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Understanding the Relationship between Early Childhood Education and Long-term Health and Quality of Life Outcomes

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Population and Public Health

Scholarship in Medicine Final Report

☒ By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission (I am in the May 2020 super short course)

Abstract

Education is widely understood to be beneficial with regard to social opportunity, health outcomes, and quality of life scoring. Society opinion and literature are in accordance with this understanding. Much of the current literature, however, focuses on how higher education provides many of these benefits, but little investigates how early childhood education correlates with such outcomes. The objective of this study is to investigate what relationships there are between early childhood education performance and long-term health and quality of life outcomes. This investigation will explore Ohio's third grade reading and math scores on standardized exams as compared to a national average and how each influences life expectancy, adult obesity rates, HIV prevalence, diabetes prevalence, premature death, number of poor physical health days, and median household income in all Ohio counties in 2020. Data were pulled from the county health rankings and roadmaps website and evaluated with Pearson correlation analyses using SPSS software. Each correlation was statistically significant, except that between math scores and obesity. Of note, the strongest correlations were between math scores and life expectancy ($r= 0.51$, $p< 0.001$), median household income ($r= 0.592$, $p<0.001$), and poor health days ($r= -0.556$, $p<0.001$). Overall, the results of this project demonstrate correlations between quality early childhood education and beneficial long-term health and quality of life outcomes.

Key Words: Early childhood education, life expectancy, median household income, math scores, reading scores, quality of life, premature death.

Introduction

Early childhood education is a societal expectation and its importance is widely understood and supported. This likely is a result of how participation in high quality early childhood education programs has been shown to improve short-term outcomes such as cognitive, behavioral, social, and motor skills.[1] Notably, these improvements are most substantial for the most disadvantaged children, but importantly no child goes without gains.[2] In the current education system early childhood education is a prerequisite for higher education, and by extension, the benefits that come from higher education.[3] Early childhood education, therefore, likely influences the life-long outcomes that are determined by higher education and its benefits.

Outcomes that are influenced by educations include median household income, quality of life (e.g., emotional and physical distress), chronic disease prevalence, premature death, life expectancy to name a few.[4] Of note, these outcomes are positively influenced by participation in and completion of higher education, usually in the form of a college degree.[5–7] Specifically, more education has been associated with higher doctor's office visits, lower health risk tolerance, and, conversely, less education has been associated with a higher likelihood of being uninsured.[6] Additionally, progressively higher levels of education correlate with incrementally lower smoking rates, more vigorous exercise, and less obesity.[4] Literature also demonstrates how higher education also influences quality of life by improvements in happiness, wealth, and even civic involvement and voting.[4,8] All of this is to say higher education routinely benefits health and quality of life outcomes, thus highlighting its value and the importance of obtainment, and in the current education system, without early childhood education that is impossible.

Without early childhood education there is no chance for achieving higher education and, thus, the healthy and quality of life benefits that follow. The first few years of life are crucially

influential on long-term outcomes like personality, behavior, and health. Early childhood is when people begin to develop intellectual curiosities, knowledge, and personal understanding through exposure to novel ideals and intriguing concepts.[9] By providing children these opportunities, early childhood education has been shown to benefit children across wide spectrums of wealth and opportunity.[10] Benefits have been shown with higher standardized test scores, lower truancy rates, fewer discipline referrals, decreased risk of premature death-including lower suicide rates, even higher incomes.[10–13] Similar to higher education, participation in early childhood education consistently shows substantial benefits both in quality of life and in health outcomes, but it is unclear if these are simply short-term gains and that higher education is what provides long-term benefits or if early childhood has more influence than just being a prerequisite for higher levels of education.

Each early childhood education program will not provide equal access, however, in order to achieve higher levels of education the quality of the early childhood program is essential. Research has demonstrated higher quality programs, as measured by guidelines including the National Association of the Education of Young Children (NAEYC), benefit all children, especially those most disadvantaged.[11] A Pittsburgh study utilized an early childhood initiative for children in "high-risk neighborhoods" and exhibited "patterns of progress that exceeded maturational expectations" for the children involved.[14] Moreover, another study showed third and fourth graders in a similar program achieve higher math and reading test scores, maintained higher attendance rates, had fewer discipline referrals, displayed better social interactions, even developed more emotional maturity as compared to a control group of children in a nearby local school system.[11] This foundation of high-quality early childhood education, therefore, not only improves a child's chance of attend higher education and its associated health benefits by way of

high test scores, but even benefits their quality of life in the short term by way of emotional maturity and developed social interactions.

The importance of early childhood education is not disputed, in fact, public opinion aligns with literature insofar that high-quality early education optimizes a child's opportunities and in doing so his or her health and quality of life. Although the higher echelons of education correlate significantly with better health outcomes and improved quality of life markers, these parameters are not determined solely by the achievement of higher education. Importantly, without early childhood education it is not possible to enter higher education, in particular high-quality early education programs. Much of the literature regarding early childhood education, however, only explores relatively short-term outcomes (e.g., test scores, truancy rates, discipline referrals); and although the improves discovered in these data likely correlate with an enhanced chance to obtain higher education and thus the benefits that ensue, they do not address the influence that high quality early childhood education itself has on long-term health and quality of life parameters. This study will explore correlations between early childhood education and long-term health and quality of life parameters in the form of life expectancy, premature death, adult obesity rates, diabetes prevalence, HIV prevalence, median household income, and poor physical health days in Ohio in 2020.

Research Questions: how does early **childhood education** (by way of math and reading scores) correlate with **long term life outcomes** (*quality of life*-poor physical health days and median household income; *length of life*-premature death, adult obesity rates, HIV prevalence, diabetes rates, and life expectancy) in Ohio between 2016 and 2019?

RQ1: Math scores correlation with length of life in Ohio-2020. Specifically, how do math scores correlate with premature death in Ohio in 2020? How do math scores correlate with life expectancy in Ohio in 2020?

RQ2: Math scores correlation with long-term health outcomes in 2020. Specifically, how do math scores correlate with adult obesity rates, HIV prevalence, and diabetes prevalence in 2020?

RQ3: Median household income correlated with math scores in Ohio-2020. As in, how do math scores correlate with median household income in Ohio in 2020?

RQ4: Correlate math scores and quality of life in Ohio 2020. As in, how do math scores correlate with poor physical health days in Ohio 2020?

Methods

Context/Protocol

Premature death rate, defined as potential life lost before age 75 per 100,000 and data were used from 2016-2018 provided by NCHS and drawn from NVSS. Life expectancy data defined as average number of years a person can expect to live and data were used from 2016-2018 and provided by NCHS and drawn from NVSS. Poor physical health days, defined as average number of physically unhealthy days reported in the past 30 days, data are from 2017 and is from BRFSS. Median household income data are defined as income where half of household in a county earn more and half earn less, are from 2018 and were collected from the US Census Bureau along with the Small Area Income and Poverty Estimates (SAIPE). Math scores, defined as average grade level performance for 3rd graders on math standardized tests-thus compared with the national average, data are from 2016 and were pulled from the Stanford Education data archive. Adult obesity data, as defined as the percentage of the adult population (age 20 and

older) that reports a BMI greater than or equal to 30 kg/m2, were collected from the county health rankings website, which includes data from the United States Diabetes Surveillance System's 2016 surveys. Diabetes prevalence data, defined as the percentage of adults (age 20 and older) with diagnosed diabetes, were collected from the United States Diabetes Surveillance System's 2016 surveys. HIV prevalence data, defined as the number of people aged 13 years and older living with a diagnosis of HIV infection per 100,000 population, were collected from the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (NCHHSTP) public health surveillance 2016 data. Together, this amounts to a data point for each Ohio county that was provided for each variable, totally sample size of approximately 88 per variable.

Data Collection

For this research study data was collected directly from the county health rankings and roadmaps website. Specifically, data was collected from Ohio's section and its corresponding subsections. Subsections include: health outcomes, length of life, premature death; additional measures, length of life, life expectancy; health outcomes, quality of life, poor physical health days; measures, social and economic factors, math scores; additional measures, quality of life, HIV prevalence; additional measures, quality of life, diabetes prevalence; health factors, health behaviors, adult obesity; and additional measures, social and economic factors, median household income. These data are all represented in numerical fashion. Inclusion criteria include only that the data are from the county health website and there are no exclusion criteria.

Data Analysis

A Pearson correlation analyses were used to determine any connection between the two variables: math scores and life expectancy in Ohio in the year 2020. Additionally, we used a

correlation analysis to determine any connection between math scores and premature death rates in Ohio in the year 2020. A correlation analysis to determine any connection between the two variables: math scores and median household income in Ohio in the year 2020. We used a correlation analysis to find any connection between the variables: math scores and poor health days in Ohio in 2020. Additionally, we used a Pearson correlation analyses to find any statistical correlations between math scores and each individual variable: obesity prevalence, HIV prevalence, and adult obesity prevalence in Ohio 2020.

Results

Early Childhood Education vs Long-Term Health Measures

To address *RQ1*, we performed correlation analyses using SPSS software to investigate any relationship between early childhood education, by way of third grade standardized math scores, against premature death rates as well as life expectancy in Ohio 2020. First, a Pearson correlation between premature death and math scores showed a poor correlation that was a negative and statistically significant relationship ($r= -0.265$, $p= 0.015$, $R^2= 0.0701$), as seen in Figure 1.

Figure 1: Correlation Between Premature Death Rates and Math Scores in Ohio 2020

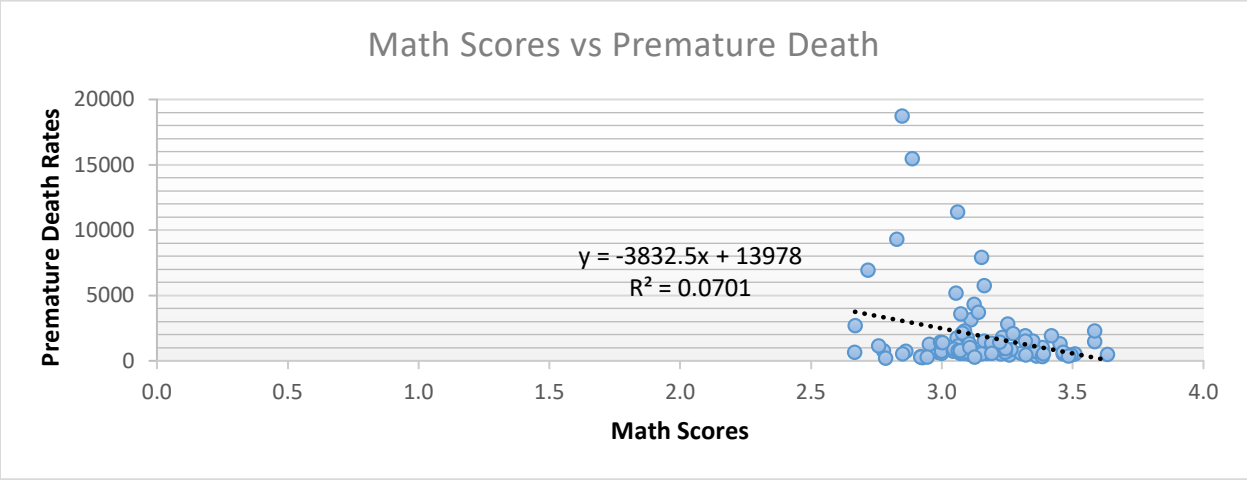

Fig 1. Pearson Correlation between Premature Death Rates, defined as potential life lost before age 75 per 100,000, and third grade math scores was significant and showed a negative relationship ($r= -0.265$, $p= 0.015$, $R^2= 0.0701$)

Similarly, a Pearson correlation analysis was used to investigate any relationship between life expectancy and math scores. We found a positive, moderate correlation between the two variables that was statistically significant ($r= 0.51$, $p<0.001$, $R^2= 0.2599$), see Figure 2.

Figure 2: Correlation Between Life Expectancy and Math Scores in Ohio 2020

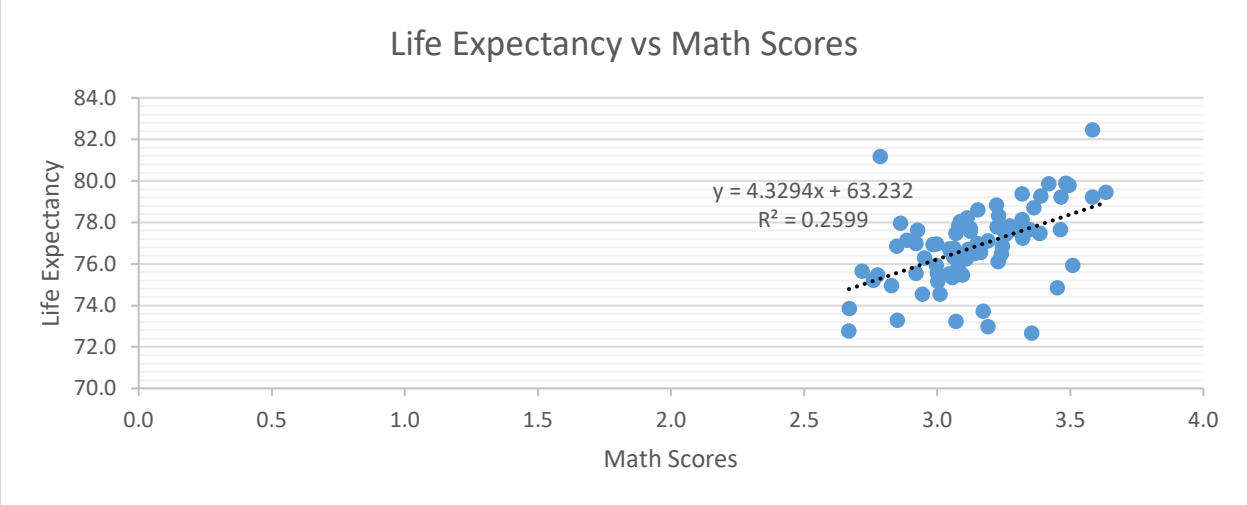

Fig. 2 Pearson correlation between life expectancy and math scores showed a significant relationship that was positive ($r= 0.51$, $p<0.001$, $R^2= 0.2599$).

Additionally, we investigated the influence early childhood education has on long-term health outcomes including adult obesity, HIV, and diabetes prevalence in Ohio 2020 (*RQ2*). All were performed with a Pearson correlation and all three displayed negative relationship. Adult obesity versus math scores was the only correlation that was not statistically significant, it had a poor correlation ($r= -0.15$, $p=0.175$, $R^2= 0.0224$), as seen in Figure 3. HIV prevalence versus math scores as showed a poor Pearson correlation, but was statistically significant ($r= -0.251$, $p= 0.023$, $R^2= 0.0629$), see Figure 4. Lastly, the relationship between diabetes prevalence and math scores was a small, negative correlation, but was significant ($r= -0.253$, $p= 0.02$, $R^2= 0.064$), as seen in Figure 5.

Figure 3: Correlation Between Adult Obesity and Math Scores in Ohio 2020

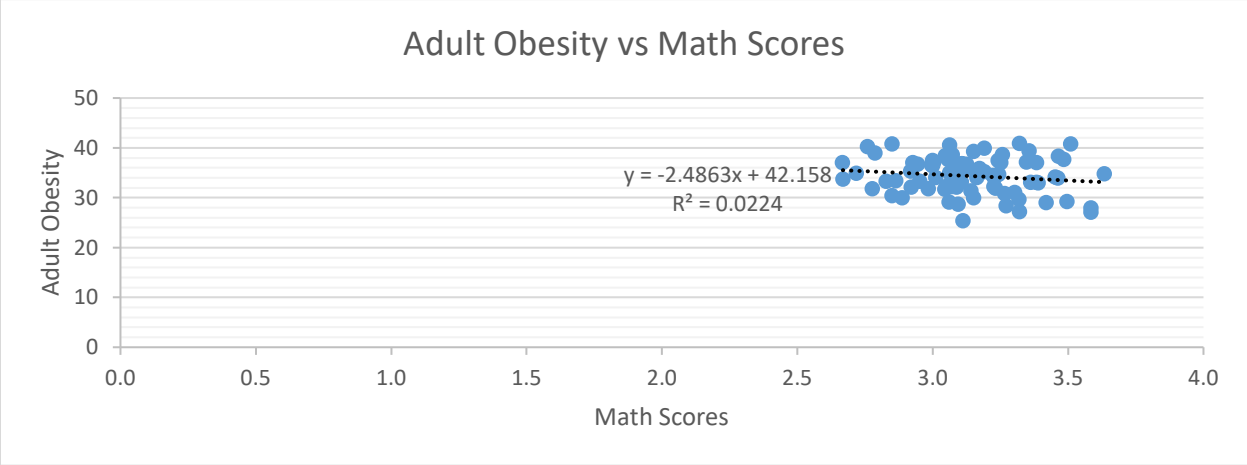

Fig. 3 Pearson correlation between adult obesity and third grade math scores showed a small, non-significant, negative relationship (r= -0.15, p=0.175, R^2= 0.0224).

Figure 4: Correlation Between HIV Prevalence and Math Scores in Ohio 2020

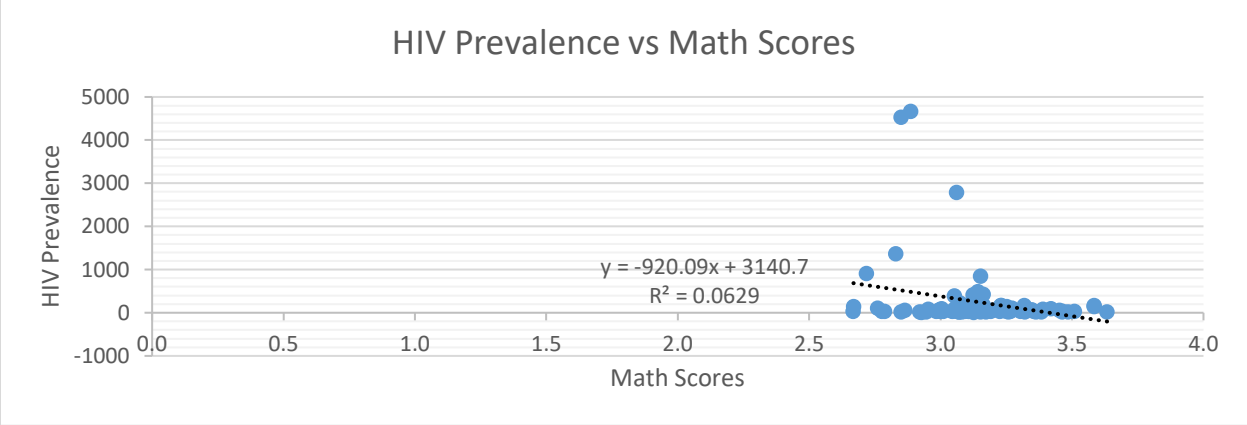

Fig. 4 Pearson correlation between HIV prevalence and third grade math scores displayed a small, but significant and negative relationship (r= -0.251, p= 0.023, R^2= 0.0629).

Figure 5: Correlation Between Diabetes Prevalence and Math Scores in Ohio 2020

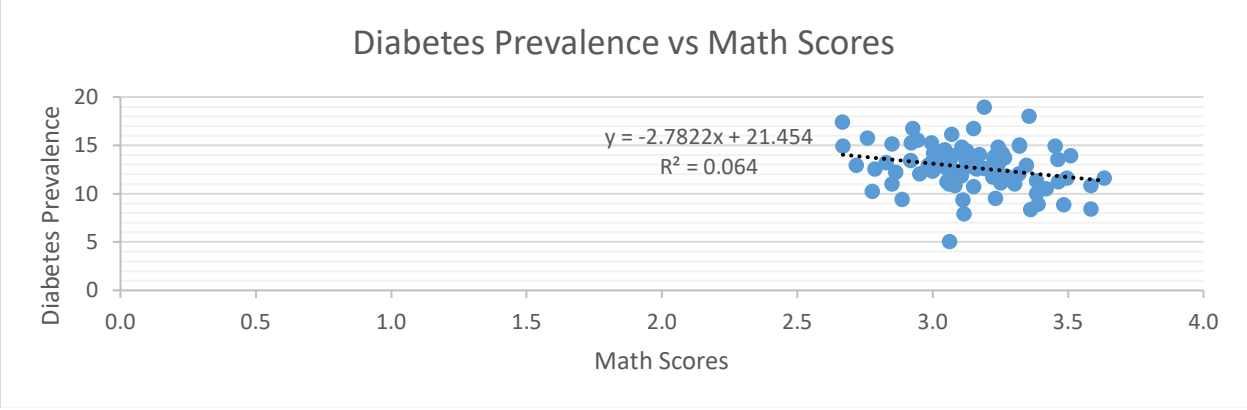

Fig. 5 Pearson correlation between diabetes prevalence and third grade math scores showed a poor correlation that was significant and had a negative relationship (r= -0.253, p= 0.02, R^2= 0.064).

Early Childhood Education versus Quality and Life Measures

The relationship between early childhood education and long-term quality of life measures were investigated by Pearson correlation (*RQ3*). First, third grade math scores were correlated with median household income of every county in Ohio 2020. A good, positive, correlation was determined between the two variables, and the relationship was statistically significant ($r= 0.592$, $p<0.001$, $R^2= 0.3501$), as seen in Figure 6.

Figure 6: Correlation Between Median Household Income and Math Scores in Ohio 2020

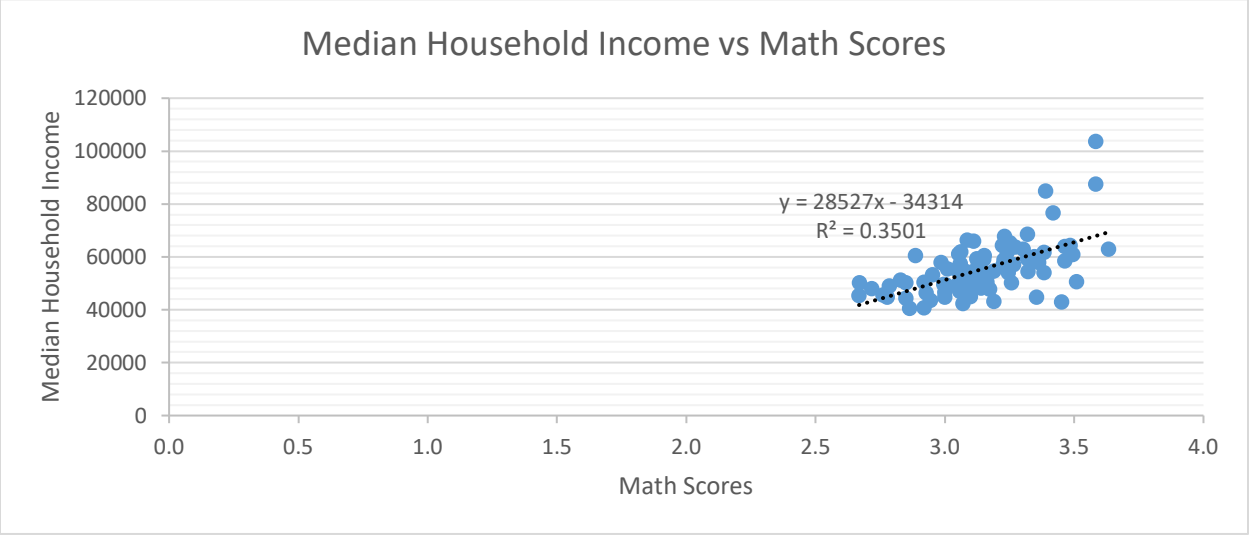

Fig. 6 Pearson correlation between median household income and third grade math scores showed a good correlation that was positive and significant ($r= 0.592$, $p<0.001$, $R^2= 0.3501$).

Lastly, to address *RQ4*, a Pearson correlation was performed to explore the relationship between math scores and number of poor physical health days in Ohio 2020. The relationship displayed a good, negative correlation that was significant ($r= -0.556$, $p<0.001$, $R^2= 0.3094$), see Figure 7.

Figure 7: Correlation Between Poor Physical Health Days and Math Scores in Ohio 2020

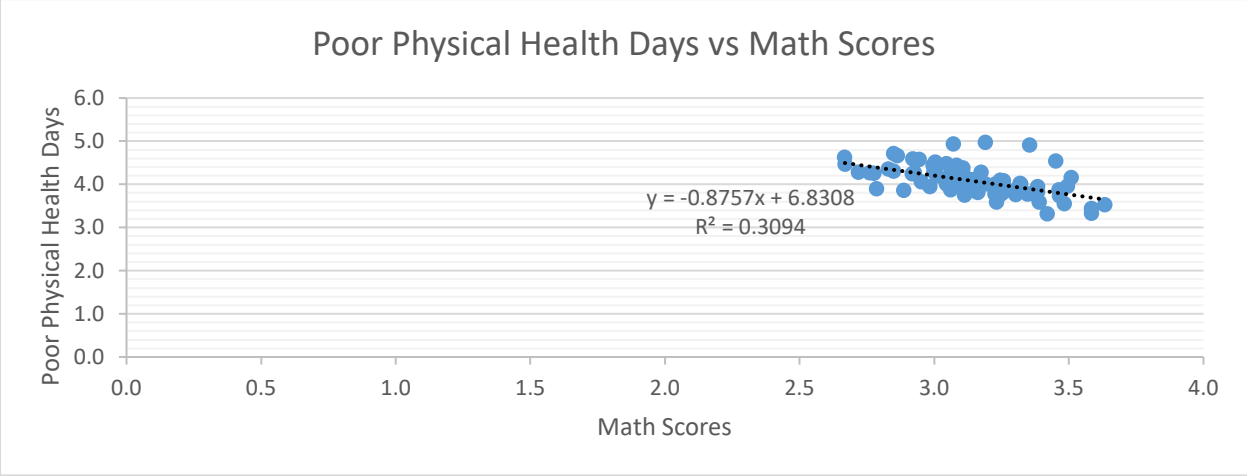

Fig. 7 Pearson correlation between poor physical health days and third grade math scores displayed a good, negative relationship that was statistically significant ($r= -0.556$, $p<0.001$, $R^2= 0.3094$).

Discussion

Early childhood education is correlated with beneficial long-term health and quality of life outcomes including lower premature death rates, longer life expectancy, reduced prevalence of HIV and diabetes, higher median household income, and fewer poor health days. Of the variables investigated, only adult obesity did not significantly correlate with math scores, although it did display a small negative relationship. While this correlation was not statistically significant, all of the relationships matched hypotheses set out at the beginning of this study.

First, early childhood education, represented by standardized third grade math scores, demonstrated a small, negative correlation with premature death rates in Ohio 2020. Although these premature death rates include adults that already completed their early childhood education and thus do not represent solely the population receiving the education investigated, this correlation does show a significant relationship between math scores and premature death rates in a given population. Under the assumption that high quality education systems represent a larger number of those scoring higher, correlated with progressively lower premature deaths.[11,14]

Such a relationship demonstrates a beneficial connection between obtaining high quality early childhood education and a reduced premature death rate, aligning with current literature.[12,13] Similarly, higher math scores significantly correlated with longer life expectancies, but this relationship was determined to be a good correlation, indicating that quality early childhood education is a strong predictor of longer life expectancy. These two correlations together indicate beneficial results of increasing quality of early childhood education and long-term health outcomes.

Long-term health benefits secondary to high quality early childhood education, however, are not limited to reduced premature death rates and lengthened life expectancy. Correlation analyses demonstrated significant, negative relationships between math scores and both HIV and diabetes prevalence. Although these relationships are small, each does demonstrate higher math scores correlate with reduced prevalence for each disease. Such relationships are congruent with recent literature insofar that education negatively, and significantly, correlates with numerous health benefits.[4]

Our study did, however, demonstrate a relationship between math scores and adult obesity that, albeit negative, was not significant. This is not in alignment with recent studies that demonstrated significant, negative correlations between the two variables.[4] This discrepancy likely arose because we explored the relationship between early childhood education and adult obesity, while the studies in current literature not only investigated higher levels of education, including college, but followed adult obesity prevalence amongst the participants in that education. What this implies is that more education correlates with lower rates of adult obesity. Therefore, our findings do not mean that early childhood education does not also correlate with lower rates of obesity later in life; likely what we have found is closer to the baseline correlation

education has on adult obesity because even with little education there is a negative relationship with adult obesity.

Lastly, along with long-term health benefits, early childhood education demonstrated beneficial correlations with quality of life parameters including median household income and poor physical health days. Specifically, math scores had a strong, positive correlation with median household income that was significant. This finding was most likely a result of access to higher levels of education and subsequent higher income opportunities, which has been shown previously in literature.[4] Additionally, math scores had a strong, negative, and significant correlation with poor health days. Arguably, this is the most important finding in this study. Importantly, fewer days of poor health is likely multifactorial and involves variables such as: number of healthcare providers, access to medications and primary care, support network, and many more. Importantly, higher math scores corresponding to fewer poor physical health days indicates that early education is one such variable, and means that implementation of reliable, quality early education can positively influence the physical health and quality of life into adulthood.

In addition to long-term outcomes, early childhood education influences short-term outcomes by increasing standardized test scores, lowering truancy rates, minimizing behavioral issues, and much more, and for this reason its importance is not disputed. Findings from this study illustrate that early childhood education reaches beyond the short-term. Of note, early childhood education correlated positively and strongly with life expectancy and median household income, as well as a strong, negative correlation with poor physical health days. Early childhood education benefits long-term health and quality of life. Thus further emphasizing the

importance of quality early childhood education, but importantly its implementation is shown to benefit beyond just short-term expectations.

Conclusion

The quality of early childhood education correlates with numerous health and quality of life benefits in adulthood. Although most of the relationships explored in this study were strong and significant limitations exist, including what data were available, only correlation analyses were performed and correlation does not equal causation, thus much is left to explore. Ideally, future directions should include a prospective study following the same subjects between early childhood, their education system, and into adulthood. Additionally, it would be helpful to compare certain populations, in particular between years as well as between states. Lastly, future studies should explore different definitions of early childhood education beyond only math scores, this could include standardized scores in reading, classroom testing, teach evaluations, and more.

Regardless, this study emphasizes the importance of quality early childhood education by demonstrating just how far a reach it has on crucial factors such as life expectancy and poor physical health days. In adulthood, our health outcomes and quality of life are, in part, influenced by the education we had in early childhood. The influence is lasting because of the opportunities that arise as a result of high-quality education early in life as well as the privilege required to obtain such an education. Importantly, early childhood education benefits all members of a society, especially those most disadvantaged.[2] Therefore, administration of quality early education should be of crucial purpose in social reform because, if implemented, it can improve numerous long-term health and quality of life parameters for all members of society.

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