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Research article

Understanding Relationships between Food Security and Education Attainment: Simulations of the Role of Racial, Ethnic, and Gender Inequity

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Abstract

We simulate changes in education attainment among men and women of different races and ethnic origins when race, ethnic, and gender inequities in education opportunities are eliminated in the US. Also, we simulate changes in the number of food-insecure people expected to accompany these simulated changes in education attainment. Education attainment simulations use American Community Survey 2017, 5-year average state-level data on adults by race, ethnicity, and gender. Food security simulations use Current Population Survey state-level 3-year average data covering 2013-2017. Results show 35.3% of non-Latine white adults attained high school degrees or less, and 34.5% Bachelor's degrees or higher. Among non-Latine Black and Latine adults, 46.4% and 60.2% respectively attained high school degrees or less, but only 20.5% and 15.9% attained bachelor's degrees or higher. Equalizing education opportunity in simulation models by race, ethnicity, and gender led to large decreases in numbers of non-Latine Black and Latine men and women attaining high school degrees or less, and large increases in numbers attaining Bachelor's degrees or higher. Education attainment gains are accompanied by large reductions in numbers of people living in food-insecure households (11.8-17.1 million people). However, race, ethnic, and gender inequities in wages and incomes at all levels of education attainment persist, pointing to the need for investments in education as well as policies to equalize economic conditions holding wages down.

Keywords: food insecurity, education attainment, race, ethnicity, gender

Introduction

Education attainment, the highest level of education completed by a person, is positively related to their employment, earnings and income [1], asset accumulation [2], health [3,4] and civic engagement and involvement. Food security, the consistent access by all people at all times to enough of the kinds of food needed for an active, healthy life, has been linked to early child development, including cognitive, social, and behavioral capacities necessary for successful adaptation to formal learning environments [5-7]. Development of these capacities, often referred to as "school readiness", in young children is also influenced by parental, family, and environmental characteristics, such as family structure, parents' mental and physical health, and socio-economic status (SES), all of which are also related to household food security status [8-11]. In turn, academic achievement is integral to successful education attainment and has been connected with food security during K-12 school years and in post-secondary education environments [13-15].

Since food security measurement began nationally in 1995, its prevalence among non-Latine white households has consistently been more than 2 times lower than among non-Latine Black and Latine households each year [16].

Among the logical implications of such reciprocal, multi-generational relationships of food security with academic achieve-

ment and education attainment, and with race and ethnicity, is the compelling likelihood that food security will improve when academic achievement and education attainment improve. On average in the US, people who have attained higher levels of education are more likely to be employed, have higher annual earnings and income, have better health, and engage in civic activities such as political activity, voting, volunteering, and community improvement projects [17-19]. However, neither the rates of higher education attainment nor the benefits of higher education attainment are equitably distributed by race, Latine origin, or gender in the U.S [20]. Nationally, and to varying degrees within states, a history of racism, racial inequity, internalized white supremacy, and patriarchy has prevented Black, Indigenous, and other people of color (BIPOC), and people of Latine origin, from accessing and taking full advantage of educational opportunities at all levels, from pre-K to post-secondary education. These persistent discriminatory forces continue to manifest in policies, practices, and behaviors, in public school finance, education, healthcare, housing, lending, and employment, worker benefits, and earnings in the US. The negative implications of these conditions are disproportionately experienced daily by BIPOC and Latine people in all states.

Thus, this research had two primary aims: (1) To simulate nationally the numbers of adults ages 25 years and above who would have attained each level of education if conditions that determine academic achievement and education attainment had been equalized by race, ethnicity, and gender within each state in the US, Washington, DC and Puerto Rico; (2) To simulate changes that would have occurred in household food insecurity under the simulated education attainment conditions.

Materials and Methods

Two nationally representative datasets were used to complete the simulation modelling. To complete aim 1, we used American Community Survey (ACS) state-level education attainment data for adults ages 25+ years by gender, race, and ethnicity, aggregated across all 50 states, Washington, DC, and Puerto Rico, and averaged over the 5-years 2013-2017. To complete aim 2, we used Current Population Survey (CPS) state-level 3-year average food security data covering 2013-2017. These data were selected to try to minimize exogenous factors, as a time of relative steady state in national policies related to employment and education. They are after the Great Recession, and before some of the policies impacting people from marginalized communities in the first Trump administration as well as the COVID pandemic, which together caused large scale disruption to education and the workforce at national scale.

Note that in the ACS data, people of Latine origin can be from any race; thus, to avoid double-counting only data from the seven race categories used in the ACS are included in the data for all people. Though contemporary gender identification includes several additional categories, these are not represented in the ACS data, and thus not included in this study. In some labels gender is referred to as sex, following Census Bureau convention.

Education attainment simulation

The goal of the simulation was to maximize education attainment within the constraints of the optimal education environment in each state, as represented by the highest proportion of people ages 25+ from all the race/ethnicity/gender subgroups in each state attaining the level that enables them to progress to the next higher level. For each level of education, we disaggregated the proportion of the population in each state achieving that level by the joint classification of gender (male or female), the seven race categories used in the ACS (white, Black/African American, Native American/Alaska Native, Asian, Native Hawaiian/Pacific Islander, some other race alone, two or more races), and ethnicity (Latine/not-Latine). This resulted in 28 (2 x 7 x 2) mutually exclusive subgroups for each education attainment level in each state. Simulations were run for males and females separately. In each step of the simulations, described below, optimal conditions (e.g., percentages) observed for females were compared with optimal conditions observed for males in the same state, and the better of the two was applied to both males and females in that state. This process equalized results by gender within each state. This procedure was replicated for race and ethnicity, using the most favourable education attainment conditions, derived from non-Latine whites, or non-Latine Asians, and equalized by state. In other words, the goal of the simulation models was to select the subgroup population within each state with the highest observed proportion of a given education level, leading to progression toward higher levels of education attainment, and apply those proportions to all race, ethnic, and gender subgroups in that state. In this way, variation within each state's socioeconomic environment and education system that supported education attainment among those whose life circumstances were most conducive to academic success and progression are equalized across all race, ethnic, and gender subgroups in the state. Thus, the six steps in the simulation algorithm flow were as follows.

• Step 1: Minimize the percent of people ages 25 years and above (25+) with less than a high school degree in each state by selecting the lowest observed percent of people from all gender-race-ethnicity subgroups in each state with less than a High School degree.

• Step 2: Maximize the percent of people ages 25+ with a High School degree or higher in each state. This is determined by Step 1 as a residual.

• Step 3: Maximize the percent of all people ages 25+ with a Bachelor's degree or higher by selecting the highest observed percent of people with a Bachelor's degree or higher from all gender-race-ethnicity subgroups in each state.

• Step 4: Among all people ages 25+ with a High School degree or higher in each state, minimize the percent of people with a High School degree and some college but not a Bachelor's degree, by subtracting the maximized percent of all people with a Bachelor's degree or higher in each state from the maximized percent of all people with a High School degree or higher in that state.

• Step 5: Among all people ages 25+ with a High School degree and some college but not a Bachelor's degree, maximize the percent with some college or an Associate's degree by selecting the smaller of the percent with, 1) a High School degree or some college but not a Bachelor's degree, or 2) some college or Asso-

ciate's degree only.

• Step 6: Among all people with a High School degree and some college but not a Bachelor's degree, minimize the percent with a High School degree only by subtracting the maximized percent of people ages 25+ with some college or Associates degree from the minimized percent with a High School degree or some college but not a Bachelor's degree. For internal consistency, if the latter value is less than or equal to the former, then set the percent with a High School degree only, to zero. The simulated "optimal" proportions (e.g., the smallest observed proportion with less than a High School degree in each state) were then multiplied by the number of people in each of the corresponding race categories (male and female separately) to produce the "equalized" number of people ages 25+ years in each of the education attainment categories in each of the race/gender subgroups within each state.

• Step 7: These optimized numbers were summed within each education attainment category within each state, and aggregated across all fifty states, Washington, DC, and Puerto Rico to produce the national totals.

Food insecurity simulation

The goal of this simulation was to understand how the simulated changes in education attainment might have influenced food insecurity, a measure of population well-being. Since food insecurity prevalence estimates were not readily available by individual adults' level of education attainment, to simulate changes in food insecurity likely to accompany the simulated changes in education attainment it was necessary to involve a triangulation process, using three hypothetical scenarios of food-insecurity prevalence. The three scenarios correspond to the simulated education attainment results obtained when education opportunities within each state were equalized by race, ethnicity, and gender. Underlying each, however, are the variations in unemployment rates and mean earnings. Unemployment rates were obtained from the Bureau of Labor Statistics tabulations of data from the 2018 Current Population Survey. Mean earnings were obtained from the US Census Bureau, 2018 Current Population Survey Annual Social and Economic Supplement.

As mentioned above, the education attainment simulations selected population subgroups in each state with the most favourable education attainment conditions at each stage of progression through the education process. For race and ethnicity, non-Latine whites or non-Latine Asians were selected. Thus, for the first scenario, in each of the five years (2013-2017), we re-estimated the number of individuals in each race/ethnicity category living in food-insecure households nationally by applying the national prevalence estimate for non-Latine whites in that year to all other subgroups (non-Latine Blacks, Latine, and non-Latine Other race). For the second and third scenarios, we selected the two states with the lowest average prevalence of food insecurity over the same 5-year period (2013-2017), based on three-year average estimates by state. The two states with lowest average prevalence over this five-year period were North Dakota and Hawaii. The population of North Dakota over 2013-2017 was predominantly non-Latine white; 96.6% non-Latine, and 90% white [21]. The population of Hawaii over this period was somewhat more diverse, but predominantly non-Latine white and Asian, either reported as one race, or those races in combination with another. Hawaii's population was 90% non-Latine over the period [22]. Two sets of estimates of the number of individuals living in food-insecure households were produced using the average prevalence estimates for these two states over 2013-2017.

Results

Aggregated initial education attainment data used in the simulation models in this study are summarized in Table 1. Data are presented for all races (Latine category not identified), Black, and Latine (of any race), and for males and females separately and combined.

Table 1: Simulation initial conditions: total numbers and percentages of US adults ages 25 years and above of all races, Black race, Latine ethnicity, by gender, and with males & females combined, by level of education attainment. American Community Survey, 2013-2017.

Education level	All races males	All races females	All races, both sexes combined	Black males	Black females	Black, both sexes combined	Latine males	Latine females	Latine, both sexes combined
Less than high school degree	10,647,778 (11.3%)	10,359,045 (10.2%)	21,006,823 (10.7%)	1,979,249 (16.7%)	1,950,057 (14.0%)	3,929,306 (15.2%)	5,809,147 (34.3%)	5,338,669 (31.2%)	11,147,816 (32.7%)
High school degree or equivalent	26,543,302 (28.1%)	27,045,310 (26.6%)	53,588,612 (27.3%)	4,120,779 (34.7%)	3,926,077 (28.2%)	8,046,856 (31.2%)	4,882,834 (28.8%)	4,457,812 (26.1%)	9,340,646 (27.4%)
Some college or Associate's degree	26,773,024 (28.4%)	31,089,089 (30.6%)	57,862,113 (29.5%)	3,652,669 (30.8%)	4,863,178 (34.9%)	8,515,847 (33.0%)	3,833,908 (22.6%)	4,316,924 (25.2%)	8,150,832 (23.9%)
Bachelor's degree or higher	30,419,724 (32.2%)	33,107,864 (32.6%)	63,527,588 (32.4%)	2,118,504 (17.8%)	3,181,761 (22.9%)	5,300,265 (20.5%)	2,406,923 (14.2%)	2,993,675 (17.5%)	5,400,598 (15.9%)

Source: American Community Survey, 2017, Five-Year Average Data (2013-2017). Column percentages, indicating the percent of column totals comprised by those attaining each level of education in that column.

Values in table 2 represent the changed numbers and respective percentages of people nationally attaining each level of education as a result of the race, ethnicity, and gender equalizations enabled by the simulation process. Negative numbers indicate people who moved into higher education categories due to equalization. Although consistent with the relatively large numbers of Latine people in the lower attainment categories in Table 1, the large reductions in the numbers of Latine males and females attaining less than a High School degree and High School Degree only stand out. As logically High School graduation is a critical hurdle that must be passed to enable further progression, the large reductions in the number of Latine people with less than a High School degree and High School degree only are accompanied by large increases in the numbers attaining both Some College but less than a Bachelor's degree and Bachelor's degree or higher.

Also notable are the decreases in the numbers of Black males and females with less than High School degrees and High School degree only, accompanied by even larger increases in numbers with Bachelor's degrees or higher. The large increase in number of Black males attaining Bachelor's degrees or higher is particularly noteworthy. Referring back to baseline conditions shown in Table 1, a relatively low percentage of Black males had attained Bachelor's degrees or higher, and a similarly larger proportion had attained High School degrees only. The simulated equalization procedures enable a large number of Black males to move beyond High School only and attain Bachelor's degrees or higher. There are relatively small changes in numbers and percentages of Black males and females attaining "Some College but less than a Bachelor's degree".

Results in Table 3 show the final state of education attainment resulting from the simulated changes in Table 2 being added to the baseline conditions in Table 1. Variations in the numbers of people from each of the three populations attaining each level of education are now determined primarily by the relative sizes of those populations since differences across subgroups based on race, ethnicity, and gender have been eliminated by the equalization algorithm. This is represented most clearly by the similarities in percentages attaining each level of education among all three population subgroups. It is worth noting that both Black and Latine people are included in the "All Races" category, in addition to people from the six race subgroups not shown separately in the tables (white, Native American/Alaska Native, Asian, Native Hawaiian/Pacific Islander, some other race alone, two or more races).

The most notable characteristic in Table 3 is the similarity in percentages of people in the three population subgroups attaining each level of education, including both gender groups. In all three subgroups, under conditions of equalized education attainment opportunity, approximately 5%-7% of both males and females attain less than High School degrees; approximately 11%-12% attain High School Degrees only; approximately 30%-35% attain some college but not Bachelor's degrees, and approximately 48%-50% attain Bachelor's degrees or higher. Compared to the respective percentages in the initial conditions (Table 1), far smaller percentages attain less than High School degrees and High School degrees only, larger percentages of Latine men and women attain some college but not Bachelor's degrees, and far larger percentages of men and women in all three population subgroups attain Bachelor's degrees or higher.

Results of the three sets of estimates of the numbers of individuals living in food-insecure households in each year from 2013-2017 are shown in Table 4, alongside annual food insecurity prevalence. The five-year averages range from 11.8-17.1 million fewer people living in food-insecure households. The estimates of reductions in numbers of food insecure individuals (all ages) can be viewed as likely reductions achievable when education attainment is equalized by race, Latine origin, and gender.

Table 2: Simulated total numbers of US adults ages 25 years and above of all races, Black race, Latine ethnicity, by gender, and with males & females combined, resulting from equalization by race, ethnicity, and gender, by level of education attainment. American Community Survey, 2013-2017.

Education level	All races males	All races females	All races, both sexes combined	Black males	Black females	Black, both sexes combined	Latine males	Latine females	Latine, both sexes combined
Less than high school degree	-3,480,624 (-32.7%)	-3,483,150 (-33.6%)	-6,963,775 (-33.2%)	-1,009,517 (-51.0%)	-937,252 (-48.1%)	-1,946,768 (-49.5%)	-4,733,008 (-81.5%)	-4,366,155 (-81.8%)	-9,099,163 (-81.6%)
High school degree or equivalent	-13,549,329 (-51.6%)	-13,352,478 (-49.4%)	-26,901,807 (-50.2%)	-2,475,469 (-60.1%)	-2,034,110 (-51.8%)	-4,509,579 (-56.0%)	-2,498,553 (-51.2%)	-2,322,143 (-52.1%)	-4,820,696 (-51.6%)
Some college or Associate's degree	6,583,077 (24.6%)	5,561,408 (17.9%)	12,144,485 (21.0%)	400,754 (11.0%)	-5,553 (-0.1%)	395,202 (4.6%)	2,684,820 (70.0%)	2,412,305 (55.9%)	5,097,125 (62.5%)
Bachelor's degree or higher	23,440,850 (77.1%)	24,967,052 (75.4%)	48,407,902 (76.2%)	4,729,541 (223.2%)	4,868,881 (153.0%)	9,598,423 (181.1%)	6,931,022 (288.0%)	6,411,662 (214.2%)	13,342,683 (247.1%)

Source: American Community Survey, 2017, Five-Year Average Data (2013-2017).

Table 3: Simulated total numbers of US adults ages 25 years and above of all races, Black race, Latine ethnicity, by gender, and with males & females combined, after equalization by race, ethnicity, and gender, by level of education attainment. American Community Survey, 2013-2017.

Education level	All races males	All races females	All races, both sexes combined	Black males	Black females	Black, both sexes combined	Latine males	Latine females	Latine, both sexes combined
Less than high school degree	7,167,154 (6.7%)	6,875,895 (6.0%)	14,043,048 (6.3%)	969,732 (7.2%)	1,012,805 (6.4%)	1,982,538 (6.8%)	1,076,139 (5.6%)	972,514 (5.1%)	2,048,653 (5.3%)
High school degree or equivalent	12,993,973 (12.1%)	13,692,832 (11.9%)	26,686,805 (12.0%)	1,645,310 (12.2%)	1,891,967 (12.0%)	3,537,277 (12.1%)	2,384,281 (12.3%)	2,135,669 (11.1%)	4,519,950 (11.7%)
Some college or Associate's degree	33,356,101 (31.1%)	36,650,497 (31.8%)	70,006,598 (31.4%)	4,053,423 (30.0%)	4,857,625 (30.7%)	8,911,049 (30.4%)	6,518,728 (33.7%)	6,729,229 (35.0%)	13,247,957 (34.4%)
Bachelor's degree or higher	53,860,574 (50.2%)	58,074,916 (50.4%)	111,935,490 (50.3%)	6,848,045 (50.7%)	8,050,642 (50.9%)	14,898,688 (50.8%)	9,337,945 (48.3%)	9,405,337 (48.9%)	18,743,281 (48.6%)

Source: American Community Survey, 2017, Five-Year Average Data (2013-2017).

Discussion

Results from the simulation models show that equalizing education opportunity by race, ethnicity, and gender would lead to large decreases in numbers of non-Latine Black and Latine men and women attaining high school degrees or less and large increases in numbers of all subgroups attaining Bachelor's degrees or higher. However, it is notable that there was not much change in numbers and percentages of Black males and females attaining Some College but less than a Bachelor's degree. One potential inference suggested by this is that equity barriers continued to prevent Black men and women from entering and/or completing four-year postsecondary education programs. Our simulations add to the case for why it is vital to not just address but eliminate them. Education attainment gains are accompanied by large reductions in numbers of people living in food-insecure households, with implications for social policy starting in childhood. Children who are healthy and live in a hardship-free environment are likely tracing a successful trajectory of academic success at each stage of their education, and may attain levels of education consistent with their potential. These in turn are expected to prepare them for life as healthy, successful adults. However, race, ethnic, and gender disparities - the result of systemic, structural, and historical environmental factors, such as internalized racism and white supremacy and their historical basis in patriarchy, colonialism, and slavery in the US, - likely hinder people's trajectory of success [23]. Established research shows that racism is a fundamental cause of poor health outcomes for people from minoritized races and ethnicities as is gender inequity, especially when it intersects and combines with racial inequity [24-28]. These persistent inequities impair the physical and mental health of Black and Latine children and routinely lead to burdensome costs to their communities [29]. Structural racism also extends well beyond the education system. After graduation, inequities persist in the workplace which further exacerbate disparities in income and health outcomes. Even with a two- or four-year degree, Black and brown professionals still make less money than their white counterparts [30]. Nonetheless, education remains one of the most fundamental avenues to better jobs, higher income, and better health.

Though not specifically included in these simulation models, to fully understand education attainment it is imperative to consider its implications for employment and earnings [31,32]. Historically, unemployment rates for Black and Latine people have varied widely by education attainment, declining at each higher level of education. As for earnings, gender differentiation in pay and earnings are a primary focus of inequities. In all race and ethnic categories, and at all education attainment levels, men earn notably more than women. These male-female earnings gaps are highest among white people, and lowest among Black people, with Latine people in between. Despite that, results of these simulations provide no indication that eliminating inequities from education opportunities and education attainment alone would also reduce or eliminate gender-based inequities in earning and income. For example, one root cause of these gaps is the historical role of women as caregivers and a lack of meaningful paid leave for care of family members [33,34]. Aligned policy changes would be necessary to fully eliminate the gender and racial/ethnic inequities, including universally available paid family leave.

An additional approach to considering implications of the education attainment simulation is through its possible influence on indicators of well-being in the population, such as household food security/insecurity. A measure of households' inability to regularly obtain enough healthy food for all its members to lead active, healthy lives due to financial constraints, food insecurity is positively associated with household members' poor physical and mental health, and with households' earnings and income levels. Food insecurity exerts a negative influence on education attainment, while failure to attain levels of education consistent with

Table 4: Food insecurity by race and ethnicity, 2013-2017, with simulated changes under three scenarios.
Note: Numbers in parentheses indicate negative numbers.

National food insecurity data			Simulated food insecurity data based on 3 scenarios			
Race/Ethnicity & Year	Total People, All Ages	Number Food Insecure	Percent Food Insecure	First Scenario: Based on Non-Latine White (in 1000s)	Second Scenario: Based on North Dakota (in 1000s)	Third Scenario: Based on Hawaii (in 1000s)
2017						
Non-Latine White	200,889	18,284	9.1%	18,284	17,578	17,176
Non-Latine Black	39,354	8,753	22.2%	3,581	3,443	3,365
Latine	54,345	10,265	18.9%	4,945	4,755	4,646
Other, non-Latine	25,829	2,741	10.6%	2,350	2,260	2,208
Totals	320,417	40,043	12.5%	29,161	28,036	27,396
Differences				**(10,882)**	**(12,007)**	**(12,647)**
2016						
Non-Latine White	200,679	19,148	9.5%	19,148	17,559	17,158
Non-Latine Black	38,831	8,668	22.3%	3,689	3,398	3,320
Latine	54,026	10,569	19.6%	5,132	4,727	4,619
Other, non-Latine	25,493	2,819	11.1%	2,422	2,231	2,180
Totals	319,029	41,204	12.9%	30,391	27,915	27,277
Differences				**(10,813)**	**(13,289)**	**(13,927)**
2015						
Non-Latine White	199,829	20,447	10.2%	20,447	17,485	17,085
Non-Latine Black	38,770	8,356	21.6%	3,955	3,392	3,315
Latine	53,194	10,893	20.5%	5,426	4,654	4,548
Other, non-Latine	24,368	2,541	10.4%	2,486	2,132	2,083
Totals	316,161	42,237	13.4%	32,313	27,664	27,032
Differences				**(9,924)**	**(14,573)**	**(15,205)**
2014						
Non-Latine White	199,215	22,131	11.1%	22,131	17,431	17,033
Non-Latine Black	38,387	10,652	27.7%	4,261	3,359	3,282
Latine	51,622	12,282	23.8%	5,730	4,517	4,414
Other, non-Latine	24,080	3,070	12.7%	2,673	2,107	2,059
Totals	313,304	48,135	15.4%	34,795	27,414	26,787
Differences				**(13,340)**	**(20,721)**	**(21,348)**
2013						
Non-Latine White	198,841	22,536	11.3%	22,536	17,399	17,001
Non-Latine Black	37,815	10,904	28.8%	4,273	3,309	3,233
Latine	50,867	12,835	25.2%	5,748	4,451	4,349
Other, non-Latine	23,330	2,802	12.0%	2,636	2,041	1,995
Totals	310,853	49,077	15.8%	35,193	27,200	26,578
Differences				**(13,884)**	**(21,877)**	**(22,499)**
Mean of differences, 2013-2017				**(11,769)**	**(16,493)**	**(17,125)**

one's potential increases the likelihood of experiencing food insecurity. By simulating changes in education attainment that could have been achieved if education opportunities had been equalized in all 50 states, Washington, DC and Puerto Rico, by race, ethnicity, and gender, we show that dramatic reductions could be achieved in the numbers of non-Latine Black and Latine people with High School degrees or less, along with large increases in the numbers attaining Associate's degrees, and Bachelor's degrees or higher. Moreover, these changes would be accompanied by notable improvements in employment, earnings and income, with reductions in the number of adults and children living in food-insecure households ranging from 11.8 million to 17.1 million people. These changes would in turn lead to large improvements in health among children and adults, lower healthcare expenditures, and overall improvements in public health, and the common good.

Ending inequities in wages and incomes will require major changes in the US political economy and its social and cultural values. However, failing to accomplish this will continue to

strongly constrain Black and Latine men, and women in all race and ethnic groups from acquiring the full benefits of higher education attainment. The results of that failure will also perpetuate inequities in food insecurity, health, and well-being across race, ethnic, and gender subgroups, robbing the country of the full benefit of its people's potential.

Policy Implications

From cradle to career, policy solutions exist in the US to transform the economy, so families have the tools to achieve financial stability necessary to support educational success. However, implementing those policies requires functional governmental infrastructures and shared commitment to equitable opportunities for all members of society. At present both these prerequisites appear to be rapidly eroding [35-38]. To address interlocking challenges, we highlight cross-cutting solutions with foci on economic, basic needs affordability, and education sectors. Under economic policies, possible solutions include: an enforced commitment to payment of equitable living wages, expansion of the Earned Income Tax Credit (EITC) and Child Tax Credit, creation of a "Baby Bond" for financing pursuit of postsecondary education with a progressive not regressive structure, universal paid family leave [39-45, 56] for implementation of guaranteed basic income [46,47].

Under basic needs affordability, policy solutions include: adequate funding of the administration and benefit amount of the Supplemental Nutrition Assistance Program (SNAP; formerly the Food Stamp program) to accurately reflect the real cost of a healthy diet, extension of child age eligibility to age 6 years (instead of its current age 5 years) or the beginning of kindergarten to ensure continuous nutrition support for children transitioning from the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) to school meals; increases in the number of housing vouchers directed to families with children to improve housing stability and reduce racial segregation; and restoration of eligibility for SNAP, Medicaid, and other means-tested federal programs for legally present immigrants [39, 48-50].

Under education: establishment of universal early education and child care starting in infancy to ensure all young children receive high quality early learning opportunities that include provision of nutritious meals, and help for parents to seek higher education and employment opportunities; [51,52] increasing funding and immigrant-inclusive eligibility to expand Early Head Start and Head Start to meet the needs of all eligible families; [53] increase in Title I funding to help provide all children with high-quality public education regardless of place of residence, skin color, country of origin, or gender; establish national no-cost or low-cost broadband access to ensure equitable education access for communities of color, rural, and other marginalized communities; ensure Title I funded schools adopt culturally proficient curricula that accurately convey the historic and continued role of racism and other forms of discrimination in present day inequities including how they uphold the myth of white supremacy, and provide guidance on how these inequities can be dismantled; provide financial aid incentives to encourage Black and brown students to pursue careers in the education profession to increase diversity among K-12 teachers; establish and increase funding for work-based learning programs such as apprenticeships, credentialing programs, business mentorship opportunities and other on-the-job training programs to build career pathways, especially for those systematically shut out of certain careers based on their race, ethnicity and/or gender; investment of additional funding in Pell Grants to offer everyone the ability to attend a two-year or four-year public college without taking on overwhelming student loan debt; and cancel existing federal student loan debt [54].

Limitations: All data and simulation results in this study relate to pre-COVID-19 pandemic periods, and do not reflect any changes in education attainment that might have resulted from pandemic conditions and their post-pandemic consequences. Additionally, these simulation results do not include specific data on influences the pandemic may have had on employment, wages or earnings, or food security. As we are confronted with the aftermath of a global pandemic on education and economic well-being, additional simulations would be important to examine those factors. Nonetheless, these simulations reflect historical disinvestments in selected race, ethnicity, and gender subgroups that persist in times of prosperity as well as economic crisis. Thus, we can infer that most of the inequities of the pre-COVID era remain unchanged, if not exacerbated. Finally, these simulations do not attempt to describe specific circumstances that would have enabled equitable access to support for success in each level of schooling for each of the race, ethnicity, and gender subgroups. Future work addressing these shifts at each level would enhance the insights built in this study.

Conclusion

Achieving higher education attainment is possible when we equalize differences associated with race, ethnicity, and gender. In turn, more equitable education attainment would likely result in greater well-being in the form of food security. Unfortunately, these scenarios are so far only achieved within the parameters of simulation models. However, simulations like these can support ideas for future improvements in health, well-being, and the common good. Knowing what these scenarios could bring if equalization were achieved may facilitate the beginning of a new era of investment in education for all. Equitable education attainment for all children can become our new reality, allowing all children to reach their potential.

Abbreviations

SES: Socio-Economic Status; BIPOC: Black, Indigenous, and other people of color, ACS: American Community Survey, US: United States

Conflict of Interest

All authors disclose they have no conflict of interest.

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