Potential Health Consequences of Plyler

People who immigrated to the US, on average, have better health than those born in the US due to positive selection and demographic advantage (Goldman et al. 2014). Yet, broad averages comparing foreign-born against non-foreign-born populations obscure the unequal experiences and health trajectories among immigrants (Bacong and Sohn 2020, Finch, Frank and Vega 2004). As immigrants assimilate into American society as long-term residents, their health converges to that of US-born citizens, shaped by their social positions and economic resources (Andrasfay and Goldman 2020, Phelan, Link and Tehranifar 2010). The process of segmented assimilation—immigrants assimilating into an unequal and stratified US society—is particularly salient for immigrants who arrived in the US as children (Goldman et al. 2006, Li and Hummer 2015), and access to continued education will determine their health trajectories for the remainder of their lives.

Throughout the report, the terms Plyler-affected people and Plyler cohort refer to people who (1) arrived as children in the US after 1981 and (2) were in the US as of 2023. The Plyler cohort also includes older teenagers who came to the US with a high school diploma.

The first section of this report details the data and methodology used to estimate the number of people who benefited from Plyler in the past and the number of people who will benefit from continued Plyler in the future. This section also describes the methods to project the expected number of years that the Plyler cohort will live in the future. The second section is organized by type of health outcome—obesity, disability, infant mortality, infant health, influenza, and mental health—and describes the data and methods used to calculate each outcome.

Part 1: Defining the Plyler Cohort

The potential health-related impact of Plyler is based on a cohort of undocumented immigrants (as defined by Phillip Conner) in the 2022 American Community Survey (ACS) who likely benefitted from Plyler since 1982. The 2022 ACS was reweighed to reflect the 2023 immigrant children population. The reweighted data are considered current and future beneficiaries under continued Plyler. Expected excess health conditions and their associated medical costs in this report were calculated using one of two approaches. All estimations were conducted at the national, select state, metro, city, and urban/rural levels.

- Lifetime rates multiplied by affected persons
- Incidence rates multiplied by person-years of exposure to risk

Generally, the timing of school attendance determined whether Plyler incurred health benefits (past gains) or will contribute to health in the future (future losses) rather than the timing of healthcare spending. For instance, disability, infant mortality, infant health, and mental health outcomes depend on educational attainment. Benefits to people who turned 18 by 2023 were categorized as past gains, and the potential impact for those under 18 in 2023 was categorized as future losses. Health benefits linked to school-based programs—obesity and influenza—were categorized differently. Obesity-related health benefits to those in the US at age 14 by 2023 were categorized as past gains, and those under 14 in 2023 contributed to future losses. Gains

from short-lived influenza vaccines were derived by the number of years that the Plyler attended school on or before (past gains) and after 2023 (future losses).

Person-year calculations

Using the ACS variables on birth year and year of US entry, I calculated the person-years lived in the US between 1982 and 2023. For example, a 20-year-old in 2023 who entered the country in 2018 would have spent three years as a school-aged child and three years as an adult in the US. The calculations for projected person-years were more complex. The Plyler population from the 2022 ACS with adjusted 2023 weights was projected into the future using the 2019 sex-specific lifetables published by NVSR (Arias et al. 2022). I used the 2019 lifetables to avoid unusually high mortality rates during the COVID-19 pandemic. The projections did not account for any fertility, immigration, or out-migration, and the Plyler cohort is expected to complete their life spans by the year 2122. The projections were executed using a Leslie Matrix (Wachter 2014).

Acronyms

ACS: American Community Survey
ADL: Activities of Daily Living
BMI: Body Mass Index
CPI: Consumer Price Index
IMR: Infant mortality rate. It is the number of deaths under age 1 per 1000 live births in a population.
PSID: Panel Study of Income Dynamics, a longitudinal and multigenerational dataset that began in 1968
RCT: Randomized Controlled Trials
TFR: Total fertility rate, the total number of births a woman is expected to have in her lifetime.
YLD: Years lived with a disability

Assumptions and limitations

The 2019 NVSR lifetables do not precisely reflect the current and future mortality of the Plyler cohort. The life expectancies of foreign-born are generally longer than their US-born counterparts (Gubernskaya 2014). At the same time, undocumented immigrants have poorer health statuses and may likely have shorter life expectancies than naturalized immigrants or immigrants with permanent residency (Bacong and Sohn 2020). Projecting populations so far into the future also poses problems when mortality conditions are changing. Life expectancies increased significantly during the past four decades (Medina, Sabo and Vespa 2020) and should this upward trend continue, the current Plyler cohort will have longer life expectancies than these calculations suggest.

Accounting for Inflation

The expenditure estimates in this report were standardized to 2023 dollars using the Bureau of Labor Statistics' Consumer Price Index (CPI) for medical care services (Bureau of Labor Statistics 2024). The CPI measures inflation using the Consumer Expenditure Survey and produces monthly estimates. Medical care services include professional services, hospital and related services, health insurance, and other medical commodities such as medicinal drugs and supplies. The cost of healthcare professionals such as physicians and dentists accounts for 45 percent of the medical CPI. I averaged monthly CPI values into annual values to convert all expenditures into 2023 dollars.

Part 2: Health outcomes

This report calculates the following health outcomes. Each outcome is estimated separately for past gains (1982-2023) and future losses (2024-2122) from Plyler.

- Lifetime obesity
- Lifetime disability
- Childhood influenza
- Infant mortality among births to Plyler cohort's women
- Preterm births to Plyler cohort's women
- Lifetime depression

Lifetime Obesity

The economic impact of obesity is substantial (Hammond and Levine 2010). Obesity is a predictor of several chronic conditions, including type 2 diabetes, coronary heart disease, hypertension, selected cancers, and musculoskeletal disorders (Pi-Sunyer 1993), and is linked to worse economic outcomes throughout the life course (Amis, Hussey and Okunade 2014). While observational studies that examine the relationship between educational attainment and obesity find a complex relationship between the two moderated by race, ethnicity, and place of birth (Cohen et al. 2013a, Cohen et al. 2013b), public health interventions have explicitly targeted schools to reduce childhood and future adulthood obesity (Serdula et al. 1993, Verdonschot et al. 2023). Several randomized controlled trials (RCT) showed that school-based programs were moderately successful in reducing obesity through increased access to healthier foods and nutrition education (Liu et al. 2022, Verdonschot et al. 2023).

Data

Wang et al. (2003) conducted a cost-effectiveness study on ten middle schools in Massachusetts in 1995. Five schools were randomly assigned to implement an obesity prevention program. The remaining five schools served as the control group. Using data from the RCT, they projected the number of averted overweight adults (defined as having a BMI equal to or greater than 25 kg/m^2). They also derived the amount of medical care averted between the ages of 40 and 65. The authors published that the school-based program would prevent 1.9 percent of students from becoming overweight adults and using estimates from Thompson et al. (1999), projected that each prevented case would avert $ 2,737 (1996 dollars) in medical costs. The study projected adulthood overweight status based on a child's overweight status at age 14.

Methods

I derived the number of the Plyler cohort who were in the US at age 14 and applied the values in Wang et al. (2003) to calculate excess overweight adults and their associated medical costs without Plyler. The 1996 dollars were then converted to 2023 dollars using the CPI.

- *Number of overweight adults that Plyler prevented in the past = number of people in the Plyler cohort who were in the US at age 14 in 2023 or earlier * 0.019*
- *Medical cost averted for past Plyler beneficiaries = number of overweight adults that Plyler prevented in the past * 2,737 (1996 dollars) * 1996 to 2023 conversion rate*

- *Number of overweight adults that continued Plyler will prevent in the future = number of people in the Plyler cohort aged under 14 in 2023* 0.019*
- *Medical cost saved for future Plyler beneficiaries = number of overweight adults that continued Plyler will prevent in the future * 2,737 (1996 dollars) * 1996 to 2023 conversion rate*

Assumptions and limitations

Wang et al. (2003) found statistically significant improvements in obesity among girls but not boys, and the authors limited their cost calculations to girls. Larger studies on the effectiveness of school-based obesity prevention programs have since found improvements among boys as well as girls (Marsigliante et al. 2022), and the calculation in this report applies Wang et al. (2003)'s effect sizes to both girls and boys in the Plyler cohort. Furthermore, the calculations here assume that the school-based obesity prevention programs were universally available in school and had an equal impact across the nation. The costs of obesity are also assumed to be constant across time. The medical care costs are estimated for a 25-year period between ages 40 to 65. Medical costs linked to obesity are likely to be low for adults below 40 but may potentially be higher after age 65. Thus, this section's cost estimations are likely to underestimate the lifetime costs associated with obesity.

Lifetime Disability

Disability status among older adults is generally determined by whether a person can conduct Activities of Daily Living (ADL). ADLs include bathing, dressing, transferring, walking, eating, toileting, and grooming. People who require personal assistance for any of the ADLs are considered to have functional dependence. Functionally dependent older adults have greater health care utilization and poorer health outcomes than similar adults without the same limitations (Manton 1988, Wolinsky et al. 1993). Educational attainment is strongly associated with the timing of disability onset in the life course (Montez et al. 2019). People with more education not only live longer on average (Olshansky et al. 2012) but also live more years without disability than those with less education (Zaninotto et al. 2020). Two major theories link education to later-life health and life expectancy. Human capital-based theories suggest that schooling improves people's abilities to pursue healthier lifestyles and adopt medical innovations, which then translates into better long-term health (Rieker and Bird 2000). Resource-based theories posit that completing high school or college offers credentials that expand people's access to more resources, such as better-paying jobs, access to health insurance, and social networks, which allows people to pursue better health (Phelan, Link and Tehranifar 2010).

Data

The calculations used data from two sources. Laditka and Laditka (2016) calculated the expected number of years with a disability at age 40 and at age 70 for those with and without a high school diploma. They used the longitudinal Panel Study of Income Dynamics (PSID) from 1999 to 2011 to simulate the probabilities of disability and death beginning at ages 40 and 70.

Compared to people with a high school degree, people without a high school degree had more years with a disability after age 40. Not having a high school degree was associated with 0.32 more disability years for men and 0.96 for women. After 70, not having a high school degree

was associated with 0.20 *fewer* disability years for men and 0.11 for women. The reversal of the relationship between education and disability years after 70 is due to the shorter overall life expectancies of people without a high school degree.

In a separate study, Fried et al. (2001) conducted a longitudinal study to calculate the excess healthcare expenditures from hospital stays, outpatient visits, home health care, and nursing homes associated with ADL limitations net of other observed characteristics. They linked clinical data to Medicare and Medicaid claims data to estimate healthcare costs. Their study included 843 participants aged over 71 living in New Haven in 1989. They found that healthcare expenditures were $5,035.37 per year (1993 dollars) higher among those with ADL limitations than those without.

Table 2. Number of expected disability years by high school completion

	No HS diploma	HS diploma	Excess disability years
Men	4.17	3.85	0.32
Women	6.73	5.77	0.96

Source: Laditka and Laditka (2016)

Methods

For past Plyler beneficiaries, I multiplied the number of Plyler beneficiaries with at least a high school degree and 18 or older in 2023 by the excess disability years for non-high school graduates calculated by Laditka and Laditka (2016). I used sex-specific excess disability years and applied them to men and women in the Plyer cohort. Then, I multiplied the excess disability years by the excess healthcare expenditures published by Fried et al. (2001). For future Plyler beneficiaries, I multiplied the number of the Plyler cohort who was under 18 in 2023 by the proportions of past Plyler beneficiaries who gained a high school degree. I used the national proportions and applied them to all geographic groups. I then multiplied the projected number of high school graduates with sex-specific excess disability years from Laditka and Laditka (2016) and excess expenditures from Fried et al. (2001). This approach assumes that mortality is equal to the patterns embedded in Laditka and Laditka (2016)'s calculations.

- *Number of years people lived in disability prevented by Plyler (person-years) = Men 18 or older in 2023 and with at least a high school degree * 0.3167 + women 18 or older in 2023 and with at least a high school degree * 0.9606*
- *Disability-related healthcare costs avoided by Plyler = Excess disability person-years from past Plyler gains * 5,035.57 (1993 dollars) * 1993 to 2023 CPI conversion rate*
- *Number of years in disability that continued Plyler will prevent in the future (person-years) = (Men under 18 in 2023 * 0.3167 + women under 18 in 2023 * 0.9606) * group-specific proportions with a high school degree among those 18 or older in 2023*
- *Disability-related healthcare costs that continued Plyler will avoid in the future = Excess disability person-years from future Plyler loss * 5,035.57 (1993 dollars) * 1993 to 2023 CPI conversion rate*

Assumptions and limitations

Laditka and Laditka's study uses longitudinal data—the PSID—to calculate expected disability life expectancies by educational attainment. Their observational study design cannot account for people who did not complete high school due to an unobserved condition that may have impacted both schooling and disability. While quasi-experimental studies that exploited compulsory schooling laws show strong relationships between education and ADL (Fonseca, Michaud and Zheng 2020), other studies also show that children in poor health have lower educational attainment (Case and Paxson 2010). Thus, Laditka and Laditka (2016) is a relatively small study of older adults over 71, and healthcare costs associated with disability at higher ages may differ from costs among younger adults. In addition, their estimates only include Medicare and Medicaid reimbursements and do not account for other out-of-pocket expenses or coverage from private health insurance. Thus, the actual annual disability-related healthcare expenditures may be higher than Fried et al. (2001)'s estimates.

Infant Mortality to Plyler Women

Infant mortality death of babies before they reach their first birthday and country- or group-level infant mortality rates (IMR) are indicators of population health. In 2021, 5.4 infants per 1,000 died before reaching their first birthdays (Centers for Disease Control and Prevention 2024a). The IMR in the US is the highest among all Organisation for Economic Co-operation and Development (OECD) nations (Gunja, Gumas and Williams 2023). IMR in the US also differs significantly by education; mothers with less education are more likely to experience the death of an infant than mothers with more education (Fishman et al. 2020).

Data

Green and Hamilton (2019) use the 1998-2002 National Vital Statistics Birth Data (approximately 17.5 million births) to estimate the probability of infant death by the mother's educational attainment. They estimated the IMR for foreign-born mothers by their educational attainment. They found that IMR among mothers with a high school diploma was significantly lower than among mothers without a high school degree. They also found that the effect of education was smaller among foreign-born mother than among their US-born counterparts. I combined estimates from Green and Hamilton with total fertility rates from the Census (Colby and Ortman 2015) to project the number of lifetime infant deaths per Plyler woman.

Methods

Women 18 and above in 2023 who graduated from high school in the US were considered past Plyler beneficiaries, and women aged under 18 in 2023 were considered future Plyler beneficiaries. I calculated education gains (high school degree, some college, and four-year college degree) under Plyler for women 18 and above in 2023. I then applied the distribution to Plyler women under 18 in 2023 to project their future educational attainment.

Table 4. Educational attainment of all undocumented women 18 and over in 2023 (past Plyler cohort)

	Plyler women 18 and over in 2023	Percent
No education gains from Plyler	432,931	33.8
High school graduate	384,832	30.1
Some college	297,002	23.2
Four-year college degree	165,220	12.9

Source: American Community Survey (ACS) 2022 using 2023 re-weights

I used total fertility rates (TFR) for Hispanic women living in the US from Census projections (Colby and Ortman 2015) to estimate the total number of live births by Plyler women throughout their lifetimes. While the TFR of foreign-born women, particularly Hispanic women, is higher than that of their US-born counterparts, the difference is largely driven by births soon after migration to the US. For long-term resident women, their fertility levels converge to the US average (Ford 1990, Parrado 2011). The overall TFR for Hispanic women averaged across all nativity statuses, was 2.13 in 2014 (Colby and Ortman 2015). This approach assumes that births take place after women complete their education. The mean age at first birth was 27.4 in 2022 (NCHS 2024). While a small proportion of women give birth in their teenage years, it is relatively infrequent (13.6 live births per 1,000 aged 15-19 compared to about 98 per 1000 aged 30-34) and is declining rapidly (Osterman et al. 2023).

In Green and Hamilton's calculations, the IMR among foreign-born Hispanic women with a high school degree was 4.37 per 1,000 live births. For similar women with a high school degree, the IMR was 4.02 per 1,000. The IMR decreases to 3.93 with some college education and further decreases to 3.04 for mothers who obtained a four-year college degree.

Table 5. Infant mortality rates among foreign-born Hispanic women by educational attainment

	No high school degree	High school graduate	Some college	Four-year college degree
IMR per 1000 live births	4.37	4.02	3.93	3.04
Excess IMR compared to women without a high school degree		0.35	0.44	1.33

Source: Green and Hamilton (2019)

- *The number of US-born infant deaths prevented by Plyler 1982-2023 = Education loss among Plyler women aged over 18 and above in 2023 * 2.13 TFR * excess IMR by the amount of education lost*
- *The number of US-born infant deaths that continued Plyler will prevent in the future = Projected education loss among Plyler women aged under 18 in 2023 based on past*

*cohort's education distribution * 2.13 TFR * excess IMR by the amount of projected education lost*

Assumptions and Limitations

TFR estimates were as of 2014. Fertility has fallen since 1982 and is expected to fall further; the Census predicts a TFR of 1.82 for Hispanic women in 2050 (Colby and Ortman 2015). Using the 2014 TFR thus underestimates the number of births to past Plyler beneficiaries and overestimates the number of births to future Plyler beneficiaries. On the other hand, the actual future educational attainment of students still in school is likely to be higher than the projected numbers based on past education distribution. More people, especially women, are completing four-year college degrees than before, and the trend will likely continue in the short—to medium-term (US Census Bureau 2023). Thus, the estimated number of future infant lives saved may be underestimated.

Infant mortality calculations focused on the mother's educational attainment. While a mother's educational attainment is a stronger predictor of infant health, the father's educational attainment is also linked to their children's survival (Balaj et al. 2021). Green and Hamilton's study does not explicitly account for fathers' education, but they are likely correlated with the mother's (Schwartz 2010). If Plyler men and women exclusively have children with each other, Green and Hamilton's effect sizes may be under-estimates. Conversely, if Plyler men and women only have children with non-Plyler partners, the effect sizes may be overestimated. The actual magnitudes of the over- and under-estimations also depend on how much each partner's education influences the other's impact on their children's outcomes. As with all observational studies, Green and Hamilton (2019)'s estimates do not account for unobserved factors that may impact both education and outcome. It also does not account for reverse causal pathways, such as when a teenage mother experiences the death of an infant and decides to drop out of high school as a result.

Preterm births to Plyler Women

Infant deaths are extreme outcomes and reflect underlying poor health in early life. Gestational age and birthweight are two common indicators of infant health that are linked to later life outcomes, including illness and disease (Barker et al. 1993), cognitive development (Mamluk et al. 2020), educational attainment (Fletcher 2011), and earnings (Black, Devereux and Salvanes 2007). Babies born before 37 weeks of gestation are considered preterm births and tend to have lower birth weights than full-term babies (Ohuma et al. 2023).

The robust linkages between maternal education, her infant's health, and the infant's later life outcomes, including their education and earnings, reproduce health and socioeconomic outcomes across generations (Currie and Moretti 2007). Education increases women's earnings potential and the chances of partnering with higher-earning spouses (Mare 1991), allowing families to invest more in prenatal health. Furthermore, women with more education are less likely to engage in risky activities such as smoking during pregnancy (Cutler and Lleras-Muney 2010, Fertig and Watson 2009). Thus, schooling future parents can be considered a direct investment in improving the health of future generations (Hoynes, Schanzenbach and Almond 2016, Osmani and Sen 2003).

Data

Noghanibehambari, Salari and Tavassoli (2022) exploited changes in state differences in minimum school dropout age since 1970 to estimate the impact of a mother's education on preterm births. They analyzed over 28 million birth records from the US Vital Statistics from 1970 to 2004 and found a 0.73 percentage-point reduction in preterm births for each additional year of schooling.

A separate study published by the Institute of Medicine (Institute of Medicine 2007), estimated the per-case maternal delivery cost to be $3,812 (2005 dollars) and an additional $33,210 (2005 dollars) over the child's life course.

Table 7. Estimated cost of preterm birth per case (2005 dollars)

Maternal delivery costs	3,812
Medical care costs for the child	33,210
Total medical costs	37,022

Source: Institute of Medicine (2007)

Methods

I estimated the increase in the prevalence of preterm babies in the absence of Plyler by multiplying education years gained under Plyler with the per education-year improvements in preterm prevalence estimated in Noghanibehambari, Salari and Tavassoli (2022). For the cohort still under 18 in 2023, I applied the average education years gained calculated from the older cohort. I then multiplied this figure by the total expected number of births to Plyler women using a TFR of 2.13 (Colby and Ortman 2015) to derive the number of additional preterm births without Plyler. To estimate the healthcare costs associated with the increase in preterm births, I multiplied the number of additional preterm births by the per-case cost estimates from Institute of Medicine (2007).

- *The number of US-born preterm births prevented by Plyler 1982-2023 = Number of education-years gained among Plyler women over 18 and above in 2023 * 2.13 TFR * 0.73 percent*
- *Healthcare expenditure associated with preterm births avoided 1982-2023 = number of preterm births prevented by Plyler 1982-2023 * $* 37,022 *(2005 dollars) * 2005-2023 conversion rate*
- *The number of US-born preterm that continued Plyler will prevent in the future = Projected years of education loss among Plyler women aged under 18 in 2023 based on past cohort's average education gains* 2.13 TFR * 0.73 percent*
- *Healthcare expenditure associated with preterm births that Plyler will avoid in the future = number of preterm births prevented by Plyler 2024 onwards * $* 37,022 *(2005 dollars) * 2005-2023 conversion rate*

Assumptions and limitations

The methodological approach for estimating preterm births makes similar assumptions as the infant mortality calculations. The TFR is assumed to be constant and is likely to underestimate

past births and overestimate future births. If growing education trends among women were to continue, actual educational attainment among the younger Plyler cohort is likely to be higher than the estimates. Lastly, the per-case estimates used in the calculations do not include other costs to society. The Institute of Medicine report (Institute of Medicine 2007) adds $ 1,203 per case for early intervention costs, $ 2,150 per case for special education costs, and $ 11,214 per case for lost productivity costs among parents (all in 2005 dollars) to the medical expenditures used in the calculations here.

Childhood Influenza

Acute respiratory disease is the most common cause of healthcare visits and hospitalization for children in the US (National Center for Health Statistics 1995). Most are caused by a viral infection such as influenza (Monto and Sullivan 1993). School-aged children have the highest incidence of the flu (Glezen et al. 1978). About 8-20 per 100,000 children aged 5-17 are hospitalized from complications each year (Iuliano et al. 2011), and about 6-15 out of 100 children use outpatient medical services to treat symptoms (Neuzil et al. 2000). Vaccines are highly effective in preventing influenza complications (Adams et al. 2023), but immunization rates are relatively low among children, especially those between 13 and 17 years old (Centers for Disease Control and Prevention 2024b).

School-based immunization programs aim to increase overall immunization rates and reduce disparities in vaccine access (Schmier et al. 2008). Schools and districts vary in how they expand access to enrolled students but often partner with local health departments, pharmacies, and community health centers to offer community or school-located vaccination clinics (Centers for Disease Control and Prevention). Eligible children, including uninsured children with no immigration status, can receive vaccines at no cost (Centers for Disease Control and Prevention 2024c). Controlled clinical trials of select schools showed a decline in influenza-like illnesses in households that sent their children to schools with vaccination programs (King et al. 2006).

Data

The calculations in this section are based on a controlled clinical trial that compared healthcare expenditures between families whose children had access to school-based immunization programs and families who did not (Schmier et al. 2008). Schmier and coauthors subtracted vaccination costs (acquisition, administration, and adverse events) from their cost-consequence analysis, which yielded about 69 dollars in net healthcare savings per household per influenza season attributable to the school-based immunization programs.

Table 9. Per household and per student influenza-related healthcare costs and savings attributed to school-based vaccination programs per influenza season

	Per household	Per student
Vaccine costs		
Acquisition	-31.14	-15.57
Administration	-3.16	-1.58
Adverse event	-1.78	-0.89

Direct savings		
Outpatient	48.61	24.31
ED	1.97	0.99
Hospitalization	0.19	0.10
Rx medication	26.72	13.36
OTC/herbal therapeutics	27.64	13.82
Net savings	69.05	34.53

Source: Schmier et al. (2008), Exhibit 3

Methods

I subtracted direct vaccine costs from influenza-related savings estimated by Schmier et al. (2008) to derive the net direct cost benefit per household. To estimate per-person savings, I divided per-household savings by two—the average number of children in households with children (Livingston, Parker and Rohal 2015). I then applied the annual savings to person-year exposure to school attendance under Plyler. The direct effects of school-based vaccination programs last for a year, and the calculations only consider school-aged years.

Person-years from 1982 and 2023 were categorized as past Plyler benefits, and person-years 2024 and onwards were categorized as future Plyler benefits. Ages 6 through 17 (inclusive) were considered "school-age," and the maximum number of school years was 12. For example, if a child entered the US at age 10 in 2020, the child would contribute four years to past Plyler benefits and the next four years to future Plyler benefits. If another child entered the US at age three in 2020, this child would contribute one year to past Plyler benefits and 11 years to future Plyler benefits.

- *Past influenza-related healthcare savings from Plyler (1982-2023) = person-years attending a US school by the Plyler cohort between 1982 and 2023 * 34.53 in 2006 dollars * CPI 2006-2023 conversion rate*
- *Future influenza-related healthcare savings from Plyler (2024 and onwards) = person-years attending a US school by the Plyler cohort 2024 and onwards * 34.53 in 2006 dollars * CPI 2006-2023 conversion rate*

Assumptions and Limitations

The calculations assume that all US schools have flu immunization programs that increase immunization rates to levels observed in Schmier et al. (2008). School-based vaccination programs are not yet universal and were even less common in the 1980s (Nguyen et al. 2022). Even among children who attend schools with vaccination programs, the actual immunization rates vary. A recent study based in Oakland, CA, showed lower rates among non-White students (Nguyen et al. 2022). Thus, the healthcare savings presented here are likely to be overestimates of healthcare costs directly attributable to reducing influenza prevalence among children. On the other hand, schoolchildren are common vectors through which the virus spreads to other, more vulnerable family and community members (Cauchemez et al. 2004), and the societal benefit of expanding vaccine access to children may far exceed the estimates from Schmier et al. (2008).

Lifetime Depression

Depression is a leading cause of disability accounting for about 16 percent of years lived with a disability (YLD) worldwide (Arias, Saxena and Verguet 2022). Prevalence in the US is also high; in 2021, about 21 million US adults experienced at least one major depressive episode (National Institute of Mental Health 2023). People with depression are more likely to experience physical conditions such as arthritis, stroke, diabetes, asthma, and lung disease (Scott et al. 2016), and chronic conditions significantly contribute to shorter life expectancies (Lawrence, Kisely and Pais 2010). Suicide, a related outcome of depression, is a leading cause of death among all US adults and is in the top three causes of death for adolescents and young adults (National Institute of Mental Health 2024). Researchers estimate that mental disorders account for about 4.4 years of potential life lost due to natural causes and 8.1 years due to suicide (Chan et al. 2023).

Societal costs attributable to depression are high. In 2019, the economic burden in the US of major depressive disorder was estimated at $382.4 billion (in 2023 US dollars), 38 percent of which was due to direct healthcare costs (Greenberg et al. 2023).

Establishing a causal connection between mental health and schooling is tricky since children who experience poor mental health also tend to have lower attendance and outcomes (Finning et al. 2019). Quasi-experimental studies examining the link between educational attainment and mental health find a consistent inverse pattern between depression and schooling but mixed results in other mental health conditions such as schizophrenia, bipolar disorder, anorexia, and anxiety (Dardani et al. 2021, McFarland and Wagner 2015, Vilaplana-Pérez et al. 2020). Such studies often involve twin study designs or changes to compulsory schooling (Crespo, López-Noval and Mira 2014). A recent study used variations in school closures during the COVID-19 pandemic to examine associations between school attendance and mental health difficulty (Hawrilenko et al. 2021). They, too, find significant relationships between school closures and emotional problems but no differences in peer problems, conduct, and hyperactivity.

In this section, I calculated the excess person-year prevalence of depression associated with having less education and estimated the incremental direct healthcare costs that would come with more people with depression in the US.

Data

Baseline depression prevalence

I used the World Health Organization (WHO) sex-specific estimates of depression rates in the US (2019) as the baseline. The WHO uses years lived with a disability (YLD) to measure prevalence, and YLD is calculated as the number of people who have a condition multiplied by the average duration of disability. YLDs are represented as rates per 100,000.

Effect of education on depression

I used Demange et al. (2024)'s estimated impact of education on depression. Demange and colleagues used within-sibship regression and Mendelian randomization study designs and found about a six percent reduction in depression per additional year of education. Their effect size is very close to Crespo, López-Noval and Mira (2014)'s study, which exploited compulsory

education reforms. Crespo, López-Noval and Mira (2014) found a 6.5 percent reduction in depression per additional year of education.

Direct healthcare expenditures from depression

Greenberg et al. (2023) published average annual incremental healthcare costs associated with depression by comparing differences in medical claims between matched cohorts with and without depression. They estimate about $5,906 (2019 dollars) per year for women with depression and $7,308 (2019 dollars) per year for men with depression.

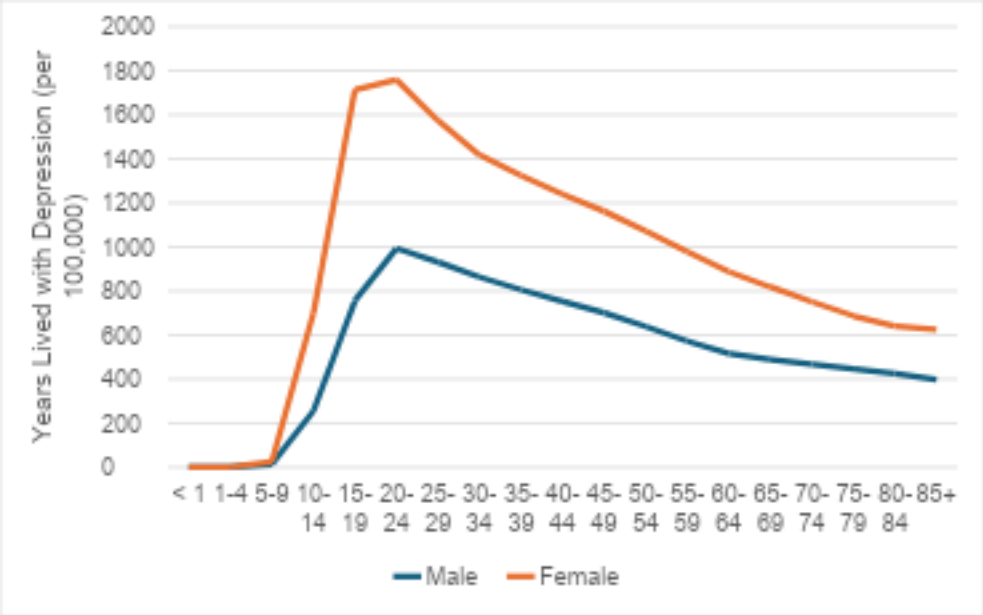

Figure 1. Age-specific rates of year lived with a depressive disorder by gender in the United States (2019)

Source: WHO Data Portal on Noncommunicable Diseases, Mental Health, and External Causes (https://www.paho.org/en/enlace)

Methods

I applied WHO's depression YLD rates to calculate the baseline prevalence of depression by year and sex using the annual population projections from 1982 to 2122. I then derived potential excess prevalence by exponentiating the 6 percent increases (Greenberg et al. 2023) by years of schooling gained through Plyler.

The years of schooling gained were derived from the difference between education at migration and total completed education (using Matt Hall's methodology and code). The figure below shows the average number of education years gained through Plyler by five-year age groups as of 2023. Age effects likely dominate the steep incline during younger ages. Children are still in school, and their education gains through Plyler will continue to increase as they age. Cohort differences likely dominate the variations after age 20—younger cohorts may have entered the US earlier in life and thus gained more education through Plyler. In the calculations, I applied actual age group-specific average education years gained for ages 5 through 19 and applied a

constant average across age groups 20 and over. I used values calculated from the national sample for all sub-regional estimates.

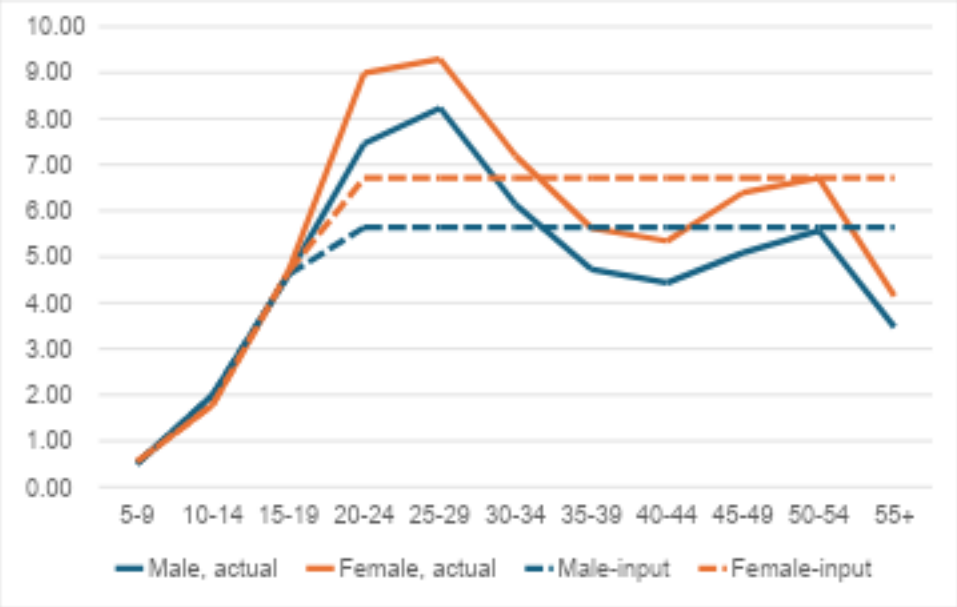

Figure 2. Actual age-specific education gained through Plyler from the ACS and illustration of model inputs

Source: 2022 ACS with 2023 weights

I summed the excess YLDs across age groups for the past Plyler period (1982-2023) and the future Plyler period (2024-2122) separately by gender. I then multiplied the excess YLDs by Greenberg et al. (2023) gender-specific annual direct healthcare costs attributable to depression.

$$Excess\ YLD\ at\ each\ year = \sum_{y}^{m,f} \sum_{x=1}^{\infty} l_{xy} r_{xy} \left(1.06^{g_{xy}} - 1\right)$$

l is the projected number of Plyler beneficiaries, r is the YLD (per 100,000), and g is the average education gain in age group x and in gender y.

The excess YLD was multiplied by the sex-specific annual direct healthcare costs associated with depression (Greenberg et al. 2023) and summed across age, gender, and year to calculate the total healthcare savings.

Assumptions and Limitations

The calculations make several assumptions. First, applying Greenberg et al. (2023) estimates assumed that the risk of depression decreases monotonically with each education-year gained. Other studies that examined the association between educational attainment (high school and college degrees) also showed a decreasing risk of depression at higher levels of education but also suggested that the effects may be smaller among Mexican-Americans (Li et al. 2022).

Second, the calculations also assumed that age- and gender-specific rates of depression are constant over time. Recent studies showed that while depression prevalence remained relatively stable for those over 35 but has been increasing rapidly among adolescents and young adults (Goodwin et al. 2022). Depressive disorders in childhood increase the risk of psychiatric disorders in later adulthood (Carballo et al. 2011), and actual depression prevalence may be higher in future years than what is estimated here. Third, while Demange et al. (2024) used Dutch national registry data to estimate the causal relationship between education and depression, their findings are likely to be applicable to those living in the US. Older observational studies using US data consistently found an inverse relationship between education and depression (Lorant et al. 2003). Finally, mental healthcare utilization and costs are also assumed to be static over time. The COVID-19 pandemic has spurred a sustained growth in telemedicine (Cantor et al. 2023) and has contributed to an increase in mental healthcare utilization (Lee et al. 2024). Should the trends continue, healthcare costs directly associated with mental health care may increase in future years. On the other hand, expanded access to mental health care may also decrease overall health care costs associated with depression as more people receive treatment and live fewer overall years with depression.

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