Abstract

Research on the relationship between fertility and intelligence, while extensive, is mostly limited to the United States.The existence and magnitude of differential fertility could vary depending on the region and the country; however, this area of research has not been explored. To overcome this limitation, the magnitude of the selection differential for intelligence in 65 different countries was calculated by consulting the literature and analyzing international datasets (n = 419,444, k = 156), as well as the magnitude of the correlation between fertility and educational attainment (n = 797,455, k = 454). Based on the results of the meta-analysis, the average country's IQ is declining by 0.35 points per decade. Region comparisons suggest that the relationship between the number of children and intelligence is strongest in Latin America, Iran, and Turkey. In Denmark, Iceland, Estonia, Finland, and Switzerland, intelligence and fertility are negligibly related. However, there were some concerns with the quality of the international data which put the latter finding in question.

The magnitude of the decline in IQ globally is about 1.1 point per decade between the years of 2023 and 2100, though the rate at which intelligence is declining is falling. When weighted by population, the magnitude of the decline within countries is 0.4 points per decade, so 36% of the global decline in IQ is within countries. National IQ and the selection differential for IQ correlates at 0.51, while socioeconomic development and the selection differential for IQ correlates at 0.48.

Keywords: intelligence, dysgenics, international, meta-analysis, IQ

1. Introduction

The impact of the relationship between heritable characteristics and fertility has been considered since at least Ancient Greece (Alamariu, 2023). Plato, in particular, wrote and spoke about selective breeding and heredity in humans; he recommended the creation of a mating program to create an aristocratic 'Guardian Class', that would be tasked with leading the civilization (Goering, 2014). In the modern world, Francis Galton pioneered the study of selective breeding in humans (Galton, 1869), coining the term 'eugenics', meaning "good birth" in ancient Greek (Watson & Berry, 2009).

The first quantitative studies that assessed the selection differential for intelligence found negative directional selection (Chapman & Wiggins, 1925; Lentz, 1927) within the United States. Meta-analyses of studies, most of them within the United States, largely support these prior findings (Woodley of Menie, 2015; Reeve et al., 2018). Large studies in Taiwan (Chen et al., 2017) and China (Wang et al., 2016) also suggest that dysgenic fertility exists for intelligence. Studies within the Middle East also support the existence of dysgenic fertility for intelligence, but the magnitude of the relationship is somewhat weaker (Abdel-Khalek & Lynn, 2008; Abdelrasheed et al., 2022; Al-Shahomee et al., 2013).

There are some studies that do not find dysgenic fertility for intelligence. Among them is a large study of Swedish men that finds a weak positive relationship between cognitive ability and fertility (Kolk & Barclay, 2019). However, male fertility is less dysgenic than female fertility (Reeve et al., 2018), so this relationship may not apply to the whole population. Another study finds no relationship between fertility and intelligence in Japan and Sweden (Vining et al., 1988), however, they adjusted for parental education, which is inappropriate as education is more likely to be a mediator than a confounder. The relationship between educational attainment and IQ exists even when it is tested in young children (Ritchie et al., 2015) and exists when controlling for parental SES (Hegelund et al., 2018; Herrnstein & Murray, 1994), so there is likely to be a causal effect of IQ on educational attainment.

To estimate the decline in intelligence, corrections for the additive heritability of intelligence must be made. Prior literature used varying estimates of .4 to .86 for the additive heritability of intelligence (Woodley of Menie, 2015). The correlation between the parental midpoint and child IQ is about .53 (Reed & Rich, 1982); assuming a test-retest reliability of IQ of .9, the additive heritability of intelligence should be roughly 0.6. However, this estimate can be biased downwards by measurement error or upwards by parental transmission effects. Classical twin studies and adoption studies that study individuals over the ages of 18 find no shared environmental effect on intelligence (Bouchard, 2013), and other methods (such as adoption studies) also suggest no effects of shared environment in adults. Therefore, it is safe to assume in general that intelligence is a highly heritable trait, though the strength of the association between genes and intelligence may vary by country.

Some researchers such as Lynn (2011) have attempted to forecast the world's IQ based on population projections and the rate at which intelligence falls. In these studies, the decline in intelligence is assumed to be the same in all countries, though this may not be the case in real data. If dysgenic fertility for intelligence correlates with population size or projections, then applying the same selection differential to every country will produce a biased estimate of the world's IQ by year. While the relationship between IQ and cognitive ability internationally is understudied, Meisenberg (2008) has examined the relationship between educational attainment and fertility internationally, and found that the correlation varied between countries, and was strongest in Latin America and the Middle East, and weakest in Continental Europe.

2. Materials

We sourced data from various highly reliable sources, including all waves of the PIAAC; all waves of the World Values Survey data; all waves of the GSS; the 2001 and 2009 waves of the PISA; the 2001 PIRLS testing wave; and both NLSY waves (1979 and 1997), together with some academic literature as cited below. Only 1.5% of the effect sizes we report here were previously published elsewhere, meaning that the effect of publication bias in the present dataset is negligible. Data regarding the average age of childbirth and the population projections were collected from the United Nations.

Data on national IQs were collected from three sources: Becker (2019), Patrinos and Angrist (2018), and Lynn and Vanhanen (2012). Specifically, the psychometric (QNW) and psychometric + scholastic (QNWSAS) estimates were used from Becker's national IQ dataset. We normalized the estimates from Patrinos and Angrist to the distribution of national IQs which are found in Becker's psychometric estimates. This was done by subsetting the dataset to only include countries that had estimates from both Patrinos/Angrist and Becker, and then the difference in means and standard deviations was calculated. Notably, the estimates from Patrinos were higher than the ones from Becker (87.6 vs 85.2) and had less variance as well (10.4 vs 12.2). After this process was completed, a composite was generated from the four different datasets.

Afterwards, we manually set the IQs for Ireland (98) and China (102), as the IQ estimates for certain countries are inaccurate (see, e.g., Warne, 2022; Jensen, 2023). Countries which had missing values for national IQ had their national IQ estimated based on their four nearest neighbours.

Data on the general factor of socioeconomic development (s-factor) was taken from Emil Kirkegaard's megadataset which was downloaded from https://osf.io/zdcbq/files/osfstorage. The general factor of socioeconomic development is the hypothesized general factor that is posited to underlie all indicators of civilizational development, including but not limited to income, years of education, and internet access. The justification for the existence and validity of this factor is based on the positive manifold and very strong correlations between the different indicators (Kirkegaard, 2014).

If an estimate of s-factor was not available, then s-factor was imputed based on the human development index. The percent of the country that was islamic was also taken from pew research (Pew Research, 2022), to assess whether certain religions were associated with increased levels of dysgenic fertility.

2.1 PISA

We derived a general factor of general ability based on PISA Reading, Math, and Science Ability scores for individuals, as follows. First, we decided not to impute missing values in order to improve the consistency of our measures. Next, we derived general factors separately by participant sex to control for potential group differences in either means or variances, which could bias the four effect sizes we intended to calculate.

Only individuals between the ages of 15 and 17 years were included in our analyses, and we made age corrections for ability using a restricted cubic spline (Harrell, 2015). We restricted the age range to exclude individuals who were either held back or accelerated a grade. This is because individuals within this subpopulation display ability differences that cannot be explained by age differences but nonetheless correlate with them.

The 2001 wave of PISA utilized the following four groupings to categorize parental education: "No education (0)," "did not complete secondary education (1)," completed secondary education (2)," and "completed tertiary education (3)." Individuals with more than 15 siblings were coded as missing values due to concerns about validity. In the 2009 wave of PISA, all individuals with more than six children were coded as "having six children" due to an error in the original dataset.

2.2 PIRLS

Reading Ability was used as a replacement for intelligence, as it was the only test that was available. As above with PISA, individuals with divergent ages (below the age of 9 and above the age of 11 years) were excluded from our analyses, and we again corrected for age via a restricted cubic spline. Likewise, here we also standardized scores by participant sex to avoid group differences in means or variances from biasing our results.

PIRLS coded Educational Attainment according to the ISCED standards of education - anything below ISCED 2 was coded as 1; ISCED 2 was coded as 2, ISCED 3A/3B was coded as 3, ISCED 3C was coded as 4, ISCED 4A was coded as 5, ISCED 4B was coded as 6, ISCED 5A was coded as 7, and ISCED 5B or higher was coded as 8. The levels of education were reported by one of the parents of the child.

2.3 PIAAC

We estimated IQs by extracting the first general factor of the “Literacy Ability”, “Numerical Ability,” and “Problem Solving Ability” variables. In countries where problem solving ability was not available [N = 3], we analyzed just the Numerical and Literary Ability scores, which were also normed by participant sex. Individuals who were below the age of 40 were removed from the data and scores were corrected for the effect of age.

PIAAC categorizes “Educational Attainment” into seven different categories: “No education (0),” “ISCED 1 (1),” “ISCED 2 (2),” “ISCED (3),” ISCED 4 (4),” ISCED 5B (4),” ISCED 5A (Bachelor's degree; 5), “ISCED 5A (Masters degree; 6),” and “ISCED 6 <- 5, and foreign qualification (5). When calculating the selection differentials, education was controlled for age, and when evaluating the correlation coefficients, the number of children was also controlled for age. Countries such as Hungary and Singapore lacked age data, and so we excluded them from the effect sizes reported here.

2.4 GSS

We utilized the 10-item vocabulary test, “WORDSUM”, as our proxy for National IQ. Although this test’s validity (as a proxy for IQ) is questionable, the effect sizes (*r* = -.14) generated from this test (since 2000) do not seem to be much lower than those generated from the NLSY (r = -.18). We also normalized scores by sex and age, and we excluded individuals above the age of 40 years.

Further, we used each participant's highest year of education as our measure of educational attainment. We then controlled for the number of children each individual had when calculating the correlation between educational attainment and fertility. Years of education was also controlled for when calculating the selection differential for educational attainment. Finally, as above, we calculated selection differentials separately by sex.

2.5 NLSY (1979 / 1997)

The Armed Services Vocational Aptitude Battery (ASVAB) was used as a proxy for cognitive ability. Scores were standardized by age and sex. Moreover, all individuals in the sample were clearly past completed fertility (ages 54-61).

The NLSY oversamples Black participants (Bureau of Labor Statistics, 2022). We dealt with this issue by assigning each Black participant a random weight, such that if a participants' weight exceeded our threshold value, we removed them from further analyses. This resulted in a sample that had a representative sample of Black people. This process was repeated 100 times; thereafter, average effect sizes were calculated and used for the analyses reported below.

2.6 Study Inclusion Criteria

A total of 25 studies were excluded from the analyses reported below. We did so because of these 25 studies: (1) 13 failed to report effect sizes, (2) Six featured datasets that we already coded above, (3) Two reported effect sizes that did not seem credible ($|r| > .3$, even within a large sample), (4) One did not report sample sizes by sex, (5) One that did not representatively sample a country, (6) and one reported cognitive-test score reliability that was too low to be of value. In addition, when calculating effect sizes here, all studies conducted before 1970 were removed. Finally, Thailand's positive relationship between fertility and intelligence was judged to be a fluke, as it came from only one sample, and the overall relationship between educational attainment and intelligence was negative (r = -.11). Because of this, Thailand's dysgenic fertility for intelligence was estimated based on its dysgenic fertility for educational attainment.

3. Methodology

Selection differentials for intelligence were calculated by regressing intelligence onto fertility, and then dividing the slope by the intercept. This produces an estimate for the selection differential, which is the difference between the current population mean and that of the selected parents. This is not the same as the response to selection, which is calculated by multiplying the selection differential by the additive heritability of the trait in question (McClean, 1997).

Then, the estimated selection differential by country was estimated using a mixed-effects meta-analysis which controlled for the effect of the source (World Values Survey, PIAAC, PISA, PIRLS, and other) and cohort. This allows between-source differences in methodology that could affect the effect size (e.g. using siblings or a certain cognitive test) to be controlled for. In the meta-analysis, the reference group for sources was 'other', and the reference cohort was that of 1973. The same process was used to calculate the correlation between educational attainment and fertility by country and the correlation between fertility and IQ by country. Publication bias was not considered in the analysis, as 98.5% of the data comes from unpublished sources. A separate meta-analysis which calculated the selection differential for intelligence was conducted within the United States due to the large amount of available data.

The best data in the United States suggested that the selection differential for IQ is -2.42 points per generation, while the international (PIRLS, PISA, PIAAC) data suggests that it is only -1.2 points, so the effect of the international datasets must be corrected for. The problem is that most of the sources of regional data are American (26/29), so the magnitude of the decline may be potentially biased, as the international data may not measure dysgenic fertility for intelligence as badly in other countries. It's unclear if the effect of international datasets on the estimation of selection differentials is additive or multiplicative, hence, the results of both models were averaged.

Because most countries did not have data for dysgenic fertility for intelligence, imputations had to be made for the other countries. Bayesian model averaging was used to determine which national variables (including s-factor, the percentage of the country that is islamic, national IQ, and dysgenic fertility for education) best predicted dysgenic fertility for intelligence. Then, imputations for dysgenic fertility were first made with dysgenic fertility for educational attainment, then national IQ, and finally s-factor; the order was chosen based on how well the variable predicted dysgenic fertility for intelligence. While this may artificially increase the global decline in intelligence by increasing the correlation between dysgenic fertility and IQ between nations, the correlation between the unimputed selection differentials with national IQ ($r = .51$, $p < .001$) was roughly identical to the correlation between national IQ and the imputed differentials ($r = .59$, $p < .001$), meaning this is not a meaningful source of bias.

Given that certain methods had the tendency to overestimate or underestimate the selection differential within regions, the average of the two methods (imputing using education dysgenics vs imputing with HDI/national IQ) was calculated within subregions, and then the imputations were regressed to that average. So, if national IQs overestimated the dysgenic fertility within Africa, the estimate was regressed upwards. A graph of estimated dysgenic fertility for intelligence by country at each stage of imputations is provided in the Appendix in Figures A1 to A8. If selection differentials continued to be missing after the first stages of imputations, they were imputed based on the four nearest neighbours.

The response to selection by country is then calculated by multiplying the selection differential by the additive heritability of intelligence (0.6). To calculate the decline by decade, the response to selection is divided by the generational length in each country, and then that number is multiplied by ten. Then, these genetic declines by decade were used to project the future IQ of each country, though these were not allowed to decline past 55, due to uncertainty regarding whatever such a low IQ is actually measuring. To project the IQ of the world at any given point, the average IQ of the world was calculated for each year between 2024 and 2122.

Because there are projections for the racial composition of the United States, it is possible to take into account changes in racial demographics when calculating the estimates. These projections were sourced from the US Census Bureau (2023), which forecasted the racial composition of the United States 40 years into the future based on national fertility patterns and immigration. This analysis was carried out separately, so immigration trends in the United States were not factored when calculating global secular trends in intelligence.

The average IQ of Blacks was estimated to be 85 (Roth et al., 2001) and the average IQ of Hispanics was estimated to be 92, the average of Amerindians was estimated to be 87 (Fuerst, 2023b), the average of Pacific Islanders was estimated to be 93 (Fuerst, 2023b), the average of mixed race individuals was estimated to be 96.3 based on a weighted average of all individuals who reported more than one race in a nationally representative dataset (Fuerst, 2023a). The average IQ of US Asians was estimated to be 105.8 based on the average SAT/ACT scores of the various Asian sub-groups, weighted by size (Wikipedia, 2023; Fuerst, 2023b). These ACT/SAT score differences appear to be consistent in size with the differences in the ABCD (Hu, 2023), so they should be reasonably accurate in determining the true IQ of US Asians as a whole. It is assumed that the composition of each racial group is invariant enough across time for the average IQs of these immigrant groups to be stable.

Mutational load was not considered when projecting the decline in world IQ because the effect it has on IQ is of uncertain magnitude, and it no longer reaches statistical significance after controlling for birth order (Wang, 2023). While priors dictate that mutational load should have an effect on IQ, the effect that it has on genotypic IQ over time cannot be quantified at the moment.

4. Results

Within the United States, a random effects meta-analysis concludes that the selection differential for IQ is -1.51 (95% CI: [-1.71, -1.32]), though there was considerable heterogeneity (I^2 = 100%), as shown by Table 1. Introducing different moderators (notably the source) changes the model parameters and leads to estimations of selection differentials that are larger in magnitude within both the United States (Table 1) and the entire dataset (Table 5).

Table 1. Moderator analysis of selection differentials for IQ within the United States. *** p < .001, ** p < .01, * p < .05. The reference group for the sources are NLSY datasets.

Parameter	Model 1	Model 2	Model 3
Intercept	-1.07 (0.31)***	-2.42 (0.34)***	-1.96 (0.57)***
Cohort	-0.01 (0.0067)		-0.0071 (0.0072)
International (source)		1.18 (0.44)**	1.13 (0.44)**
Other (source)		0.95 (0.35)**	0.78 (0.39)

I2	100.00%	100.00%	100.00%
R2	4.34%	18.35%	18.30%

Because of these high levels of heterogeneity, it would be better to consult the effect size from the source of highest quality. In the United States, the best source that contains completed fertility and IQ is the NLSY79, since all of the individuals are very close in age, it is very large (n = 11,912), has a very accurate measurement of cognitive ability (ASVAB), and all of the individuals are likely beyond completed fertility (54-61). This dataset suggests the selection differential for IQ is -2.14 [-2.37, -1.91] , reasonably higher than the meta-analytic average of -1.51. A source of similar quality, the NLSY97, also has a relatively high selection differential -2.72, though the parents are not as close to completed fertility (ages 35-38).

Moderator analyses were conducted separately for each type of effect size. National differences in each effect size calculated from different datasets always correlated positively (r = 0.1 - 0.6), as shown in Tables 2 to 4. In addition, national differences explained a substantial amount of heterogeneity in all effect sizes (40-60%), suggesting that there are true differences in selection differentials for intelligence between nations, as is shown in Table 5.

Table 2. Correlation matrix of national differences in correlations between educational attainment and fertility from various datasets. *** p < .001, ** p < .01, * p < .05.

	PISA	PIRLS	WV
PISA			
PIRLS	.33		
WV	.43**	.62***	
PIAAC	.62**	.28	.46*

Table 3. Correlation matrix of national differences in the selection differential for IQ from various datasets. *** p < .001, ** p < .01, * p < .05.

	PISA	PIRLS
PISA		
PIRLS	0.51*	

PIAAC	0.21	0.15

Table 4. Correlation matrix of national differences in the correlations between IQ and fertility. *** p < .001, ** p < .01, * p < .05.

	PISA	PIRLS
PISA		
PIRLS	0.42	
PIAAC	0.44*	0.33

Table 5. Moderator analysis of selection differentials for IQ for all sources of data. The reference group for the sources are regional datasets and academic literature, while the reference group for the countries is Albania. *** p < .001, ** p < .01, * p < .05.

Parameter	Model 1	Model 2	Model 3	Model 4
Intercept	-1.73 (0.33)***	-1.85 (0.23)***	-1.86 (0.23)***	-2.26 (0.71)***
Cohort	0.013 (0.0058)*		0.00040 (0.0068)	
Country				included
GSS (source)		0.36 (0.26)	0.36 (0.28)	0.5 (0.31)
PIAAC (source)		1.45 (0.25)***	1.45 (0.26)***	1.08 (0.4)**
PIRLS (source)		0.69 (0.25)**	0.69 (0.26)**	0.54 (0.4)
PISA (source)		0.83 (0.25)***	0.83 (0.25)***	0.57 (0.4)
I2	100.00%	100.00%	100.00%	100.00%
R2	2.43%	30.14%	29.66%	51.07%

Dysgenic fertility for educational attainment correlated strongly with dysgenic fertility for intelligence (r = .62, p < .001), as shown in Table 6.

Table 6. Correlation matrix of effect sizes between countries. Edu Corr - correlations between educational attainment and fertility, IQ SD - selection differential for IQ by country, and IQ Corr - correlation between IQ and fertility by country.

	Edu Corr	IQ SD
Edu Corr		
IQ SD	.62***	
IQ Corr	.65***	.96***

Bayesian model averaging was used to best model the relationship between various national variables and dysgenic fertility for intelligence. This was done in 3 rounds - after a round is completed, the best variable is removed from the modeling procedure and the process is repeated. This is to generate various possible methods of imputing missing values in the dataset. Based on these results, dysgenic fertility for education is the best proxy for dysgenic fertility for IQ, followed by national IQ, and then s-factor. The percentage of the country that is islamic is unrelated to the selection differential for intelligence, as shown by the analysis in Table 7.

Table 7. Bayesian model averaging results by round. Dependent variable is the selection differential for IQ by country. Posterior inclusion probability placed in brackets, estimated value placed outside of it.

Parameter	Round 1	Round 2	Round 3
National IQ	0.14 (59.5%)	0.39 (77%)	
% Islamic	0 (0%)	0 (0%)	0 (0%)
S-factor	0 (0%)	0.11 (23%)	0.48 (100%)
Dysgenic fertility for education	0.59 (100%)		
R2	0.48	0.26	0.23

The average IQ of the world is projected to fall from 85.9 to 77.4 between 2023 and 2100, a total of 8.55 points, which translates to a decline of 1.1 points per decade, as shown in Figure 1. The rate at which intelligence is declining per decade is projected to fall, with the current rate being roughly 1.3 points per decade, decreasing to roughly 0.8 in 2100, as shown in Figure 2.

Within countries, IQ is declining at a rate of 0.4 points per decade when population size weights are used. This means that about 36% of the global decline is due to decline within countries and the remaining variance is due to decline between countries. The decline varied by region (F =

7.7, $p < .001$), ranging from -0.13 points per decade in Nordic countries to -0.42 points per decade in Oceania, as shown in Table 8. Projections for each country are available in Figures 4 to 5, and the decline in IQ.

Figure 1. Projected world IQ by year.

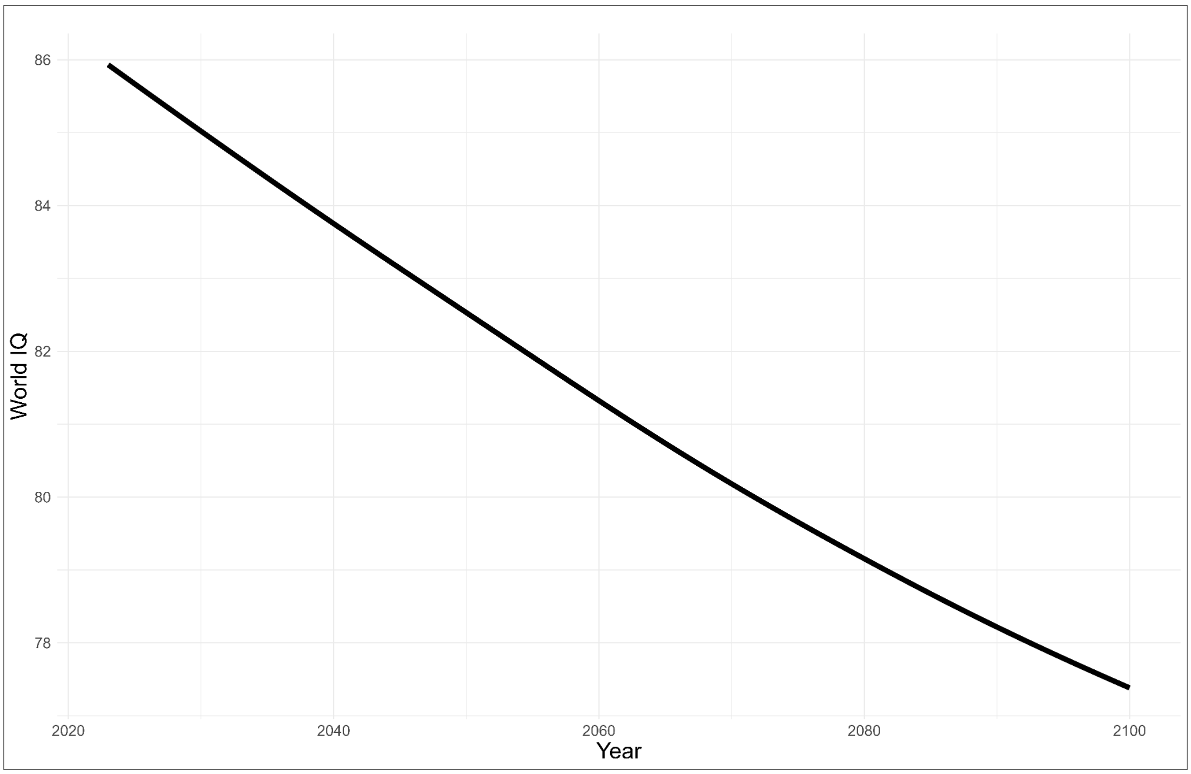


Figure 2. Projected decline in IQ per decade by year.

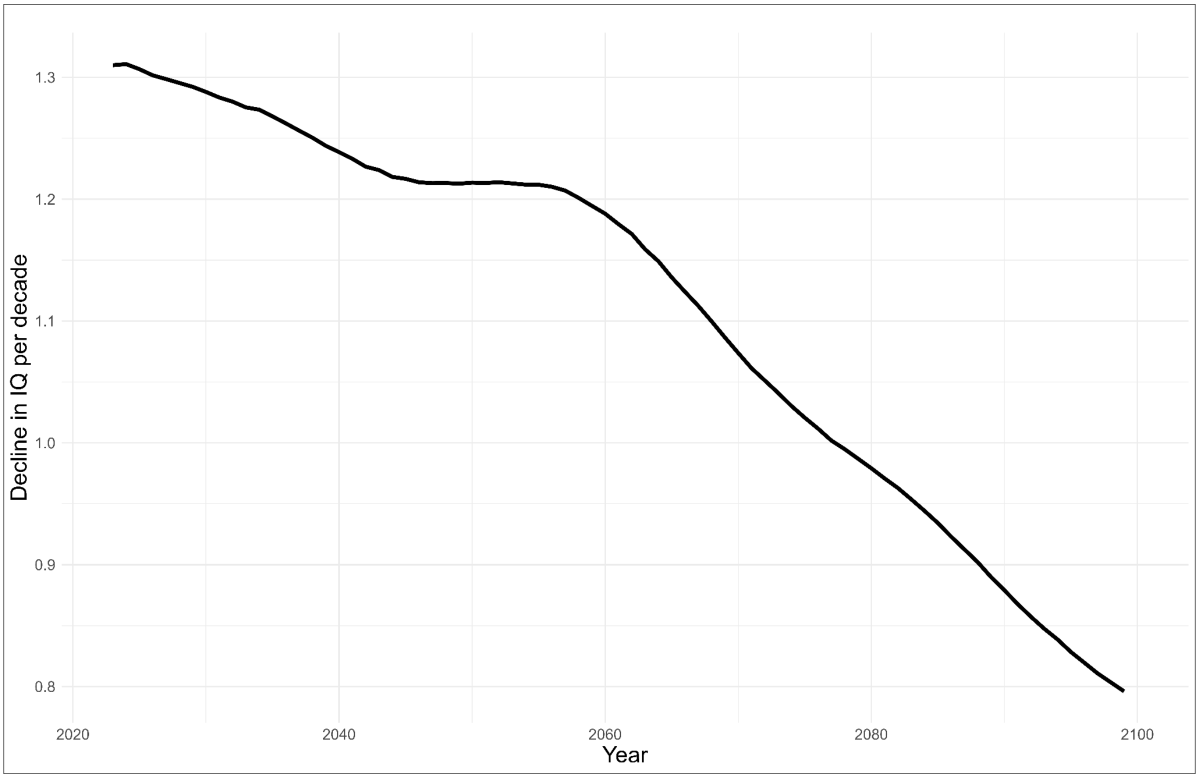

Decline in IQ per decade
1.3
1.2
1.1
1.0
0.9
0.8
2020
2040
2060
2080
2100
Year

Figure 3. Decline in IQ per decade by country.

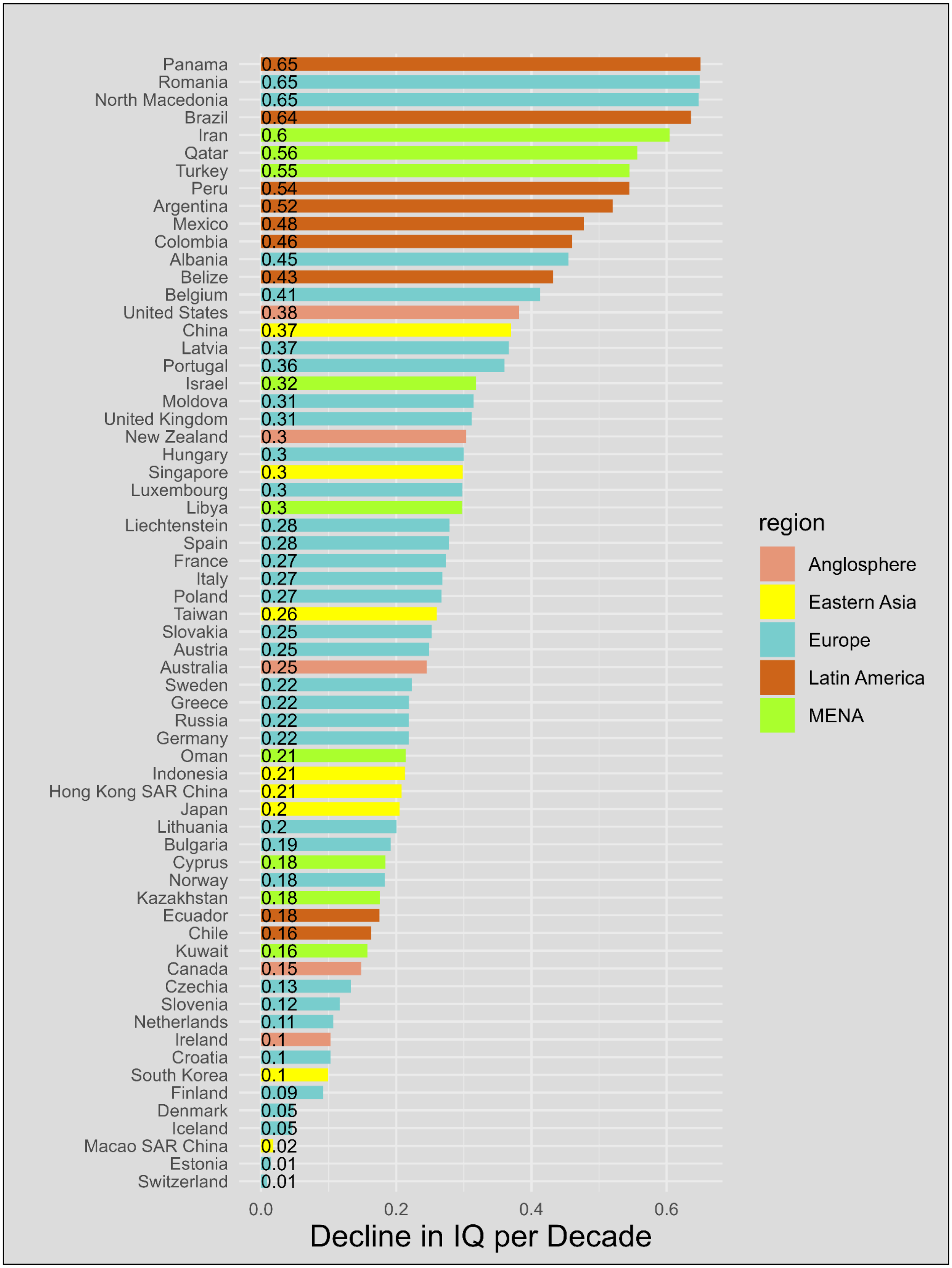


Table 8. Decline in IQ points per Decade by region.

Region	Decline per Decade
Oceania	-0.42
Latin America and the Caribbean	-0.40
Sub-Saharan Africa	-0.40
Western Asia and Northern Africa	-0.36
Balkan	-0.33
East Asia	-0.31
Northern America	-0.27
Southern Europe	-0.26
Anglo	-0.25
Eastern Europe	-0.24
Continental Western Europe	-0.23
Northern Europe	-0.19
Western Europe	-0.19
Nordics	-0.13

Figure 4. IQ by country (2023)

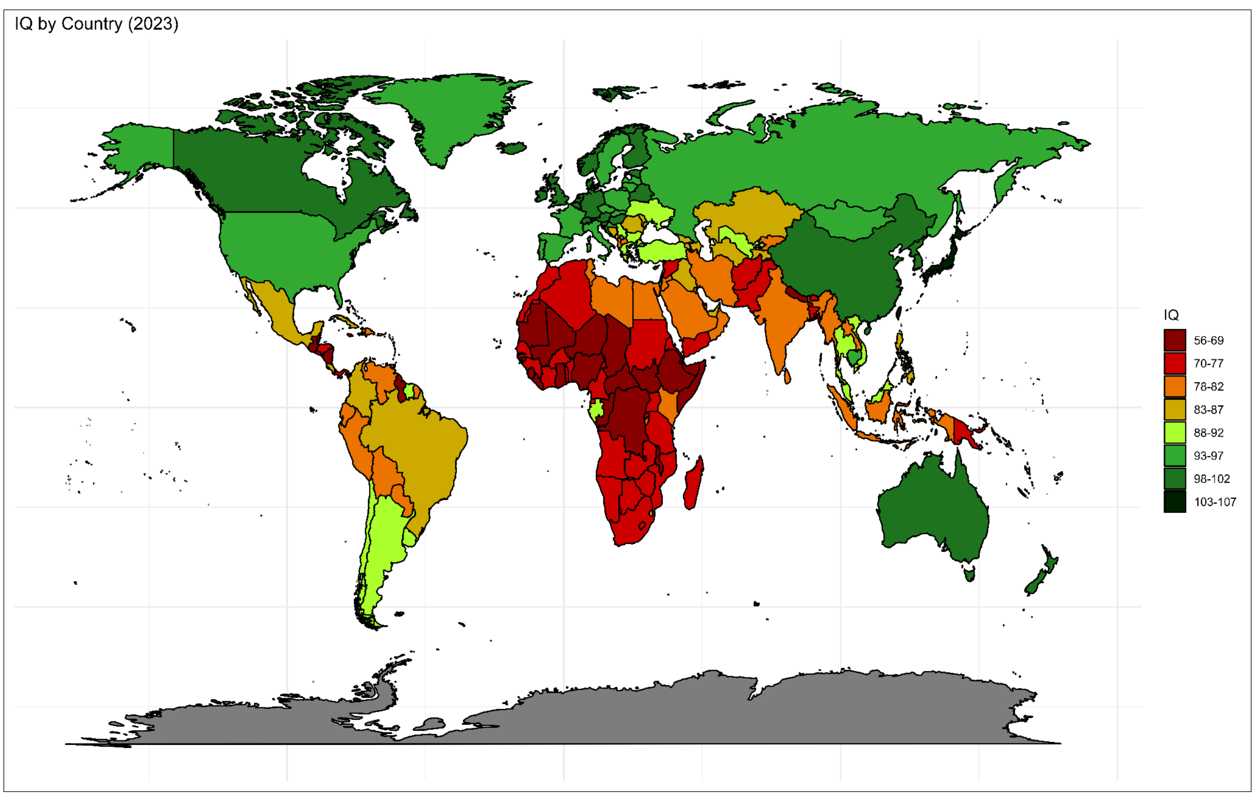
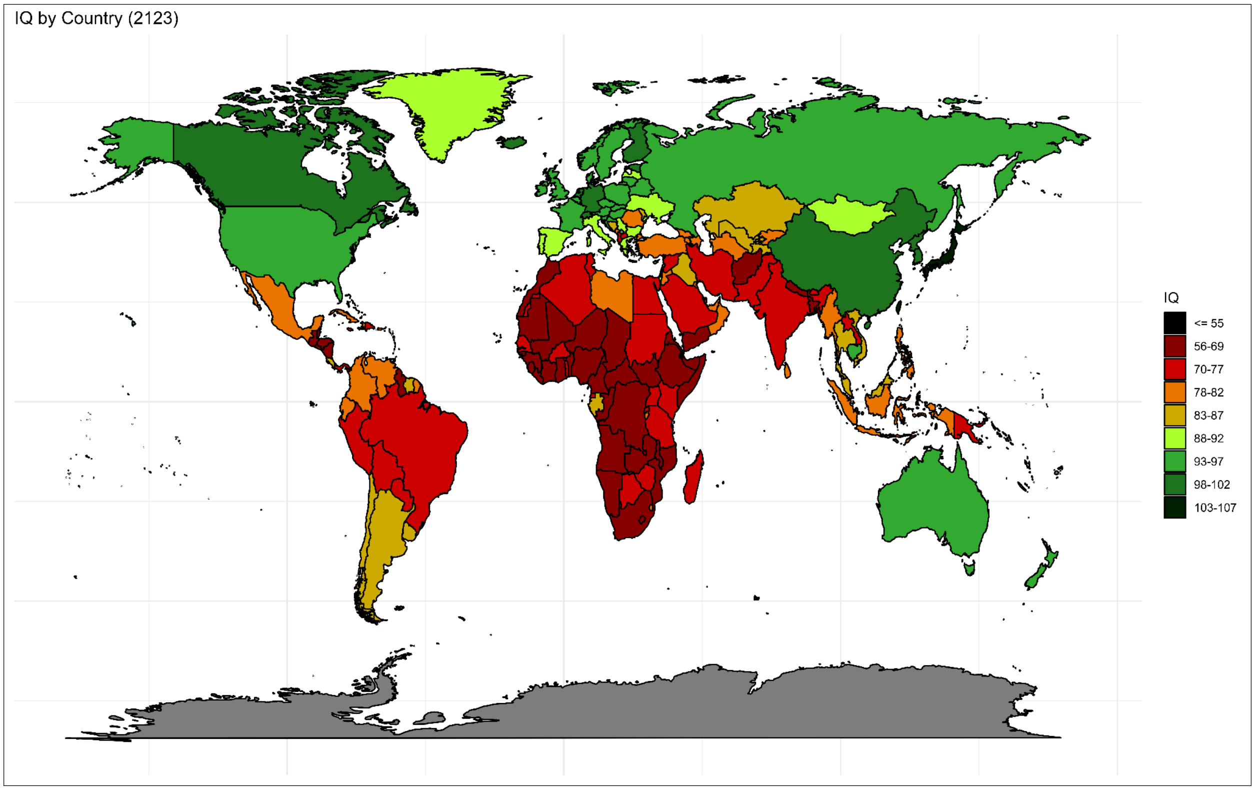
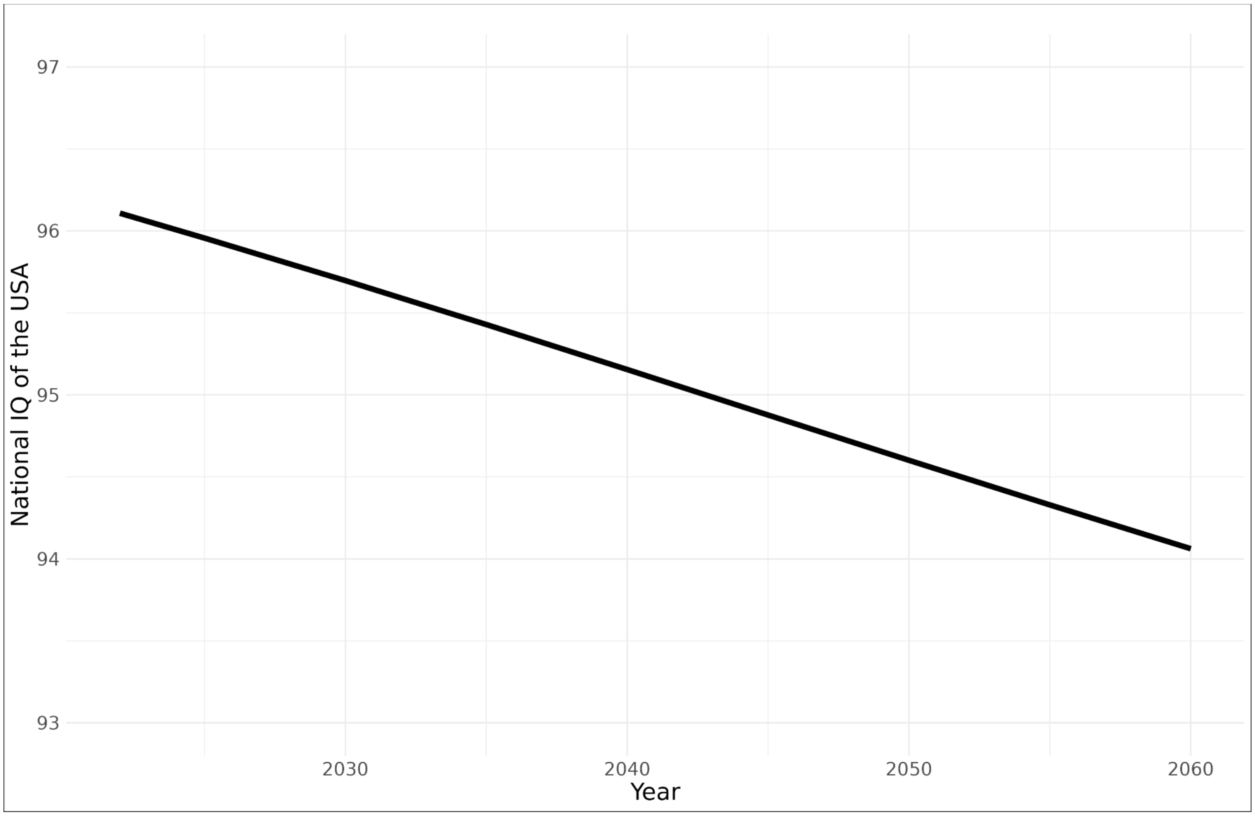


Figure 5. Projected IQ by country (2123)



Based on the demographic projections done by the US Census and our data, the magnitude of the change in national IQ between 2023 and 2060 due to changes in racial demographics is estimated to be 0.58 points, while the decline due to dysgenic fertility between that same time period is estimated to be 1.51 points. In Figure 5, the national IQ of the USA is forecasted based on both dysgenics fertility and changes in racial composition, while Figure 6 only forecasts the decline using changes in racial composition.

Figure 5. Projected national IQ of the USA, based on dysgenic fertility and racial composition.



Of interest was also whether selection differentials for IQ were correlated with national IQ or socioeconomic development (s-factor). To improve the reliability of the relationship, only selection differentials that were not imputed or were imputed based on the correlation between IQ and fertility were imputed. The selection differential for IQ and s-factor were correlated at .48 (95% CI [.25, .65], $p < .001$) and the selection differential for IQ and national IQ were correlated at .51 (95% CI [.29, .67], $p < .001$). The relationship between the selection differential for IQ and both variables is graphed in Figures 7 and 8.

Figure 7. Relationship between national IQ and selection differential for IQ.

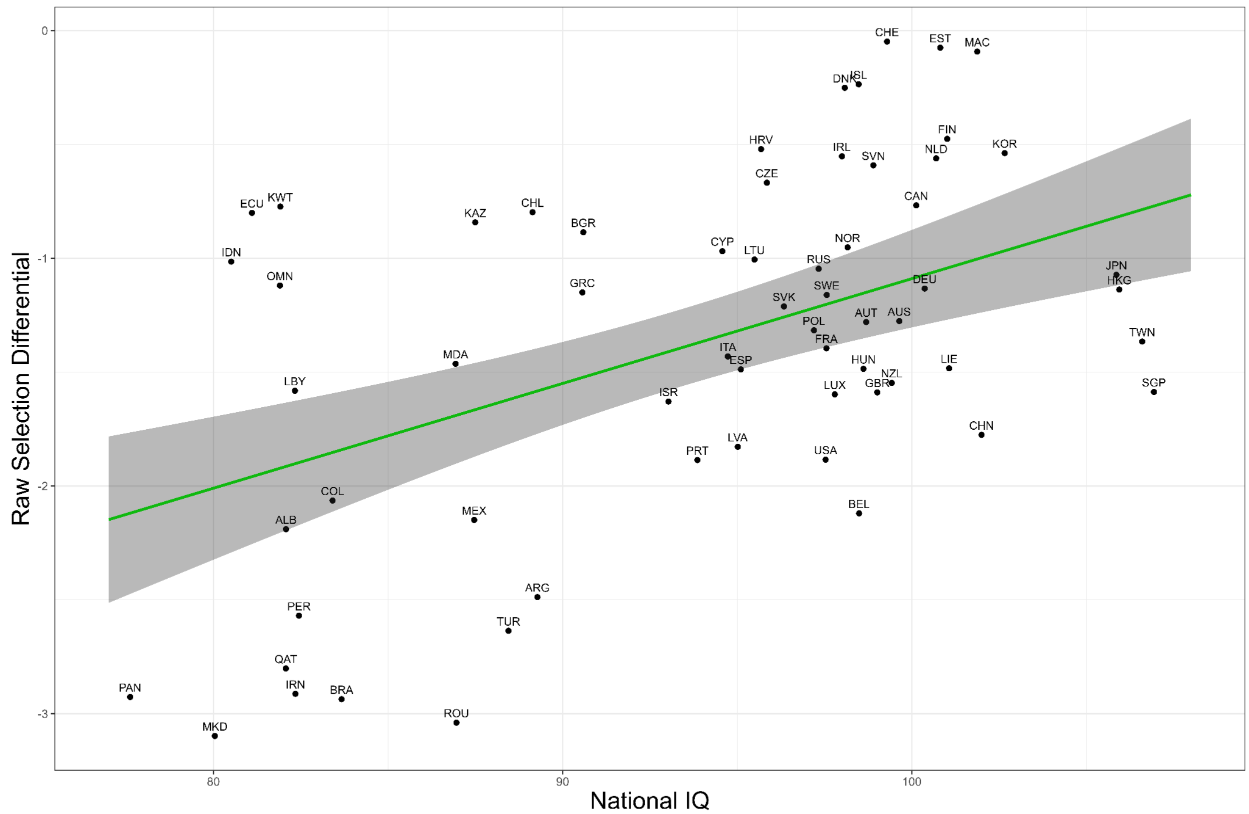
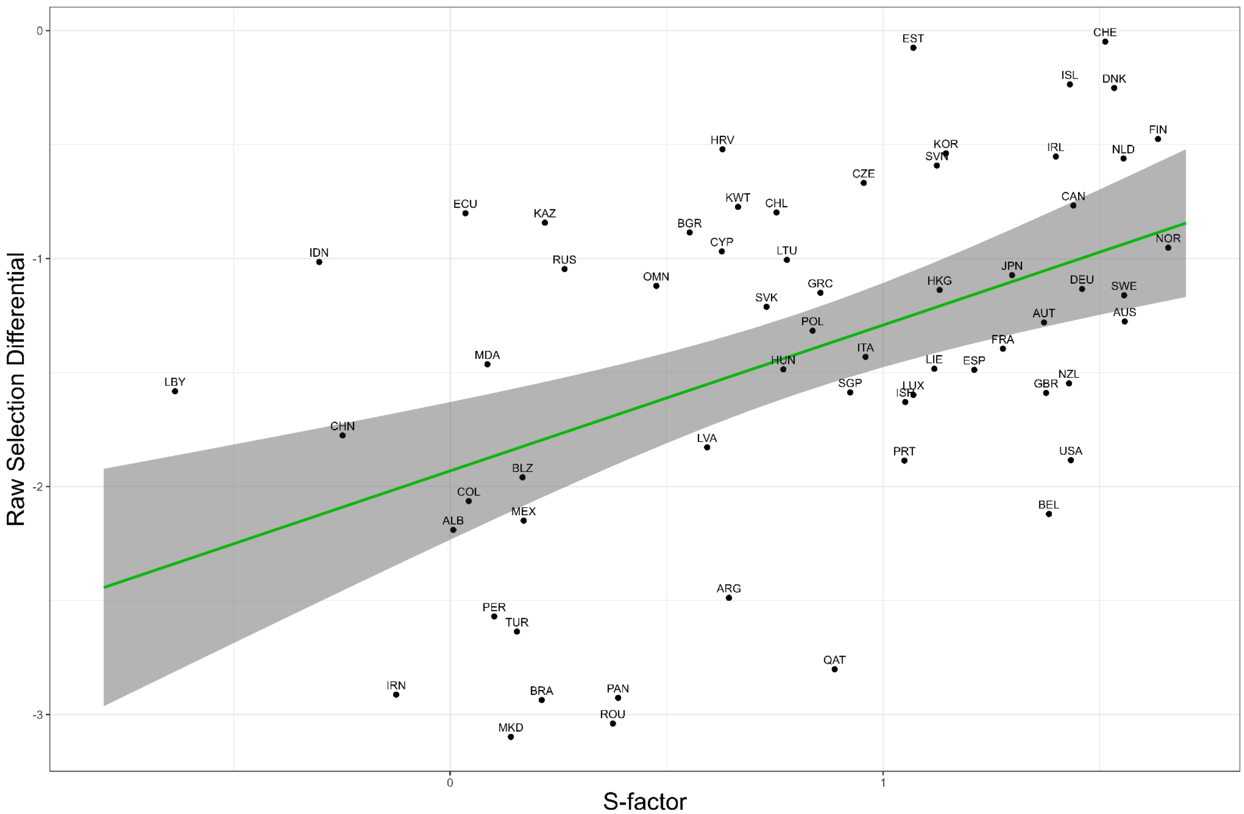


Figure 8. Relationship between s-factor and selection differential for IQ.



Discussion

The magnitude of the decline in intelligence per decade (-.392 points) within countries was in line with the previous literature (Woodley of Menie, 2015). Between countries, the size of the decline in intelligence between countries has been estimated to be higher (-1.1 points) than Lynn's (2011) estimate of 0.5 points per decade. While this study has been able to deal with some of the shortcomings of the prior literature, such as the varying estimates for the additive heritability of intelligence and the reliance on data from the United States, there are still many improvements that can be made

In several countries, the selection differential for intelligence is negligible or positive in the international data, notably Thailand (S = 0.59), Estonia (S = 0.076), Finland (S = -0.22), Denmark (S = -0.12), and Switzerland (S = 0.03). In the case of Thailand, the positive relationship between fertility and intelligence only comes from one effect size, which does not reach statistical significance (p = .13). In addition, the relationship between educational attainment and fertility was negative (r = -.11), which indicates that the null relationship found in that dataset may be a fluke.The other countries which exhibit no dysgenic fertility for intelligence, the relationship between educational attainment and fertility is close to null, the relationship between educational attainment is also close to null as well ($r = -0.026$ in Denmark, $r = -0.043$ in Switzerland, $r = -0.035$ in Estonia, $r = -0.027$ in Finland). The strong dysgenic fertility for intelligence that is observed in Turkey, Iran, and Latin America is likely to be a true relationship, because the dysgenic fertility of educational attainment is also very strong in these countries.

While it was assumed that the heritability of intelligence was equal in all countries, this is unlikely to be true. Notably, assortative mating for educational attainment varies by country (Jensen & Kirkegaard, in review), and intelligence and educational attainment correlate at approximately .5 (Strenze, 2014). Therefore, the additive heritability of intelligence should also be higher in countries with higher levels of assortative mating for intelligence, as assortative mating increases phenotypic variation (Nordsletten et al., 2020). In addition, international Scar-Rowe effects might be suppressing the heritability of intelligence in less developed nations, which could lead.

Our research has implications for several countries, notably those that are projected to fall substantially in intelligence, including Turkey, Iran, and some Latin American countries. Because national IQ is a strong cause of differences in economic growth (Francis & Kirkegaard, 2022), it is probable that these countries will exhibit a decline in national development within the next 200 years. While the development of artificial general intelligence may alleviate this decline, there are also other problems that could result from this decline in intelligence. For example, a lack of intelligence is a predictor of marital instability (Holley et al., 2006), obesity (Kanazawa, 2014), and criminality (Frisell et al., 2012).

Some researchers have raised concerns about the low IQ of individuals immigrating to the United States (Richwine, 2009). However, we found that a larger fraction of the projected IQ decline in the United States is due to differential fertility for intelligence (1.51 points) than changes in racial composition (0.58 points) between the years of 2022 and 2060. This disparity in findings could be due to several reasons; it could be the change in immigration patterns, with recent immigrants being more likely to come from Asia (Budiman, 2020); or it could be that immigrant IQs are depressed due to environmental causes such as malnutrition and poor English, which are not transmitted to subsequent generations.

There are some uncertainties to the forecast of the effects of immigration on the average IQ of the United States. Notably, there have been recent concerns about a crisis in the southern border, with border encounters having increased vastly since 2020 (US Customs and Border Protection, 2023), so the growth of the Hispanic population will be underestimated a bit. In addition, there is no guarantee that these immigrant groups will not change in composition - new immigrants are becoming increasingly Central American (MPI, 2023) and Southeast Asian (MPI, 2021). The United States' immigration policy has also changed frequently historically, and there is no reason to believe that this will not apply to the future.

It is also a possibility that emigration could lead to changes in national IQ within some regions, such as China (Taplin, 2023). However, this is very difficult to model, as high quality data on immigration in countries outside of the United States is scarce, and there is also no guarantee that the immigration and emigration flows of today will continue in the near future.

Appendix

Table A1. Source datasets used by country.

Country	Sources
Albania	PISA
Argentina	PISA, PIRLS
Australia	PISA
Austria	PISA, PIAAC
Belgium	PISA
Belize	PIRLS
Brazil	PISA
Bulgaria	PISA, PIRLS
Canada	PISA, PIRLS, PIAAC
Chile	PISA, PIAAC
China	academic literature
Colombia	PIRLS
Croatia	PISA
Cyprus	PIRLS
Czech Republic	PISA, PIRLS, PIAAC
Denmark	PISA, PIAAC
Ecuador	PIAAC
Estonia	PIAAC

Finland	PISA, PIAAC
France	PISA, PIRLS, PIAAC
Germany	PISA, PIRLS, PIAAC
Greece	PISA, PIRLS, PIAAC
Hong Kong	PISA, PIRLS
Hungary	PISA, PIRLS
Iceland	PISA, PIRLS
Indonesia	PISA
Iran	PIRLS
Ireland	PISA, PIAAC
Israel	PISA, PIRLS, PIAAC
Italy	PISA, PIRLS, PIAAC
Japan	PISA, PIAAC
Kazakhstan	PIAAC
Korea	PISA, PIAAC
Kuwait	PIRLS
Latvia	PISA, PIRLS
Liechtenstein	PISA
Lithuania	PISA, PIRLS, PIAAC
Luxembourg	PISA
Macao	PISA
Mexico	PISA, PIAAC
Moldova	PIRLS
Netherlands	PISA, PIRLS, PIAAC
New Zealand	PISA, PIRLS
North Macedonia	PISA, PIRLS
Norway	PISA, PIRLS, PIAAC
Panama	PISA
Peru	PISA, PIAAC
Poland	PISA, PIAAC
Portugal	PISA
Qatar	PISA
Romania	PIRLS
Russia	PISA, PIRLS, PIAAC
Singapore	PIRLS
Slovakia	PIRLS, PIAAC
Slovenia	PIRLS, PIAAC
Spain	PISA, PIAAC
Sweden	PISA, PIRLS, PIAAC

Switzerland	PISA
Taiwan	academic literature
Thailand	PISA
Turkey	PIRLS, PIAAC
UK	PISA, PIRLS, PIAAC
USA	PISA, PIRLS, PIAAC, GSS, NLSY

Figure A1. IQ by Country with no Imputations.

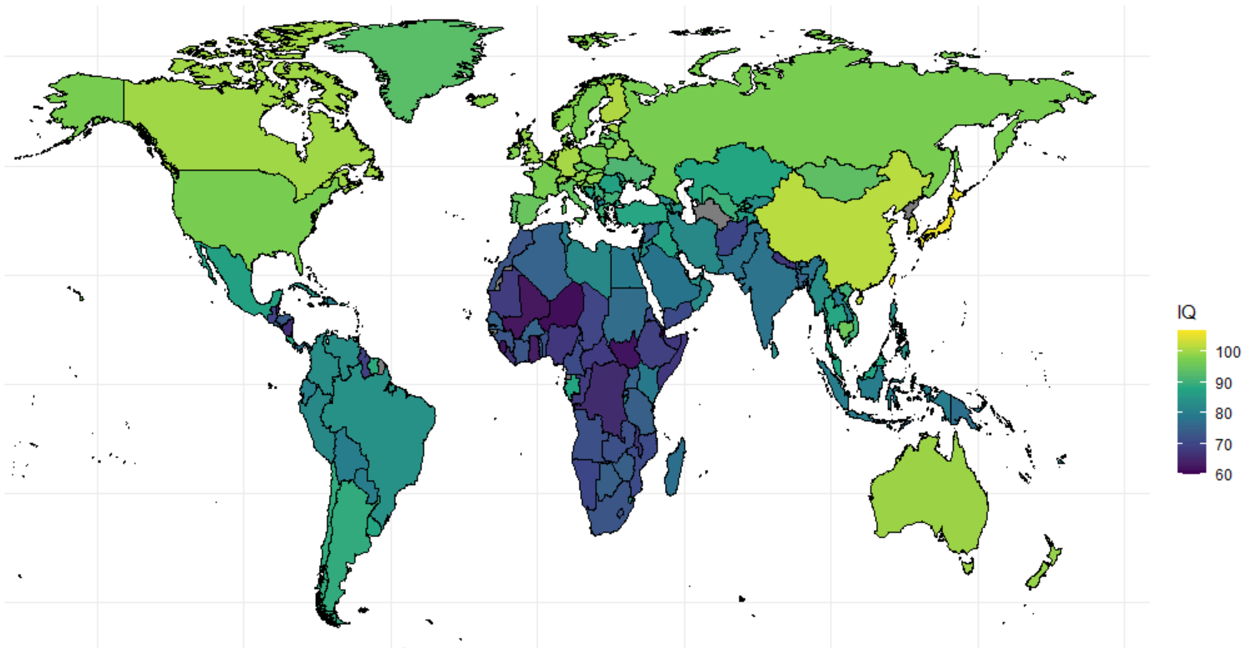


Figure A2. IQ by Country with imputed values based on neighbours.

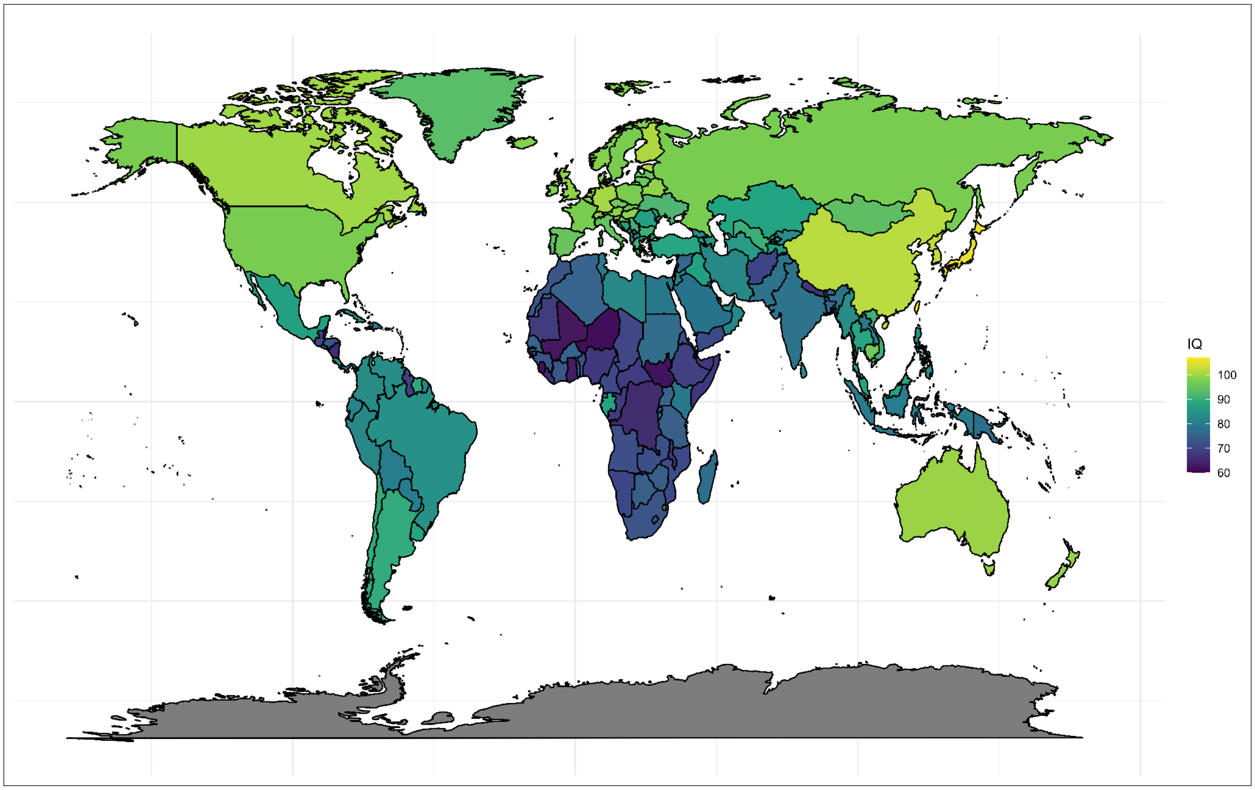


Figure A3. Selection differential for IQ by country with no imputations.

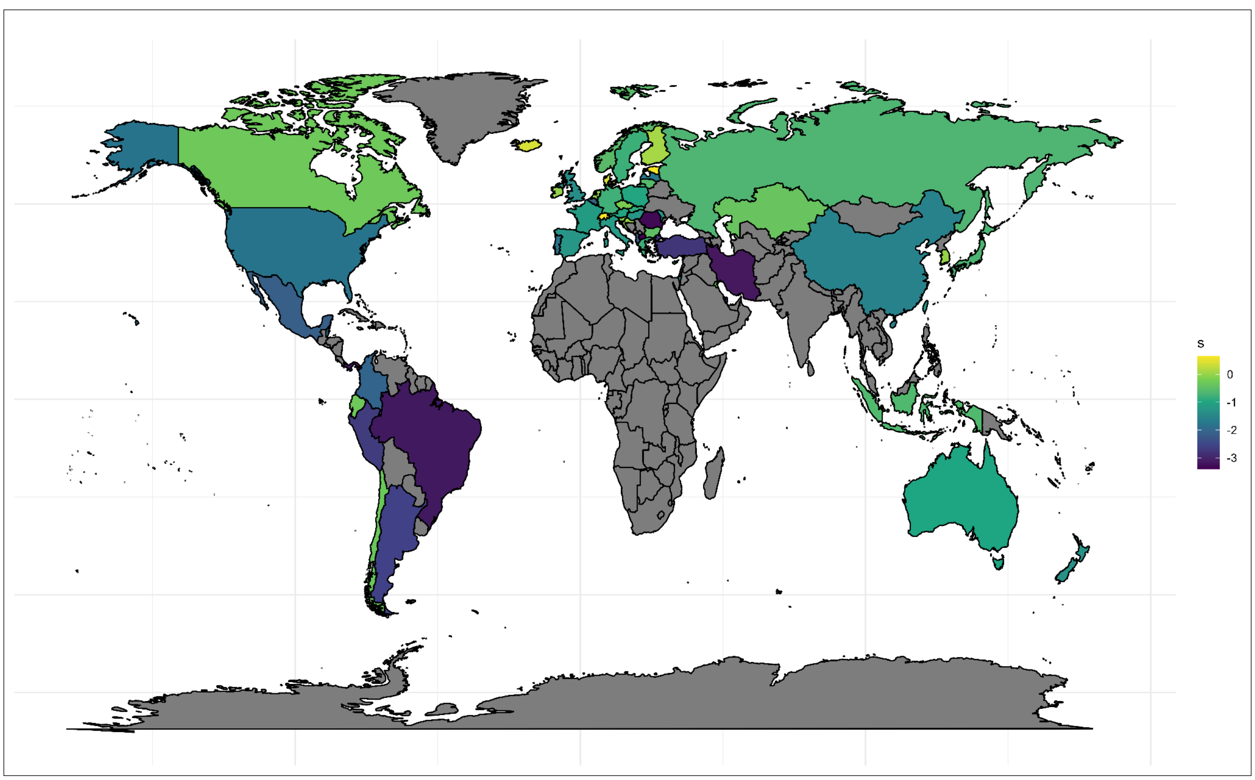


Figure A4. Selection differential for IQ by country with imputed values based on the correlation between IQ and fertility.

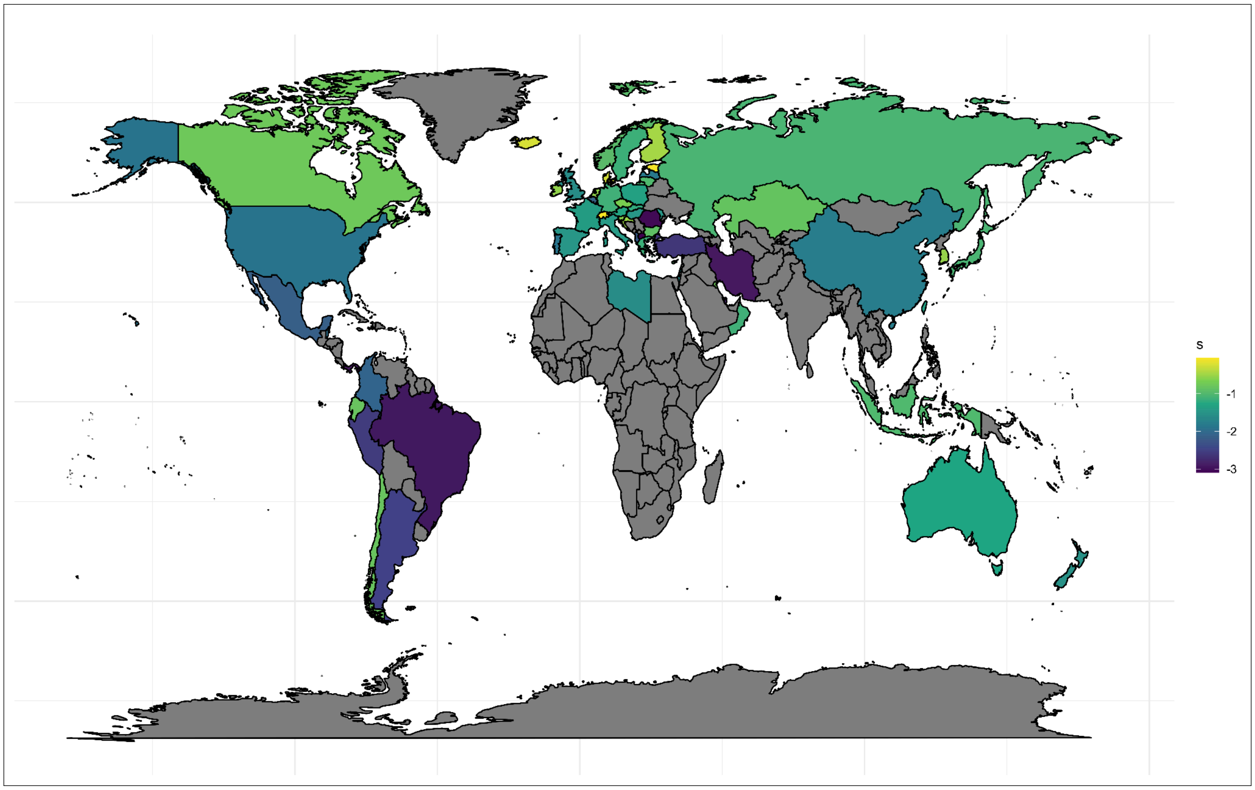


Figure A5. Selection differential for IQ by country with imputed values based on the correlation between educational attainment and fertility.

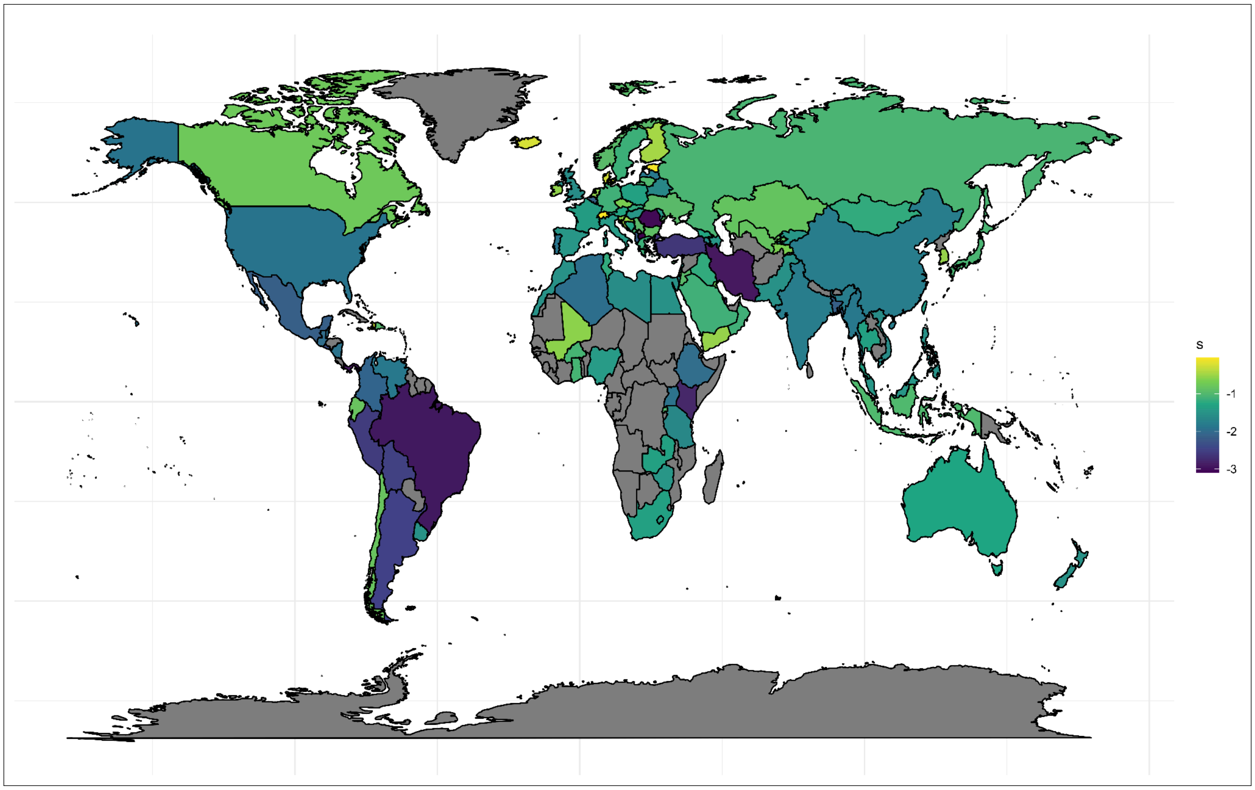


Figure A6. Selection differential for IQ by country with imputed values based on national IQs.

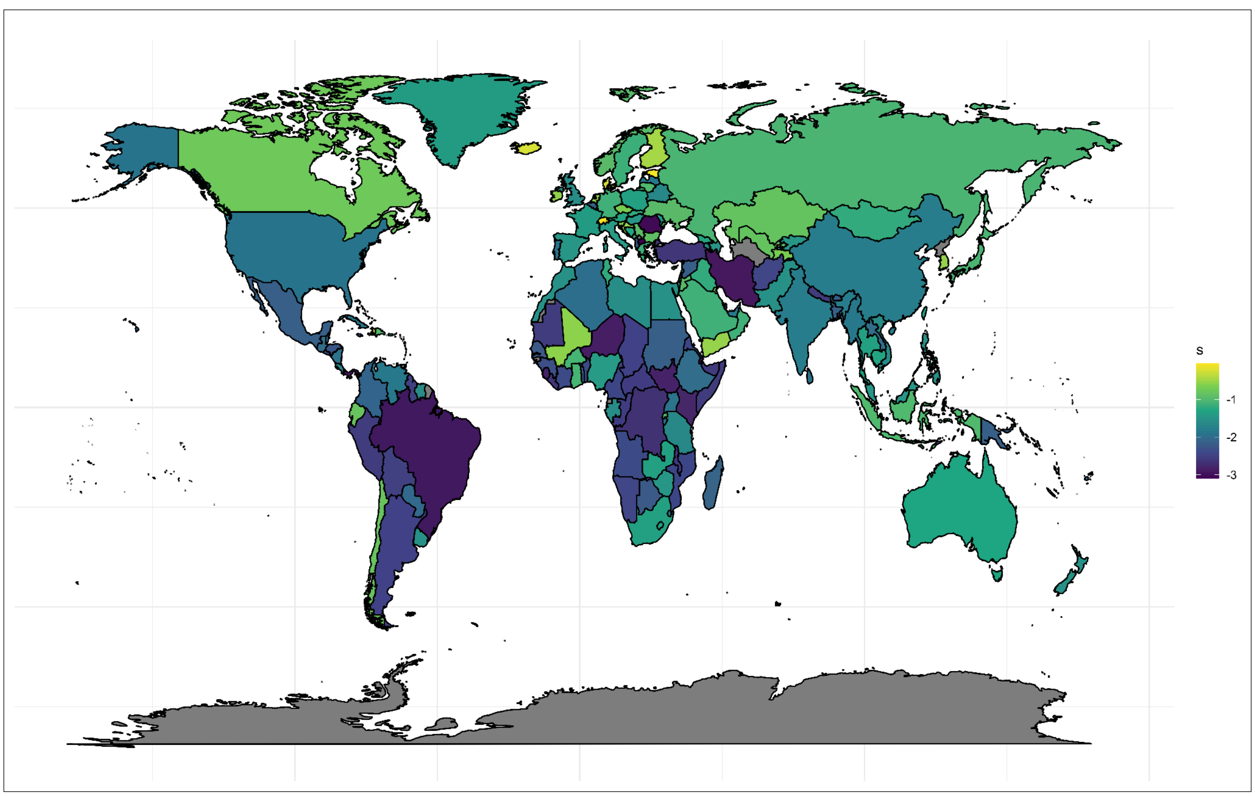


Figure A7. Selection differential for IQ by country with imputed values based on s-factor

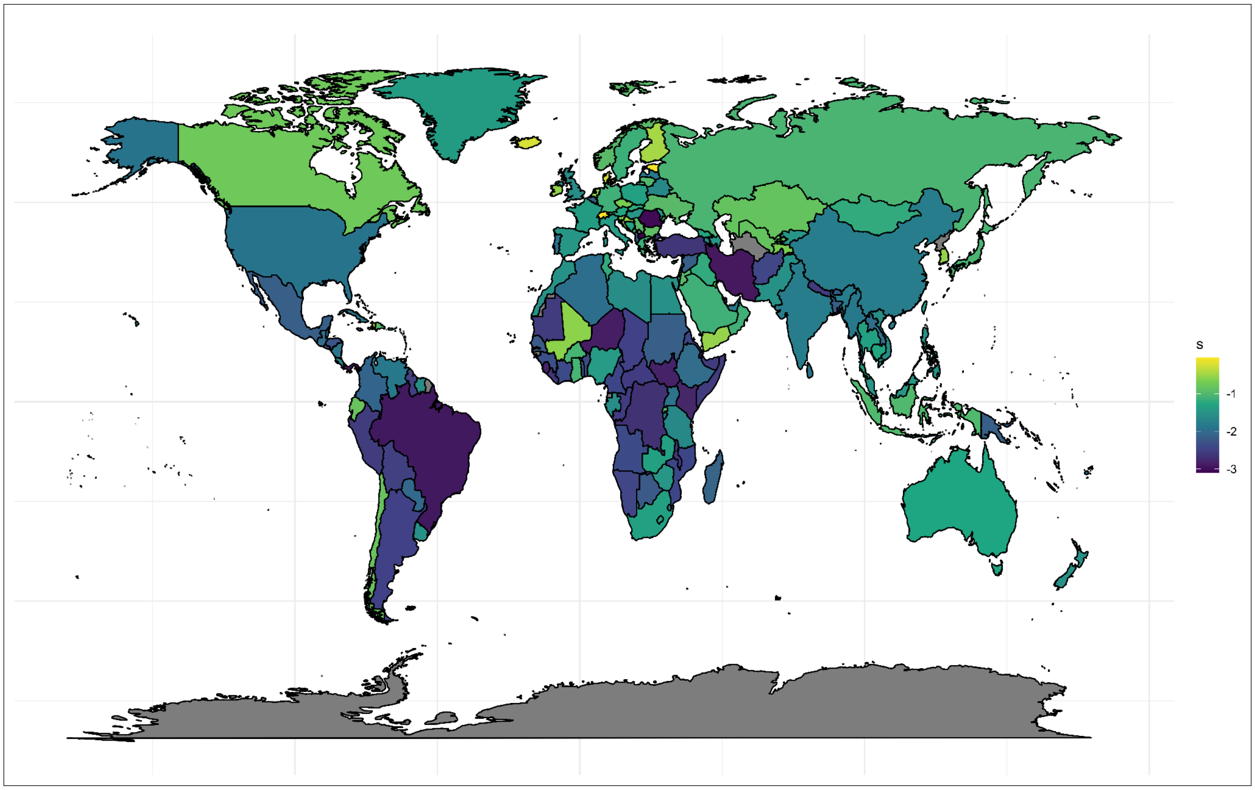


Figure A8. Selection differential for IQ by country with imputed values corrected for imputation bias within regions, and with regional imputations

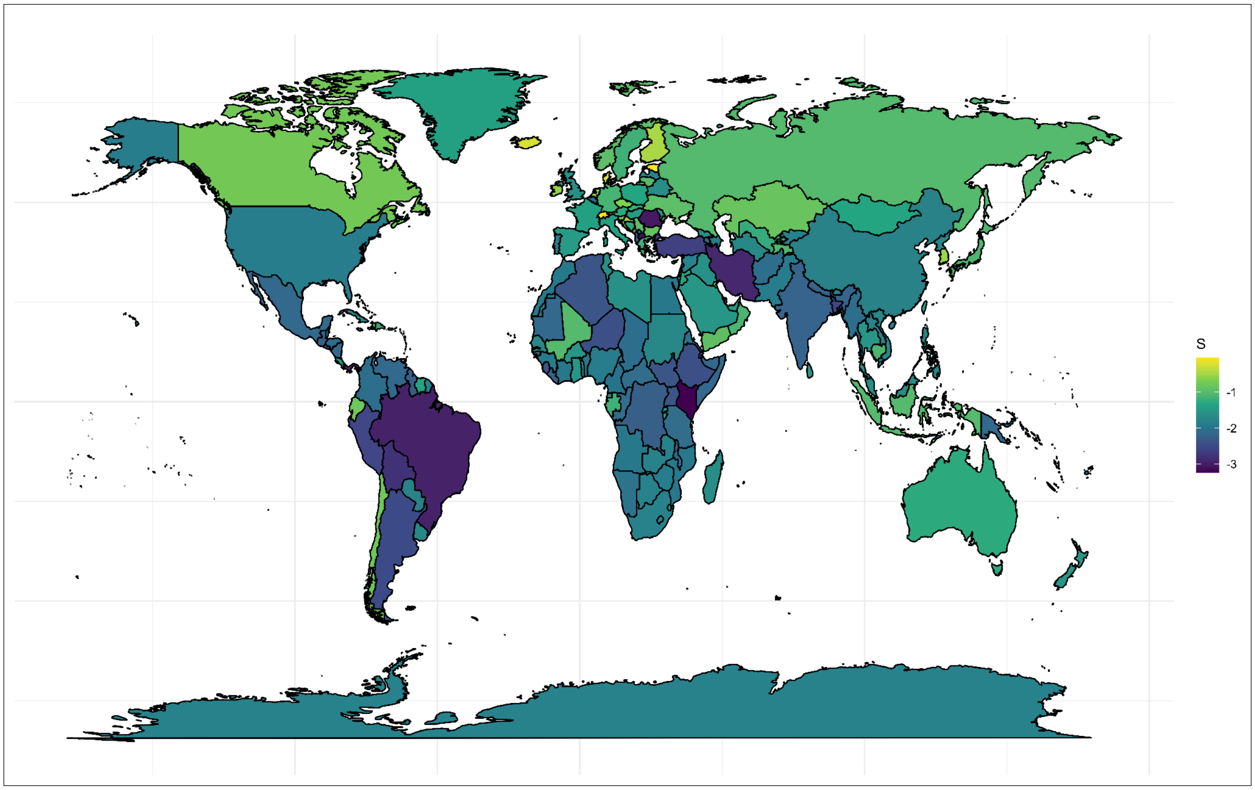


Figure A9. Correlation between educational attainment and fertility by country.

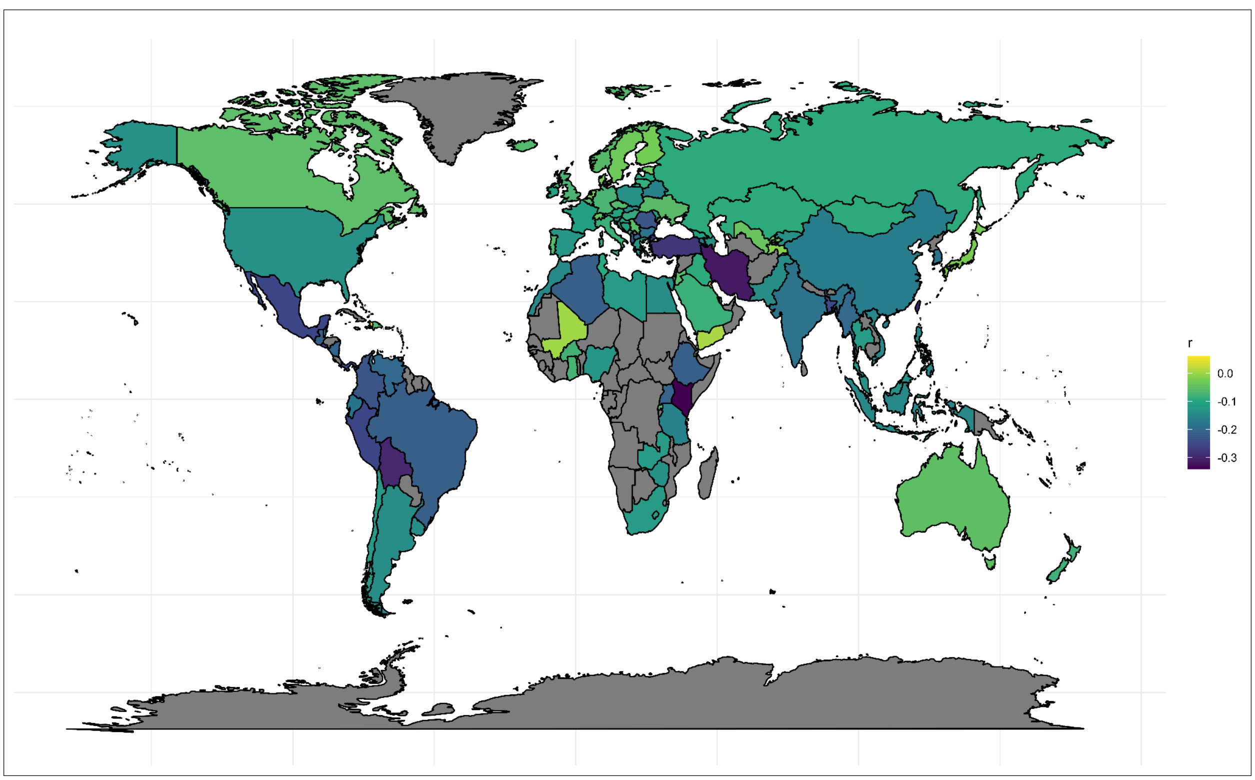
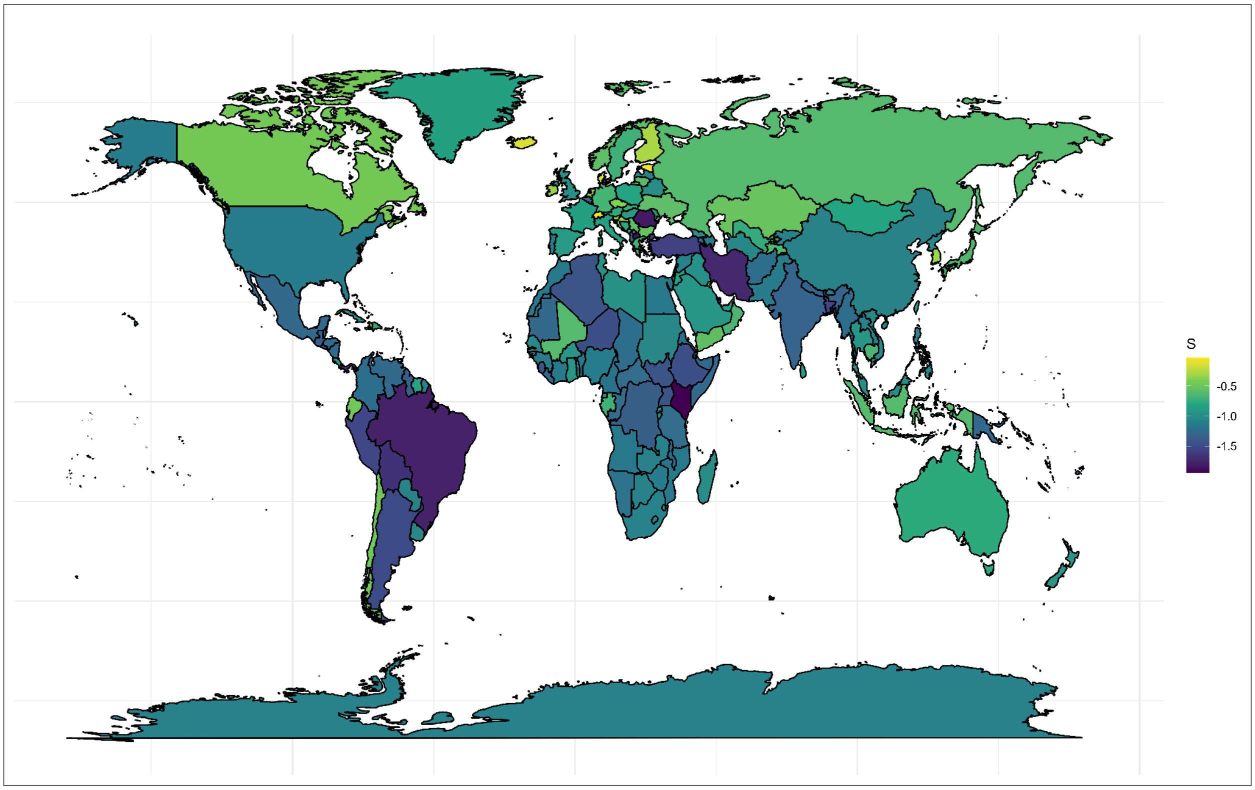


Figure A10. Estimated decline in IQ per generation by country.



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