the diminishing returns hypothesis does not apply to post-initial learning; rather, involvement in courses/private lessons generated similar health benefits for all racial/ethnic groups.

In sum, the study elucidates how various types of skills and post-initial learning are (and are not) related to self-reported health. It underscores the importance of literacy proficiency and participation in courses/private lessons for improving U.S. adults' health status, along with key demographic characteristics that strongly influence health (e.g., disability, educational degree, nativity, age) and promising areas for policy intervention (expanding access to college, health insurance, ESL instruction). Our findings also reveal that only the most highly educated adults accumulate health rewards from technological problem-solving skills, which highlights the need to explore why people with less education are less able to convert these skills into health benefits.

Introduction

Higher educational attainment is strongly associated with better health, but we know much less about how basic skills such as literacy and continuing participation in formal and non-formal education shape health outcomes. Our study is situated in research on the social determinants of health, which traces how social and economic resources and opportunities influence adult health status. Specifically, this paper uses U.S. data from the Program for the International Assessment of Adult Competencies (PIAAC) to analyze the relationship between self-reported health and (a) literacy, numeracy, and technological problem-solving skills and (b) post-initial learning, and to determine whether those relationships vary by race/ethnicity and levels of formal educational attainment. That is, do people from differing racial/ethnic groups and levels of formal schooling experience similar health benefits from these proficiencies and post-initial learning activities? Post-initial learning entails participation in formal and non-formal education and training beyond one's highest level of completed schooling.¹ This study examined respondents' post-initial learning within the previous year.

The research questions are as follows: (1a) Are literacy, numeracy, and technological problem-solving skills associated with self-rated health net of controls for race/ethnicity, socioeconomic status (SES), and other respondent characteristics? (1b) Does the relationship between skills in these areas and self-rated health vary across racial/ethnic groups? (1c) Does the relationship between skills in these areas and self-rated health vary across levels of formal educational attainment? (2a) Which types of post-initial learning activities are most strongly associated with self-rated health? (2b) Which types of post-initial learning matter most for the health statuses of different racial/ethnic groups? (2c) Which types of post-initial learning matter most for the health statuses of people at different levels of educational attainment?

This study contributes to the scholarship in adult education, sociology, and demography by identifying how literacy, numeracy, technological problem-solving skills, and post-initial learning are associated with adult health status and how those relationships vary across racial/ethnic and educational attainment groups. In particular, the study adds to the burgeoning interest in research, policy, and practice concerning health and adult education.²⁻¹⁵ It also contributes to the sociological and demographic literatures on the social determinants of health by focusing on literacy, numeracy, and technological problem-solving skills as specific types of human capital that influence health, potentially offering evidence for new areas for public health intervention.

Literature Review

Education as a Social Determinant of Health

To frame our analyses, we borrow from conceptual frameworks that emphasize formal educational attainment as a social determinant and fundamental cause of health and health disparities. Prior research in this arena consistently finds that people with higher levels of educational attainment enjoy better health, as indicated by higher self-rated health and physical functioning, and lower morbidity, mortality, and disability, than those with less education.¹⁶⁻¹⁸ According to Link and Phelan,¹⁹ educational attainment is a fundamental cause of health disparities because it influences access to and use of health-promoting resources through

