Faculty of Economics and Administration
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# Demographic Characteristics as Drivers of Inequality

Habilitation Thesis

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# Bibliographic record


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# Abstract

The habilitation thesis “Demographic Characteristics as Drivers of Inequality” investigates how demographic factors contribute to disparities in well-being, health, and access to essential services. It presents empirical evidence from two lines of research: discrimination in access to mental health care and effects of relative age (i.e., within-school class age differences) on students’ wellbeing.

The first part of the thesis examines discrimination in access to mental health services, based on a large-scale audit correspondence experiment conducted in the United States. The findings reveal that transgender and nonbinary individuals face significant barriers to mental health care, particularly when they are also racial or ethnic minorities. Additionally, the study explores how the COVID-19 pandemic influenced access to mental health services, showing that increased pandemic intensity reduced appointment availability without altering existing disparities.

The second part of the thesis investigates relative age effects among European adolescents using data from the Health Behaviour in School-Aged Children survey. The findings indicate that relatively younger students have weaker social networks, lower life satisfaction, and poorer health outcomes, including higher psychosomatic complaints and a greater likelihood of being overweight.

By analyzing discrimination and age-based disparities, this thesis underscores the role of demographic characteristics in shaping inequality. The findings contribute to ongoing policy discussions on reducing barriers to mental health care, addressing age-related disadvantages in education, and fostering equitable social and health outcomes.

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I thank Patrick Button and Doug Harris from Tulane University, for their unwavering support in the midst of the COVID19 pandemic; that experience helped me grow as an economist and as a person.

Francesco Sarracino and all the STATEC people, who assisted me when I was not sure whether I really wanted to be in academia yet.

I owe a debt of gratitude to my fantastic coauthors for letting me learn from you.

I also thank Amber and all my family for supporting me in these years of traveling and working.

# Declaration

I declare that I wrote the habilitation thesis "Demographic Characteristics as Drivers of Inequality" as a collection of my previously published scholarly works. All the co-authors of these works, and their respective contributions, are reported in the "Authorship contribution statements." For the purposes of syntax and grammar improvement, as well as LaTeX formatting, I employed artificial intelligence technologies (e.g., Grammarly and OpenAI). Eventually, I reviewed a final time, and edited where needed, the content of this manuscript. Thus, I take full responsibility for the content of this thesis; moreover, the intellectual contribution and conceptual development remain mine.

# Contents

# Introduction

Demographic characteristics play a crucial role in shaping economic, social, and health-related inequalities. Research has consistently shown that characteristics such as age, gender, race, and socioeconomic background influence individuals' access to resources and opportunities. This habilitation thesis explores two key causes of such demographic-induced disparities: discrimination and age differences between school classes–which is determined by students' birthdays.

The first chapter of this thesis examines how discrimination affects access to mental health services, drawing from the results of one field experiment, an audit correspondence test, which I conducted in the US in the first semester of 2020–the first semester of the COVID-19 pandemic. In this chapter, I am discussing the results from two related studies that are based on data from this experiment.

First, in L. Fumarco, B. J. Harrell, et al. 2024. "Gender identity-, race-, and ethnicity-based discrimination in access to mental health care: Evidence from an audit correspondence field experiment." *American Journal of Health Economics* 10 (2): 182–214,[1] I provide experimental evidence of discrimination based on gender identity and race in access to mental health care. I find that, although cisgender patients do not suffer any gap in access to mental health care regardless of their race/ethnicity, transgender and nonbinary people (TNB) face discrimination only when they are also Hispanics or Afro-Americans.

Second, in B. Harrell et al. 2023. "The Impact of COVID-19 on Access to Mental Health Care Services." *AEA Papers and Proceedings* 113:420–422,[2] I investigate how the intensity of the COVID-19 pandemic impacted access to mental health care. Here, COVID-19 intensity is measured with data on weekly excess deaths from the Centers for Disease Control and Prevention (CDC), along with the daily number of deaths and the number of contagions from a New York Times database that was active at that time. All these measures are at the state level and are merged to the dataset created with the above field experiment.

1. Full text of the paper is available at https://www.journals.uchicago.edu/doi/10.1086/728931.
2. Full text of the paper is available at https://doi.org/10.1257/pandp.20231058.

As an expansion to Harrell et al. (2023), in Fumarco, Harrell, et al. (2024), I investigate whether the intensity of COVID-19 differently affected patients' chances of obtaining an appointment with mental health professionals based on their gender identity or race / ethnicity.

Together, these two studies show that: (a) gender identity could be an important source of disparity in access to mental health care in combination with race and ethnicity, and (b) COVID-19 has decreased access to such services, but without altering gaps caused by the above individual characteristics in (a).

The second chapter discusses how European adolescents' well-being is impacted by relative age. This chapter discusses the results from two related studies, both of which investigate data from the Health Behavior in School-Aged Children (HBSC) survey of students between 10 and 17 years of age from about 30 European countries.

First, in L. Fumarco and S. Baert. 2019. "Relative age effect on European adolescents' social network." *Journal of Economic Behavior & Organization* 168 (C): 318–337,[3] I study how relative age influences adolescents' social networks. I find that the youngest students within a class e-communicate more frequently than older classmates but have fewer friends and meet with them less frequently. This result suggests that there is a substitution effect, where relatively younger students prefer to interact with friends online.

Second, in L. Fumarco, S. Baert, and F. Sarracino. 2020. "Younger, dissatisfied, and unhealthy – Relative age in adolescence." *Economics & Human Biology* 37 (C): 100858,[4] I investigate the impact on life-satisfaction and various health measures. I find that the youngest students within a class suffer from lower life-satisfaction, and lower self-rated general health. Moreover, they suffer from higher frequency of psychosomatic complaints and higher chances of being overweight. Finally, most of these gaps seem to persist during the entire adolescence.

Results from these two studies are compatible with the literature that finds that the youngest students in their cohort have more frequent health and socialization problems.

These two studies are part of a broader research agenda which I am currently developing, and that includes, among others, a survey of the literature and a study on effects on the elderly with Swedish administrative data.

Synthesizing evidence from these two sources of demographic-induced disparities, that is, discrimination and age differences between school classes, this thesis underscores the ongoing influence of demographic factors in shaping inequality.

The Appendix reports the articles in full, appendices included.[5]

3. Full text of the paper is available at https://doi.org/10.1016/j.jebo.2019.10.014.

4. Full text of the paper is available at https://doi.org/10.1016/j.ehb.2020.100858.

5. The publicly available version of this habilitation thesis does not include the Appendix due to legal reasons. However, all essays are available on-line.

# Chapter 1

# Impact of Discrimination and COVID-19 on Access to Mental Health Care

## 1.1 Introduction

Mental health care is a fundamental component of overall well-being, yet substantial disparities persist in its accessibility. Structural barriers, ranging from economic constraints to systemic discrimination, affect who receives treatment and how quickly they can access care. Marginalized populations, such as individuals of racial, ethnic, and gender minorities, often face additional hurdles when seeking mental health services. These disparities may have profound consequences, exacerbating existing inequalities in mental health outcomes and overall quality of life.

In particular, TNB individuals are more likely to experience mental illness and severe psychological stress. They have higher rates of anxiety, depression, substance misuse, and suicidality (Safer et al. 2016; Lagos 2018; Meyer et al. 2017; Streed et al. 2018; Mustanski et al. 2010; Su et al. 2016).

These disparities are stark: in a sample of 1,053 transgender persons, for example, 41 percent report having attempted suicide; this rate is 26 times higher than the general population (Safer et al. 2016). Racial and ethnic minorities face similar discrimination and disparities (Miranda et al. 2008; Williams 2018), especially TNB people of color. Despite an increased need for general and mental health services, real or perceived discrimination by mental health care providers may affect a prospective patient's ability to access (or desire to seek) appropriate mental health care services and treatment. Previous research found that approximately one-fourth of transgender individuals opted not to seek health care when needed for fear of being mistreated due to their gender identity, and one-third report having had a negative experience related to identifying as transgender (James et al. 2016).

A recent study provides experimental evidence on discrimination in access to mental health care appointments. In Fumarco, Harrell, et al. (2024), I explore discrimination in mental health care based on race, ethnicity, and gender identity. Using an audit correspondence experiment, I assess whether mental health providers respond differently to prospective patients based on perceived perceived race, ethnicity, or gender identity.

In a related study, Harrell et al. (2023), I use the same data to investigate how the COVID-19 pandemic affected the availability of mental health services. This study hypothesizes that as the intensity of the pandemic increased, mental health providers faced increased demand and operational constraints, leading to reduced availability of appointments. If access to care declined more sharply in certain regions, it could disproportionately impact already vulnerable populations.

Based on the study above, in Fumarco, Harrell, et al. (2024), I investigated whether discrimination based on race, ethnicity, and gender identity in access to therapy appointments varies with COVID-19 intensity.

Together, these studies contribute to the growing literature on inequality in access to healthcare. They provide empirical evidence that systemic biases persist. By examining these effects through rigorous field experimental methods, the research highlights the urgent need for policy interventions to ensure equitable mental health care for all individuals, regardless of demographic background.

The conclusion of this chapter will summarize and discuss venues for future developments.

## 1.2 Data and Methodology

Between January to May 2020, I conducted a correspondence audit field experiment to examine discrimination in access to mental health care based on gender identity, race, and ethnicity. I created fictitious patient identities to request therapy appointments from mental health providers (MHPs) across the United States. This approach, commonly referred to as a "simulated patients" study, allows for the controlled testing of discrimination by standardizing communication while varying only the characteristics of the prospective patient that signal race, ethnicity, and gender identity. By randomly assigning names that correspond with different racial and ethnic backgrounds, as well as explicitly (but naturally) signaling TNB status, I isolate the effects of these characteristics on providers' willingness to offer appointments.

To construct the sample, the study draws on a widely used online directory of mental health professionals. I applied predetermined selection criteria of such providers to ensure that only those providers actively accepting new patients and offering services for common

mental health conditions—such as stress, anxiety, and depression—are contacted. The sample is also designed to be nationally representative, and mental health providers were selected to proportionally reflect state and zip code population distributions. Before starting the experiment, power analyses were conducted to determine the minimum detectable effect size, ensuring that the study is adequately powered to detect meaningful differences in provider responses.

Each provider in the sample received one appointment request email from a randomly assigned fictitious patient.[1] The emails are designed to be as uniform as possible, with only key variables being manipulated. These include the patient's name–used to signal race and ethnicity–and an explicit statement of transgender or nonbinary identity in a subset of cases. The structure of the emails follows a standardized format, briefly introducing the patient, stating the reason for seeking therapy, and inquiring about the availability of appointment. In addition, each email includes an email address and a phone number for the provider to use in responding.

I measure discrimination by analyzing differences in provider response rates across the randomized characteristics of the fictitious patients. Responses are categorized into seven mutually exclusive outcomes, ranging from an explicit offer of an appointment to outright rejection or nonresponse. The key dependent variable is a binary measure of whether the provider extends a "positive response," defined as an offer for an appointment, consultation, or phone call. Responses that involve referrals, screening questions, waitlist placement, or outright rejection are coded as negative. This categorization follows standard conventions in audit correspondence studies and allows researchers to quantify differential access to care.

The experiment is designed to identify both general and intersectional discrimination. By comparing response rates for White, African American, and Hispanic prospective patients, the study tests for racial and ethnic discrimination. By comparing TNB and cisgender patients,[2] it tests for gender identity discrimination. Additionally, the interaction of these characteristics allows the researchers to examine intersectionality, determining whether TNB people of color face compounded discrimination relative to their White or cisgender counterparts.

The empirical strategy consists of regression models that quantify the differences in response rates across patient identities. The primary model is a linear probability regression that estimates the likelihood of receiving a positive response while controlling for state,

1. This is the so called random assignment. The experiment was initially designed as the usual matched assignment, where two messages should have been sent to the same therapist; however, with the uncertainty due to the COVID-19 pandemic only one message was sent to each MHP.

2. Cisgender is the person that recognize with the gender assigned at birth.

week, and day-of-week fixed effects. The inclusion of these controls accounts for random variation in provider behavior due to time factors.

The robustness of the findings is evaluated through multiple alternative specifications. A probit model is used to confirm the linear probability estimates. Additionally, I explore an alternative coding of the dependent variable that considers referrals and screening questions as positive responses, testing whether the findings hold under a broader definition of access to care.

Because I conducted the experiment during the first wave of the COVID-19 pandemic, marked by rapidly increasing infection rates and public health disruptions, I decided to expand the initial project and investigate the impact of the pandemic in Harrell et al. 2023.

Therefore, I merged these data to state-level data on daily COVID-19 cases per 100,000 people, daily COVID-19 fatalities per 100,000 people, and weekly excess deaths relative to historical averages. The latter data were collected from the CDC, while the former data are collected from an ad hoc New York Times database.

Moreover, with these additional data, I conducted further robustness checks in Fumarco, Harrell, et al. (2024). Here, I examined whether the onset of the COVID-19 pandemic, which overlapped with data collection, affected response rates of the different minority groups. I incorporate state-level COVID-19 intensity measures to ensure that observed discrimination patterns are not confounded by pandemic-related disruptions in mental health care availability.

## 1.3 Results

### 1.3.1 Discrimination - Harrell et al. (2024)

Table 1.1 reports the main findings of the study. I disaggregate cisgender and TNB people by race and ethnicity to quantify any intersectional discrimination. Column (1) reports baseline estimates without considering intersectional aspects. These basic results do not suggest presence of discrimination against TNB patients, while they provide evidence of discrimination against racial and ethnic minorities.

Column (2) reports differences in response rates for African Americans, Hispanics, and Whites, by TNB status. I find that African American TNB prospective patients are 13.3 percentage points less likely to receive a positive response compared to White cisgender prospective patients. This is a significant gap, considering that the mean positive response rate of White cisgender patients is 68.3%. Moreover, Hispanic TNB patients have a 4.3 percentage point lower response rate–although this difference is not statistically significant. In contrast to TNB individuals from ethnic and racial minority groups, White

TNB benefit from positive discrimination as they are about 12 percentage points more likely to receive a positive response compared to White cisgender patients. Finally, while I find evidence of intersectional discrimination, there is inconclusive evidence of racial and ethnic discrimination against cisgender prospective patients, as the estimates on cisgender and African American or Hispanic are not statistically significant.

These results confirm that mental health providers may engage in discriminatory behavior, creating additional barriers for minority and gender-diverse individuals.

Table 1.1: Differences in positive response rates. Results by Trans/Cisgender Status and Race/Ethnicity.

| | (1) | (2) |
|---|---|---|
| Transgender or non-binary | 0.0260 | |
| | (0.0405) | |
| . . . and White | | 0.1196** |
| | | (0.0526) |
| . . . and African American | | -0.1337** |
| | | (0.0546) |
| . . . and Hispanic | | -0.0430 |
| | | (0.0604) |
| Cisgender | | |
| . . . and African American | | 0.0008 |
| | | (0.0572) |
| . . . and Hispanic | | -0.0243 |
| | | (0.0625) |
| All African American | -0.1302*** | |
| | (0.0364) | |
| All Hispanic | -0.1072** | |
| | (0.0481) | |
| N | 1,000 | 1,000 |

Notes: These regressions include the following control variables: mental health concern (depression, anxiety, stress), state fixed effects, day of the week sent fixed effects, and week sent fixed effects. Column (1) reports the main results without studying intersectional aspects, while Column (2) studies how discrimination against TNB patients varies with the ethnic / racial group. The mean positive response rate for the excluded group (cisgender White men) is 68.3%. Standard errors, clustered at the patient level, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

### 1.3.2 COVID-19 - Fumarco et al. (2023)

Table 1.2 reports the main findings of this study, which investigates the effect on positive response rate of state-level daily COVID-19 cases per 100,000 people, daily COVID-19

fatalities, and weekly excess deaths relative to historical averages. These measures of COVID-19 intensity are standardized for sake of comparability.

I find weak evidence that a one standard deviation increase in daily case decreases the probability of receiving an appointment offer by 7.8 percentage points (statistically significant at the 10% level), a 13.7% decrease compared to the average appointment offer rate of 56.6%.[3]

The standardized quantity of state-wide daily deaths has no statistically significant effect on the outcome. There is a positive sign, which suggests that COVID-19 cases that do not result in death are the ones associated with reduced access to appointments, but this could be due to unobserved heterogeneity by state rather than non-fatal cases necessarily being the causal mechanism. Similarly, it could be the case that counts of deaths due to COVID-19 is subject to more or different measurement error than counts of cases.

Finally, I assess how the probability of receiving an appointment offer is affected by excess weekly deaths measured by the CDC–which measures whether mortality was higher than expected compared to previous similar periods. This measure may better capture the intensity of the pandemic at a given moment. I find that weekly excess deaths has a negative impact on the likelihood of receiving an appointment offer. More concretely, a one standard deviation increase in weekly excess deaths is associated with a 5.4 percentage point, or 9.7%, decrease in the appointment offer rate (statistically significant at the 10% level).

### 1.3.3 Discrimination and COVID-19 - Harrell et al. (2024)

Table 1.3 shows mixed evidence of differential effects of COVID-19 on positive response rates by demographic groups. However, I urge caution when interpreting these results, particularly for how COVID-19 moderates discrimination by group, given that this analysis is likely underpowered to detect such results in a relatively small sample. Overall, our main conclusion–that discrimination occurs against African American and Hispanic TNB prospective patients–is robust to the inclusion of controls for state-level COVID-19 intensity.

## 1.4 Policy implications and future developments

These findings have at least three important policy implications. First, they highlight the need for increased oversight and regulation of the MHP market to reduce discrimination, potentially through federal or state anti-discrimination laws, state licensing board oversight,

3. This is the average appointment offer rate across all race, ethnic, and gender identity groups.

Table 1.2: State-level COVID-19 intensity and positive response rate.

| | (1) | (2) |
|---|---|---|
| Daily Cases | -0.078* | |
| | (0.040) | |
| Daily Deaths | 0.069 | |
| | (0.045) | |
| Weekly Excess Deaths | | -0.055* |
| | | (0.028) |
| N | 1,000 | 1,000 |
| Std Cases | 11,121.9 | |
| Std Deaths | 489.4 | |
| Std Excess Deaths | | 355.2 |

Notes: These regressions include the following control variables: mental health concern (depression, anxiety, stress), state fixed effects, day of the week sent fixed effects, and week sent fixed effects. Standard errors, clustered at the patient level, in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

or enhanced leadership from professional organizations like the American Counseling Association.

Second, our results emphasize the need for better access to trans-friendly mental health services and culturally competent MHPs. Efforts to diversify the profession and improve training on LGBTQ+ and racial/ethnic issues could help address the shortage of competent providers.

Finally, our findings suggest that the growing anti-transgender legislative movement in the U.S. will exacerbate barriers to mental healthcare. As of 2023, eight states allow clinicians to deny care based on religious beliefs, and similar laws under consideration could affect nearly a quarter of Americans. Additionally, 19 states have banned gender-affirming care for minors, with some laws potentially criminalizing mental healthcare.

Currently, with my coauthors, I am collecting a new wave of data to study whether ethnic, racial, and gender-identity based discrimination in access to mental health appointments varies with payment methods, and with the characteristics of the mental health practitioners and of the area (e.g., city or state) where they work.

The data collection for this entire project (published and on-going studies) is funded by the National Science Foundation.[4] Moreover, the work on the data was financed through the SYRI project.[5]

4. National Science Foundation CAREER Grant "Sexual Orientation and Gender Identity Discrimination;" PI: Patrick Button.

5. 2022-2025, National Institute for Research on the Socioeconomic Impact of Diseases and Systemic Risks; PI: Pavla Seilerová, Systemic Risk Institute Office, MUNI. Provider: Ministry of Education, Youth and Sports, CZ.

Table 1.3: Moderating effects of state-level COVID-19 intensity on discrimination.

| | (1) | (2) |
|---|---|---|
| Transgender or non-binary | -0.2309 | 0.1458* |
| | (0.1943) | (0.0750) |
| African American | -0.3833* | 0.0386 |
| | (0.1909) | (0.0722) |
| Hispanic | -0.3307* | 0.0989 |
| | (0.1934) | (0.0778) |
| Trans. or non-binary | 0.1640 | -0.2688*** |
| and A-A or Hispanic | (0.2329) | (0.0933) |
| COVID-19 daily cases | -1.7000** | |
| | (0.7930) | |
| COVID-19 daily deaths | 2.6330** | |
| | (1.2536) | |
| Weekly excess deaths | | -0.1809 |
| | | (0.1961) |
| African American x | 1.5099** | |
| . . . COVID-19 daily cases | (0.6950) | |
| . . . COVID-19 daily deaths | -2.4625** | |
| | (1.1769) | |
| Hispanic and | 1.7524** | |
| . . . COVID-19 daily cases | (0.7797) | |
| . . . COVID-19 daily deaths | -2.9013** | |
| | (1.2379) | |
| Trans. or non-binary x | 1.4038* | |
| . . . COVID-19 daily cases | (0.7744) | |
| . . . COVID-19 daily deaths | -2.4233* | |
| | (1.2111) | |
| A-A or Hispanic x TNB x | -1.7098** | |
| . . . COVID-19 daily cases | (0.7004) | |
| . . . COVID-19 daily deaths | 2.8734** | |
| | (1.1668) | |
| African American x | | 0.1875 |
| weekly excess deaths | | (0.1951) |
| Hispanic x | | 0.0974 |
| weekly excess deaths | | (0.1977) |
| Trans.gender or non-binary | | 0.1102 |
| x weekly excess deaths | | (0.2026) |
| A-A or Hispanic x TNB x | | -0.0416 |
| weekly excess deaths | | (0.2049) |
| N | 1,000 | 1,000 |

Notes: These regressions include the following control variables: mental health concern (depression, anxiety, stress), state fixed effects, day of the week sent fixed effects, and week sent fixed effects. Standard Errors, clustered at the state level, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

# Chapter 2

# Relative Age Effects on Adolescents' Social Networks and Well-being

## 2.1 Introduction

Relative age effects (RAEs) refer to the advantages or disadvantages individuals experience due to their age differences within a given cohort, typically determined by academic year cutoff dates. This phenomenon has been extensively studied in education, sports, and medical fields, revealing that younger students in a class often face developmental and social disadvantages compared to their older peers.

Prior research has established that relatively younger students are more likely to experience: lower academic performance due to cognitive and emotional immaturity, higher chances of grade retention and assignment to special education programs, and increased risk of behavioral and psychological difficulties, including lower self-esteem and higher stress levels (Peña 2017; Ponzo and Scoppa 2014; Bedard and Dhuey 2006; Elder and Lubotsky 2009).

Less attention has been paid to the impact of relative age on adolescents' social networks. However, RAEs on social networks may have significant societal and policy implications for two main reasons. First, social networks play a crucial role in well-being and non-cognitive skills by fostering socialization, communication, learning opportunities, and civic engagement. Second, addressing RAEs in social networks is more feasible than in education, as it requires less disruptive interventions, such as promoting after-school activities with flexible age groupings, rather than major educational reforms.

Fumarco and Baert (2019) fills this research gap by investigating whether relative age affects the strength of adolescents' social networks. In particular, using data from the HBSC survey, I analyze how relative age influences peer relationships, social integration, and frequency of social interactions. In this study, I use a two-stage least square (2SLS)

methodology to address the endogeneity of relative age. The endogeneity could have multiple causes, and the most frequent ones are teachers holding back students who are thought to underperform or misbehave (which is most often the case of relatively younger students), and parents having their children entering school one year earlier (if they would have been relatively old in their initially assigned school cohort) or later (if they would have been relatively young in their initially assigned school cohort); these behaviors and the endogeneity are mostly country specific.

The various negative effects of a lower age than ones' classmates should reflect onto students' perceived well-being, but this aspects was so far unexplored; I fill this literature gap in Fumarco, Baert, and Sarracino (2020). This study further contributes to the literature by additionally focusing on an important correlate of subjective well-being: health. Studies from various disciplines mostly focus on mental health, the (over)diagnosis of disorders, and disabilities (Dhuey and Lipscomb 2008; Schwandt and Wuppermann 2016). These studies find that relatively old students are less often misdiagnosed with such conditions; this is because they have higher relative age, they are on average more attentive, less hyperactive and less impulsive than their younger peers. Other aspects of health have not been investigated so far. This study contribute by investigating the effects on self-rated general health, frequency of psychosomatic complaints (as a proxy for mental health), and overweight status (as a proxy for physical health). The study of this third health outcome is among the first ones to provide an objective and visible measure of RAEs on physical health.[1] This study is conducted with the same methodology and data of Fumarco and Baert (2019).

Together, these studies provide empirical evidence that relatively younger students do indeed suffer from weaker social network, lower life-satisfaction and worse health.

By leveraging on a quasi-experimental technique, this research highlights how the youngest students in their cohort suffer from gaps beyond the mere educational ones, potentially impacting future well-being and health related outcomes.

The conclusion of this chapter will summarize and discuss venues for further developments.

## 2.2 Data and Methodology

The HBSC survey, conducted by the WHO, examines factors influencing young people's health, well-being, and behaviors. It is administered by teachers to nationally representative student samples aged 10.5 to 16.5, with classes as the smallest unit. The two studies in this

1. Recent studies have investigated the effect of relative age on dietary habits in greater details (Carpenter and Churchill 2024; Fumarco, Hartmann, et al. 2024).

chapter are based on the 2001/2, 2005/6, and 2009/10 waves, as they include adolescent life satisfaction data; more recent waves were not publicly available at the moment of completing these studies.

During data preparation, students from certain countries were excluded if a precise cutoff date couldn't be assigned or if birthdate[2] was missing. Additionally, students from improperly labeled classes were removed to ensure accurate relative age estimates; to do that, students in classes exceeding the 95th percentile (more than 33 students) or below the 5th percentile (fewer than 8 students) in class size were excluded. The final dataset consists of about 380,000 students from 32 countries.

In both studies, the empirical strategy consists of 2SLS regression models, where relative age[3] is instrumented with expected relative age.[4] Relative age is measured in months, so that its coefficient represents the effect on the outcome of a one month increase in relative age.

Balance tests provide evidence that in general, month of birth is as good as random and thus expected relative age is a valid instrument. The validity of the instrument can also be investigated by exploiting the possibility of naturally disaggregating month of birth into dummies, as recommended in Angrist and Pischke (2008) "...many credible instruments can be thought of as defining categories, such as quarter of birth..." and "...any 2SLS estimator using a set of dummy instruments can be understood as a linear combination of all the Wald estimators generated by these instruments one at a time (pp. 100-103)." While this approach was still relatively unfrequent at the time the two studies were prepared, this approach has now taken off, with an entire literature on the so-called "many-weak-instruments," which is considerably popular in economics of law.[5]

2. It is important to stress that this detail is composed only of year and month of birth; thus, it is not possible to use the regression discontinuity design as in most of the literature.

3. The age difference between student i and the oldest regular student in class, where are regular student is someone who started school in the year when they were supposed to and were, they were not retained and did not skip a grade

4. The month of birth within the academic year. While January is the first month of the calendar year for all countries, the first month of the academic year depends on the country-specific cutoff date.

5. The reader can refer to the literature on judge or examiner fixed-effects directly used as instruments or used to create instruments Kling (2006), Maestas et al. (2013), Aizer and Doyle Jr (2015), Dobbie et al. (2018), Agan et al. (2023), Mueller-Smith (2015), Bhuller et al. (2020), and Di Tella and Schargrodsky (2013). Also part of Angrist and Krueger (1991) could be put into this literature. They use various transformations of quarter of birth instruments and, with the increases in the number of instruments–and the decrease in observations per instrument–the many-weak-instrument inference problem surfaces (e.g., by interacting quarter with year of birth and place of birth) Angrist and Frandsen (2022). One of the main differences of the two papers in this thesis with this literature is that these two studies are characterized by many observations per dummy instrument; thus, dummies for academic month of birth are not weak instruments, as showed by the first stages.

## 2.3 Results

### 2.3.1 Social Networks - Fumarco and Baert (2019)

#### Main results

Table 2.1 reports the main results of the study. I find highly statistically significant and negative effects of relative age on e-communication. A one-month increase in relative age decreases e-communication by 0.004 standard deviations; or, equivalently, a twelve-month increase decreases e-communication by 0.048 standard deviations (0.004 × 12). These results on RAEs move in the opposite direction compared to what I originally expected.

Results on the quantity of friends and meetings with them after school also are positively affected by relative age. An increase by one month in relative age increases the quantity of friends by 0.004 standard deviations, which corresponds to 0.048 standard deviations for a one-year within-class age difference. The estimates are similar for quantity of meetings with friends after school. Both results are highly statistically significant.

In general, ancillary tests on the instrumental variables return reassuring results. The tests for under-identification and for weak-identification reject the null hypotheses that the instruments are not correlated with the endogenous variable and that they are only weakly correlated (see critical values in Stock and Yogo (2005)), respectively. The the analyses on e-communication and quantity of friends, the over-identification test does not reject the null hypothesis that the instruments are uncorrelated with the second-stage error term.

I conduct additional analyses at the country level. I find that, overall, the results on RAEs on social network are confirmed for most countries. There are negative RAEs on e-communication for 24 out of 33 countries and positive RAEs on both quantity of friends and meetings with them after school for 21 and 22 countries, respectively.

#### By ability grouping

Policy makers could be more interested in how different countries fare than in average RAEs on social networks across European countries. Thus, I expand the main analyses and explore how RAEs vary with a country-specific educational feature, namely ability grouping. More specifically, for all the three outcomes, I repeat the main analyses on two separate groups, which are formed based on whether the students' country adopts ability grouping or not.

Table 2.2 includes the main statistics from these six analyses. In the upper panel, I report the estimated RAEs from the second stage of the 2SLS regressions, with the according sample sizes, for both country groups. In the bottom panel, I report the $\chi 2$

Table 2.1: Relative age on standardised e-communication, quantity of friends and of meeting with friends after schoo; 2SLS second stage results.

| | E-com<br>(1) | Friends<br>(2) | After school<br>(3) |
|---|---|---|---|
| Relative age | -0.004***<br>(0.001) | 0.004***<br>(0.001) | 0.003***<br>(0.001) |
| N | 357,128 | 363,461 | 352,429 |
| *2SLS ancillary tests* | | | |
| Under-identification test: | | | |
| Lagrange-Multiplier statistic | 5402.661 | 5392.064 | 5201.931 |
| p-value | [0.000] | [0.000] | [0.000] |
| Weak -identification test: | | | |
| F-statistic | 1258.310 | 1255.646 | 1203.530 |
| Over-identification test: | | | |
| Hansen J statistic | 12.928 | 9.255 | 17.153 |
| p-value | [0.228] | [0.508] | [0.071] |

Notes: These regressions include the following control variables: absolute age (centred), female, both parents at home, medium SES, high SES, country fixed effects, wave fixed effects, and season of birth fixed effects. Standard errors clustered on class are in parentheses.* p < 0.10, ** p < 0.05, *** p < 0.01.

statistic on the difference between the estimated RAEs for the two groups of countries, with the corresponding p-value.

Table 2.2: Relative age effects on standardized e-communication, quantity of friends, and quantity of meetings with friends after school, by ability grouping; two-stage least square.

| | E-com | | Friends | | After school | |
|---|---|---|---|---|---|---|
| | RAEs<br>(1) | N<br>(2) | RAEs<br>(3) | N<br>(4) | RAEs<br>(5) | N<br>(6) |
| *Ability grouping* | | | | | | |
| Allowed | -0.006*** | 258,441 | 0.003*** | 263,205 | 0.001 | 254,126 |
| Not allowed | -0.003** | 84,341 | 0.005*** | 85,543 | 0.001 | 83,995 |
| *Test difference* | | | | | | |
| $\chi 2(1)$ | 2.53 | | 0.94 | | 0.02 | |
| p-value | [0.111] | | [0.331] | | [0.899] | |

Notes: These regressions include the following control variables: absolute age (centred), female, both parents at home, medium SES, high SES, country fixed effects, wave fixed effects, and season of birth fixed effects. Standard errors clustered on class are in parentheses.* p < 0.10, ** p < 0.05, *** p < 0.01.

This table does not provide resounding confirmation that RAEs on social network differ by the possibility to group students based on their perceived ability. Estimated RAEs on e-communication are twice the magnitude when ability grouping is possible, compared to when it is not possible—see Column (1). Estimated RAEs on quantity of friends appear to be smaller when ability grouping is possible—see Column (3), and estimated RAEs on quantity of meetings with friends after school are not statistically significant for either group—see Column (5). The difference in RAEs between the two groups of countries (i.e., where ability grouping is possible and where it is not possible) is nearly statistically significant at a conventional level only when I investigate e-communication, while it is far from being statistically significant when I investigate the other two outcomes. Taken together, these results do not provide resounding confirmation that RAEs on social network differed by the possibility to group students based on their perceived ability.

### 2.3.2 Well-being - Fumarco et al. (2020)

#### Main results

Table 2.3 reports the main results. It is important to notice that, as a difference from Fumarco and Baert (2019), this study includes controls for absolute age square; this is done because of the finding that life-satisfaction is a concave function of age.

Column (1) tells us that an increase in relative age by one month increases life satisfaction by 0.014 standard deviations; this means that an increase in relative age by twelve months increase life-satisfaction by 0.168 standard deviations. This is effect is economically important: it is comparable to that of passing from a low to a medium SES family or from a medium to a high SES family–these estimates are reported in the Appendix. Column (2) to (4) provide evidence that relative age increases self-rated general health, reduces psychosomatic complaints and reduces the chances of being overweight. A twelve-month increase in relative age increase self-rated general health by 0.108 standard deviations, decreases the index of psychosomatic complaints by 0.072 standard deviations, and decreases the chances of being overweight by 2.4% (i.e., 0.002 x 12 × 100).[6] Also in this case, the three ancillary tests return mostly reassuring results.

#### Interaction with absolute age

Table 2.4 investigates whether relative age varies with absolute age. With the interaction between these two variables, this study aims to determine whether younger students recover from their initial disadvantages.

6. Please note that the Appendix to this paper reports a wrong name for Index of Psychosomatic, being mistakenly labeled as Lack of Psychosomatic–see Table O.14

Table 2.3: Relative age on standardized life-satisfaction, standardized self-rated general health, index of psychosomatic complaints, and the dummy for overweight status; 2SLS second stage results.

| Variables | Life-satisfaction (1) | General health (2) | Index of psychosomatic (3) | Overweight (4) |
|---|---|---|---|---|
| Relative age | 0.014*** | 0.009*** | -0.006*** | -0.002*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| N | 344,239 | 349,501 | 350,523 | 195,991 |
| *2SLS ancillary tests* | | | | |
| Under-identification test: | | | | |
| Lagrange-Multiplier statistic | 5141.926 | 5166.931 | 5097.705 | 3257.876 |
| p-value | [0.000] | [0.000] | [0.000] | [0.000] |
| Weak-identification test: | | | | |
| F-statistic | 1097.211 | 1121.362 | 1087.009 | 609.501 |
| Over-identification test: | | | | |
| Hansen J statistic | 11.281 | 9.112 | 10.769 | 16.513 |
| p-value | [0.336] | [0.521] | [0.376] | [0.086] |

Notes: These regressions include the following control variables: absolute age (centred) and its square, female, both parents at home, medium SES, high SES, country fixed effects, wave fixed effects, and season of birth fixed effects. Standard errors clustered on class are in parentheses.* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 2.4: Relative age on standardized life-satisfaction, standardized self-rated general health, index of psychosomatic complaints, and the dummy for overweight status; 2SLS second stage results.

| Variables | Life-satisfaction (1) | General health (2) | Index of psychosomatic (3) | Overweight (4) |
|---|---|---|---|---|
| Relative age | 0.014*** | 0.009*** | -0.005*** | -0.002*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Relative age × | 0.001 | 0.001 | -0.001 | -0.000 |
| Absolute age | (0.001) | (0.001) | (0.001) | (0.000) |
| N | 344,239 | 349,501 | 350,523 | 195,991 |

Notes: These regressions include the following control variables: absolute age (centred) and its square, female, both parents at home, medium SES, high SES, country fixed effects, wave fixed effects, and season of birth fixed effects. Standard errors clustered on class are in parentheses.* p < 0.10, ** p < 0.05, *** p < 0.01.

Taken together, these findings suggest that relative age gaps in well-being do not decrease with age. In other words, these results suggest that these well-being gaps are not driven by maturity differences alone, suggesting there are more complex externalities that might be caused by the initial bare maturity gap.

However, additional analyses reported in the Appendix suggest that relative age gaps might decrease in countries when ability tracking occurs later, at 15 years of age.

## 2.4 Policy implications and future developments

A simple, universal, and benign rule such as that which dictates that students born after a cutoff date have to be grouped in the same one-year class might have various effects on students well-being. In particular, relatively younger students suffer from a disadvantage. They have fewer friends and interact with them less often in person, while preferring online encounters. These gaps do not vary when the country allow grouping students by perceived ability. Moreover, they suffer from lower life-satisfaction, general health, more psychosomatic complaints, and higher probability of being overweight. These gaps do not vary with absolute age, but seem to vary when ability grouping occurs at later stages of the education system.

There are two implications: relative age effects are pervasive, geographically extended, and seem to persist in time. While the former is confirmed by various studies (Cavallo et al. 2025), there is less convincing evidence on the latter. However, postponing age at first tracking might help in reducing well-being gaps. Potentially, this delay would give younger students more time to develop their abilities and reduce the disadvantages associated with being among the youngest in their cohort. Postponing tracking could help mitigate stress and mental health burdens faced by relatively younger students as well.

I have been working with HBSC data, and the same methodology, in three additional studies. In one published study (Fumarco and Schultze 2020), I investigated the effect of relative age on time use.[7] In two on-going studies Fumarco and Principe (2024) and Fumarco, Hartmann, et al. (2024), I investigated the effect of relative age on dietary behaviors and on risky behaviors, with the the latter additionally exploring mechanisms with causal mediation analyses.

There are two additional on-going studies. First, a literature review on the entire economic literature on relative age and the related concept of age-at-school start (Cavallo

7. I have published four other studies on this topic, although with different data and even in different disciplines. In Fumarco, Carlsson, et al. (2020), I used administrative data to investigate the effect of relative age on participation to the Erasmus exchange program. Fumarco et al. (2017) and Rađa et al. (2018) are two multidisciplinary studies where I investigated RAEs on hockey and soccer players, respectively. Fumarco and Rossi (2018) is a management study that focuses on RAEs on Serie A soccer players.

et al. 2025). Second, a study on age-at-school start effects on the elderly's health; this study will be conducted with Swedish administrative data.

The work on current projects in development is financed by the SYRI[8] and AGEING-CZ[9] projects.

Based on the work for Cavallo et al. (2025), future research should focus on the long-term effects of RAEs on well-being and health outcomes into adulthood, explore how these effects vary with: (i) country-specific social norms, laws, and features of the schooling system, and (ii) causal mechanisms, which are often speculative in nature.

8. 2022-2025, National Institute for Research on the Socioeconomic Impact of Diseases and Systemic Risks; PI: Pavla Seilerová, Systemic Risk Institute Office, MUNI. Provider: Ministry of Education, Youth and Sports, CZ.

9. 2025-2028, Ageing of the population and related challenges for health and social systems (AGEING-CZ); PI: Jakub Hlávka, MUNI. Provider: Ministry of Education, Youth and Sports, CZ

# Summary and Concluding Remarks

This thesis has examined two critical dimensions of demographic-driven inequality: discrimination in mental health care access and relative age effects in education. Using rigorous empirical methods, it provides new evidence on how demographic characteristics—such as gender identity, race, ethnicity, and relative age—shape disparities in well-being, health, and access to essential services. The findings underscore that these inequalities are not incidental but rather systematic, with implications for both individual outcomes and broader societal structures.

The first part of this thesis focused on discrimination in access to mental health care. Through a large-scale audit correspondence experiment in the United States, I found that transgender and nonbinary individuals, particularly those who are Hispanic or African American, face significant discrimination when seeking mental health services. While cisgender patients did not experience access disparities based on race or ethnicity, TNB individuals from racial or ethnic minority backgrounds were less likely to receive a positive response from mental health providers. This intersectional discrimination highlights the compounding barriers faced by marginalized groups. Additionally, the study examined the impact of the COVID-19 pandemic on access to mental health services, revealing that increasing pandemic intensity reduced appointment availability across all groups but did not fundamentally alter the existing disparities. These findings contribute to the broader literature on healthcare discrimination and point to the urgent need for policies aimed at ensuring equitable access to mental health care.

The second part of this thesis investigated relative age effects in adolescence, focusing on social networks, subjective well-being, and health. Using data from the Health Behaviour in School-Aged Children survey, I found that relatively younger students experience weaker social networks, interacting less frequently with friends in person and relying more on digital communication. Additionally, they report lower life satisfaction, poorer general health, higher psychosomatic complaints, and are more likely to be overweight. These disadvantages persist throughout adolescence, suggesting long-term consequences for well-being and development.

The implications of these findings are significant. First, they highlight the systemic nature of demographic-driven disparities and the need for targeted interventions. In mental health care, anti-discrimination policies, better oversight of mental health providers, and expanded access to trans-friendly services could help reduce inequities. In education, policymakers might consider delaying formal tracking, revising age-grouping practices, or implementing support mechanisms for younger students to mitigate the negative effects of RAEs. Additionally, the finding that younger students are more likely to be overweight

suggests the need for age-sensitive approaches to physical education and extracurricular engagement.

Future research should extend these analyses in several directions. First, the long-term effects of RAEs on adulthood well-being, career outcomes, and health warrant further investigation. Second, the interaction between demographic factors and institutional policies—such as state-level healthcare regulations or educational tracking rules—should be explored in greater detail. Finally, additional research is needed to assess the effectiveness of policy interventions aimed at reducing disparities in both mental health care access and educational settings.

By analyzing discrimination and relative age-based disparities, this thesis underscores the profound role of demographic characteristics in shaping economic, social, and health inequalities. The findings contribute to ongoing policy discussions on reducing barriers to mental health care, addressing age-related disadvantages in education, and fostering equitable outcomes for diverse populations.

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# Abbreviations

Abbreviations.

| Acronym | Meaning |
|---|---|
| CDC | Centers for Disease Control and Prevention |
| HBSC | Health Behavior in School-Aged Children |
| MHP | Mental Health Practitioner |
| RAE | Relative Age Effect |
| TNB | Transgender and Nonbinary People |
| WHO | World Health Organization |
| 2SLS | Two-stage Least Square |

# Authorship contribution statements

The authors are listed in alphabetical order.

**Gender Identity-, Race-, and Ethnicity-based Discrimination in Access to Mental Health Care: Evidence from an Audit Correspondence Field Experiment (Fumarco, Harrell, et al. 2024)**

Luca Fumarco's contribution: 25%

- Corresponding author: Benjamin J. Harrell
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- Methodology: Patrick Button, **Luca Fumarco**, Benjamin J. Harrell, David J. Schwegman
- Data curation: Patrick Button, E Dils, **Luca Fumarco**
- Data analysis: Patrick Button, Luca Fumarco, Benjamin J. Harrell
- Writing (original draft): Patrick Button, Benjamin J. Harrell, David J. Schwegman
- Writing (review): Patrick Button, **Luca Fumarco**, Benjamin J. Harrell, David J. Schwegman

**The Impact of COVID-19 on Access to Mental Health Care Services (Harrell et al. 2023)**

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**Relative Age Effect on European Adolescents' Social Network (Fumarco and Baert 2019)**

Luca Fumarco's contribution: 80%

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- Writing (review): Stijn Baert, **Luca Fumarco**

**Younger, Dissatisfied, and Unhealthy? Relative Age and Life-satisfaction in Adolescence (Fumarco, Baert, and Sarracino 2020)**

Luca Fumarco's contribution: 80%

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- Data curation: **Luca Fumarco**
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- Writing (review): Stijn Baert, **Luca Fumarco**, Francesco Sarracino

# Appendix

### Gender Identity-, Race-, and Ethnicity-based Discrimination in Access to Mental Health Care: Evidence from an Audit Correspondence Field Experiment

Fumarco, L., B. J. Harrell, P. Button, D. J. Schwegman, and E Dils. 2024. "Gender identity-, race-, and ethnicity-based discrimination in access to mental health care: Evidence from an audit correspondence field experiment." American Journal of Health Economics 10 (2): 182–214.
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### The Impact of COVID-19 on Access to Mental Health Care Services

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### Relative Age Effect on European Adolescents' Social Network

Fumarco, L., and S. Baert. 2019. "Relative age effect on European adolescents' social network." Journal of Economic Behavior & Organization 168 (C): 318–337.
Available at: https://doi.org/10.1016/j.jebo.2019.10.014

### Younger, Dissatisfied, and Unhealthy? Relative Age and Life-satisfaction in Adolescence

Fumarco, L., S. Baert, and F. Sarracino. 2020. "Younger, dissatisfied, and unhealthy – Relative age in adolescence." Economics & Human Biology 37 (C): 100858.
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