SOCIETIES SICKENED BY PUNISHMENT? AN EXAMINATION OF THE RELATIONSHIP BETWEEN INCARCERATION AND POPULATION HEALTH ACROSS NATIONS

A Dissertation
Submitted to
the Temple University Graduate Board

In Partial Fulfillment
of the Requirements for the Degree
DOCTOR OF PHILOSOPHY

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by
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May 2023

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ABSTRACT

Research, primarily based out of the United States, has shown that incarceration is related to a variety of negative outcomes for individuals, families, communities, and even broader populations. For example, studies have highlighted primarily negative physical and mental health effects of incarceration at multiple levels. However, we know little about societal consequences of incarceration, even as the global imprisoned population reaches its highest number yet. This dissertation aims to add to the small existing body of cross-national research on nation-level outcomes of imprisonment by examining the effect of incarceration rates on population health. To do so, I have collected, cleaned, and compiled longitudinal data from 1990-2019 from a range of sources, including datasets from the United Nations' Office on Drugs and Crime and the World Bank. Using multilevel models with repeated measures within countries, this dissertation examines the overall relationship between incarceration and five population health outcomes – life expectancy, infant mortality, suicide rate, HIV prevalence, and TB incidence – for over 100 nations. In addition, models explore factors suggested by the literature to moderate or mediate these relationships, including prison conditions, welfare support, and racial diversity for the former and social capital for the latter.

The findings from this research partially support hypotheses that incarceration levels relate to negative health outcomes at the population level. Bivariate and simple multivariate analyses of around 200 countries show that incarceration can be protective, especially at lower levels of country wealth, but high-income countries are often negatively affected by high levels of incarceration. When looking at a smaller sample of around 130 countries with available data for a range of relevant variables in this 30-year

time period, most of these overarching relationships between incarceration and health do show negative effects – the one consistent outlier is infant mortality rate. Moderation analyses showed many of the direct effects to be moderated by country contexts such as racial diversity and exclusion, social protection expenditure, and prison conditions. Adding in these interactions revealed some relationships that were obscured in the direct effect models; sometimes, these were relationships that supported the narrative suggested by the literature, such as infectious disease outcomes being exacerbated by high racial diversity (HIV prevalence) or harsh prison conditions (TB incidence), but other times these were in the opposite, or an unexpected, direction. Subsample analyses allowed examination of subgroups of countries that were driving overall effects. For example, the negative effect of incarceration on life expectancy over time was found to be present only in the subsample of countries with above average racial diversity and/or exclusion, below average social protection expenditure, and worse than average prison conditions. Mediation analyses within a smaller sample of countries and years (2007-19) showed some evidence of partial mediation through civic participation and social networks, but also evidence of a suppressive effect of social capital variables on the relationship between incarceration and both infant mortality rates and HIV prevalence.

While there are limitations to this research due mainly to characteristics and availability of comparative international data, there are also implications for theory, research, policy, and practice. Hopefully this work will promote more theory and research on the effects of incarceration at the country level, as negative consequences are not confined to the U.S., and encourage policymakers and practitioners to better understand how incarceration levels are affecting the health of the whole population.

ACKNOWLEDGMENTS

Although I found the process of getting my PhD pretty isolating, especially during a pandemic, there are many people I need to thank for helping me get to the end of it and setting me up for a successful future, whatever path that may take.

To Dr. Rely Vîlcică – I cannot thank you enough for your support throughout this entire process. I am so thankful that the department paired me with you since the beginning. I truly believe that it was your unwavering support that got me this far – your cheerleading, your letters of recommendation for multiple opportunities, your editing, your feedback, your responsiveness, your perspective, and your humor. I left every meeting with you feeling better than I went in. This process was a lot, and I made you read a lot, but I hope you know how much I appreciate your efforts because I came out stronger – and more willing to say positive things about myself and my work – and I thank you for that.

To my committee – Dr. Jeff Ward, not just my "methods person", but someone with an incredible breadth of knowledge, whose presence on my committee I am so grateful for. A helpful guide since my first year, even though I never took a class with you, I appreciate your advice, and effort, and responsiveness to my many emails. Maybe I'll end up back in academia someday. Dr. Amarat Zaatut – I'm very thankful you agreed to join my committee. Your perspective was such a helpful one, in the overall process and the dissertation itself. I'm sorry I tortured you, as a primarily qualitative researcher, with so many tables, but I think the end result was much better given your advice and feedback. Dr. Susanne Karstedt – I appreciate your willingness to answer a random email from across the globe, and share your hard-earned data coding efforts with me. You were

open and responsive, even as my timing shifted, and I am grateful for your flexibility and willingness to take on the external reader task.

To Drs. Caterina Roman and Aunshul Rege – thank you for the opportunity to work closely with you, both impressive scholars and women. Though the subject matter did not overlap, I appreciated working with you both – Aunshul, for opening up a world I had never even fully considered studying before, and being flexible but having a high standard for our work (and supporting me taking an extra course that inspired my 601 and dissertation); Caterina, for exposing me to a number of interesting and important efforts across Philadelphia and guiding my work but allowing for independence. I gained so much from my time as both of your RAs, and I appreciate you giving me the opportunity. Additionally, Caterina, thank you for the recommendation and support as I found a full-time job opportunity I was excited about – I would not be in my current position without your endorsement and flexibility.

To the other professors in the department – those who brought me into this department, such as Dr. Fader; those that I also provided some research support for, such as Drs. Groff and Wood; those who taught key courses, such as Drs. Auerhahn, Taylor, Belenko, and Ratcliffe; and those who listened and supported my interests early on, such as Dr. Olaghere; and the rest of the faculty that supported me – I cannot thank you enough for your help along the way. I knew this process would be difficult but worth it and, each in your own way, you helped me through.

To those who came before me – Nili, thank you for your mentoring from before day one. I knew I could come to you with any question or issue, and you had helpful things for me to consider. Hannah, your knowledge and humor, and complementary

Hogwarts house, helped me so much throughout this entire process, even after you graduated. Dijonée, Ryan, Juwan, Meg, and Courtney, I always appreciated your humor and insight, and I hope our paths get to cross again in the future – professionally and/or personally.

To those that came with me – Ed, our time together as officemates was brief but deep. I'm glad you asked me all those random questions, and that even after you left, you supported me and forced me to try new places for lunch occasionally. Chelsey, Mollie, and Ronni – though we were separated by comps, I always enjoyed our early course comradery as a cohort; we were all so different but bonded under shared pressure-filled conditions and I'm glad it was with you. Nicole and Katorah – together until the end. I am so lucky to have not just gone through classes and comps with both of you, but gotten to work with you both as RAs. I was so impressed as I watched the two of you navigate not just this program, but other important junctures in life, and I wish you nothing but the best for the future.

To those who came after me – I am continually impressed by the cohorts who have joined the program since. From those I've sat through classes with, to those I've worked alongside on projects and CJGSA, to those I've mentored and who have helped mentor others, and just those happy to chat when I'm randomly on campus, I'm very hopeful for the department and just know that I'm happy to listen, provide advice, or connect you to resources should you think that might be useful in the future.

To my new colleagues at the Crime and Justice Policy Lab – especially Ben Struhl, thank you for bearing with me and making the conclusion of my dissertation process manageable. I am very thankful to work with such knowledgeable and

welcoming colleagues, and could not have gotten here without the support and understanding of my new boss and coworkers.

To my friends – even though most of you did not know what I was talking about or going through exactly over these last 6 years, you were happy to listen and celebrate the small wins along the way. I'm thankful to have such wonderful people in my life, from Philly, to Cincinnati, to the West Coast, and abroad. Thank you for bearing with me.

To my family – Mom and Dad, I appreciate your support in abandoning my previous full-time job to become a student again. I could not have done it without you. Even as I questioned my ability to finish amidst a pandemic, you were there to subtly nudge me in the direction of completion without overstepping. Our family has gained another degree, and I completed my last one (I promise), with your help. Luca and Alexandra, thank you for checking in and keeping me sane. We're a studious bunch, but it's been inspiring to see you finish your schooling and find your partners, your homes, and your places in life. I'll keep working on the latter two.

To Evan – after all that you have put up with, I think they should give you a PhD as well. Thank you for bearing with me and supporting me – prepping my dinners, walking the dog, doing the dishes – when I needed some extra time to work. And for making me want to take breaks when I needed to stop working. I am forever thankful that I met you during that "spring break" of my first year at Temple, and that you stuck around to build a life with me in Philly. I am so excited for our future together, especially now that this dissertation is done. I'm hoping future me will be slightly more fun. But I know that you would love and support me regardless.

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CHAPTER 1: INTRODUCTION

Worldwide, over 11 million people are currently imprisoned, which is the highest number yet (PRI & TIJ, 2020; 2021). In fact, this figure reflects an increase of 20% since 2002 (PRI & TIJ, 2020) and an 8% increase since 2010 (PRI & TIJ, 2021). Every world region except for Europe has seen at least a 20% increase in prison population from 2000 to 2018; excluding Russia, which has made concerted efforts to drop their population by 45%, the rest of Europe has seen a 3% increase (Walmsley, 2018). This increased global use of incarceration did not come alongside large increases in crime. Although crime data is difficult to measure and compare across countries (Harrendorf, 2018), the available evidence suggests that, at least in some parts of the world, countries have increased their use of incarceration alongside a crime drop (Tonry, 2014; Pease & Ignatans, 2016). Most scholars agree that rising imprisonment may have played some part in this observed crime drop, but that it cannot explain most of the decrease, especially cross-nationally (Farrell et al., 2014; Tonry, 2014). Therefore, many countries have increased their use of incarceration while the direct impetus for incarceration, crime, has decreased; this suggests that rising use may be more of a policy decision than a justice response to crime.

For example, national governments have made policy changes either specifically aiming to decrease their prison populations (e.g., Russia) or have accepted increased incarceration size as a potential consequence of policies targeting crime reduction via incapacitation. In the U.S., there were many separate policy decisions that scholars believe led to the current state of mass incarceration. Sentences became longer and mandatory (more increasingly as a result of "three-strikes" laws; Mauer, 2003), the "War on Drugs" escalated the prosecution of and penalties for drug crimes, and parole

supervision intensified, leading to a cycle of prison releases and admissions (Blumstein & Beck, 2005; NRC, 2014). Sentence length, in particular, has been shown to be much higher in the U.S. than in other industrialized countries (Lynch & Pridemore, 2011). In contrast, penal policies in other countries, such as Finland (Lappi-Seppälä, 2007), Russia, and Germany (Mauer, 2003), have been found to contribute to decreased prison populations by specifically targeting the use and size of incarceration or de-emphasizing the role of incapacitation as a crime reduction mechanism. In Russia, reduction came through prisoner amnesty to reduce the financial costs and physical (health) costs of overcrowding in prisons; in West Germany, when it still existed, officials stopped using short prison terms for low-level offenses because they saw the harm of cutting social ties and stigmatizing individuals convicted of such crimes as greater than any good that would come from their imprisonment (Mauer, 2003). In Finland, officials implemented a number of policy changes over many decades, such as prisoner amnesty, reduced penalties for low-level crimes, and introduction and expansion of community service as a punishment, which cut the size of their incarcerated population (Lappi-Seppälä, 2007).

These policy decisions are grounded in existing criminal justice system philosophies and practices. Criminal justice system structures and their components, such as prisons, exist and play similar roles across nations (Maguire et al., 1998); yet penal policies and systems vary around the world, especially in regard to the punishment philosophies guiding policy. As mentioned above, countries can make policy decisions that can led to either increases or decreases in their prison populations. Countries embracing community-based rehabilitative or restorative approaches would see lower

prison populations while countries relying on retributive-, incapacitation-, or deterrence-driven policies would see greater use of incarceration.

This said, general penal structure may look more similar within world regions and country policy decisions may be guided by regional standards. For example, Finland's high prison rate compared to its Scandinavian neighbors was seen as "a disgrace" by its politicians and justice officials. This, in turn, led to a "conscious, long-term, and systematic criminal justice policy strategy" in Finland that involved decades of policy changes to reduce criminal punishment severity, described above, to bring it closer to its Scandinavian counterparts (Lappi-Seppälä, 2007, p. 241). Karstedt (2015) suggests that countries have "cultural peers" with common histories and philosophies which help shape the landscape of their penal systems and often fall along regional lines (e.g., in different parts of Europe). Other research has provided evidence for this as well, such as the findings that penal institutions in North and South America, while thought to be converging, look distinct in practice because of differences in penal laws (Birkbeck, 2011). For example, the judiciary in Venezuela has the power to review all penal decisions, including parole/conditional release from prison, whereas in the U.S. sentencing and parole decisions are made by different actors. Similarly, the retention and use of capital punishment varies both within Asia and between Asian nations and Europe due to differences in culture and government structure (Johnson & Zimring, 2009).

There is a large body of research which has examined structural factors that affect countries' penal policies and incarceration use, whether looking at shared regional characteristics or otherwise. Studied factors include those that span political, economic, social, and cultural/historical dimensions. Research has found that measures of such

concepts as democracy and civil liberties (e.g., Neapolitan, 2001; D'Amico & Williamson, 2019; Marier, 2020), economic well-being (e.g., Clark & Herbolsheimer, 2021), racial diversity (e.g., Ruddell & Urbina, 2004), social assistance (e.g., Sutton, 2000; Jacobs & Kleban, 2003; Lappi-Seppälä, 2011), colonial history (Davis & Gibson-Light, 2020) and region (Neapolitan, 2001), among others, likely play a role in differences in penal policy and punishment across countries. Yet despite the knowledge accumulated on predictors and correlates of incarceration rates and trends at the country level, there is limited information on the effects of incarceration use cross-nationally. As incarceration rates appear to be the products of policy decisions within established penal structures, as opposed to purely products of the level of crime, the ramifications of these decisions and their outcomes should be further explored at the societal level.

Research at the individual and community level, primarily from the U.S., shows that there are a host of negative outcomes that result from imprisonment. Formerly incarcerated individuals in the U.S. have been shown to have difficulties securing housing (Gowan, 2002; Geller & Curtis, 2011), staying in marriages (Lopoo & Western, 2005; Massoglia et al., 2011), obtaining employment and experiencing growth in earnings (NRC, 2014; Mueller-Smith, 2015), and engaging civically or politically (Manza & Uggen, 2006). Negative outcomes have also been found to extend to the families of formerly incarcerated individuals, especially spouses and children (Braman, 2004; Comfort, 2007; Wakefield & Wildeman, 2013), and their communities (Lynch & Sabol, 2004; Clear, 2007). Although less extensive, studies outside of the U.S. have also found negative effects of incarceration, such as increased male child mortality due to

parental incarceration in Denmark (Wildeman et al., 2014) and decreased trust in legal institutions in areas of colonial imprisonment in Nigeria (Archibong & Obikili, 2020).

Yet despite increasing incarceration rates in many countries and research at more micro levels, we still have little understanding of how incarceration affects societies. As societies imprison higher levels of their populations, it is important to understand the effects of this practice. Theory might suggest two pathways leading to societal-level effects of incarceration (Figure 1). The first is that macro-level consequences could be amassed from individual-level impacts (Pathway 1). The second is that the extent of incarceration use within a nation affects the degree to which the prison is a social institution and could be related to societal well-being through its relationships with other institutions and spending or the cultural adaptations that accompany a high level of social distrust (Pathway 2).

This research aims to build upon the small existing literature examining societal effects of incarceration. While there are a variety of ways in which imprisonment could affect a nation, one in particular is of interest in this research: population health. This study focuses on population health due to its importance and an existing body of

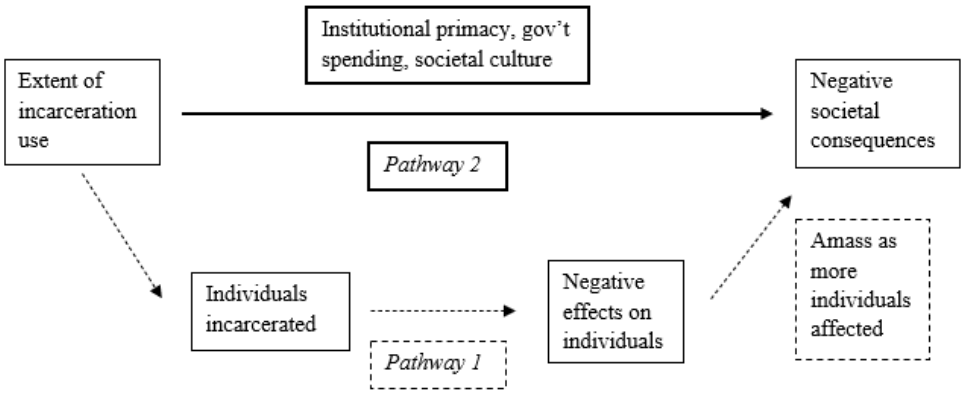

Figure 1. Potential Theoretical Pathways

literature examining this relationship at micro, meso, and even macro levels. Unhealthy people can be costly, so it is crucial to explore causes of morbidity and mortality among populations. Whether incarceration is contributing to a nation's morbidity and mortality levels, through physical or mental health, is essential for practitioners and policymakers to understand. The existing literature suggests that incarceration, and incarceration levels within communities, may relate to individual- and community-level health. Only one study has examined this relationship broadly at the country level (Wildeman, 2016), and results showed a negative relationship to exist, though primarily driven by the U.S. out of the sample of 21 developed democracies, so further study is warranted.

Cross-national research is an important tool to help understand macro-level issues such as these. According to Bennett (2009), there are four broad benefits of comparative criminal justice research: 1) providing an in-depth understanding of how justice systems work throughout the world; 2) understanding justice system evolution and challenges to help developing nations advance their systems to better meet these challenges; 3) identifying factors related to policy and its implementation across cultural contexts to help guide successful efforts; and 4) finding "best practices" amongst criminal justice systems. The goal of this research is to understand the effects of the evolution of incarceration as a justice system practice, and to examine whether there are "worst practices" to be avoided due to negative societal consequences or "best practices" in terms of mitigating negative outcomes – here, in terms of health. This research could then provide direction for future efforts to identify and promote the best use of incarceration as it relates to societal health and well-being.

Comparative cross-national research is also important in order to avoid pitfalls of ethnocentrism. Ethnocentrism is "preference for one's own group, and ethnocentric beliefs are typically expressed as a feeling of superiority over others", and three common types are Western, White, and American ethnocentrism (Croll, 2012, p. 524). The prison as a punishment itself can be seen partially as a result of ethnocentrism, developed in predominantly White, Western nations and often imported to other areas through colonialism, seen as superior to more "barbaric" practices (Dikötter, 2007). It is important to note, though, that the spread of the prison was not entirely forced and was seen as a modern ideal by political elites globally to accompany new civilized states through local adaptations (Dikötter, 2007). However, despite almost the entire world now utilizing imprisonment as a major form of punishment, most of the body of research about prisons and their consequences comes from the United States, and when it is comparative it typically only includes other Western countries. It is important to broaden this view to understand these relationships worldwide and interrogate the potential negative effects of prison in other regions as well, especially because the Western world played a large part in the spread of prison establishment and use. There could be certain factors, such as wealth, which increase adverse consequences of incarceration use, which cannot be studied only among wealthy countries.

The current study aims to understand the incarceration effects on population health across a large sample of nations, including through the investigation of moderating and mediating relationships. The international comparative literature in this area is underdeveloped. Previous research (Wildeman, 2016) has examined the relationship between incarceration and health cross-nationally, and these findings were instructive,

but the study only looked at this association among a small sample of developed nations and did not examine potential contextual factors and mechanisms. To conduct a broader examination, this research uses data that I have compiled from a variety of sources over a 30-year time span for as many countries as possible. The most complete sample includes 128 countries spanning all world regions and income levels, and certain analyses may have more or fewer countries included based on data availability. First, simple analyses are conducted to understand the basic relationship between incarceration and five outcomes of population health (life expectancy, infant mortality, suicide rates, human immunodeficiency virus (HIV) rates, and tuberculosis (TB) incidence) in this broad sample of nations. The first two outcomes were chosen as they are common indicators of population health (Wildeman, 2016), the third is included to incorporate an outcome that focuses more specifically on mental health, and the final measures are added to examine infectious disease outcomes, of particular concern in prison settings. Multilevel models are run to answer the main research questions in this dissertation: whether there are direct relationships between incarceration and population health, factors that may influence the existence or direction of a relationship, and a mechanism that could mediate this link.

The following chapter covers existing literature related to the health effects of incarceration and the research questions for the current study. Chapter 3 outlines the methods of this research, including the data, sample, and analytic plan. Chapters 4 through 7 present results related to preliminary analyses, direct effects (RQ1), moderation effects (RQ2), and mediation effects (RQ3), respectively. The concluding chapter discusses these findings and the implications of the research in terms of theory and practice; limitations and directions for future research are also discussed.

CHAPTER 2: LITERATURE REVIEW

According to micro- and meso-level research, incarceration affects individuals, families, and communities in a variety of ways, such as job earnings (Western et al., 2001; Mueller-Smith, 2015), housing (Geller & Curtis, 2011), family relationships and community supports (e.g., DeHart et al., 2018), and perceptions of government fairness and political participation (Lee, Porter, & Comfort, 2014; Shannon & Uggen, 2012). While all outcomes are important for study, and are likely interconnected, this literature review will focus on one of particular importance to societal wellbeing: health.

Micro-Level Incarceration Effects on Health

As incarceration rates expanded in the U.S. and around the world, and more of the population became incarcerated or formerly incarcerated, a growing body of literature has examined the relationship between incarceration and health. Generally, research from multiple countries has documented higher prevalence of mental and physical health issues, such as mental disorders and infectious disease, among the prison population, in addition to higher suicide rates and increased mortality after release (Fazel & Baillargeon, 2011; NRC, 2014).

One issue with studying the health impacts of incarceration to note up front is potential bias from selection effects (Massoglia & Pridemore, 2015). Higher prevalence does not necessarily mean that incarceration causes mental and physical health declines. The additional strains of incarceration are placed upon a population that already have high rates of physical and mental illness (NRC, 2014), which complicates the isolation of specific incarceration effects. For example, associational research has highlighted the significantly higher levels of anxiety, mood, impulse control, and substance use disorders

among the formerly incarcerated respondents to the National Comorbidity Survey Replication (NCS-R) as compared to those who were not incarcerated (Schnittker, 2014); however, related research revealed that many of these disorders, such as those that were anxiety-related, likely predated incarceration as they were associated with childhood background and early onset substance abuse (Schnittker et al., 2012). In fact, prior mental and physical health issues could contribute to later incarceration (Link et al., 2019); this is an area in which more research is needed (NRC, 2014). To combat potential bias, scholars have used a variety of methods to provide stronger statistical evidence of this relationship outside of association, but purely causal evidence, including that which evaluates mechanisms, is still largely lacking.

This review will start by discussing the mechanisms that could lead incarceration to affect the health of prisoners and former prisoners, their families, and their communities, and then research that has examined this relationship. While related, effects on mental health will be reviewed first, followed by physical health.

Mental Health of Prisoners

Mechanisms. Sykes (1958) was one of the first scholars to document the psychological pains of modern prison life. Although the penitentiary moved away from the physical harm caused by previous methods of punishment, the separation and isolation of prison was not without its costs. Through ethnographic research of New Jersey State Prison, Sykes (1958) determined that there were five "pains" of incarceration, which imposed mental rather than physical pains: deprivation of 1) liberty, 2) desirable goods and services, 3) heterosexual relationships, 4) autonomy, and 5) security. Indeed, the National Research Council (NRC, 2014) found that there are

multiple conditions of prisons that could lead to negative psychological outcomes, including material deprivations, restricted movement, absence of personal privacy, and high levels of uncertainty and fear. Some conditions have been linked with serious degradation of mental health, such as extreme overcrowding and placement in isolation. Within prison, negative relationships between prisoners and staff and staff shortages have also been linked to stress and mental health issues (Nurse et al., 2003).

Secondary consequences of incarceration may also lead to further mental health challenges upon release. Incarceration could be an instigator of a stress process (Pearlin, 1989), which occurs when a primary stressor (e.g., imprisonment) triggers secondary stressors (e.g., job loss, family strain, or housing insecurity). These secondary stressors could create or exacerbate mental health issues within the population of formerly incarcerated individuals as well.

Research. Research from the U.S. and abroad has found evidence that incarceration can lead to mental health issues among imprisoned populations and after release, although causality is not always clear. For example, Schnittker and colleagues (2012) examined data from the NCS-R, a nationally-representative survey which included almost 6,000 individuals, and found that incarceration was related to subsequent mood disorders, including major depressive disorder, bipolar disorder, and dysthymia, after controlling for multidimensional influences. The authors also analyzed how incarceration and psychological disorders contributed to six types of disability: inability to complete normal activities, self-care limitations, mobility limitations, cognition limitations, reduced social functioning, and health-related withdrawal from social participation. Mood disorders were more strongly related to disability than substance

abuse or impulse control disorders and could create an additional barrier for returning citizens. Further research highlighted the additional consequences of psychological effects on incarceration within the realm of social reintegration (Schnittker, 2014). Another study utilized the Fragile Families and Child Wellbeing Study to explore the relationship between incarceration and depression (Turney et al., 2012). They found that both current and recent incarceration were significantly associated with the risk of major depression, and this relationship was at least partially attributed to consequences of incarceration on socioeconomic status and family functioning. These results suggest that the conditions of incarceration as well as the consequences of that incarceration upon release can contribute to mental health issues for returning citizens.

Some research also suggests that the mental health consequences of imprisonment could be fatal. Using national data on U.S. prisons, Huey and McNulty (2005) examined conditional effects of deprivation (based on prison security level) and overcrowding on prison suicide. Their results did confirm this relationship, with the probability of a prison experiencing a suicide increasing substantially as overcrowding increased, and this being especially true for minimum-security prisons (the lowest level of deprivation). Other research has also found a combination of deprivation and institutional conditions (overcrowding, violence) to be predictive of prison suicides in state prisons in the U.S. (Dye, 2010). Cross-national research has found that prison suicide rates do not reflect underlying general population rates and likely reflect differences in criminal justice systems (Fazel et al., 2011).

There is some discrepancy in the literature as to whether length or number of incarcerations are important to mental health effects. Schnittker and colleagues (2012),

described above, found that the length of incarceration was "generally unrelated to psychiatric outcomes beyond the difference between those with and without histories of incarceration" (p. 452). However, other research has found dosage of incarceration matters to mental health outcomes. Although not comparing to a shorter-term population, Liem and Kunst (2013) sought to examine whether there were unique mental health conditions particularly present in those who have experienced long-term incarceration. The authors conducted in-depth life interviews with 25 released "lifers", incarcerated for an average of 19 years, and found a specific cluster of mental health symptoms, including PTSD, institutionalized personality traits, social–sensory disorientation, and alienation, which they termed Post-Incarceration Syndrome and considered to be a subset of PTSD.

Another study, utilizing data from the National Longitudinal Study of Youth 1997 (NLSY97) cohort, specifically analyzed whether the number of incarcerations and the months of incarceration were related to mental health outcomes (Porter & DeMarco, 2019). The results suggested that "longer and more numerous bouts of incarceration worsen mental health" for former prisoners (p. 149). However, incarceration appears to have a protective effect on current inmates, as time served was negatively related to mental health symptoms and the odds of depression, and number of spells was unrelated. These results suggested that inmates may be adapting to the stressful situations they are in and/or receiving treatment for mental health issues while incarcerated, and then are faced with a new environment and potential lack of support upon release. Some protective effects may be related not just to deprivations, as mentioned in the "Mechanisms" section, but also to relative deprivation, which is the feeling that one is deprived of a state or thing in relation to some standard or other people (Williams, 1975).

Outside of the U.S., Dudeck and colleagues (2011) examined trauma, PTSD, auto-aggressive behaviors, and suicide attempts in a sample of over a thousand long-term (5+ years) male prisoners in 11 European countries. Previous research in Europe has found a wide range of prevalence estimates for mental health disorders in prisoner populations, although they agree that levels are significantly higher than the general population. This research showed that traumatic experiences and post-traumatic stress disorders were relatively common among long-term prison populations, with an average of 3 meaningful traumatic events per prisoner and symptoms of current PTSD in 14% of the sample. They also found that about one-third of respondents had attempted suicide, either before (12%) or during (13%) incarceration, but only 4% had attempted both before and during incarceration, suggesting that suicidal behaviors are not simply imported into prisons. As a note, these results did not control for prior incarceration, so there may have been some further effect of imprisonment on suicidal behaviors that was not examined there. A previous study (Dudeck et al., 2009) of short-term prisoners found fewer traumatic experiences and a much lower prevalence of PTSD (4%), but higher levels of auto-aggressive behaviors such as cutting and burning. Compared to these short-term prisoners, long-term prisoners had 50% higher treatment needs (Dudeck et al., 2011). These results suggest that the protective effects of current incarceration found by Porter and DeMarco (2019) may be limited to the U.S., or at least were not found in Europe, where prison conditions and levels of mental health support both inside and outside prison may be significantly different.

Another reason why mental health outcomes of prisoners and former prisoners may be different across countries is related to the context of release: discrimination.

Assari and colleagues (2018) used structural equation models (SEM) to examine the relationship between history of incarceration, discrimination, and mental health (depressive symptoms and psychological distress) among a nationally representative sample of African American men. They found a direct and significant positive pathway between incarceration and mental health outcomes that disappeared once everyday instances of discrimination were taken into account. Their results suggest an indirect relationship between incarceration and mental health which is mediated by discrimination for Black men in the U.S. This is likely related to many legal forms of discrimination that occur for those convicted of a felony (e.g., losing the right to vote; or the obligation to disclose prior record on employment applications), which may heighten perceptions of discrimination that are also connected to race. Other countries that do not allow legal discrimination against those with criminal histories may not see the same relationship between incarceration and mental health, but all of the evidence above would suggest that this relationship is worth further exploration.

Overall, there is fairly strong evidence that the conditions of prison and the consequences of incarceration negatively affect the mental health of individuals who are and/or were previously incarcerated. More causal evidence is needed; however, the existing evidence points to a strong association between mental health issues of current and former prisoners across multiple country contexts, and there may be some protective effects for those who receive inadequate healthcare outside of prison, such as many low-income individuals in the U.S. The consequences of incarceration could also be exacerbated by legal and racial discrimination after release.

Incarceration's effect on the mental health of those currently and formerly incarcerated, while an important outcome in and of itself, could also affect physical health outcomes. Massoglia and Pridemore (2015), in their review of linkages between incarceration and health, suggested that one of the pathways through which incarceration can impact health is by way of incarceration being an "acute and chronic stressor", which can negatively affect physical health. These negative psychological outcomes could relate to physical health in a variety of ways, such as stress-related illness or suicide. They could also exacerbate one another, as physical health issues have also been shown to contribute to mental health issues like depression (Geerlings et al., 2000; Turner & Noh, 1988). Therefore, this review now turns to the literature on physical health.

Physical Health of Prisoners

Mechanisms. In addition to pathways through negative mental health effects, the review by Massoglia and Pridemore (2015) suggests two other pathways for incarceration to influence physical health negatively. First, within prisons and jails people may be exposed to infectious diseases, including both sexually transmitted infections (STIs) and other types of contagious illnesses. Increased exposure to STIs may occur because of first-time homosexual relationships and/or contact with individuals engaged in other risky behavior such as intravenous drug use (Thomas et al., 2008; Chacowry Pala et al., 2018). In addition, conditions related to hygiene and crowding could facilitate the spread of other non-sexually transmitted infections and diseases (Massoglia & Pridemore, 2015). Indeed, at least a quarter of people in the U.S. living with HIV, HCV, or TB at the end 20th century had passed through a correctional facility during the year of study (Hammett et al., 2002). More recent evidence has been found in relation to infectious disease during

the COVID-19 pandemic. For instance, correctional facilities were associated with clusters of COVID-19 cases and deaths in the U.S. (Andersen et al., 2021). Globally, officials were concerned about COVID-19 spread in prisons and detention centers due to overcrowding, unhygienic conditions, and lack of medical care (WHO, 2020) and scholars have also suggested that prison staff transmission may play a crucial role as well (Wallace et al., 2021; Cingolani et al., 2021). On a more local scale, countries with prior experience of endemics might have also had transmission of these diseases aided by prisons and their conditions, and therefore may have seen worse health outcomes.

Second, incarceration can act as a barrier to social integration, and prosocial bonds have been found to have protective effects on morbidity and mortality. Schnittker and John (2007) also mention that this mechanism could relate to stigma attached to incarceration, which could affect the behavior of others or work through identity-related factors, such as shame and low self-esteem. Therefore, incarceration could affect physical health by exposing prisoners to infectious diseases, fostering mental health stressors which then present physically, or inhibiting social connections which would protect them from physical illness upon release (Massoglia & Pridemore, 2015). There may also be other mechanisms between incarceration and poor health. For instance, Link and colleagues (2019) have suggested that low-quality prison food may deteriorate physical health and exacerbate existing medical conditions, resulting in processes that may facilitate a cycle of reincarceration.

In another article, Massoglia and Remster (2019) provide policy recommendations to mitigate these pathways between incarceration and poor physical health, such as improving healthcare during and after prison, improving prison

conditions, and reducing legal barriers to reintegration. In the U.S., for example, a large proportion of people who were formerly incarcerated come from low-income backgrounds, and rely on federal programs such as Medicaid to provide for their healthcare after release; however, Medicaid is suspended upon incarceration and there are often coverage gaps after release that make this population vulnerable to insufficient healthcare support (Mallik-Kane & Visher, 2008; Albertson et al., 2020). Incarceration has also been shown to be associated with higher levels of unemployment, potentially due to employers' hesitancy to hire those with criminal records (NRC, 2014), and this could have an effect on health insurance for those in the U.S., as it is traditionally offered through employment. There may be additional barriers to care once people are released into communities, such as housing and personal relationships (Rich et al., 2014).

For countries that already have broader healthcare and welfare support, and better prison conditions than the U.S., these relationships between incarceration and physical health may not be as strong; however, a large number of countries worldwide have worse healthcare and welfare support, so negative health outcomes might be further exacerbated there. Additionally, the research above has shown that prisoners in Europe, which includes those in countries generally considered to have better healthcare systems and high welfare support, still suffer mental health issues related to incarceration (Dudeck et al., 2011), so there is at least one mechanism that should link incarceration to physical health globally. This could be linked to relative deprivation and the mental pains of imprisonment (Sykes, 1958; Williams, 1975). Although conditions may be better in European prisons than in the U.S., incarcerated individuals there are still actually and

relatively deprived of their liberty and material goods as compared to their previous status and the free citizens in those countries, which can cause mental strain.

Research. Studies have examined the individual-level effects of incarceration on a range of physical health issues (morbidity) and mortality. For instance, Schnittker and John (2007) examined data from the National Longitudinal Survey of Youth (NLSY) to understand incarceration's effect on severe medical limitations, using fixed- and random-effects methods to explore mediating factors and control for stable individual features. The authors found that incarceration significantly impacts these health outcomes, though only after release, which suggests that these negative health outcomes may be related to issues upon reentry. The results also showed that any contact with incarceration is more important than the length of contact, supporting the idea that stigma may be an influential mechanism. Massoglia (2008) utilized the same dataset to examine the health issues of those with a history of incarceration by analyzing effects on 20 different measures of health. Related to the mechanisms described above, the results showed a consistent relationship between incarceration history and affliction with infectious disease and stress-related illness, although no pattern emerged for health issues outside of those.

Other research has typically found a higher level of STIs among incarcerated individuals than the general population. In the U.S., many studies have documented a high prevalence of STIs among adults and, especially, youth entering correctional facilities (e.g., Joesoef et al., 2006; Javanbakht et al., 2009). Research outside of the U.S. has also found elevated levels of STIs in their prison populations. In Switzerland, STI prevalence has been found to be 2-9 times higher in detainees than in the general Swiss population (Chacowry Pala et al., 2018). Research in Malawi found a high level of STIs

in their prison population, and evidence that a considerable proportion of STIs among inmates were acquired within prison (Zachariah et al., 2002). These findings indicate that it is not just an issue of people entering prison with STIs at a higher rate than the general population, but these STIs are then spread within correctional facilities. In addition, STIs may affect women in prison more so than men (Hammett, 2009), and can lead to severe consequences such as a higher risk of cervical cancer (Escobar & Plugge, 2020).

Scholars have also examined short- and long-term effects of incarceration on mortality. In their review, Massoglia and Pridemore (2015) concluded that the evidence for incarceration effects on short-term mortality is strong. Binswanger and colleagues (2007), for example, compared inmates released from Washington State prisons from 1999 to 2003 to residents in the general population and found a significantly higher rate of mortality among former inmates after release from prison, especially within the first two weeks of release. The risk of death for former inmates was 12.7 times higher than for the general population in that first two weeks. Drug overdose was the leading cause of death overall and for the first two weeks, followed by cardiovascular disease, homicide, and suicide, though these latter causes typically resulted in death after two weeks. Studies of post-release mortality in New York City have also shown elevated short-term mortality rates, largely driven by drugs and also by homicide (Lim et al., 2012; Alex et al., 2017).

Similar research has confirmed these findings outside of the United States. Farrell and Marsden (2008) looked at deaths among a retrospective national sample of newly released prisoners in England and Wales. They found that there were significantly more deaths among this population than would be expected in the general population in the first year after release, and 95-100% of deaths which occurred in the first two weeks after

release were drug-related for men and women. Taken together, these studies suggest that formerly incarcerated persons have significantly higher risks of death shortly after release than the general population, and this risk is largely driven by drug use. However, the mechanisms that connect incarceration to short-term mortality, especially through the primary driver of drug use, have not been explored (Massoglia & Pridemore, 2015).

The evidence on the long-term effects of incarceration on mortality is less robust and may be driven by strong short-term effects (Massoglia & Pridemore, 2015). For instance, Binswanger and colleagues (2007) found the overall risk of death to be 3.5 times higher in the population of released inmates, but this includes the substantially higher risk within 1-2 weeks of release. In addition, other studies outside the U.S. have found no association between incarceration and long-term premature mortality after adjusting for other variables (Kjelsberg & Laake, 2010) or applying propensity score analysis to match previously incarcerated and general population samples (Dirkzwager et al., 2012). However, a large-scale, population-based, case-control design study of men in Russia provides strong evidence that incarceration can have lasting effects on health leading to premature mortality (Pridemore, 2014). "Cases" were men who had died between the ages of 25 and 54 in the city of Izhevsk, and controls were selected at random from the city population register. Using logistic regression to estimate mortality ratios, results showed that men with a history of incarceration were twice as likely as those without to die early, and were more likely to die from infectious disease, respiratory disease, non-alcohol-related accidental poisoning, and homicide – largely consistent with studies above from the U.S. (e.g., Massoglia, 2008; Binswanger et al., 2007).

In contrast, other research has shown that effects may be moderated by gender. A study from the U.S., again utilizing the NLSY, which examined both men and women found premature mortality effects of incarceration only on the latter (Massoglia et al., 2014). In Western Australia, Stewart and colleagues (2004) found that prisoners had an increased relative risk of death that was significantly higher than the general population after release; this risk was substantially elevated for female non-Aboriginal prisoners in the first six months after release. These findings suggest that the context into which former prisoners are released may influence the relationship between incarceration and health, and collateral consequences (which can differ by state or country) may have different effects on men and women.

Incarceration may also have distinct health effects on members of different racial groups, as suggested above in relation to mental health. Kuper and Turanovic (2021) analyzed data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) in the U.S. using hierarchical generalized linear models (HGLM) to understand within-person changes to health after a first incarceration. The authors found that self-reported health declines were more substantial among Blacks than Whites, with this effect even more pronounced among Black males.

It is worth noting that research has also uncovered positive effects of incarceration on health. When examining severe medical limitations, Schnittker and John (2007) actually found a protective effect of current incarceration on these medical outcomes, although this positive effect was limited to those who had previously been incarcerated, with no effects found for people incarcerated for the first time. However, other studies have shown that these protective effects may only relate to specific subgroups. Research

comparing within-prison mortality to the general population (or non-prisoners) in the U.S. has found higher mortality rates among prisoners (Mumola, 2007), especially White (Rosen et al., 2011) and White male prisoners (Patterson, 2010; Spaulding et al., 2011) compared to their counterparts outside of prison; yet these same studies found lower within-prison mortality rates for Black men than similarly-situated individuals in the general population. These lower rates have been proposed to occur for four reasons: 1) protection from high rates of violence and transportation fatalities that Black men are subjected to outside of prison; 2) limited access to illicit drugs and alcohol; 3) greater availability and use of healthcare within prison for low-income groups; or 4) end-of-life prison policies that allow for compassionate release of moribund prisoners (the latter suggests a statistical artifact not a true protective effect) (Massoglia & Pridemore, 2015; Wildeman & Wang, 2017).

Many of these mechanisms could be at work for prisoners across racial groups and present for prisoners worldwide but may be more visible for Black Americans because of racial disparities in living conditions linked to discrimination. Systems related to discrimination are complex, but historical processes related to segregation, disinvestment, and over-policing in Black neighborhoods (Peterson & Krivo, 2010; Hawkins & Thomas, 1991) may have contributed to higher levels of imprisonment among Black Americans than their counterparts in other racial groups. Therefore, the fact that imprisonment, and substandard living conditions, is more prevalent amongst Black males and Black neighborhoods in the U.S. than other subgroups (Wildeman & Wang, 2017; Peterson & Krivo, 2010) may make the protective effects of incarceration, and the negative effects of incarceration after release, more statistically perceptible.

Mental and Physical Health of Prisoners' Families

Research has also been conducted on the health effects of incarceration on the families of incarcerated individuals. Although family members of those who are incarcerated are legally innocent, they often experience intense contact with the criminal justice system which can cause direct and indirect negative consequences (Comfort, 2007). Condry and Minson (2021) have termed these consequences "symbiotic harms", as negative effects flow both ways through interdependent intimate relationships.

DeHart and colleagues (2018) conducted inmate focus groups and family interviews within a Southeastern state corrections system as part of a broader mixed-method study of the impact of incarceration on families. Common themes on families' mental and physical health echoed results related to their incarcerated family members, such as stress, loneliness and isolation, escalation of substance abuse, mental health disorders, and stress-related conditions. There were further complications for families, in terms of aging, disability, abuse, or neglect if the incarcerated persons were caregivers.

Additional research has shown detrimental effects of incarceration on family health, especially regarding children. Lee, Wildeman, and colleagues (2014) found, among a nationally representative sample in the U.S., that family member incarceration was associated with poor health for women, especially in terms of risk for heart attack or stroke. Using data from the Pregnancy Risk Assessment Monitoring System (PRAMS), Wildeman (2012a) found that recent parental incarceration elevated early infant mortality risk by almost 30%, with effects concentrated in the post-neonatal period, and partner violence moderated these relationships. In a review of research on the effects of incarceration on children, Wakefield and Wildeman (2013) concluded that there was

evidence for a broad range of negative effects on children's health and well-being, including mental health and behavioral problems.

Stress across generations could be a primary mechanism linking parental incarceration to children's health (Turney, 2014), but there may also be many indirect mechanisms in this relationship, such as incarceration affecting family processes, relationships, economic well-being, or educational performance, which in turn impact child health (Massoglia & Pridemore, 2015). Incarceration strains family relationships and connections to the labor market, which can have indirect effects on children's health. For example, Arditti and colleagues (2003) interviewed a sample of caregivers who shared a minor child with an incarcerated person in a local jail and found that almost half of respondents thought incarceration had changed their relationships with their children and almost a third said they spent more time with their children before incarceration; in addition, about half had seen their health deteriorate since the incarceration and this was found to relate to deterioration of child health in a quarter of the sample as well. Other scholars have suggested that findings related to financial strain from incarceration, both during and after imprisonment (Geller et al., 2011), to the extent that it leads to deprivation of basic necessities like food and housing, could affect children's health (Schwartz-Soicher et al., 2011).

Community-, County-, and State-Level Incarceration Effects on Health

Mechanisms

With high rates of incarceration in the U.S. and large growth for multiple decades, scholars have suggested the possibility of aggregation to levels above the individual and their family. In addition, if contact is more important than length of exposure to

incarceration for negative health effects then, as Schnittker and John (2007) noted, “the large number of individuals now cycling through the prison system with relatively short sentences implies a potentially large population-level impact” (p. 125). As incarceration rates rise globally, aggregate health effects could be found in other nations as well.

As larger numbers of people are being exposed to the effects of incarceration, which could accumulate, the aggregation is even more likely among low-income and minority individuals, who are disproportionately represented among incarcerated populations. Research has found a concentration of effects among specific geographic areas and social communities (e.g., Rose & Clear, 1998; Clear et al., 2003; Clear, 2007). Incarceration tends to affect minority populations in countries across the globe (PRI & TIJ, 2020; 2021), and therefore effects of incarceration have also been found to be concentrated. The health effects have been found to be worse among minority individuals and within poor communities and communities of color in the U.S. (Willmott & van Olphen, 2005; Kuper & Turanovic, 2021) and outside the U.S. (Stewart et al., 2004). While aggregate outcomes may not entirely be due to accrued individual-level outcomes, this geographic and social concentration may allow negative outcomes from incarceration to build, affecting neighborhoods, cities, counties, and states—and possibly even nations.

Nosrati and King (2021) suggested three mechanisms for how high rates of incarceration, as a representation of punitive social policy, can impact well-being: relegation, amplification, and corrosion. Relegation involves downward social mobility caused by immediate physical seclusion and the consequences of a criminal record, which can affect individuals and groups. Amplification is the magnification or exacerbation of other negative determinants of health through the interaction with

incarceration. For example, criminalization of social disorder behaviors, like public urination or begging for food, can create of cycle of imprisonment and homelessness for those already disadvantaged, exacerbating material hardships which can affect health. Corrosion describes the decline of social cohesion, through "fractured social networks, neighborhood violence, and fading collective imaginaries" (p. 3). These mechanisms are similar to those suggested as determinants for individual health outcomes, yet better describe how negative outcomes could accumulate among groups of people and communities that are disproportionately affected by incarceration.

Outside of aggregation of individual-level effects, or cumulative effects on communities, there could be broader population-level mechanisms. Even though the U.S. has high rates of incarceration which have grown exponentially in the past 50 years, current and former prisoners are still only about 3% of the adult population (Schnittker et al., 2015). However, this population could still have impacts on the larger population through high utilization of the healthcare system, especially emergency medicine (Wang et al., 2013; Frank et al., 2014), depending on their needs, how care is accessed, and who pays for those services. For example, Wang and colleagues (2013) found that, among Medicare beneficiaries, released inmates were 2.5 times more likely to be hospitalized after release compared to a control group; however, many of these costly hospitalizations could have been prevented by regular engagement in primary care (Wang et al., 2013). If previously incarcerated populations have more health issues than the general population and have barriers to service such as Medicaid gaps, this could drive up costs of medical care for the entire population and shift resources away from other people in need. These mechanisms could create spillover effects from the formerly incarcerated population to

the general population. In addition, funding of the prison system could take away from other governmental priorities, such as healthcare (Shannon & Uggen, 2012). Testa and colleagues (2020) found an inverse cross-national relationship between incarceration rates and hospital beds, suggesting that "incarceration may increase the strain placed on national health care systems by contributing to adverse health outcomes while simultaneously reducing the capacity of the systems that treat these health problems" due in part to funding trade-offs (p. 3). These macro-level mechanisms go beyond individual health and have the potential affect societal well-being.

Research

Studies have found a relationship between incarceration and the broader communities' mental and physical health, including neighborhood-, county-, and state-level analyses. At the neighborhood level, Hatzenbuehler and colleagues (2015) found that residents in high-incarceration neighborhoods in Detroit were more likely than those in low-incarceration neighborhoods to meet standards for current and lifetime depressive and generalized anxiety disorders. In terms of physical health, a study of census tracts in a city in North Carolina found incarceration rates were associated with gonorrhea rates in the subsequent year (Thomas et al., 2008). Ethnographic interviews suggested that mechanisms for this relationship could be sexual relationship changes, such as first-time homosexual experiences in prison and new or multiple partners after release.

There has also been recent research examining population health outcomes at the county level. Weidner and Schultz (2019) analyzed a national sample of U.S. counties in 2015, using an instrumental variable approach to account for the endogeneity of incarceration rates, and found higher incarceration to be associated with higher levels of

morbidity (rating health as fair or poor) and mortality (life expectancy), even after controlling for public health spending, indicators of health behavior, and demographic factors. In a follow-up study, the authors found that these results were even more pronounced in Southern and rural jurisdictions (Weidner & Schultz, 2021). Nowotny and colleagues (2020) found that jail and prison incarceration rates in U.S. counties were associated with increases in chlamydia and gonorrhea incidence. Examining county-level panel data from a majority of American states and a technique suited to isolating exogenous treatment variation, Nosrati and King (2021) found that high imprisonment rates substantially increased the population-wide risk of premature death, controlling for poverty, unemployment, and ethno-racial disparities. The authors suggested that this was strong evidence that incarceration is a driver for geographic mortality inequality.

At the other end of the life course, there is also evidence that incarceration can affect preterm birth rates. Jahn and colleagues (2020) suggested that county-wide rates of jail incarceration could be a contextual stressor for individual-level preterm births. They examined preterm births for non-Hispanic Black and White American women between 1999 and 2015, the vast majority of whom never experienced incarceration, and found that those living in counties with the highest quintile of jail incarceration rates had 1.08 times greater odds of preterm birth as compared to women in the lowest quintile counties.

Research has examined whether negative health outcomes have aggregated to the level of states in the U.S. as well. State-level studies have found a relationship between incarceration and male and female AIDS infection rates (Johnson & Raphael, 2009), female life expectancy (Wildeman, 2012b), preterm and low-weight births (Conway, 2021), and infant mortality (Wildeman, 2012b; Light & Marshall, 2018; Conway, 2021).

Related to the latter, Light and Marshall (2018) found that the increases in infant mortality rates in the U.S. from 1978 to 2010 largely offset lives saved by decreases in homicide rates due to incarceration. Studies also found that the negative outcomes discussed above were more strongly related to incarceration or harsher when looking at Black populations (Johnson & Raphael, 2009; Wildeman, 2012b; Conway, 2021). Recent evidence from the U.S. also suggests that prison healthcare provision and spending connect the formerly-incarcerated population and the population as a whole at the state level, with incarceration being related to higher rates of diseases that are poorly addressed in prison but lower rates for those that are better routinely tested and treated (Uggen et al., 2023). Although using varying statistical methods to promote a causal link, these studies suggest a strong relationship between incarceration and negative health outcomes at the state level, with the potential for mitigation if spending and treatment is targeted, and provide evidence that the negative consequences of incarceration concentrated among Black persons and communities can result in outcomes visible at aggregate levels.

Another state-level study provided evidence for an alternative explanation for population-level health outcomes: spillover effects of former prisoners on quality and functioning of healthcare systems. Schnittker and colleagues (2015) examined aggregate individual-level health data combined with state-level incarceration data. They found that individuals who lived in states with a larger number of formerly incarcerated individuals had diminished access to healthcare, less access to specialists, less trust in physicians, and less satisfaction with the care that they receive. These results held even for those who appeared to be the least likely to be affected by incarceration personally – those who were insured, over 50, women, non-Hispanic Whites, and had incomes far exceeding the

federal poverty threshold. The authors propose that these relationships were driven by the uncompensated care for large numbers of formerly incarcerated individuals, and they did find that increases in this population were associated with higher percentages of uninsured residents in a state and higher emergency room use per capita. These findings suggest another avenue for aggregate-level health consequences in terms of spillover into the healthcare system and funding trade-offs.

Macro-Level Incarceration Effects

Despite the large body of research examining incarceration effects at individual, family, and community levels, there are only three studies that the author is aware of related to incarceration effects at the nation level. The first cross-national comparison of incarceration effects on health outcomes was conducted by Stuckler and colleagues (2008). Their aim was to examine whether rapid growth in incarceration rates ("mass incarceration") could help explain diverging outcomes as related to tuberculosis (TB) and multidrug-resistant tuberculosis (MDR TB) in 26 Eastern European and Asian countries from 1991-2002. Incarceration rates, and their growth, could affect TB transmission for three reasons (some of which were touched on previously in terms of general infectious disease transmission): higher effective contact rate, decreased care rate, and greater population susceptibility. In addition, TB transmitted in prisons can be easily transferred into the community, by infected individuals released from prison and those working in prisons. The authors examined within-country and between-country variations in TB incidence rates, using sentencing rates to capture incarceration estimates. They found that incarceration rates were strongly associated with TB incidence rates, controlling for TB infrastructure, HIV prevalence, and several surveillance, economic, demographic, and

political indicators. Rising incarceration rates had a net effect of a 20.5% increase in TB incidence. Seeing as TB incidence for the average country rose overall by 35.5% during this period, three-fifths of the total increase was related to growing incarceration rates. Results also showed that the growth of incarceration was a more important determinant of TB and MDR TB than differences in numbers of prisoners, and that HIV transmission exacerbated these effects. This study provided early evidence that incarceration, and especially the growth of incarceration, could affect health at a societal level.

A more recent study examined incarceration's relationship with broad health measures at the nation-level. Wildeman (2016) examined the relationship between population health, in terms of life expectancy and infant mortality, and incarceration rates over time in a sample of developed democracies. Wildeman hypothesized that the relationship between population health, considered to be an indicator of societal well-being, and incarceration rates would be negative, but largely driven by the United States. The author noted five ways in which incarceration could affect population health: 1) a mortality-suppressing effect for those incarcerated (typically young men); 2) a mortality-inducing effect for those released (typically more middle-aged men); 3) a mortality-suppressing effect for those who were at risk of violent encounters with individuals had they not been incarcerated (typically young men); 4) both a protective and risk factor on infant mortality as incarceration would suppress births but also put young children in riskier situations, although a strong welfare state could offset that risk; and 5) spillover could affect families and communities of incarcerated individuals, especially the health of women, but lower rates may negate the concern of consequences spilling over. The first three mechanisms were thought to apply to all countries, while last two would be

mechanisms for a negative relationship for U.S. only due to lower welfare provision and higher incarceration rates than the other developed democracies in the sample.

Wildeman (2016) examined this relationship using an unbalanced panel dataset including 21 developed democracies from 1981-2007. The study found an inverse relationship between changes in incarceration and changes in population health, although this was almost entirely due to the United States. Despite the vast literature in the U.S. connecting incarceration to negative outcomes for incarcerated individuals, as well as their families and communities, Wildeman hypothesized that these effects might be limited to the U.S. for any of four reasons: 1) the U.S. has an extremely high starting rate of incarceration compared to other developed democracies, which could negate any crime-fighting benefits of incarceration and cause negative spillover in communities, likely not occurring in countries with low starting rates; 2) recent increases in incarceration were larger in the U.S. than elsewhere; 3) the conditions of confinement in the U.S. may be worse than in other developed democracies; and 4) the U.S. welfare system is less equipped to deal with the needs of formerly incarcerated individuals than other developed countries.

While the research could not fully examine the mechanisms above, Wildeman did find an inverse relationship between population health (total life expectancy at birth, male life expectancy at birth, female life expectancy at birth, and infant mortality rate) when examining the main effect of incarceration rates, but these effects were entirely subsumed by an interaction term (incarceration x U.S.) after its inclusion. In fact, incarceration rates had a significant protective effect on infant mortality in the other nations. Wildeman also estimated the magnitude of the effect of changes in incarceration on population health

outcomes by plotting expected outcomes for variables including the actual incarceration rate changes compared to outcomes when the incarceration rates stayed at 1983 levels. He found null effects for countries outside the U.S. but showed that the U.S. missed out on 1.79 years of total life expectancy gains and a 1.78 per 1,000 infant mortality rate decline due to increasing incarceration rates. Tests of age-specific mortality effects largely fit with the proposed mechanisms above in terms of suppressing and inducing effects, suggesting that the findings are likely not spurious. Wildeman lists the following limitations of the study: 1) lacks exogenous shock in incarceration to provide evidence for causal associations; 2) only able to focus on short-term effects; 3) focuses exclusively on developed democracies; 4) substantial heterogeneity among the other 20 countries in the sample which was ignored in these analyses; and 5) the analysis was unable to uncover why U.S. health was affected more than other countries. Despite these limitations, this study showed that it is possible for incarceration to have broad negative (and positive) health effects felt at the population level, even if currently the only society shown to be affected is the United States.

Finally, one other study has examined a societal-level effect of incarceration – in this case, poverty. Gottlieb (2017) studied the effects of incarceration on relative poverty from 1971-2010 in 15 advanced democracies. The author remarks, “If incarceration rates influence family incomes at the bottom of the economic distribution, then a country’s criminal justice system may be an important determinant of its relative poverty rate” (p. 2). Gottlieb suggests that incarceration could do so negatively via the following mechanisms: reducing income at the individual/family level by incarcerating an earner and reducing future earnings, making a non-incarcerated earner take over caregiving

duties, or cutting off avenues for other financial support; or by increasing single parenthood (shown to be related to poverty) by decreasing the likelihood of marriage and increasing the likelihood of divorce. Incarceration could also affect relative poverty positively in the following ways: increasing the wages of low-wage workers who are not incarcerated; reducing family size; or creating a statistical artifact of poverty reduction by removing the most disadvantaged from poverty statistics. Although the author was unsure of the overall relationship between incarceration rates and poverty due to the contrasting mechanisms above, he did hypothesize that the level of female employment and welfare generosity should moderate this relationship, due to their ability to offset negative incarceration effects. Using a fixed-effects model with an unbalanced panel, Gottlieb found no average effects of incarceration on relative poverty, but the results did show significant moderating relationships with a country's female employment rate and welfare state generosity. At low levels of female employment or welfare state generosity, increases in incarceration were associated with higher levels of relative poverty; however, in countries with high levels of either of these, increases in incarceration were related to lower levels of relative poverty. Therefore, it is important to understand country contexts that may be influencing whether rates of incarceration lead to population-level effects.

Overall, these studies show the promise in examining country-level effects of incarceration, and there is much more to expand on, in terms of potential outcomes, moderating or mediating relationships, and larger samples. The next section discusses how the current research contributes to this developing area of literature by building on the outcomes examined, looking deeper into moderating and mediating factors, and using data from a larger, more diverse sample of countries.

Purpose of the Current Research, Research Questions, and Hypotheses

The goal of this dissertation research is to build upon the existing literature just outlined, expanding our understanding of macro-level effects of incarceration on societies. To do so, multilevel models are analyzed to understand the effect of incarceration rates and trends on five population health outcomes, three of which are in fact measures of population death. Two of these, life expectancy and infant mortality, were chosen as common measures of population health concerns, and the other three, suicide rate, HIV prevalence, and TB incidence, were added to more closely examine specific mental and physical health issues that have been suggested to affect previously-incarcerated individuals, their families, and their communities (Massoglia & Pridemore, 2015). Using multiple indicators provides greater understanding of the multiple facets of population health that may be related to incarceration within a society. Models will help answer the following research questions.

Investigation of Direct Effects

RQ1) Controlling for other relevant predictors, are incarceration rates related to population health?

1A) As measured by life expectancy

1B) As measured by infant mortality

1C) As measured by suicide rates

1D) As measured by HIV prevalence

1E) As measured by TB incidence

H1: *Overall, incarceration rates will have a negative relationship with life expectancy and a positive relationship with the other population health measures.*

There are reasons to suggest that the results may or may not show an overall relationship between incarceration rates and health across countries. First, the existing literature has not found evidence of broad relationships between incarceration rates and such outcomes as health and poverty. For instance, Gottlieb (2017) found no overall association between incarceration rates and relative poverty, and Wildeman (2016) found an overall association between incarceration and health that was solely driven by the U.S.

However, both of the aforementioned studies only examined a small sample of developed countries and only examined changes over time. Gottlieb (2017) found evidence that certain country contexts, such as female employment rate and welfare state generosity, moderated the relationship between incarceration and relative poverty, which was obscured when only looking at the main effects. In addition, although Wildeman (2016) found an overall relationship between incarceration and population health that was purely driven by the United States, examining this relationship among a broader sample of countries could uncover a largely negative relationship, as the potential contexts leading to macro-level effects he suggested (high starting rates, high growth in rates, weak welfare state, and/or poor prison conditions) exist in other countries outside of the 21 examined in that initial study. The aforementioned studies also used fixed effects models, which control for any variation between countries and only examine within-country changes; however, an important part of this relationship may be driven by average levels of incarceration between countries, and these were not examined previously. In addition, this research will also consider measures for two other kinds of population health: suicide rate (as a proxy for mental health problems) and infectious disease rates. These health issues have been specifically linked to individual- and

community-level health concerns due to incarceration (Massoglia & Pridemore, 2015) and could be visible at more macro levels, either through aggregated individual effects or macro-level mechanisms affecting healthcare systems, such as strain from formerly incarcerated individuals and/or funding trade-offs (Schnittker et al., 2015).

Therefore, models that can examine the effects of both average incarceration levels and changes in these levels among a larger, more diverse sample may uncover a statistically significant population-level relationship between incarceration and aspects of population health; there is the possibility, though, that the overall relationship is null but may obscure significant moderating relationships, which the research turns to next.

Investigation of Moderating Effects

RQ2) Are the effects of incarceration rates on population health (2A: life expectancy; 2B: infant mortality rates; 2C: suicide rates; 2D: HIV prevalence; 2E: TB incidence) moderated by specific country contexts (racial/ethnic diversity; social protection expenditure; or prison conditions)?

H2: *At least one, but potentially all, of the above factors moderates the relationship between incarceration and five population health outcomes.*

Moderation occurs when a third variable affects the direction and/or strength of the relationship between an independent variable and a dependent variable (Baron & Kenny, 1986). Within multilevel models, there is the potential for this relationship to occur across levels (Bell & Jones, 2015). In this case, there may be qualitative or quantitative variables that change the relationship between incarceration rates and health at the nation level. As mentioned above, Wildeman (2016) suggested that four factors were likely involved in the United States' having a negative relationship between

incarceration rates and health while other countries do not (i.e., variables that change the relationship from non-significant to significantly negative): high starting rates of incarceration, steep increase in that rate, weak welfare state, and incarceration regime, including conditions of confinement. The author was unable to test any of these propositions in that study, though he saw the latter avenue as potentially the most fruitful for understanding consequences of incarceration for health disparities. This study examines the latter two factors explicitly for this question, as average rates and changes in incarceration are considered in RQ1. Countries with harsher prison conditions and/or weaker welfare states (as measured by social protection expenditure) may have (stronger) negative relationships between incarceration and health outcomes, due to additional strain and exposure from overcrowding and the inability to offset the strains of incarceration with strong social assistance.

In addition to these two factors, there may be another moderating factor related to racial composition. As imprisonment is disproportionately likely to affect minority communities around the globe (PRI & TIJ, 2020; 2021), racial make-up of a country may also affect whether health effects of incarceration are seen at the nation-level. Countries with more racial diversity (and higher potential for more marginalized racial/ethnic groups) may see more of a negative relationship between incarceration and health outcomes because of the aggregation of effects within these groups.

Investigation of Mediating Effects

RQ3) Is the relationship between incarceration and population health (3A: life expectancy; 3B: infant mortality rates; 3C: suicide rates 3D: HIV prevalence; 3E: TB incidence) mediated by factors associated with barriers to social integration, as measured

by social capital and its elements (civic participation, institutional trust, interpersonal trust, personal and family relationships, and social networks)?

H3: *Population health estimates are partially mediated by measures of social integration*.

Mediation, in contrast to moderation, occurs when a third variable accounts for the relationship between an independent variable and a dependent variable (Baron & Kenny, 1986). The mediating relationship could be perfect (effect of X on Y reduces to zero once the mediator is included) or partial (effect of X on Y reduces a nontrivial amount but not to zero) (Preacher & Hayes, 2004). Mediators would therefore be the mechanisms through which incarceration affects population health. Again, in multilevel models, this relationship is made more complex by the possibility for mediation through factors at more than one level (Zhang et al., 2009).

At lower levels, three pathways have been primarily investigated as the links between incarceration and general population health: infectious disease transmission, negative mental health issues, and barriers to social integration (Massoglia & Pridemore, 2015). These relationships could be found at the country level because of aggregated individual effects or mechanisms at a higher level. Because the first two pathways are outcomes of interest themselves, the focus in RQ3 is just one mediator (and its components): social capital. There may be a connection between incarceration and social capital, similar to social integration for which prison is a barrier, aggregated from individual loss of connections and macro-level changes to the social fabric.

Social capital, generally defined as "the resources available to individuals and groups through membership in social networks" (Villalonga-Olives & Kawachi, 2015, p. 62), has been previously connected to incarceration, mostly in terms of prisoner reentry,

and there is a body of literature that links incarceration with outcomes related to family, community, and civic engagement. In the U.S., incarceration has been linked to a decreased likelihood of marriage and an increased likelihood of divorce (Liu, 2020; Mueller-Smith, 2015). In addition, impacts have been found on prisoners' and their families' communication and involvement with community supports (DeHart et al., 2018). Families may suffer informal costs, such as stigma and loss of social support (Comfort, 2007; Braman, 2004). Incarceration may affect civic participation both by changing views on government legitimacy and fairness (Lee, Porter, & Comfort, 2014) and felon disenfranchisement laws, which curtail political participation among former inmates in the U.S. and internationally (Shannon & Uggen, 2012).

High levels of incarceration may also affect neighborhoods and informal social control by limiting the levels of social and human capital contained within them (Rose & Clear, 1998). There is evidence that suggests that the concentration of incarceration geographically and socially contributes to changes in social organization through weakening family formation, labor force attachments, and social interactions among residents (Lynch & Sabol, 2004), which are related to social capital. In addition, communities with high levels of incarceration, which are more likely to be minority communities, are at greater risk for social instability and diminished political and civic engagement (Clear, 2007; Manza & Uggen, 2006). Even at the state level, increases in incarceration have been associated with more negative views of legal institutions, especially among Black individuals (Muller & Schrage, 2014). Research beyond the U.S. has found similar consequences. For instance, research found that the removal of indigenous Australians from one territory contributed to intergenerational demographic,

social and economic dysfunction in small communities (Taylor et al., 2018). In Nigeria, scholars have also found reduction of trust in legal institutions in areas with historically high levels of colonial imprisonment (Archibong & Obikili, 2020). This body of research suggests that social capital could weaken among individuals and families that are exposed to the prison system and could aggregate as those affected are disproportionately located in geographically and socially concentrated groups, which can impact broader institutional trust and engagement.[1]

A large and increasing body of literature has connected social capital to health outcomes at multiple levels. Social capital has been suggested to affect health through mechanisms at the individual level (e.g., through social support, influence, and engagement), neighborhood level (e.g., through informal social control, maintenance of healthy norms, and enhancement of services and facilities), and state level (e.g., through "egalitarianism-oriented political participation and policy making") (Song et al., 2010, p. 196). Effects at lower levels, like individuals and communities, could also aggregate to higher levels, in addition to the macro-level mechanism suggested above. Research has been mostly supportive of a relationship between social capital and health. For example, one study at the individual level in the U.S. found that social capital can enhance self-reported health (Schultz et al., 2008). At the community level, civic participation, trust, and reciprocity were found to predict all-cause, heart disease, and other-cause deaths (except cancer deaths), but these were conditional based on race and gender (Lochner et al., 2003). Research at more macro levels has also been promising, such as Kim and colleagues' (2011) OLS regression and instrumental variable analysis that found higher

[1] This last point could suggest a more complex relationship, including moderation, but the present research only examines a mediating role based on the literature.

average country-level trust to be associated with better self-reported health among individuals of both genders in 64 nations. In sum, the research above suggests that incarceration may relate to population health through its effect on social capital.

CHAPTER 3: METHODOLOGY

The following chapter describes the methodology of the current research, which is detailed due to the nature of compiling international data for a multilevel study. This includes the data (its sources and compilation), measures, analytic method and sample, analytic plan, missing data considerations, other data preparation, and a description of the sequence of analyses.

Data

Data Compilation and Sources

The data utilized in this research draws on a variety of sources that capture international cross-national data. I compiled, cleaned, and prepared for analysis variables of interest and selected measures that provide the most available data over a thirty-year period (1990-2019) for the largest number of nations possible. This time period balances the desire for historic data to examine changes in relationships of interest with data quality and availability limits. Measures, their sources, and their use in this research are provided in Table 1.

Three of the population health outcome measures (life expectancy, infant mortality, and HIV prevalence) are gathered from the World Development Indicators (WDI), compiled by the World Bank. The WDI is "the primary World Bank collection of development indicators, compiled from officially-recognized international sources, … [and considered to be] the most current and accurate global development data available" (World Bank, 2021b). The dataset includes data on over 1,000 longitudinal indicators for almost 220 countries, some of which span over 50 years, and incorporates national, regional, and global estimates (World Bank, 2021b). The WDI draws on data from

Table 1. Data Sources and Uses in Research

Measure	Source	Use in research
Total life expectancy at birth (years)	World Development Indicators	Dependent variable
Infant mortality rate (per 1,000 live births)	World Development Indicators	Dependent variable
Self-harm death (suicide) rate (per 100k pop.)	IHME	Dependent variable
Prevalence of HIV (% of pop. ages 15-49)	World Development Indicators	Dependent variable
Estimated TB incidence (per 100k pop.)	WHO Global Tuberculosis Programme	Dependent variable
Incarceration rate (per 100k pop.)	UNODC/WPB	Independent variable
GDP per capita (per 1000 current US$)	World Development Indicators	Control variable
GINI	World Inequality Database	Control variable
Intentional homicide rate (per 100k pop.)	World Development Indicators	Control variable
Population 65+ (% of pop.)	World Development Indicators	Control variable
Fertility rate (births per woman)	World Development Indicators	Control variable
Unemployment (% of total labor force)	World Development Indicators	Control variable
Urban population (% of pop.)	World Development Indicators	Control variable
Democracy	Polity5 Project	Control variable
Hospital beds (per 1,000)	World Development Indicators	Control variable
Health expenditure (per capita/100 in US$)	WHO Global Health Expenditure Database	Control variable
Government health exp. (% of total)	WHO Global Health Expenditure Database	Control variable
Government closeness (decentralization)	Ivanyna & Shah (2014)	Control variable
Civilian firearms per 100 persons	Small Arms Survey	Control variable
Excluded minority population	Ethnic Power Relations Dataset	Control/moderating variable
Ethnic fractionalization	Alesina et al. (2002)	Control/moderating variable
Social protection expenditure (% of GDP)	ILO World Social Protection Report 2017-19	Control/moderating variable
Prison conditions (outside of U.S.)	Karstedt (2011a; 2011b; 2021)	Control/moderating variable
U.S. prison conditions (*used with above*)	BJS: Carson (2021); Mumola (2005)	Control/moderating variable
Social capital index	Legatum Institute	Mediating variable
Region	United Nations Statistics Division	Grouping variable
Income group	World Bank's historical Country & Lending Groups	Grouping variable

Notes. IHME=Institute for Health Metrics and Evaluation; WHO=World Health Organization; UNODC=United Nations Office on Drugs and Crime; WPB=World Prison Brief; BJS=Bureau of Justice Statistics; ILO=International Labour Organization.

country reports to the World Bank, in addition to data from the U.N. and its affiliated agencies such as the International Monetary Fund (IMF) (World Bank, 2006). If necessary, estimates may be adjusted by staff to ensure conformity with international definitions and concepts (World Bank, 2006). Many of the mediating and control variables are drawn from this database as well, as noted in Table 1.

The proxy used for mental health issues, suicide (death by self-harm) rate, comes from the Institute for Health Metrics and Evaluation's (IHME) Global Health Data Exchange (GHDx). The GHDx is an easily accessible data catalog which provides "the best information on population health" (IHME, 2021). Health outcome data are available for around 200 countries in the desired period.

The other infectious disease measure, estimated TB incidence, originates from the World Health Organization's Global Tuberculosis Programme for the *Global Tuberculosis Report* (WHO, 2021; WHO, 2022a). The report began in 1997 and data are available from 2000-2019 for 218 countries, 211 of which are included in this research.

The main independent variable of interest, incarceration rate, is primarily compiled from the United Nations Survey on Crime Trends and Operations of Criminal Justice Systems (UN-CTS). The UN-CTS uses a national coordinating officer from each country to provide the data on criminal justice system and processing factors, including corrections data, in survey form (Bennett, 2009; UNODC, 2018a). Data collection for the UN-CTS began in the late 1970s, and data were collected on a biennial or triennial basis until 1997, when data collection became annual (Bennett, 2009); only data from 2003-18 are available through the UNODC data portal (United Nations Office at Vienna, 2010; UNODC, n.d.). Data from the UN-CTS are supplemented, either by the UNODC

themselves (2003-18) or the author (1988-2002), with data from the World Prison Brief (Walmsley, 2018). The World Prison Brief (WPB) is another popular source for incarceration data (Clark & Herbolsheimer, 2021), which is updated monthly through governmental or other official sources (WPB, ICPR, 2021). However, estimates are typically only available every two years since 2000 and every five years prior to 2000, so the UNODC compilation was seen to be more complete. For years prior to 2003, available estimates are used from the UN-CTS, the WPB, or both if available and consistent; if both were available and there was a discrepancy, the WPB estimates are often used, as these were found to be more consistent with the trends overall than early UN-CTS numbers. The compilation of data from two sources, especially for 1989 through 2002, could introduce some error both over time and between countries, but allows for data to be used in this research that provides at least two (and often many more) prison population estimates during this time frame for 221 countries, a larger sample than possible with either source alone.

Another data source derives from the scholarly data coding efforts of Susanne Karstedt and colleagues. Neapolitan (2001) first used U.S. State Department Country Reports on Human Rights to qualitatively code prison conditions in 170 countries for one annual report during the late 1990s, grouping them into three categories: prison conditions meet minimum international standards, prison conditions are harsh and do not meet minimum international standards, and prison conditions are harsh to the point of being life threatening. Karstedt (2011a; 2011b; 2021) built upon this effort by coding prison conditions over time and expanding the categories to five (described below). Annual country reports have now been coded for 176 countries with populations over

500,000 (plus Iceland) from 1995-2019 (although not necessarily all years for every country) (S. Karstedt, personal communication, February 16th, 2022) and are used in this research. Unfortunately, because these ratings come from U.S. reports on other countries, the U.S. is not included in the dataset. However, this measure was felt to be superior to other proxies for prison conditions, such as prison overcrowding, because it is able to capture more than one aspect of quality of life in prisons which may be affecting population health, such as sanitation and violence. In addition, because of the coding rules related to homicide in prison (again, described below), I created another version of this variable that incorporated the U.S., based on other data sources related to homicide and violence within U.S. state and federal prisons (Carson, 2021; Mumola, 2005; *U.S.A v. State of Alabama and Alabama Department of Corrections,* 2020).

Other sources, which are used to derive control measures, as well as mediating and moderating variables, and not discussed in detail here, include those for the following constructs:[2]

- Income inequality: World Inequality Database (2022)
- Democracy: The Center for Systemic Peace's Polity5 Project (2021)
- Health expenditure: World Health Organization's Global Health Expenditure Database (WHO, 2022b)
- Government decentralization: Government Closeness Index (Ivanyna & Shah, 2014)

[2] In addition to these constructs, measures of poverty were also considered using the PovcalNet database from the World Bank (Castaneda Aguilar et al., 2019); however, poverty measures were either based on income or consumption data and were not comparable across these originating sources and both were not available for most countries, so poverty measures had to be excluded to retain the large sample (90-128 n) in final models.

- Gun availability: Small Arms Survey (2018)
- Racial diversity/exclusion: Ethnic Power Relations Dataset (excluded population: Vogt et al., 2015; ETHzürich, 2021) and Alesina and colleagues (2002) (ethnic fractionalization)
- Social protection:[3] World Social Protection Report 2017-19 (ILO, 2017)
- Social capital: Legatum Institute's Prosperity Index (Legatum Institute, 2021)
- Region: United Nations Statistics Division (2022)
- Income group:[4] World Bank's historical Country and Lending Groups (2022)

Measures

As indicated, the data needed to answer the research questions have been compiled from a variety of sources. Where possible, data are utilized from 1990 to 2019 (incarceration data has also been collected from 1988-1989 to account for possible lags). This 30-year time period balances the desire for historic data to examine changes in the variables of interest with data quality and availability constraints. Again, a full list of measures included in the research is provided in Table 1.

Dependent Variables. The five population health variables that are examined in this research are life expectancy, infant mortality rate, suicide rate, HIV prevalence, and TB incidence. Life expectancy and infant mortality are common indicators of population health, providing both an "overview of the health of a population" and focusing

[3] Datasets from the OECD (Social Expenditure Database) and the World Bank (Atlas of Social Protection Indicators of Resilience and Equity) were previously considered but rejected in favor of the ILO data due to more comparable country and year coverage in the latter (despite high levels of missing data still).
[4] Historical income group is taken from 2005 where possible (middle of time period), if not possible taken from the closest available year for the following: British Virgin Islands (2015); Curacao (2010); Gibraltar (2009); Kosovo (2008); Montenegro (2006); Nauru (2015); Serbia (2006); Sint Maarten (Dutch part) (2010); South Sudan (2011); St. Martin (French part) (2010); Turks and Caicos (2009); and Tuvalu (2009).

specifically on the health of women of childbearing age and their infants (Wildeman, 2016, p. 366). Life expectancy is defined in the WDI as "the average number of years a newborn is expected to live if mortality patterns at the time of its birth remain constant in the future… provid[ing] a snapshot of a country's mortality pattern at a given time" (World Bank, 2021a). Infant mortality rate is "the number of infants dying before reaching one year of age, per 1,000 live births in a given year" (World Bank, 2021a). In addition, suicide rates are also considered in this study as issues related to mental health have been noted among prisoners and formerly incarcerated individuals in countries worldwide, so it is worth exploring suicide rates as a proxy for population-level mental health issues as well. The measure used in this research is deaths due to self-harm per 100,000 population (Global Burden of Disease Collaborative Network, 2020).

There are two measurements that are used for this research to understand the relationship between incarceration and infectious disease: HIV prevalence and estimated TB incidence. The goal is to examine infectious diseases that affect countries around the world, which is difficult as many infectious diseases are more likely to affect low-income than high-income countries (Michaud, 2009). HIV and TB are both leading causes of death worldwide but are primarily concentrated in low- and middle-income countries and are not within the top 10 causes of death for high-income countries; however, there is no infectious disease that is a top cause in those countries (Michaud, 2009). Nevertheless, there may be a relationship between incarceration and infectious disease, either sexually transmitted or otherwise, and these options present the best opportunity to examine this relationship. There are data trade-offs, however, between the two measures: HIV estimates are available for the entire time period of interest but for a smaller sample of

countries (often excluding high-income countries) and TB estimates are only available starting in 2000 but are accessible for a larger number of countries. HIV is usually a sexually transmitted infection, while TB is spread through the air, therefore signaling two different transmission patterns which may be connected to prison life. Additionally, there is macro-level research linking incarceration to TB estimates (Stuckler et al., 2008) and HIV infections (Altice et al., 2016). For these reasons, both of these measures are included to give a fuller picture of how incarceration relates to infectious diseases within country populations. Moreover, it is important to examine all five of these indicators as there are several ways in which incarceration could affect health.

Independent Variable. The main independent variable of interest is incarceration rate per 100,000 population. This traditional metric is scaled to rate per 1,000 population in the regression analyses (shown in the descriptive statistics table in Chapter 4) to facilitate interpretation, similar to Wildeman (2016). The count estimates are primarily gathered by the UN-CTS (described above), which defines the incarcerated population as "persons held in prisons, penal institutions or correctional institutions" (UNODC, 2018b, "5 – Prisons"). This includes sentenced and unsentenced populations, only excluding non-criminals held for administrative purposes (e.g., pending immigration status). To allow for comparison across countries, variables for incarceration rate per 100,000 population have been created from 1989-2018 using population estimates from the World Development Indicators, a source for many other variables in this study.

There has been debate over the best measure of incarceration level; however, the most common is the rate, i.e., the number of persons imprisoned per 100,000 total population (Young & Brown, 1993). This measure is seen as more comprehensive than

either prison admission rates or sentence length (Jacobs & Kleban, 2003) and enjoys the advantage of being the most easily accessible way to measure a prison system cross-nationally (Neapolitan, 2001).

Moderators. There are three moderating constructs of interest in this research: two suggested by Wildeman (2016) and one additional variable suggested by other relevant literature. These constructs include level of social protection, prison conditions, and racial diversity. Operationally, there are five variables measuring these constructs: one for social protection, two for prison conditions (with and without the U.S.), and two for racial diversity, described below.

Social protection expenditure comes from the International Labour Organization's (2017) *World Social Protection Report 2017-19*. The ILO report compiles statistics on public social protection expenditure as a percentage of GDP from a variety of sources, from 1995 to the latest available year (2014-15) for 172 countries. There is a maximum of 8 data points available for each country within this time period.[5]

Prison conditions are examined using qualitative ratings by Karstedt and colleagues (2011a; 2011b; 2021). As discussed above, these ratings were coded from U.S. Human Rights Reports and rate country prison conditions from 1 to 5:

> (1) compliance with and fulfilment of minimum standards; (2) some deficits, in particular resulting from overcrowding; (3) prison conditions below minimum standards, in particular deficiencies of buildings and sanitary provisions due to the age of buildings; (4) harsh prison conditions, violence between inmates and violence by prison officers; and (5) reports explicitly noting threats to the lives of inmates. (Karstedt, 2011b, p. 170)

[5] Two other measures of welfare provision, from the Organization for Economic Co-operation and Development's (OECD) Social Expenditure Database and the Atlas of Social Protection Indicators of Resilience and Equity (ASPIRE), were considered but ultimately rejected based on data availability and comparability.

This measure goes beyond just examining whether a prison system is overcrowded, and by how much, and notes whether there are other aspects of prison life that may affect the health of prisoners and the outside community. Because of the drawback that the U.S. could not be included from the original source, two variables were included: one excluding the U.S., and the other with the U.S. coded as a 5 for all years available for other countries (1995-2019) based on homicides within prisons noted through other sources for a majority of these years (Carson, 2021; Mumola, 2005).[6] Karstedt (personal communication, February 16th, 2022) noted that life-threatening conditions in one prison were enough to code the entire country as life-threatening (code 5) for that year, so homicide counts and non-zero homicide rates as confirmed through other data sources were enough to consider the U.S. as having life-threatening conditions in their prisons for each year in this time period (Carson, 2021; Mumola, 2005; *U.S.A v. State of Alabama and Alabama Department of Corrections,* 2020).

Finally, the fact that incarceration disproportionately affects racial and ethnic minority communities globally (PRI & TIJ, 2020) suggests that the level of a country's diversity could moderate the relationship between incarceration and health. If a country is highly diverse, allowing for more and larger racial and ethnic groups, this may translate into population-level health effects in a way that may not occur for countries with more homogenous populations. Ethnic fractionalization, measured as the probability that two randomly selected individuals from the population belong to different groups (Alesina et al., 2002), has been used as a gauge of population diversity in previous cross-national

[6] Data from 1996-1998 were not available to show homicides occurred explicitly, but based on non-zero rates from 1995 and 1999, and other historical estimates, it is more than likely that at least one homicide occurred within U.S. prisons in each of these years.

incarceration research (Davis & Gibson-Light, 2020; Mendlein, 2021); these estimates are often based on data primarily compiled in the mid- to late- 20th century and capture the degree of multiculturalism (e.g., Alesina et al., 2002; *Atlas Narodov Mira*, 1964). However, it may be more than just the level of racial/ethnic diversity, but rather the political exclusion of certain racial/ethnic groups that relates incarceration to more negative health outcomes. Therefore, this research also includes a measure for excluded population from the Ethnic Power Relations dataset (Vogt et al., 2015). The excluded population measure provides the percentage of the population that belongs to a racial group that is deemed to be "powerless", "discriminated against", or has "self-excluded" politically (Vogt et al., 2015). This measure provides longitudinal estimates, rather than one time point. Ethnic fractionalization only provides one estimate over the time period in question but is a common measure of diversity in the literature. Both of these measures are used to understand how racial/ethnicity dynamics moderate the relationship between incarceration and health.

In addition, each of the moderators could be contributing to incarceration rates or population health outcomes. Societies may be generally discriminatory or have trade-offs with government funding for criminal justice rather than social welfare, and previous research has found a relationship between ethnic fractionalization (Ruddell & Urbina, 2004; Ruddell, 2005), excluded minority population (Davis & Gibson-Light, 2020), and social protection/welfare expenditure (e.g., Sutton, 2000; Downes & Hansen, 2006; Lappi-Seppälä, 2011) and incarceration rates. While Karstedt (2011b) has noted that incarceration rates and prison conditions are not correlated, prison conditions could have an effect on population health outcomes outside of their relationship with rates of

incarceration. Therefore, the measures for all moderators are also included as controls in the direct effect models.

Mediators. The micro-level health literature suggested three popular mechanisms of interest that connect incarceration to negative physical health outcomes: infectious disease transmission, mental health issues, and barriers to social integration. These pathways could also affect macro-level health outcomes, either through aggregation or affecting systems that are responsible for supporting population health. As the former are health outcomes themselves, the research examines the latter concept (barriers to social integration) as a mediator between incarceration and the population health outcomes.

Social capital is used here as a proxy for social integration within a country. Social capital is a potential mediating mechanism for the relationship between incarceration and health, as one consequence that incarceration shares across the globe is removal of an individual from their community, and therefore social ties to these networks, both private and public, may be severed. There may be consequences for disrupted social networks in terms of health, for formerly incarcerated individuals, communities they are removed from, and the broader population. The social capital index, and its elements, has been retrieved from Legatum Institute's Prosperity Index, which is available for 167 countries from 2007-2020. Social capital is one pillar of the Legatum Institute's Prosperity Index, which uses publicly available data to create a broad range of indicators of "characteristics of inclusive societies, open economies, and empowered people" (Legatum Institute, 2020). The social capital pillar is comprised of five elements: personal and family relationships, social networks, interpersonal trust, institutional trust, and civil and social participation. Questions that contribute to each of

these elements can be found in Appendix A. The full index and its individual components are used separately in mediation models.

Controls. Data related to a broad range of other independent and control variables included in the research have been compiled from a variety of sources across all available years within the relevant time frame for as many countries as possible, as noted in Table 1. Many details are not discussed here due to space limitations, but the following indicators are included as control variables, the selection of which has been informed by previous literature (e.g., Wildeman, 2016; Stuckler et al., 2008): GDP, income inequality, intentional homicides, population 65+, fertility rate, unemployment, urban population, democracy, excluded minority population, hospital beds, health expenditure, government health expenditure (% of total), prison conditions, social protection expenditure, government decentralization, ethnic fractionalization, gun availability, and region.

Region is included as a control here for multiple reasons. As mentioned earlier, Karstedt (2015) suggested that countries have "cultural peers" that have similar penal policy, which often, but not always, "develop along the fault lines of regions" (p. 376), so region may be important in controlling for cultural differences that lead to specific criminal justice system policies and practices. Countries in the same region often share historical and cultural similarities that do not translate to other regions but are typically hard to measure. Neapolitan (2001) used region as a proxy for historical and cultural similarities between countries. In addition, philosophical and political variables that may affect both incarceration and health, such as legal tradition and welfare regime (JuriGlobe, 2008; Wood & Gough, 2006), also find regional similarities. By controlling for region, a number of cultural-historical factors can be incorporated into the model

without having to include a multitude of distinct, and possibly related, factors. Regions were determined using classifications from the United Nations Statistics Division (2022) and are based on continent. Subregion classifications were considered, but region based on continent was more parsimonious as there were 19 subregions which could not simply be combined into mid-level regions.

Analytic Method and Sample

Population health outcomes based on incarceration rates are examined utilizing multilevel models for longitudinal data. Multilevel models are generally used to analyze hierarchically structured data, or nested data, such as individuals within nations (Hox et al., 2017). "Multilevel modeling" often refers to hierarchical linear regression models – also known as hierarchical-linear models, variance-component models, or random-coefficient models – which are an extension of multiple regression models (Hox, 2000) and both terms will be used interchangeably here. Analysis of data with repeated measures can be conducted with multilevel models as well, as a special case of nesting, where repeated measures (Level 1) are nested within individual units (Level 2) (Hox, 2000) – here, the repeated measures/observations within each country stand for the Level-1 unit of analysis, and the countries stand for the Level-2 unit of analysis. Models that consider the structure of nested data are important as standard statistical tests assume independence of observations; when this assumption is violated, which is often the case with nested data, estimated standard errors are too small and can spuriously suggest significant results (Type I error) (Hox et al., 2017; Luke, 2020).

Level-2 Sample

The Level-2 sample, therefore, includes as many countries as possible with available data for relevant indicators. The full dataset compiled includes relevant data for 225 countries. However, based on available data for dependent and independent variables of interest and controls, the sample size is 128 countries for full models (Models 1.3A-C, E) for four of the dependent variables (life expectancy, infant mortality, suicide, and TB). There are 90 countries in the full models for HIV prevalence (Model 1.3D). The list of these countries is available in Appendix B. Figure 2 presents a map of these countries highlighted dark gray for those 90 countries included in all models, including the HIV outcome models, and the additional 38 countries that are included in the other four models are in medium gray (lightest gray for countries not included). The countries included in the larger sample (128 n) constitute 66% of recognized countries in the world; the sample for models with HIV as an outcome (90 n) include 46% of recognized countries. Region, income group, and subsample information (for moderation and mediation models) for those 128 countries are also in Appendix B, based on regional divisions from the UN and income level classifications from the World Bank (2021d).

Level-1 Sample

The Level-1 sample includes annual observations over time within each country (Level 2). For a simple model with incarceration rate as the independent variable and life expectancy as the dependent variable, for example, this is the number of years in which there is an available estimate for both a country's life expectancy and incarceration rate. Multilevel modeling allows the number of observations for each country to differ, so countries could have between 1 and 30 observations in models that use annual data for

Figure 2. Map of Countries Included in the Full Models (n=128, n=90 for HIV)

the period from 1990-2019, although countries with only one observation used in the model would only contribute to the mean country estimates (Level 2) rather than any estimates of changes over time (Level 1). In practice, the highest number of observations countries contribute to the full models for RQ1 is 26, with an average of 15 observations (i.e. annual estimates) per country for life expectancy, infant mortality rates, and suicide rates (Models 1.3A-C), 13 observations per country for HIV prevalence (Model 1.3D), and 12 observations per country for TB incidence (Model 1.3E). The total number of observations in each model at Level 1 is the number of annual estimates per country for each country in the Level-2 sample.

Analytic Strategy

Modeling Approach

Consideration of Fixed-Effects Models. Fixed-effect models, those that control for all country-level differences, were considered as they are seen as the "gold standard" for repeated measures data in some social sciences such as economics and political science. However, this type of model was rejected based on the goals of this research and the argument that properly specified random-effects (multilevel) models are preferable for their flexibility, generalizability, and capacity to model context (Bell & Jones, 2015). There have been arguments against using country-level data in random effects models, as countries are not typically drawn randomly from a population (Babones, 2013); however, in this study there is a relatively large number of countries included, and the focus is on variability across countries and not the effects of any specific country thus it is valid to consider them as random factors (Luke, 2020).

Main Approach: Within-Between (Hybrid) Effects Models. The modeling methods used in this research are considered by some scholars to be a "hybrid" model, between fixed- and random-effects models; others just see it simply as a specification of random-effects model that allows for within- and between-country effects to be decomposed into their separate effects (Bell & Jones, 2015). This approach, also termed a within-between (WB) specification of a random-effects model, draws on work by Mundlak (1978) and involves group-mean-centering a Level-1 predictor and including the group mean as a Level-2 predictor as well. This process helps avoid the heterogeneity bias that occurs when adding a raw Level-1 predictor to the model (Bell & Jones, 2015). Heterogeneity bias results when estimates combine the within- and between-effects, resulting in an "uninterpretable weighted average" of these processes that does not fully account for either (Bell & Jones, 2015; Raudenbush & Bryk, 2002). This unaccounted-for variance then becomes part of the model error terms, which leads to their correlation with the covariate, violating the exogeneity assumption of the model (Bell & Jones, 2015; McNeish & Kelley, 2019). This also relates to omitted variable bias concerns at Level 2, which has caused the political science and econometrics fields to heavily favor fixed-effect models which control for all Level-2 variation.

However, the WB approach – centering the predictor at the group-mean level, and then incorporating the group mean at Level 2 – allows for within- and between-effects of the predictor to be obtained from the model (Bell & Jones, 2015; Hamaker & Muthen, 2020). The Level-1 (within) effects can be estimated regardless of possible omitted variables (and these estimates will be the same as in fixed-effects models), as the effects of Level-2 variables are now consolidated into the between component; in addition,

assuming proper specification of the Level-1 model, the coefficients of Level-2 predictors can now be directly estimated, which is not possible in fixed-effects model in which all Level-2 variation is controlled (McNeish & Kelley, 2019). Here, the effect of changes in incarceration over time and the effect of average level of incarceration in a country on health outcomes can be examined. By including region variables in some models, these models will technically allow for random effects at the country-level and fixed effects at the region level, thereby also controlling for unobserved region heterogeneity.

Incarceration rate variables are included in most models as described above (group-mean centered Level-1 variables and country average at Level 2); however, in order to fully examine the underlying relationship between incarceration and population health, as described in RQ1, models are also run to examine the contextual effect of incarceration on health, by including the raw Level-1 incarceration rate and the average incarceration rate at Level 2 (Hamaker & Muthen, 2020; Bell & Jones, 2015). This allows for untainted within-effects estimation, but also estimation of a parameter that shows the difference in between- and within-country effects, or the incremental between-country effect (Hamaker & Muthen, 2020). This can suggest whether there is some incremental effect on health by having a higher or lower average level of incarceration above and beyond the current level of incarceration.

Marginal Models. Lastly, another type of model used in this research is what is known as a marginal model. In this type of model, the population-averaged relationship between the dependent variable and the covariates is the main relationship of interest, but the within-subject covariance matrix is modeled as well (Rabe-Hesketh & Skrondal, 2022). The former is the fixed part of the model, similar to multilevel models. However,

marginal models do not allow for subject-specific relationships. Instead of including random effects by country and allowing each annual observation to have its own residual and then estimating parameters that relate to these, marginal models focus on population averages (excluding random effects) and explicitly specify the covariances, or correlations, among residuals (West et al., 2006). The covariance structures explicitly modeled by marginal models may be a better fit for some longitudinal data than those provided for by including a random intercept and/or random slope in a multilevel model. For RQ1 and RQ2, covariance structures were compared by Akaike Information Criterion (AIC) and Bayes Information Criterion (BIC) fit statistics to find the best fitting model for each outcome, the progression of which follows the testing sequence suggested by Rabe-Hesketh and Skrondal (2022). Each final model covariance structure is specified in the results sections, but all of these best fitting models turned out to be some type of marginal model. These model structures typically included a random intercept, an autoregressive residual covariance structure (which means correlations between residuals decrease as the number of occasions between them increases, in this case, by one-year or -period intervals), and allowance of the covariance matrix to differ by groups, either based on income level or region. RQ3 models were allowed to be simpler, examining mediating relationships for models using random intercepts only, as shown by Zhang and colleagues (2009).

Missing Data

Missing data related to data availability is a common problem in international comparative research (LaFree, 2021), including the current study, thus this section discusses this issue, and approaches considered to address it, in more detail.

Types of Missing Data

There are three classifications of missing data problems, originally developed by Rubin (1976). These missing data mechanisms, as they are called, are the following: missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). Data are considered to be MCAR when "the propensity for missing data on a particular variable is unrelated to other measured variables and to the would-be values of that variable" (Enders, 2011, p. 269). Data are MAR when the missing data is related to other measured variables, but not the variables' own values. The missing data mechanism is ignorable, or unnecessary to model, if a) missing data are missing at random and b) the parameters that relate to the missing data mechanism and the parameters to be estimated are distinct (Rubin, 1976). By contrast, MNAR data have missingness on a variable that is related to the potential values of that variable.

General Approaches to Handling Missing Data

There are multiple ways to handle missing data analytically, all of which may introduce varying levels of bias depending on the missing data mechanisms discussed above. Conventional methods include the following: listwise deletion, pairwise deletion, dummy variable adjustment, and single imputation (Allison, 2002). Listwise deletion, or complete-case analysis, deletes any case for which missing data on relevant variables is present. Methods for analysis are then applied to the dataset of complete cases. If data are MCAR, using listwise deletion is defensible because the observed data can be thought of as a representative random sample of a complete dataset. However, if data are MAR or MNAR, listwise deletion can introduce bias to regression coefficients. The other

conventional methods mentioned above can also produce biased estimates of regression coefficients and standard errors (Allison, 2002).

More modern and complex missing data techniques include full information maximum likelihood and multiple imputation. Full information, or direct, maximum likelihood chooses values of parameters so that the likelihood of observed data becomes maximal and incomplete records can contribute to that likelihood with their available data (Grund et al., 2019). Multiple imputation, by contrast, generates replacements for the missing data by drawing several imputations from a predictive distribution, given the observed data and parameters (Grund et al., 2019). These state-of-the art methods provide accurate estimates if data are MCAR or MAR, but can produce biased estimates under an MNAR mechanism (Enders, 2011). There are also practical limitations to conducting multilevel models with these missing data methods.

Methods for Handling Missing Data in Current Study

In this research, multiple imputation and full information maximum likelihood (FIML) methods were explored in order to avoid listwise deletion of cases with missing data. However, these were not found to be feasible using Stata for this dataset. For multiple imputation, the number of data points in the dataset presents an issue. Stata requires the conversion of "long" format data, one row per country per year, to "wide", which has one row per country and therefore creates a unique variable for each measure and year in the dataset. Multiple imputation using all 30+ years for 20+ measures is too computationally intensive. A two-step method (twofold: Welch et al., 2014) was attempted using a smaller dataset (dependent variables, incarceration rate, and two auxiliary variables), but the underlying multiple imputation command still struggled

computationally. Other methods that retain the "long" format of the data are available using R, but only allow for random-effects using a random-intercept model (current multiple imputation methods are not yet adept at including random slopes and cross-level interactions: Grund et al., 2018) and are complicated due to the inclusion of mean-centered variables, which would need to be created separately after imputation but before analysis. FIML estimation, possible using a structural equation modeling framework, was seen to be outside the scope of this research but may be an avenue for future analysis. In sum, incorporation of FIML estimation or multiple imputation into the random-effects modeling underlying study analyses was deemed not feasible in this research.

However, it should be noted that multilevel modeling itself is useful in terms of handling missingness in longitudinal data. This is because of its ability to handle varying time points of observations in the dependent variable which results in an "unbalanced" dataset (Hox et al., 2017). For example, if a country is missing some annual observations of its outcome variable, the entire country will not be excluded by listwise deletion, or those time points will not be deleted from the analysis, but the model will use all available time points for each country even if these differ across countries. However, this flexibility does not extend to explanatory variables; if a time point is missing an observation of an independent variable, the entire year will be excluded from analysis for that country (Hox et al., 2017). If, for instance, Germany does not have an estimate of its GINI coefficient in 2004 (the measure controlling for income inequality in this research), all of the data for Germany from 2004 will be excluded from analysis, though other time points that do have estimates for all relevant variables remain in the models.

Ultimately, considering all of the above, listwise deletion was determined to be the most appropriate, and feasible, method for handling most of the missing data. This approach is common when working with cross-national data, and was preferable to restricting the sample only to developed countries with more complete data. If data are completely missing for certain years, some predictors are used for country-average (Level 2) only (hospital beds, health expenditure variables, prison condition variables, and social protection expenditure) or analyses are restricted to available years only (mediation models). Table 2 shows the missing data for each study variable and the method for handling it in the analyses. For instance, life expectancy has 5,891 observations for 205 countries from 1990-2019, which means that the variable is missing around 4% of the annual observations for the available countries (205) and years (30), and almost 13% missing for all possible countries and/or territories (225) and years (30). While the percentage missing from the incarceration rate variable is high, this is a common limitation when working with international prison data, especially as the full dataset included almost all countries and recognized territories in the world, and results are still valid for those observations included in the full models. Incarceration rate is not included as just a country average, like some other variables with a high percentage of missing data, because this study is also interested in effects of incarceration over time.

Analyses to Detect Limitations Due to Missing Data

Using listwise deletion could introduce bias into the results. Listwise deletion, as mentioned above, can cause coefficient estimates in regression analyses to be biased if data are not MCAR and standard errors may also be larger because less data is utilized (Allison, 2002). MCAR can be tested by examining whether any variables in the model

Table 2. Missing Data Description

Measure	Years Available	Countries Available (Level 2)	Total Obs. (Level 1)	% Missing (Available Countries & Years)	% Missing (All Possible Countries & Years)	How Missing Data Handled
Dependent variables						
Life expectancy	1990-2019	205	5891	4.21	12.73	Listwise deletion
Infant mortality rate	1990-2019	192	5760	0.00	14.67	
Suicide rate	1990-2019	202	6060	0.00	10.22	
Prevalence of HIV	1990-2019	122	3659	0.03	45.79	
Estimated TB incidence	2000-2019	211	4177	1.02	38.12	
Independent variable of interest						
Incarceration rate	1988-2018	221	3522	48.59	49.51	
Control variables (trend and/or country-level)						
GDP	1990-2019	213	5914	7.45	12.39	
GINI	1990-2019	175	5250	0.00	22.22	
Intentional homicide rate	1990-2018	199	3773	34.62	44.10	
Population 65+	1990-2019	192	5752	0.14	14.79	
Fertility rate	1990-2019	205	5894	4.16	12.68	
Unemployment	1991-2019	185	5365	0.00	20.52	
Urban population	1990-2019	212	6352	0.13	5.90	
Democracy	1990-2018	166	4633	3.76	31.36	
Excluded minority pop.	1990-2019	173	5077	2.18	24.79	
Hospital beds	1990-2019	196	2930	50.17	56.59	Country-level average used only
Health expenditure	2000-2019	192	3774	1.72	44.09	
Government health exp.	2000-2019	192	3774	1.72	44.09	
Prison conditions (without U.S.)	1995-2019	168	4069	3.12	39.72	
Prison conditions (with U.S.)	1995-2019	169	4094	3.10	39.35	
Social protection expenditure	1995-2015	172	1011	72.01	85.02	

Table 2. Missing Data Description (Continued)

Measure	Years Available	Countries Available (Level 2)	Total Obs. (Level 1)	% Missing (Available Countries & Years)	% Missing (All Possible Countries & Years)	How Missing Data Handled
Mediating variables						
Social capital index	2007-2019	167	2171	0.00	67.84	Mediation models used reduced sample (2007-2019 only)
Civic and social participation element	2007-2019	167	2171	0.00	67.84	
Institutional trust element	2007-2019	167	2171	0.00	67.84	
Interpersonal trust element	2007-2019	167	2171	0.00	67.84	
Personal/ family relationships element	2007-2019	167	2171	0.00	67.84	
Social networks element	2007-2019	167	2171	0.00	67.84	
Only country-level variables						
Government closeness (decentralization) index	1 estimate (mid-2000s)	175	175		22.22	Listwise deletion
Ethnic fractionalization	1 estimate (1979-2001)	188	188		16.44	
Civilian firearms per 100 persons	1 estimate (2017)	219	219		2.67	

predict missingness for any other (the null hypothesis being that they do not); for instance, in this research it was found that other variables, such as democracy level, predict missingness for incarceration rate data (not shown here) – therefore, these data are not MCAR. By contrast, there are no tests to determine whether the MAR condition is satisfied, because this would involve knowing the missing values on the variable itself (Allison, 2002). It may be a reasonable assumption, though, that missing incarceration rate values do not depend on the value of the incarceration rate itself, as high and low values of incarceration are represented in this dataset. Yet, knowing that the data are not MCAR, while using listwise regression, may bias the regression estimates towards countries and observations with more complete data, which is important to understand.

Appendix C shows a comparison of means for variables and their observations that were included and excluded in the full model results for RQ1. There are some differences in values for observations that were included versus those excluded based on missing data on other measures. For instance, relating to the dependent variables, observations included in the full model results retained countries and years that had higher life expectancy, lower infant mortality, higher suicide rates, lower HIV prevalence (not statistically significant), and lower TB incidence than excluded observations due to missing data. Incarceration rate is lower in the full model observations for the first three outcomes, higher in the full model for HIV prevalence, and about the same for TB incidence, as compared to excluded observations. Therefore, it is important to keep in mind some limitations to generalizability when considering the results presented in the next chapters. Other strategies to limit, or at least understand, the effect of missing data on the models were running models using 5-year estimates (which limited missing data

by averaging all available data over the 5-year period) and running sensitivity analyses, described in later sections.

Other Data Preparation

In addition to changes related to missing data, certain variables needed to be centered or shifted to facilitate interpretation (i.e., making the first time point=0 to allow for the intercept to be understood as the expected outcome on the first occasion). In particular, incarceration rate is group-mean centered (centered at its average) and country average is also added in as a Level-2 predictor, to follow the WB specification detailed above. This process occurred for all Level-1 variables, including the mediating measures (social capital and its components) as the same confounding of effects can also occur in mediation models (Zhang et al., 2009). Time was also centered to make 1990 the 0 point, this being the year in which most data is first available.

Annual incarceration rates are incorporated into initial models as 1-year and 5-year lags to establish time order, while control variables are kept simultaneous to the outcome (similar to Wildeman, 2016).[7] Incarceration could affect health both in the short term (as incarcerated populations face the highest risk of death directly after release) and in the long term (as health effects aggregate to the larger population and macro-level effects move through their systems). The lags examine both of these effects. In addition to annual time points, 5-year intervals are also examined, to reduce error in annual measurements (and help with data missingness) yet retain validity as representative of

[7] The decision to lag incarceration rate but not the control variables, while establishing time order for the main relationship of interest, could affect some of the pathways through which incarceration is related to population health. However, full causal modeling is not the primary goal here, but the interplay of these relationships may be of interest for future research.

that particular time point (Babones, 2013). With the 5-year intervals, initial models are run with a one-interval lag.

Sequence of Analyses and Models

Descriptive and Bivariate Analyses

To start with data analysis, I first examine the main variables of interest graphically through histograms, empirical growth plots, and also through descriptive summary statistics to understand their basic components. For bivariate analyses, I look at correlations and create scatterplots between the five dependent variables and the main independent variable of interest (incarceration). I also examine graphs based on levels of incarceration, income classifications, and mean population health outcomes. Even if no bivariate association is present, the complexity of macro-level relationships like the ones hypothesized in this investigation here still warrant further multivariate analyses.

Null and Growth Models

Once bivariate relationships are explored, I then turn to multivariate analyses. I first run null multilevel models to obtain estimates and serve as baselines for future models, including the intraclass correlation (ICC), BIC, and AIC, the latter two used to assess model fit. The ICC shows the proportion of variance in the dependent variable that can be accounted for by the group level (Luke, 2020), which in this case is countries. The next models include linear or piecewise time functions – however time is determined to be best modeled for each outcome.

Models Testing Research Questions

Next, I run models that correspond to my research questions. Tests are conducted to see if random-intercepts, random-slopes, random-intercepts-and-slopes or various

types of marginal models are more appropriate for each (Luke, 2020; Rabe-Hesketh & Skrondal, 2022).

Direct Effect Models. To start, multilevel models are analyzed with time and incarceration rate as a time-varying Level-1 predictor and average Level-2 predictor (RQ1). Models then incorporate Level-1 controls (other time-varying predictors) and Level-2 controls (time-invariant predictors) and region.

Moderating Models. Moderating interactions are added into the full models and are also explored using subsamples of countries that were either above or below average on each moderating variable to understand how incarceration rates (and other controls) may be more or less related to population health outcomes among these different types of countries (RQ2). These moderating interactions are tested within level (Level 2) and across levels (Level-1 variable interacting with Level-2 variable), as moderators are averaged over time (Level 2). Average marginal effects, also called Johnson-Neyman regions of significance, and confidence bands are examined graphically to understand the moderating relationships as signaled by the significant interactions. Average marginal effects show over what range of the moderator the main predictor of interest is either significantly positive, non-significant, or significantly negative (Bauer & Curran, 2005). In this case, the question is at what levels of racial diversity/exclusion, social protection, and prison conditions do incarceration rates affect population health outcomes.

Mediating Models. The final set of models examine mediating mechanisms (RQ3). These models test mediation at both levels, following Zhang and colleagues' (2009) procedure – see Chapter 7 for more details. Models first test incarceration rate's effect on the population health outcomes using various forms (country average, average +

1-year lag, average + 2-year lag) and a random-intercept structure, and then incarceration rate's relationship with the mediating variables (country average MLM, country-level regression, simultaneous MLM, and 1-year lag MLM). Then models are run that regress population health outcomes onto incarceration rate and the mediators. The models test mediation both at the year- and country-level, using the method Zhang and colleagues (2009) described, and Preacher and colleagues (2011) termed the "unconflated multilevel model", which separates out between- and within-effects. While this procedure is not perfect, and may inflate the potential for Type I error (Zigler & Ye, 2019; Hu et al., 2020), it provides an important initial examination of potential mechanisms in the relationship between incarceration and population health outcomes.

Assessing Model Fit and Sensitivity Analyses. Model fit is assessed for each of these models by examining the BIC and AIC values and calculating R^2 (proportional reduction in error) at each level to understand the improved predictive ability of each model (Luke, 2020). Due to complications in calculating R^2 for multilevel models, and lack of agreement on the best way to calculate this measure, R^2 is only being calculated for proportional reduction in error between growth models and incarceration rate-only models with random intercepts (Luke, 2020), though there may be better ways to calculate proportional reduction of error at multiple levels and for fixed and random effects in R (Rights & Sterba, 2019). In addition, because errors are not typically normally distributed or independent in longitudinal data, alternative error covariance structures need to be chosen. Different types of error covariance structures, such as autoregressive, are tested and evaluated using BIC and AIC values to determine the best model fit (Luke, 2020).

Full models are evaluated to ensure model assumptions are not being violated (not shown here) (Bauer & Curran, 2022). Level-1 and Level-2 residuals are examined graphically, through histograms and quantile plots, to analyze if these were generally normally distributed. Scatter plots between predicted values and residuals and the incarceration rate variables are also analyzed for signs of a trend or heteroscedasticity. Residuals are examined for outliers and models are rerun without Level-2 outlier countries to determine how influential they were in each model. Other sensitivity analyses include conducting the full models with a dataset collapsed into 2-year periods, which incorporate a one-interval lag (2 years) and a three-interval lag (6 years), to see if there are changes related to missing data.

CHAPTER 4: UNIVARIATE, BIVARIATE, AND SIMPLE MULTIVARIATE RESULTS

This chapter, and the three that follow, discuss the results from this research. This chapter provides results for univariate, bivariate, and simple multivariate analyses, while each of the next three show findings related to each of the main research questions.

To start, descriptive statistics for the full study sample are provided in Table 3. The average life expectancy at birth in the sample is 68.58 years and the median is 70.96 years, with a minimum observation in one year being 26.17 (Rwanda, 1993) and a maximum of 85.42 (San Marino, 2012). The average infant mortality rate for the sample (per 1,000 live births) is 33.76 and the median is 22.3; the lowest infant mortality rate in the sample is 1.5 (San Marino, 2019) and the highest is 176.5 (Liberia, 1991). The average suicide rate per 100,000 population is 11.34 for this sample of countries and the median is 8.15, with the lowest observed rate being 1.4 (Sao Tome and Principe, 1990) and the highest at 95.57 (Greenland, 1993). The mean HIV prevalence, as a percentage of the population aged 15-49, is 2.06 and the median is .4, with a minimum observation of .1 (many countries and years with this prevalence, over 1200 observations) and a maximum of 28.9 (Eswatini, 2015). The average TB incidence per 100,000 population in this sample is 126.8 and the median is 49, with the minimum observation of 0 (96 nation-years with 0 TB incidence) and a maximum of 1590 (Eswatini, 2009 and 2010). The average incarceration rate is 1.74 per 1,000 population and the median is 1.29, with a minimum of 0 (Holy See, 2009-11, 2013-14) and a maximum of 12.94 (Saint Vincent and the Grenadines, 2004). As is seen and will be discussed below, these variables are skewed, and heavily for the infectious disease estimates.

Table 3. Descriptive Statistics of Study Variables for Full Sample

	Observations							
	Per nation per year (Level-1)	Per nation (Level-2)	Mean	SD	Median	IQR	Min	Max
Dependent variables								
Total life expectancy at birth (years)	5891	205	68.58	9.67	70.96	12.92	26.17	85.42
Infant mortality rate (per 1k live births)	5760	192	33.76	31.42	22.30	41.35	1.50	176.50
Self-harm death (suicide) rate (per 100k pop.)	6060	202	11.34	9.44	8.15	9.30	1.43	95.57
Prevalence of HIV (% of pop. ages 15-49)	3659	122	2.06	4.46	0.40	1.50	0.10	28.90
Estimated TB incidence (per 100k pop.)	4177	211	126.80	190.70	49.00	152.00	0.00	1590.00
Independent variable of interest								
Incarceration rate (per 1k pop.)	3522	221	1.74	1.41	1.29	1.51	0.00	12.94
Control variables (trend and/or country-level)								
GDP per capita (per 1k current US$)	5914	213	12.33	20.63	3.64	14.03	0.00	201.02
GINI	5250	175	0.57	0.09	0.59	0.13	0.29	0.87
Intentional homicide rate (per 100k pop.)	3773	199	8.02	12.30	3.20	7.90	0.00	141.72
Population 65+ (% of pop.)	5752	192	7.28	5.08	5.02	7.60	0.69	28.00
Fertility rate (births per woman)	5894	205	3.16	1.66	2.60	2.60	0.86	8.61
Unemployment (% of total labor force)	5365	185	8.13	6.21	6.51	7.34	0.11	37.97
Urban population (% of pop.)	6352	212	56.88	24.55	56.29	40.69	5.42	100.00
Democracy	4633	166	3.31	6.50	6.00	12.00	-10.0	10.00
Excluded minority population[m]	5077	173	0.14	0.19	0.07	0.19	0.00	0.91
Hospital beds (per 1k)	2930	196	4.19	3.12	3.40	4.16	0.01	21.68
Health expenditure (per capita/100 in US$)	3774	192	8.80	15.35	2.54	7.69	0.04	109.21
Government health exp. (% of total)	3774	192	50.57	22.08	51.26	36.19	0.89	99.64
Prison conditions (without U.S.)[m]	4069	168	3.61	1.34	4.00	2.00	1.00	5.00
Prison conditions (with U.S.)[m]	4094	169	3.62	1.34	4.00	2.00	1.00	5.00
Social protection expenditure (% of GDP)[m]	1011	172	10.60	8.22	8.17	13.75	0.10	31.68

Table 3. Descriptive Statistics of Study Variables for Full Sample (Continued)

	Observations							
	Per nation per year (Level-1)	Per nation (Level-2)	Mean	SD	Median	IQR	Min	Max
Mediating variables								
Social capital index	2171	167	51.25	9.74	49.95	11.84	19.83	81.65
Civic and social participation element	2171	167	42.66	15.88	41.26	21.60	3.46	85.30
Institutional trust element	2171	167	48.40	15.30	48.07	22.36	9.15	93.23
Interpersonal trust element	2171	167	37.46	13.27	34.80	15.63	6.74	87.14
Personal and family relationships element	2171	167	67.05	15.95	69.87	21.20	4.24	93.68
Social networks element	2171	167	60.70	14.01	63.08	18.53	3.14	85.08
Only country-level (Level-2) variables								
Government closeness (decentralization) index	5250	175	2.29	4.95	0.17	2.19	0.00	31.96
Ethnic fractionalization[m]	5640	188	0.44	0.25	0.45	0.46	0.00	0.93
Civilian firearms per 100 persons	6570	219	9.63	12.18	5.40	11.60	0.00	120.50
Region								
Africa			0.25					
Americas			0.22					
Asia			0.22					
Europe			0.21					
Oceania			0.09					

Notes. 0's in this table are real zeros. For incarceration rate, the only 0 is Holy See, which was not actually included in any of the final models due to other missing data. Region "Mean" shows the proportion of countries included in the total dataset. SD=Standard deviation; IQR=Interquartile range; Min=Minimum value; Max=Maximum value; [m]=Moderating variable.

To display the data in a different way, the following sets of figures show average estimates (Panel A) and the difference in first and last estimates (Panel B) for all available observations during the relevant and accessible time periods (typically 1990-2019). Deeper shades of the color show higher rates on average in Panel A; countries that are closer to green made changes that are better for population health, gray is more stable, and red indicates changes that are worse for population health (Panel B). Figure 3 provides the maps for incarceration rates estimates; Figure 4 is life expectancy; Figure 5 is infant mortality rates; Figure 6 is suicide rates; Figure 7 is HIV prevalence; and Figure 8 is TB incidence. For incarceration rates (Figure 3), the highest average levels can be seen in the U.S. and Russia most predominantly, and the lowest levels in Europe and parts of Africa (Panel A); Panel B shows that many countries increased their level of incarceration across this period, although some countries in Asia and Africa decreased their use (at least from first to last estimate during this period). Figure 4 shows that life expectancy is higher among "Western" nations and lowest in regions of Africa (Panel A), although most countries improved their life expectancy over this period (Panel B). Figure 5 shows the highest rates of infant mortality in Africa and parts of Asia (Panel A), and the largest decreases in these rates were also found there (Panel B). Countries in the sample generally improved their population health outcomes in terms of life expectancy and infant mortality rates across this time period. Figure 6 shows the highest average suicide rates in the Northern hemisphere (Panel A), though countries in regions across the world increased in their suicide rates during this period (Panel B). Infectious disease rates are highest in Africa for both HIV (Figure 7) and TB (Figure 8) (Panel A for both), although

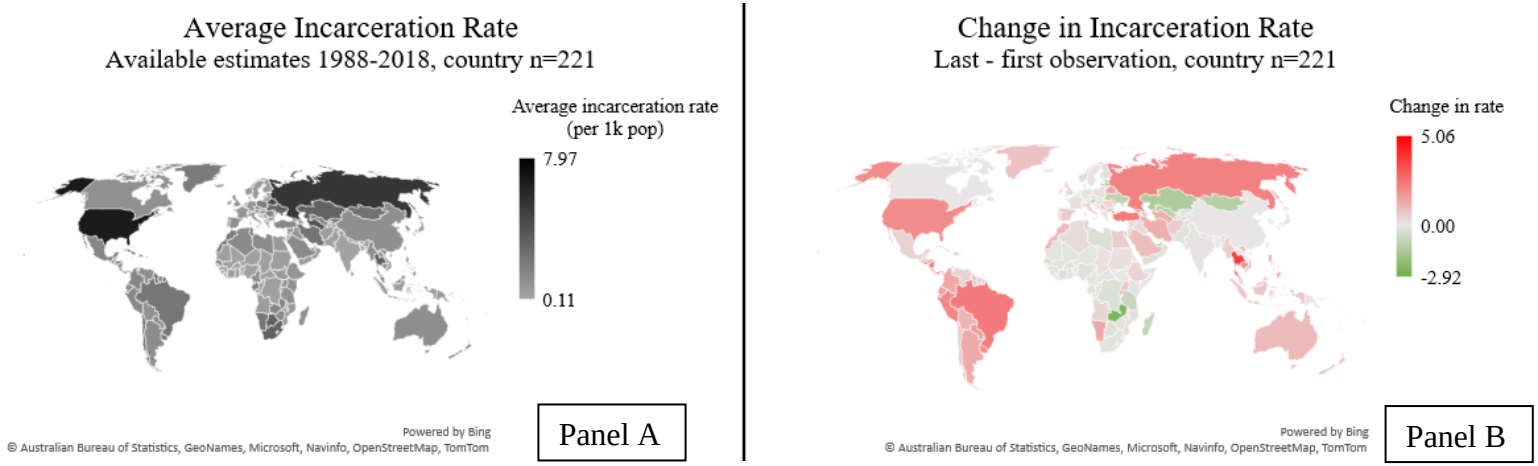

Figure 3. Map of Average (Panel A) and Changes (Panel B) in Incarceration Rate Estimates for All Available Obs. and Countries

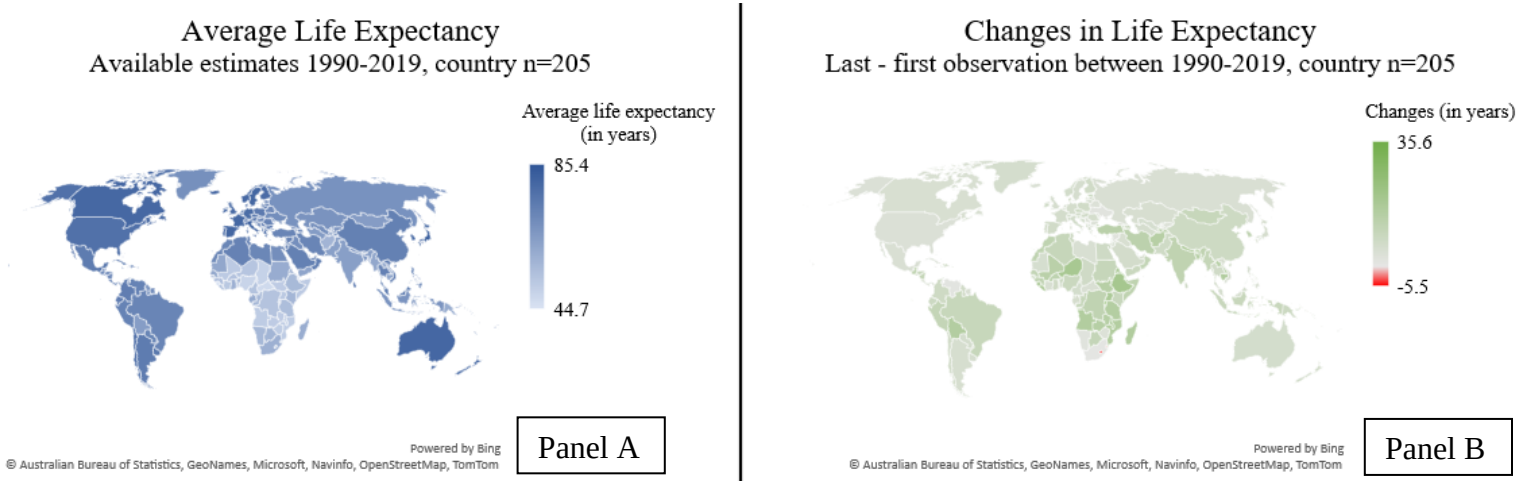

Figure 4. Map of Average (Panel A) and Changes (Panel B) in Life Expectancy Estimates for All Available Obs. and Countries

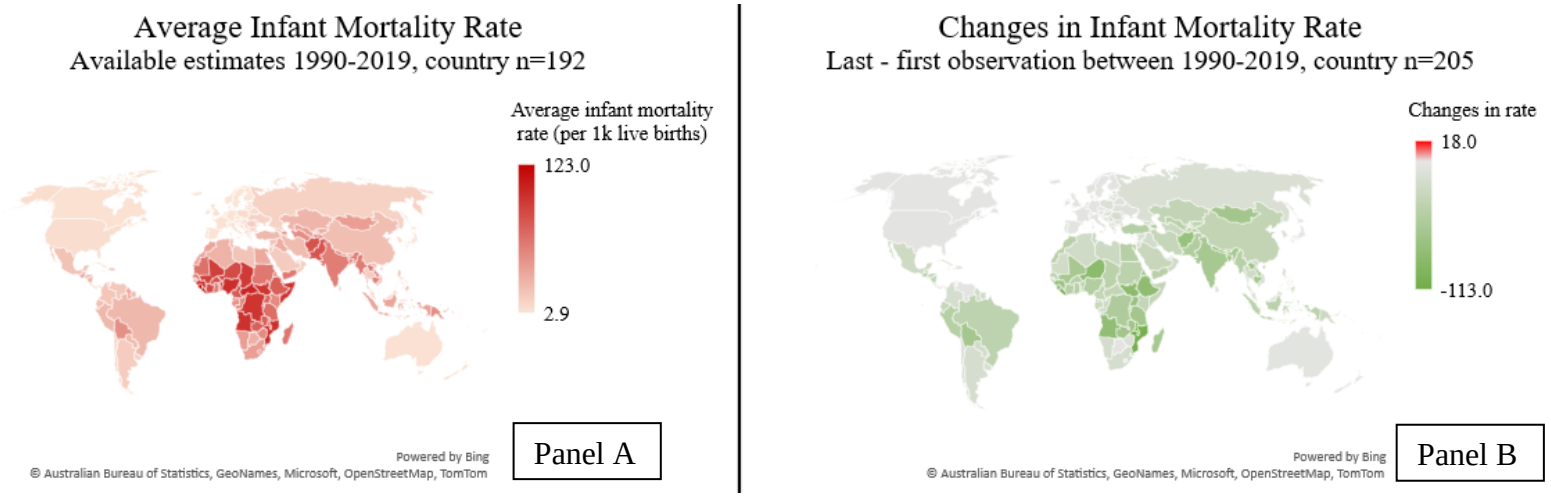

Figure 5. Map of Average (Panel A) and Changes (Panel B) in Infant Mortality Rate Estimates for All Available Obs. and Countries

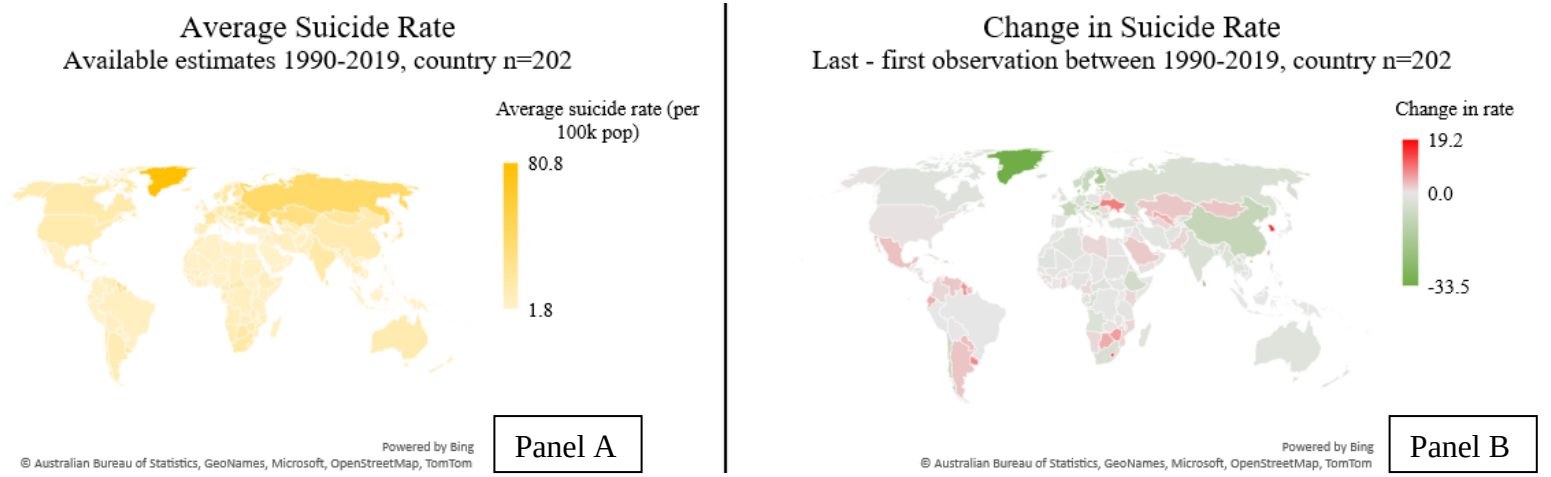

Figure 6. Map of Average (Panel A) and Changes (Panel B) in Suicide Rate Estimates for All Available Obs. and Countries

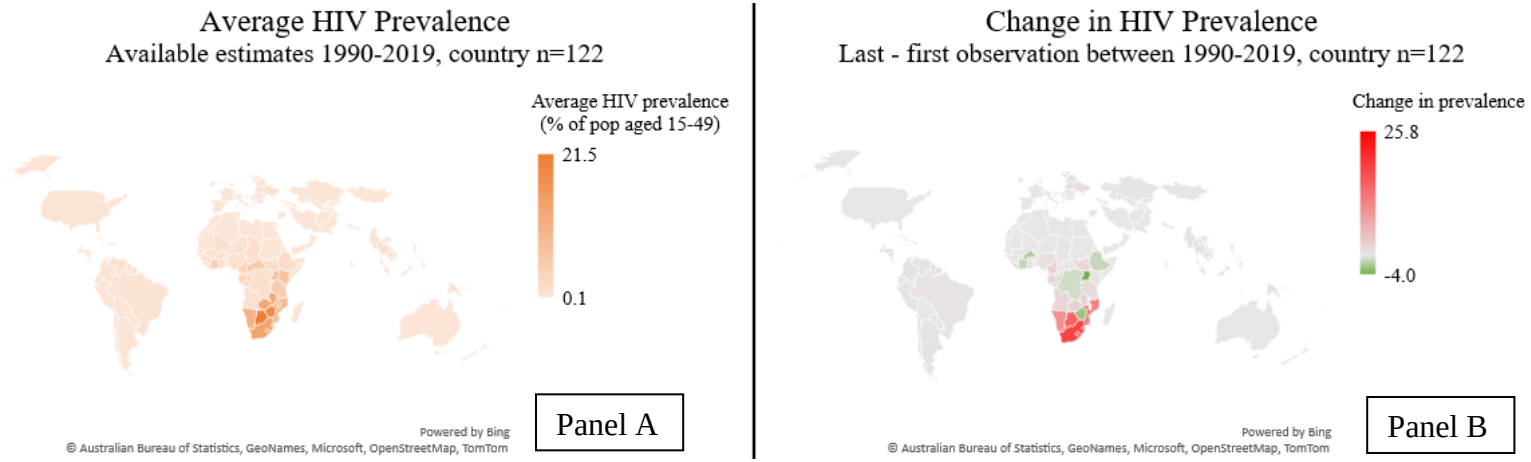

Figure 7. Map of Average (Panel A) and Changes (Panel B) in HIV Prevalence Estimates for All Available Obs. and Countries

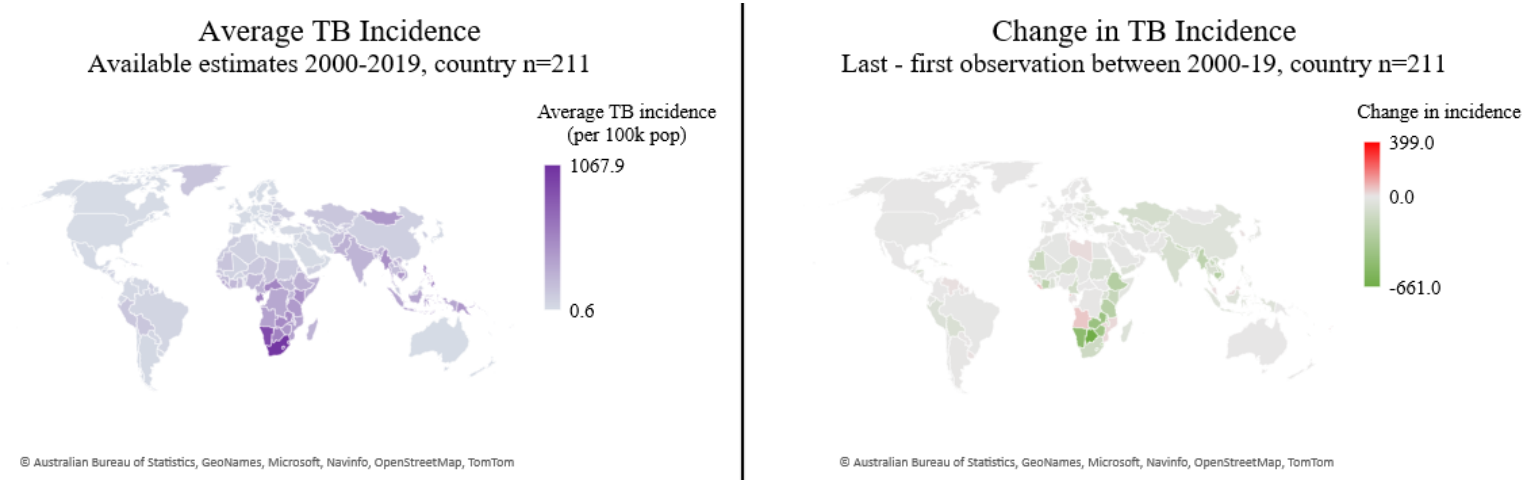

Figure 8. Map of Average (Panel A) and Changes (Panel B) in TB Incidence Estimates for All Available Obs. and Countries

many countries generally improved their TB outcomes over this period while HIV prevalence increased for many countries in Southern Africa (Panel B).

Univariate Results

To start, histograms and growth plots for each of the dependent variables were created (not shown here) to understand the properties of these outcomes and inform later multilevel model decisions. These suggested that the variables were all skewed, either left skewed (life expectancy) or right skewed (all others). While dependent variables in a multilevel model do not need to be normally distributed, one of the assumptions is that the residuals of these models are (Luke, 2020), which can be aided by transforming the outcome. Transformation was considered but decided against for ease of interpretation (some interpretation issues noted in Bernier et al., 2011). Knief and Forstmeier (2021) show that multilevel models are fairly robust to violations of the normality assumption, though, except where data includes influential outliers (Osborne & Overbay, 2004), and robust standard errors were used to help protect against biases. However, sensitivity analyses are conducted for full models without countries with outlying Level-2 residuals.

Time trends were also explored in the dependent variables. Examining the means of these outcomes over time (in graphs and tables), life expectancy, infant mortality rate, and TB incidence showed generally linear trends, while suicide rate and HIV prevalence both showed evidence of a change in direction at some point in the data trend. Therefore, linear time trends (and time squared) were tested for the three former variables, while piecewise time trends were used for the latter.

Bivariate Results

Correlations and scatterplots were examined to understand the basic relationship between each of these outcomes and incarceration rates (latter not shown here but available upon request). Table 4 shows the pairwise correlation results between these variables over time and on average (by country). The correlations show significant relationships between incarceration and population health outcomes, although not very large. Many of these are in the opposite direction as hypothesized, such as incarceration being positively related to life expectancy, and negatively related to infant mortality rate and TB incidence.

Table 4. Pairwise Correlations Between Trend and Average Incarceration Rate and Dependent Variables

Dependent Variable	Over Time	Country Avg.
Life expectancy	0.104	0.247
Infant mortality rate	-0.223	-0.330
Suicide rate	0.159	0.167
HIV prevalence	0.086	0.081
TB incidence	-0.071	-0.149

Notes. Correlations over time are with lagged incarceration rate, as is used in the multilevel models. All correlations are significant at the $p<.05$ level except HIV prevalence with country averages.

Simple Multivariate Results

However, the relationship between incarceration and population health outcomes is likely more complex than these correlations allow. For instance, the relationship between incarceration and level of development (as measured by GDP) has been found to be an example of a "Kuznets Curve", an inverted U-shaped association in which incarceration rates rise as development increases (or for middle-income nations) and then starts to fall at the highest levels of development (Clark & Herbolsheimer, 2021). Overall associations may therefore be obscuring relationships happening within different types of countries. As income level may affect both incarceration rates and population health

outcomes, it is worth examining these relationships among countries with different income groups. Figures 9-18 show these relationships overall and by country income group, which is taken from one point of time, where possible in the middle of the study period (2005) (World Bank, 2022b). These first look at means (odd numbers) and then by changes (even numbers). Incarceration rate groups were created using the 25th and 75th percentiles, so that 55 countries were included in the "low" group, 110 in the "medium" group, and 60 in the "high" incarceration rate group. Mean life expectancy uses all available observations for countries in each group. Change in incarceration rate was determined by subtracting a country's first recorded incarceration rate by their last

Table 5. Group N's for Figures 9-18

Grouping	**Country N**
Low income group, low incarceration rate	30
Low income group, med incarceration rate	18
Low income group, high incarceration rate	5
Lower-mid income group, low incarceration rate	10
Lower-mid income group, med incarceration rate	34
Lower-mid income group, high incarceration rate	16
Upper-mid income group, low incarceration rate	2
Upper-mid income group, med incarceration rate	19
Upper-mid income group, high incarceration rate	20
High income group, low incarceration rate	12
High income group, med incarceration rate	34
High income group, high incarceration rate	14
Low income group, decreasing incarceration rate	25
Low income group, increasing incarceration rate	28
Lower-mid income group, decreasing incarceration rate	17
Lower-mid income group, increasing incarceration rate	43
Upper-mid income group, decreasing incarceration rate	13
Upper-mid income group, increasing incarceration rate	28
High income group, decreasing incarceration rate	18
High income group, increasing incarceration rate	42

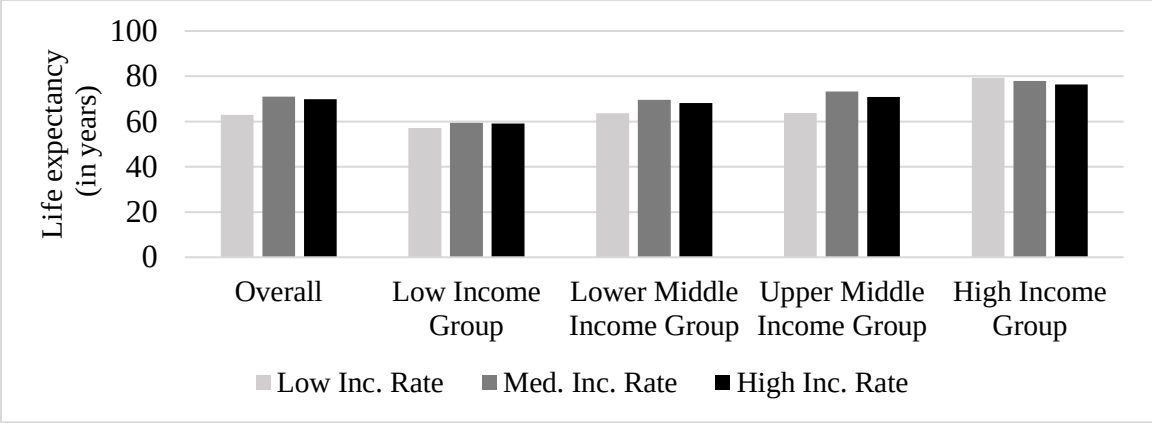

Figure 9. Mean Life Expectancy by Income Group and Incarceration Rate (Observation n=5,891)

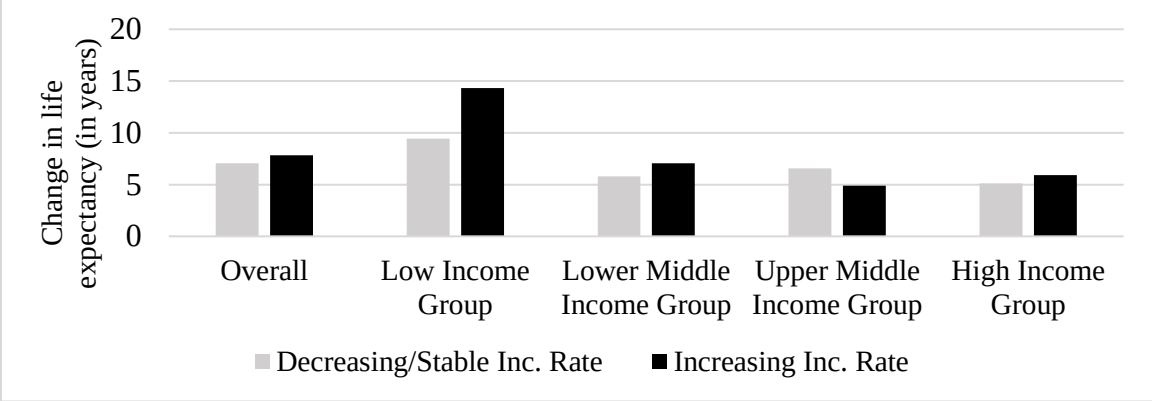

Figure 10. Change in Life Expectancy by Income Group and Incarceration Rate Change (Country n=205)

observed incarceration rate, so a rudimentary measure of change over the observed period as a whole. Those that were 0 or below were considered "decreasing or stable" (n=74) and those above 0 were "increasing" (n=151). Changes are calculated for each country. Country N's for each grouping are provided in Table 5 (details in Appendix D).

Figure 9 and Figure 10 show mean life expectancy and changes over the thirty years based on income group and incarceration rate. As seen on the left-hand side of the figures, life expectancy was lowest overall for low incarceration rate countries (62.9 years) and highest for medium incarceration rate countries (70.9); those with increasing incarceration rates had slightly higher increases in life expectancy overall compared to those with decreasing or stable rates (+7.8 vs. 7.0, respectively). However, for high-

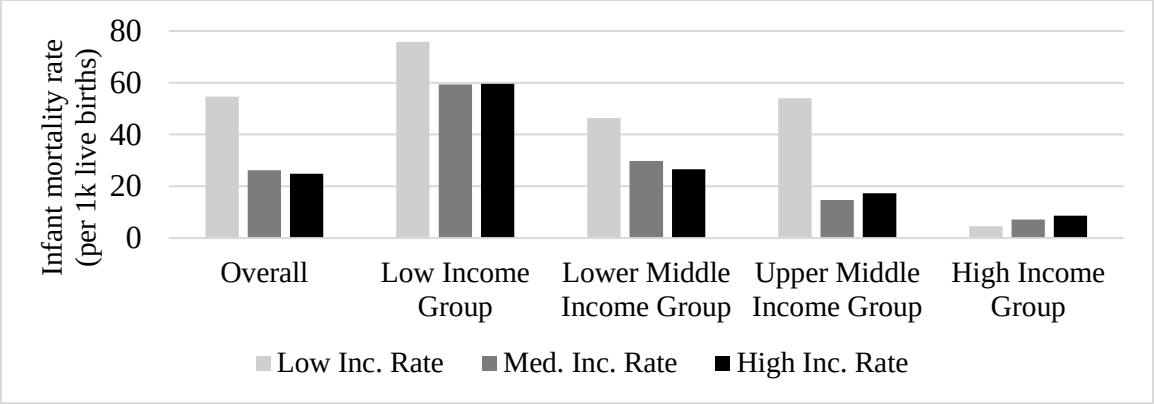

Figure 11. Mean Infant Mortality Rate by Income Group and Incarceration Rate (Observation n=5,760)

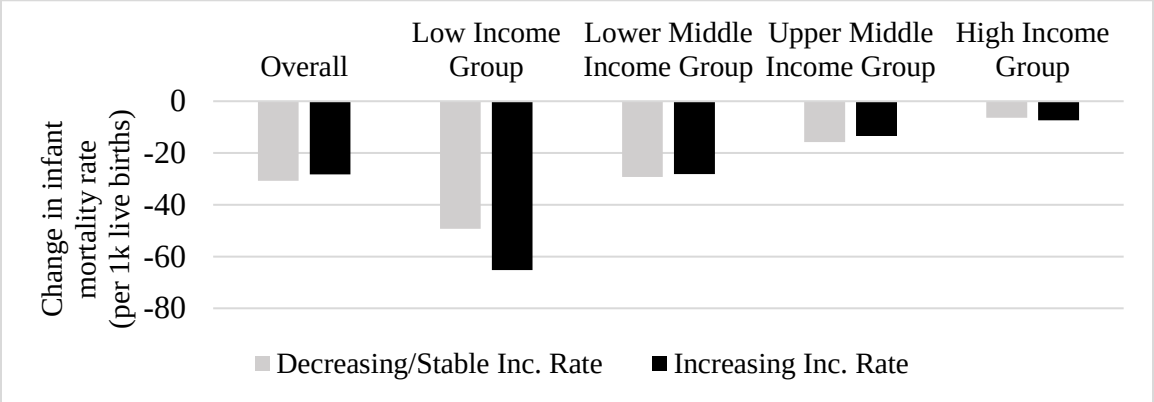

Figure 12. Change in Infant Mortality Rate by Income Group and Incarceration Rate Change (Country n=192)

income countries, the lowest incarceration rates were associated with the highest life expectancy. In addition, for the upper-middle-income group, decreasing or stable incarceration rates were associated with bigger gains in life expectancy.

For infant mortality (Figure 11 and Figure 12), low incarceration rates were associated with the highest infant mortality rates overall (54.6 per 1,000 live births), yet decreasing or stable incarceration rate changes were related to slightly larger decreases in infant mortality rates (-30.7 compared to -28.2 for increasing rates). The mean association holds for all but the high-income group, who have low infant mortality rates overall, but have the highest rates among high incarceration countries, then medium, then

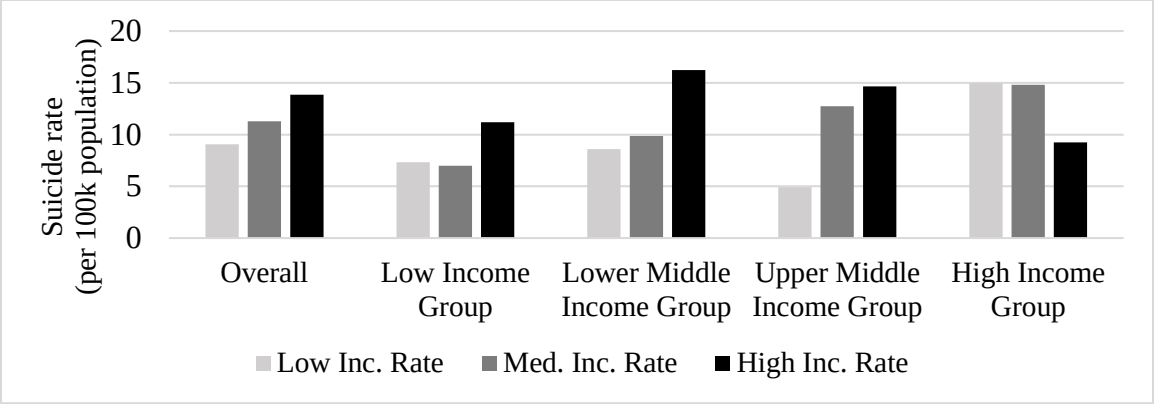

Figure 13. Mean Suicide Rate by Income Group and Incarceration Rate (Observation n=6,000)

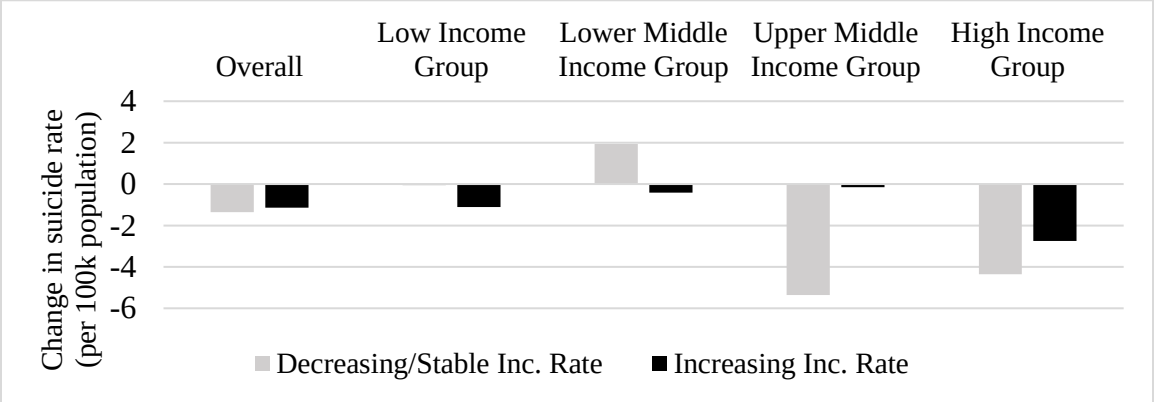

Figure 14. Change in Suicide Rate by Income Group and Incarceration Rate Change (Country n=200)

low. The overall change in mean infant mortality rate is very similar between the decreasing/stable and increasing incarceration countries, as is the comparison for all income groups except the low-income group, where increasing incarceration rates were associated with larger reductions in infant mortality rates.

Suicide rates were related to incarceration rates overall (Figure 13), with the highest incarceration rates being seen in conjunction with the highest suicide rates (13.8 per 100,000 population). Countries had similar decreases in suicide rates overall regardless of the directionality of their incarceration rates (Figure 14) (-1.4 for decreasing/stable, -1.1 for increasing). However, again, the high-income trend differs

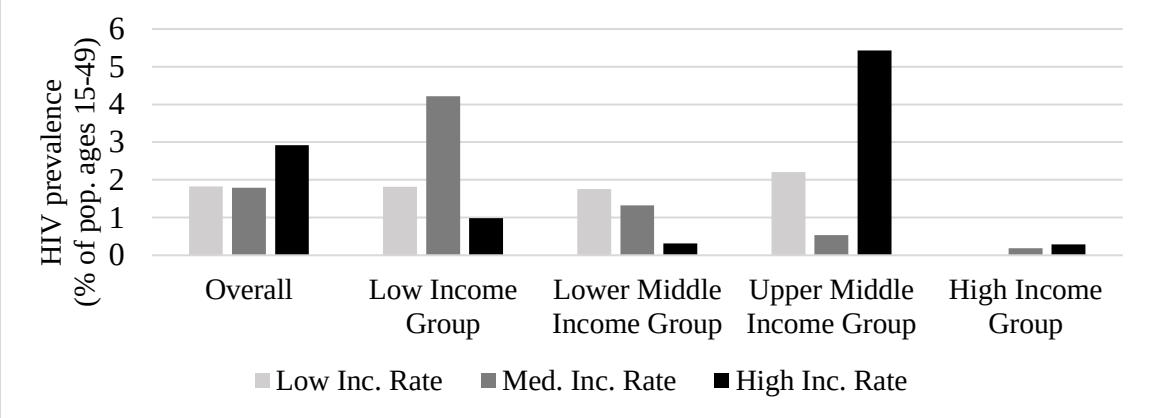

Figure 15. Mean HIV Prevalence by Income Group and Incarceration Rate (Observation n=3,659)

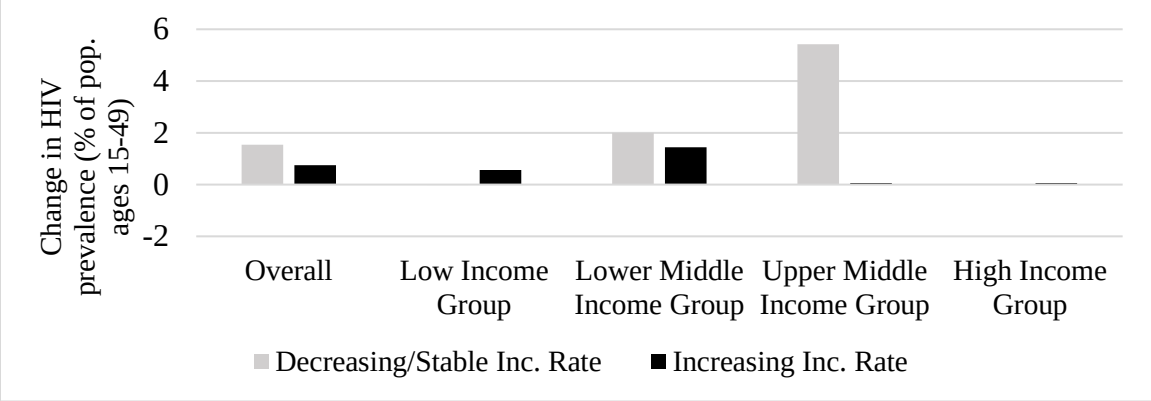

Figure 16. Change in HIV Prevalence by Income Group and Incarceration Rate Change (Country n=122)

from the rest of the groups for mean suicide rate, with the highest incarceration rates associated with the lowest suicide rates. Countries with decreasing or stable incarceration rates in upper-middle- and high-income countries saw the largest reductions in suicide rates, though.

Overall, HIV prevalence is higher when incarceration rates are higher (2.9% of population aged 15-49 for countries with high incarceration rates), but decreasing or stable incarceration rates have occurred in countries where slightly higher increases in prevalence were seen (Figure 15 and Figure 16) (+1.5 for decreasing/stable countries, +.8 for increasing). These trends look very different for each income group, however, and the

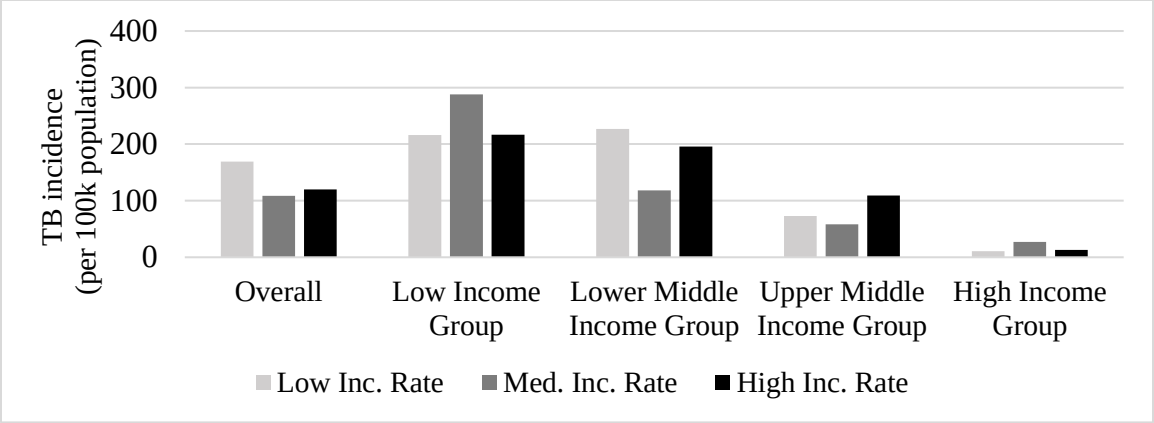

Figure 17. Mean TB Incidence by Income Group and Incarceration Rate (Observation n=4,097)

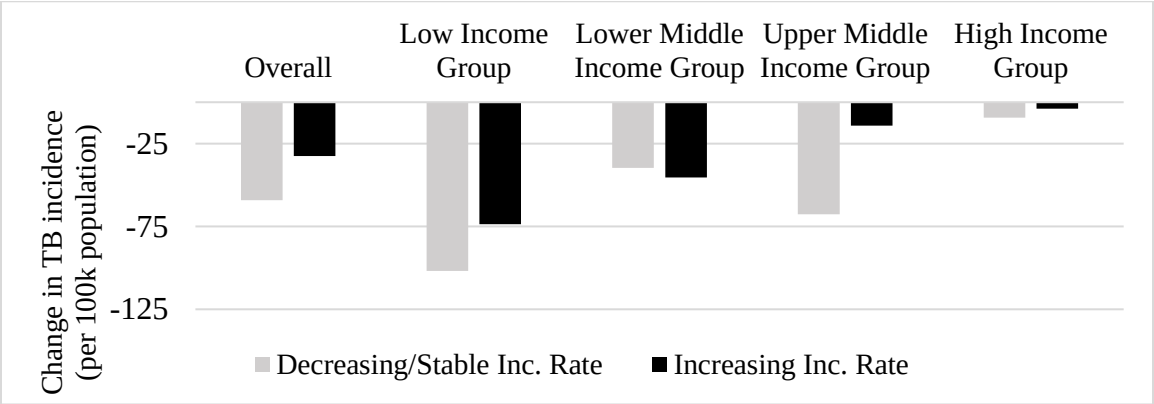

Figure 18. Change in TB Incidence by Income Group and Incarceration Rate Change (Country n=207)

total trends look to be driven by upper-middle-income group countries and observations.

Tuberculosis incidence is slightly higher in countries and years with low incarceration rates (169.3 per 100,000 population for low incarceration rates, 108.5 for medium incarceration rates, and 120.1 for high incarceration rates), but decreases in incarceration rates were found alongside larger reductions in TB incidence (-59.1 for decreasing/stable rates, -32.4 for increasing rates) (Figure 17 and Figure 18). Again, these trends looked different across the income groups. Such as, medium incarceration rates were related to the highest TB incidence among low-income countries but the lowest for lower-middle-income countries. High-income nations largely had low TB incidence.

Summary of Preliminary Analyses

Overall, these basic univariate and multivariate analyses show variations within and across countries in terms of incarceration and population health. Countries across the world generally bettered health outcomes in terms of life expectancy, infant mortality rates, and TB across the period of interest. At the same time, incarceration was generally increasing across the globe. Bivariate correlations show a basic relationship that is positive for incarceration and life expectancy and negative for incarceration and infant mortality rates and TB incidence, suggesting that these improvements in health were related to growing incarceration. However, the opposite was found for suicide rates and HIV prevalence, and these simple associations are likely to be confounded by other factors, such as wealth and development. Country context (in terms of wealth) appears to affect the way in which incarceration rates relate to health outcomes among their populations, with incarceration often being protective in low-income countries and detrimental in high-income countries for life expectancy and infant mortality rates. In contrast, suicide rates are generally aggravated by high incarceration across income levels, except for high-income countries where high incarceration is associated with the lowest suicide rates. Infectious disease outcomes have less straightforward patterns in relation to country wealth and incarceration which may be better explored through models that allow for more complexity. These results will be further examined in the discussion section, but it may be helpful to keep these basic relationships in mind as the rest of the results are presented in the following chapters.

CHAPTER 5: RQ1 RESULTS – DIRECT EFFECTS OF INCARCERATION ON POPULATION HEALTH MEASURES

RQ1) Controlling for other relevant predictors, are incarceration rates related to population health, as measured by life expectancy (1A), infant mortality rates (1B), suicide rates (1C), HIV prevalence (1D), and TB incidence (1E)?

Null and Growth Model Results

Before the full multilevel models were run to explore RQ1, null and growth models were analyzed to examine the means of each dependent variable, the role of time trends, and the level of between- versus within-level variation. Table 6 shows the null and growth models for each dependent variable. Throughout the rest of this text, models with "A" in their title denote life expectancy outcomes, "B" is for infant mortality rates, "C" is suicide rates, "D" is HIV prevalence, and "E" is TB incidence.

For all dependent variables, at least 84% of the variation in population health outcomes are due to variation between countries (see ICC in .n models). When adding in the appropriate time trend, between-country variation contributes at least 90% of the variation in the outcomes. Therefore, most of the variation in these outcomes is occurring between countries rather than over time (see ICC in .g models). This highlights the value of a multilevel model, which analyzes changes over time and differences between countries, the latter of which are excluded in fixed effects models.

It may be helpful here to describe the parameters in the unconditional growth curve models (.g models), to understand the basic relationship and compare with the more complex models. For instance, Model 1.1A.g shows that the mean life expectancy at birth for the sample in 1990, controlling for a linear time trend, is 64.59 years. This

Table 6. Null and Growth Models for Dependent Variables (with Random Intercepts)

	Life Expectancy				**Infant Mortality Rate**				**TB Incidence**			
	Model 1.1A.n Null Model		**Model 1.1A.g Growth Model**		**Model 1.1B.n Null Model**		**Model 1.1B.g Growth Model**		**Model 1.1E.n Null Model**		**Model 1.1E.g Growth Model**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Constant	68.86***	(0.64)	64.59***	(0.75)	33.76***	(2.09)	48.57***	(2.97)	126.43***	(12.63)	150.67***	(15.87)
Year			0.30***	(0.01)			-1.02***	(0.07)			-2.52***	(0.46)
Model fit												
ICC	0.88		0.95		0.84		0.91		0.92		0.93	
AIC	31960.70		26648.32		46586.52		42695.85		46233.77		45915.07	
BIC	31980.74		26675.04		46606.50		42722.48		46252.78		45940.42	
Observations (L-1)	5891		5891		5760		5760		4177		4177	
Countries (L-2)	205		205		192		192		211		211	

	Suicide Rate				**HIV Prevalence**			
	Model 1.1C.n Null Model		**Model 1.1C.g Growth Model**		**Model 1.1D.n Null Model**		**Model 1.1D.g Growth Model**	
	b	se	b	se	b	se	b	se
Fixed effects								
Constant	11.34***	(0.64)	12.31***	(0.78)	2.06***	(0.38)	2.45***	(0.46)
Year - pre-peak			0.18**	(0.06)			0.12***	(0.03)
Year - post-peak			-0.09***	(0.02)			-0.02**	(0.01)
Model fit								
ICC	0.93		0.94		0.89		0.90	
AIC	29314.27		28921.13		13889.94		13700.39	
BIC	29334.39		28954.68		13908.56		13731.41	
Observations (L-1)	6060		6060		3659		3659	
Countries (L-2)	202		202		122		122	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; Models include random intercepts (random effects not shown here); Investigation of trends suggested the suicide rate and HIV prevalence models would better fit with piecewise time trends rather than one overall linear trend: peak for suicide rate is 1995; peak for HIV prevalence is 2001.

increases by .3 years for each additional year. Model 1.1C.g shows results for suicide rate, which has a mean of 12.31 suicides per 100,000 population for the sample in 1990. This controls for a piecewise time trend, based on analysis of the average data mentioned previously. The growth parameters show that the suicide rate increases by .18 per 100,000 population for each year until 1995 (pre-peak), after which the rate drops by .09 suicides per 100,000 population for the remaining years on average (post-peak). These time trend configurations were shown to be the best fitting for each of the variables (based on AIC and BIC values) except for infant mortality rate and TB incidence, which was better fitting with a squared time variable as well, included in later models.

Incarceration-Only Models

Next, incarceration rate is incorporated into the models. These models are run with two different specifications: 1) random intercepts and slopes; and 2) with a first-order autoregressive structure (AR1) with heteroskedastic residuals, either grouped based on region (life expectancy, HIV prevalence, and TB incidence models) or income (infant mortality and suicide rate models). The latter was determined by AIC and BIC (model fit) values for a range of multilevel and marginal models with full covariates to be the best fit (as described in Chapter 3). The AR1 structure suggests that residuals (the difference between the actual and predicted values) are partially determined by the residual at the previous occasion, which is commonly the case for repeated measures data; the heteroskedastic addition means that this relationship can be different for different groups, in this case based on country income levels or world regions (Rabe-Hesketh & Skrondal, 2022). AIC and BIC values suggest, like the models with the full covariates, that the models that have AR1 structure with heteroskedastic residuals (AR1het) fit better than

those with random intercepts and slopes (Random-IS): both are shown to build fairly consistently from the null models to the full models with covariates.

The results (Table 7) show small but significant effects of incarceration rate over time, lagged one year, for two outcomes: it is significant in both types of models for TB incidence only, while significant for HIV prevalence in just the Random-IS model. The directionality is as hypothesized for TB, but the opposite of hypothesized for HIV (this outcome decreases as incarceration rate increases). A 1 per 1,000 population increase in incarceration is associated with a .01 increase in TB incidence per 100,000 population and a .01 percent decrease in HIV prevalence for the adult population in the following year based on .a models. Country-level incarceration rate is significant for all outcomes, but only one model type for some. Directionality is again split between those matching the research hypotheses (suicide rate and HIV prevalence) and in the opposite direction of the hypotheses (life expectancy, infant mortality rate, and TB incidence). For example, a 1 per 1,000 population increase in average incarceration is associated with a .80 year increase in average life expectancy from birth. And despite finding positive effects over time, an increase in average incarceration by 1 per 1,000 population is associated with a decrease in average TB incidence by .14 per 100,000 population. Directionality and opposing Level-1 and Level-2 relationships will be further discussed when examining the full models with all controls, as these relationships appear complex.

Growth and incarceration rate models were also run with random-intercepts only to facilitate calculation of R^2, the coefficient of determination, considered to be the proportional reduction in error at each level for incorporating incarceration rate variables into growth models (see Appendix E). This calculation is complicated for models that

Table 7. Incarceration Rate Only Models (with Random Slopes/Intercepts or AR1 Heteroskedastic Residuals)

	Life Expectancy				**Infant Mortality Rate**				**TB Incidence**			
	Model 1.2A.r		**Model 1.2A.a**		**Model 1.2B.r**		**Model 1.2B.a**		**Model 1.2E.r**		**Model 1.2E.a**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Year	0.23***	(0.04)	0.27***	(0.02)	-1.52***	(0.12)	-0.40***	(0.03)	-0.01*	(0.00)	-0.00*	(0.00)
Year - squared	0.00*	(0.00)	-0.00*	(0.00)	0.02***	(0.00)	0.01***	(0.00)	-0.00*	(0.00)	-0.00**	(0.00)
Inc. rate (lagged 1 yr)	0.01	(0.04)	-0.01	(0.01)	0.02	(0.10)	0.02	(0.03)	0.01*	(0.01)	0.01**	(0.00)
Avg. incarceration rate	1.24***	(0.35)	0.80**	(0.27)	-2.26**	(0.79)	1.42+	(0.73)	-0.13***	(0.03)	-0.14***	(0.03)
Model fit												
ICC	0.998				0.999				0.990			
AIC	7526.92		4060.27		12292.57		9484.63		-3705.50		-5526.34	
BIC	7599.74		4157.37		12365.06		9569.21		-3634.76		-5443.89	
Observations (L-1)	3193		3193		3106		3106		2683		2668	
Countries (L-2)	198		198		190		190		206		204	

	Suicide Rate				**HIV Prevalence**			
	Model 1.2C.r		**Model 1.2C.a**		**Model 1.2D.r**		**Model 1.2D.a**	
	b	se	b	se	b	se	b	se
Fixed effects								
Year - pre-peak	0.24*	(0.11)	0.10+	(0.05)	0.10**	(0.03)	0.01***	(0.00)
Year - post-peak	-0.09***	(0.02)	-0.06***	(0.01)	-0.02*	(0.01)	0.00	(0.00)
Inc. rate (lagged 1 yr)	-0.04	(0.06)	0.02	(0.04)	-0.01	(0.02)	-0.01*	(0.00)
Avg. incarceration rate	0.09	(0.29)	1.59***	(0.45)	-0.08	(0.17)	0.06*	(0.03)
Model fit								
ICC	0.992				0.997			
AIC	11388.23		7597.22		2471.62		-2407.44	
BIC	11461.17		7682.27		2538.07		-2318.84	
Observations (L-1)	3223		3214		1877		1877	
Countries (L-2)	199		198		120		120	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; all models were run with either a random intercept and random slopes (for the year variables) (.r) or with a first-order autoregressive structure (AR1) with heteroskedastic residuals (.a), as determined to be the best fitting model for models with full covariates (Models 1.3A-E) (random effects and constants not shown here for space reasons); Investigation of trends suggested the suicide rate and HIV prevalence models would better fit with piecewise time trends rather than one overall linear trend: peak for suicide rate is 1995; peak for HIV prevalence is 2001.

also include random slopes (Luke, 2020). By just incorporating incarceration rate (over time), the models' predictive ability improved, as compared to a growth model, from 12%-48% for Level 1 depending on the outcome, excluding suicide rate where inclusion decreased predictive ability by 4%, which can happen when using estimates from two models to determine R^2 (Rights & Sterba, 2019). For Level 2 (country average), adding incarceration decreased predictive ability by 2% for TB incidence and 16% for HIV prevalence, but improved predictive ability for the other three outcomes between 8% and 34%. Overall, adding incarceration to the model seemed most helpful for infant mortality rate (R^2_1=.48; R^2_2=.34) and life expectancy (R^2_1=.34; R^2_2=.14).

Full Models

The full multilevel model results with Level-1 and Level-2 control variables are presented in the next sections for each dependent variable.[8] Models 1.3A-E include annual data with lagged incarceration rate (one year) group-mean centered and country-average incarceration rate grand-mean centered. Models 1.4A-E include raw incarceration effect (still lagged) to examine the contextual effect of incarceration. Models 1.5A-E incorporate group-mean centered incarceration rate lagged five years. Models 1.6A-E and 1.7A-E use a dataset that collapses observations into 5-year periods and include group-mean-centered incarceration rate (former) and raw incarceration (latter), both lagged one time period. These models with 5-year periods are included to reduce potential error, and help with data missingness, in annual estimates. In addition, there are models with 2-year averaged estimates provided in Appendix F. Results are

[8] While important to the model, the random effects are not the focus of the research questions and therefore will not be included in the following tables or discussed in the following sections – only the fixed effects.

similar to annual models, but help shed more light on the robustness of results to missing data, discussed in the concluding chapter.

Multivariate Multilevel Model Results for Life Expectancy

The full multilevel model results for life expectancy are presented in Table 8 (annual data) and Table 9 (5-year data). The constant for Model 1.3A is 64.07, meaning that, for the average country (Level-2 variables=0) in 1990 (Year=0) the mean life expectancy is about 64 years from birth. A one-year increase in time is associated with a .24 increase in life expectancy, controlling for other variables in the model. The one-period lagged incarceration rate is significantly related to life expectancy in this sample. For annual data, an increase in incarceration rate of 1 per 1000 population is associated with a decrease in life expectancy by .09 years; for 5-year-averaged data, this decrease is .26 years, controlling for other Level-1 and Level-2 variables and time. A country's average incarceration rate is only marginally related to life expectancy ($p<.1$), with a .45, .48, and .5 decrease in mean life expectancy associated with a one unit increase in average incarceration rate for 1-year-lagged annual data, 5-year-lagged annual data, and 5-year-averaged data, respectively. No contextual effects of incarceration were found for life expectancy.

There are only a few control variables at Level 1 that show a significant relationship to life expectancy. Percentage of population 65+ and excluded minority population were both significantly, negatively associated with life expectancy for both models with annual data and a 1-year lag. For example, with yearly data, a 1% higher senior population is associated with a .18-year lower life expectancy that year. Excluded minority population loses this significant relationship when 5-year-lagged incarceration is

Table 8. Direct Effects of Incarceration on Life Expectancy (with Annual Data)

		Model 1.3A Full Model		Model 1.4A Contextual Model		Model 1.5A 5-Year Lag	
		b	**se**	**b**	**Se**	**b**	**se**
	Fixed effects						
	Constant	64.07***	(0.92)	64.21***	(0.91)	64.01***	(0.94)
	Year	0.24***	(0.02)	0.24***	(0.02)	0.25***	(0.02)
	Inc. rate (lagged 1 year)	-0.09*	(0.04)				
	Inc. rate (lagged 1 yr. raw)			-0.09*	(0.04)		
	Inc. rate (lagged 5 years)					-0.03	(0.03)
	Avg. incarceration rate	-0.45+	(0.26)	-0.37	(0.26)	-0.48+	(0.26)
Level-1 controls	GDP	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
	GINI	-0.36	(0.45)	-0.36	(0.45)	-0.29	(0.48)
	Homicide rate	-0.00+	(0.00)	-0.00+	(0.00)	-0.00	(0.00)
	Population 65+	-0.18**	(0.06)	-0.18**	(0.06)	-0.16**	(0.06)
	Fertility rate	-0.42+	(0.24)	-0.42+	(0.24)	-0.34	(0.21)
	Unemployment	0.01	(0.01)	0.01	(0.01)	0.01**	(0.01)
	Urban population	0.03	(0.03)	0.03	(0.03)	0.02	(0.03)
	Democracy	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
	Excluded minority pop.	-0.29*	(0.14)	-0.29*	(0.14)	-0.27+	(0.15)
Level-2 controls	GDP	-0.05	(0.04)	-0.05	(0.04)	-0.04	(0.04)
	GINI	-8.91+	(4.70)	-8.91+	(4.70)	-6.46	(4.54)
	Homicide rate	-0.02	(0.03)	-0.02	(0.03)	-0.04	(0.03)
	Population 65+	0.17	(0.12)	0.17	(0.12)	0.19	(0.12)
	Fertility rate	-2.63***	(0.41)	-2.63***	(0.41)	-2.61***	(0.41)
	Unemployment	0.01	(0.06)	0.01	(0.06)	-0.02	(0.07)
	Urban population	0.09***	(0.01)	0.09***	(0.01)	0.09***	(0.01)
	Democracy	-0.07	(0.05)	-0.07	(0.05)	-0.05	(0.05)
	Excluded minority pop.	3.13	(1.95)	3.13	(1.95)	3.30+	(1.93)
	Hospital beds	-0.43***	(0.11)	-0.43***	(0.11)	-0.46***	(0.11)
	Health expenditure	0.10*	(0.04)	0.10*	(0.04)	0.10*	(0.04)
	Government health exp.	0.03	(0.02)	0.03	(0.02)	0.02	(0.02)
	Prison conditions (with US)	-0.70+	(0.36)	-0.70+	(0.36)	-0.81*	(0.35)
	Social protection exp.	0.02	(0.06)	0.02	(0.06)	0.01	(0.06)
	Government decentral.	-0.10*	(0.05)	-0.10*	(0.05)	-0.10*	(0.05)
	Ethnic fraction.	-2.16+	(1.17)	-2.16+	(1.17)	-2.58*	(1.16)
	Gun availability	0.03	(0.02)	0.03	(0.02)	0.03	(0.02)
Region	Africa	-1.55	(1.59)	-1.55	(1.59)	-1.76	(1.64)
	Americas	3.44**	(1.32)	3.44**	(1.32)	3.37*	(1.35)
	Asia	3.27**	(1.20)	3.27**	(1.20)	2.89*	(1.22)
	Oceania	0.84	(0.67)	0.84	(0.67)	0.67	(0.70)
	Model fit						
	AIC	1593.4		1593.4		1346.8	
	BIC	1837.9		1837.9		1584.2	
	Observations (Level-1)	1912		1912		1630	
	Countries (Level-2)	128		128		129	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

Table 9. Direct Effects of Incarceration on Life Expectancy (with 5-Year Data)

		Model 1.6A Full Model		Model 1.7A Contextual Model	
		b	se	b	se
	Fixed effects				
	Constant	64.13***	(0.87)	64.63***	(0.86)
	Year	1.29***	(0.07)	1.29***	(0.07)
	Inc. rate (lagged 1 period)	-0.26**	(0.09)		
	Inc. rate (lagged 1 period raw)			-0.26**	(0.09)
	Avg. incarceration rate	-0.50+	(0.27)	-0.24	(0.28)
Level-1 controls	GDP	0.00	(0.00)	0.00	(0.00)
	GINI	-2.34	(1.79)	-2.34	(1.79)
	Homicide rate	-0.01+	(0.01)	-0.01+	(0.01)
	Population 65+	-0.12*	(0.05)	-0.12*	(0.05)
	Fertility rate	-0.18	(0.25)	-0.18	(0.25)
	Unemployment	0.03***	(0.01)	0.03***	(0.01)
	Urban population	0.02	(0.02)	0.02	(0.02)
	Democracy	0.01	(0.02)	0.01	(0.02)
	Excluded minority pop.	-0.40	(0.65)	-0.40	(0.65)
Level-2 controls	GDP	-0.05	(0.05)	-0.05	(0.05)
	GINI	-5.10	(4.57)	-5.10	(4.57)
	Homicide rate	-0.03	(0.03)	-0.03	(0.03)
	Population 65+	0.23+	(0.13)	0.23+	(0.13)
	Fertility rate	-2.49***	(0.39)	-2.49***	(0.39)
	Unemployment	-0.04	(0.07)	-0.04	(0.07)
	Urban population	0.09***	(0.01)	0.09***	(0.01)
	Democracy	-0.05	(0.05)	-0.05	(0.05)
	Excluded minority pop.	3.80*	(1.77)	3.80*	(1.77)
	Hospital beds	-0.38***	(0.11)	-0.38***	(0.11)
	Health expenditure	0.09+	(0.05)	0.09+	(0.05)
	Government health exp.	0.02	(0.02)	0.02	(0.02)
	Prison conditions (with US)	-1.02**	(0.37)	-1.02**	(0.37)
	Social protection exp.	-0.01	(0.06)	-0.01	(0.06)
	Government decentral.	-0.09+	(0.05)	-0.09+	(0.05)
	Ethnic fraction.	-2.61*	(1.16)	-2.61*	(1.16)
	Gun availability	0.03	(0.02)	0.03	(0.02)
Region	Africa	-1.89	(1.59)	-1.89	(1.59)
	Americas	3.45*	(1.35)	3.45*	(1.35)
	Asia	2.90*	(1.21)	2.90*	(1.21)
	Oceania	0.42	(0.73)	0.42	(0.73)
	Model fit				
	AIC	1636.0		1634.0	
	BIC	1828.7		1822.4	
	Observations (Level-1)	534		534	
	Countries (Level-2)	132		132	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

included or the data are averaged over 5 years. Unemployment rates become positively related to life expectancy for the aforementioned models.

There are multiple control variables that are significantly related to life expectancy at the country-level (Level 2). Fertility rate, hospital beds, and government decentralization are negatively associated with life expectancy using annual data – a one-unit increase in these is associated with a decrease in mean life expectancy at the country level, controlling for other variables. Urban population percentage is significantly positively associated with average life expectancy. Results for the 5-year-averaged data look similar, except that prison conditions and ethnic fractionalization are now significantly negatively related to life expectancy. For prison conditions, that means an incremental worsening of prison conditions (say, from meeting minimum standards to some deficit likely caused by overcrowding) is related to an average decrease in life expectancy by about 1 year over this 5-year period. For ethnic fractionalization, this one-unit change is full homogeneity to complete heterogeneity, and this would be associated with an average loss of 2.6 years in life expectancy. Regionally, the Americas and Asia have a significantly higher life expectancy than the reference category of Europe. Some of these findings may be counter-intuitive and may be avenues for future research.

Multivariate Multilevel Model Results for Infant Mortality Rate

The full multilevel model results for infant mortality rate are presented in Table 10 (annual data) and Table 11 (5-year data). The constant for Model 1.3B is 23.94, meaning that, for the average country in 1990 the mean infant mortality rate is almost 24 per 1,000 live births. The linear trend variable is negative and the quadratic trend is positive, suggesting a general negative trend in infant mortality rates over time with

Table 10. Direct Effects of Incarceration on Infant Mortality Rate (with Annual Data)

		Model 1.3B Full Model		**Model 1.4B Contextual Model**		**Model 1.5B 5-Year Lag**	
		b	se	b	Se	b	se
	Fixed effects						
	Constant	23.94***	(1.23)	23.93***	(1.23)	22.23***	(1.16)
	Year	-0.36***	(0.02)	-0.36***	(0.02)	-0.33***	(0.03)
	Year - squared	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
	Inc. rate (lagged 1 year)	0.00	(0.03)				
	Inc. rate (lagged 1 yr. raw)			0.00	(0.03)		
	Inc. rate (lagged 5 years)					-0.03	(0.02)
	Avg. incarceration rate	-0.81+	(0.42)	-0.82+	(0.43)	-0.73+	(0.40)
Level-1 controls	GDP	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
	GINI	0.60+	(0.35)	0.60+	(0.35)	0.23	(0.42)
	Homicide rate	0.01+	(0.01)	0.01+	(0.01)	0.01*	(0.01)
	Population 65+	0.09	(0.07)	0.09	(0.07)	0.05	(0.06)
	Fertility rate	1.29***	(0.29)	1.29***	(0.29)	1.05***	(0.23)
	Unemployment	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
	Urban population	-0.03	(0.05)	-0.03	(0.05)	-0.02	(0.04)
	Democracy	-0.05*	(0.02)	-0.05*	(0.02)	-0.02	(0.02)
	Excluded minority pop.	-0.11	(0.15)	-0.11	(0.15)	-0.06	(0.14)
Level-2 controls	GDP	0.08+	(0.05)	0.08+	(0.05)	0.07+	(0.04)
	GINI	-10.48	(8.61)	-10.48	(8.61)	-10.29	(7.90)
	Homicide rate	0.26***	(0.07)	0.26***	(0.07)	0.27***	(0.07)
	Population 65+	0.31+	(0.18)	0.31+	(0.18)	0.25	(0.17)
	Fertility rate	5.80***	(0.82)	5.80***	(0.82)	5.13***	(0.79)
	Unemployment	-0.04	(0.12)	-0.04	(0.12)	-0.03	(0.12)
	Urban population	-0.11***	(0.03)	-0.11***	(0.03)	-0.11***	(0.03)
	Democracy	-0.42***	(0.10)	-0.42***	(0.10)	-0.35***	(0.09)
	Excluded minority pop.	-1.00	(3.36)	-1.00	(3.36)	-2.46	(3.15)
	Hospital beds	0.10	(0.14)	0.10	(0.14)	0.09	(0.13)
	Health expenditure	-0.10*	(0.05)	-0.10*	(0.05)	-0.08*	(0.04)
	Government health exp.	-0.05+	(0.03)	-0.05+	(0.03)	-0.04	(0.02)
	Prison conditions (with US)	1.33**	(0.51)	1.33**	(0.51)	1.33**	(0.48)
	Social protection exp.	-0.01	(0.10)	-0.01	(0.10)	0.00	(0.09)
	Government decentral.	0.02	(0.05)	0.02	(0.05)	0.02	(0.05)
	Ethnic fraction.	4.61**	(1.62)	4.61**	(1.62)	4.95**	(1.51)
	Gun availability	-0.01	(0.03)	-0.01	(0.03)	-0.01	(0.03)
Region	Africa	15.08***	(3.11)	15.08***	(3.11)	14.84***	(3.05)
	Americas	2.83+	(1.67)	2.83+	(1.67)	2.79+	(1.57)
	Asia	-2.09	(1.47)	-2.09	(1.47)	-1.58	(1.37)
	Oceania	2.63*	(1.08)	2.63*	(1.08)	2.56*	(1.03)
	Model fit						
	AIC	4197.5		4197.5		3716.3	
	BIC	4442.0		4442.0		3953.8	
	Observations (Level-1)	1912		1912		1630	
	Countries (Level-2)	128		128		129	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

Table 11. Direct Effects of Incarceration on Infant Mortality Rate (with 5-Year Data)

		Model 1.6B Full Model		**Model 1.7B Contextual Model**	
		b	se	b	se
	Fixed effects				
	Constant	22.48***	(1.44)	22.76***	(1.42)
	Year	-1.49***	(0.16)	-1.49***	(0.16)
	Year - squared	0.11***	(0.03)	0.11***	(0.03)
	Inc. rate (lagged 1 period)	-0.15	(0.11)		
	Inc. rate (lagged 1 period raw)			-0.15	(0.11)
	Avg. incarceration rate	-0.94*	(0.42)	-0.79+	(0.43)
Level-1 controls	GDP	0.00	(0.01)	0.00	(0.01)
	GINI	5.25+	(3.08)	5.25+	(3.08)
	Homicide rate	0.06+	(0.03)	0.06+	(0.03)
	Population 65+	0.17+	(0.09)	0.17+	(0.09)
	Fertility rate	2.66***	(0.65)	2.66***	(0.65)
	Unemployment	0.01	(0.01)	0.01	(0.01)
	Urban population	-0.04	(0.04)	-0.04	(0.04)
	Democracy	-0.09	(0.09)	-0.09	(0.09)
	Excluded minority pop.	-1.42*	(0.71)	-1.42*	(0.71)
Level-2 controls	GDP	0.06	(0.06)	0.06	(0.06)
	GINI	-9.43	(8.62)	-9.43	(8.62)
	Homicide rate	0.24***	(0.07)	0.24***	(0.07)
	Population 65+	0.24	(0.18)	0.24	(0.18)
	Fertility rate	4.87***	(0.79)	4.87***	(0.79)
	Unemployment	-0.00	(0.12)	-0.00	(0.12)
	Urban population	-0.12***	(0.03)	-0.12***	(0.03)
	Democracy	-0.36**	(0.11)	-0.36**	(0.11)
	Excluded minority pop.	-2.33	(3.24)	-2.33	(3.24)
	Hospital beds	-0.01	(0.15)	-0.01	(0.15)
	Health expenditure	-0.05	(0.05)	-0.05	(0.05)
	Government health exp.	-0.04	(0.03)	-0.04	(0.03)
	Prison conditions (with US)	1.67**	(0.52)	1.67**	(0.52)
	Social protection exp.	0.02	(0.10)	0.02	(0.10)
	Government decentral.	0.02	(0.05)	0.02	(0.05)
	Ethnic fraction.	6.03***	(1.70)	6.03***	(1.70)
	Gun availability	-0.03	(0.03)	-0.03	(0.03)
Region	Africa	16.59***	(3.19)	16.59***	(3.19)
	Americas	2.90	(1.87)	2.90	(1.87)
	Asia	-0.82	(1.58)	-0.82	(1.58)
	Oceania	3.55**	(1.17)	3.55**	(1.17)
	Model fit				
	AIC	2782.2		2782.2	
	BIC	2970.5		2970.5	
	Observations (Level-1)	534		534	
	Countries (Level-2)	132		132	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

stronger effects in later years. The one-period lagged incarceration rate is not significantly related to infant mortality rate changes, either using annual data or 5-year-averaged data, controlling for other variables. A country's average incarceration rate is only marginally related to infant mortality rate in these models ($p<.1$), with the exception of the 5-year-averaged full model (Model 1.6B), where an increase in average incarceration rate of 1 per 1,000 population is related to a mean decrease of infant mortality rate of .94 deaths per 1,000 live births. This suggests a protective effect of incarceration on infant mortality (opposite than hypothesized). Similarly, only marginal contextual effects of incarceration were found for infant mortality rate.

There are some significant relationships from the control variables at Level 1 and Level 2. Briefly, fertility rate changes were strongly and positively associated with infant mortality rates, examining annual data or 5-year-average. An increase in fertility rate of one birth per woman is associated with a 1.29 higher infant mortality rate that year, using annual data; the association strengthens to a 2.66 higher infant mortality rate in a 5-year period when analyzing 5-year-averaged data. Democracy changes were less strongly and negatively related to this outcome with annual data, but not significantly related in the 5-year-period data. Excluded minority population was negatively related to infant mortality examining 5-year-periods of time. Homicide rates, fertility rates, prison conditions, and ethnic fractionalization were positively associated with infant mortality rates on average, while urban population and democracy were negatively related. An average democracy level being 1 point higher on a -10 (full autocracy) to 10 (full democracy) scale decreases average infant mortality rates by .42 (annual data) or .36 (5-year data). Africa has

significantly higher infant mortality rates than Europe, while the difference is smaller but still significant between Oceania and the reference region.

Multivariate Multilevel Model Results for Suicide Rate

The full multilevel model results for suicide rate are presented in Table 12 (annual data) and Table 13 (5-year data). The constant for Model 1.3C is 14.46, meaning that, for the average country in 1990 the mean suicide rate is about 14.5 per 100,000 population. The time variables are piecewise for this dependent variable, with the first trend (from 1990-1995) showing no significance, while the linear trend after 1995 is strong and negative, suggesting a one-year increase after 1995 is associated with a .18 decrease in suicide rate, controlling for other variables. The one-year lagged incarceration rate is not significantly related to suicide rate changes, but the 5-year lagged variable with annual data is significantly positively related to suicide. An incarceration rate increase of 1 per 1,000 population 5 years previous is associated with a .15 increase in suicide rate. The relationship for the 5-year-averaged data is still positive but only marginally significant. A country's average incarceration rate is only marginally related to suicide rate in the full annual model (Model 1.3C; $p<.1$); however, this relationship is significant when examining annual data with a 5-year lag or 5-year-averaged data (Models 1.4-5C). An increase in average incarceration rate of 1 per 1,000 population is related to a mean increase of suicide rate of .9 to 1.29 deaths per 100,000 population, respectively. No contextual effects of incarceration were found for suicide rate.

Control variables showed some significant relationships at both levels. At Level 1, homicide rate and urban population (annual data only) were significantly positively related to suicide rates, while fertility rate was negatively associated with suicide.

Table 12. Direct Effects of Incarceration on Suicide Rate (with Annual Data)

		Model 1.3C Full Model		Model 1.4C Contextual Model		Model 1.5C 5-Year Lag	
		b	se	b	se	b	se
	Fixed effects						
	Constant	14.46***	(2.00)	14.30***	(1.99)	14.50***	(2.06)
	Year - pre-peak (1990-95)	-0.06	(0.07)	-0.06	(0.07)	-0.19*	(0.09)
	Year - post-peak (1995-2019)	-0.18***	(0.04)	-0.18***	(0.04)	-0.17***	(0.04)
	Inc. rate (lagged 1 year)	0.09	(0.08)				
	Inc. rate (lagged 1 yr. raw)			0.09	(0.08)		
	Inc. rate (lagged 5 years)					0.15*	(0.07)
	Avg. incarceration rate	0.80+	(0.45)	0.70	(0.45)	0.90*	(0.43)
Level-1 controls	GDP	-0.01+	(0.00)	-0.01+	(0.00)	-0.01+	(0.00)
	GINI	-1.45	(1.15)	-1.45	(1.15)	-0.98	(1.33)
	Homicide rate	0.03***	(0.01)	0.03***	(0.01)	0.02**	(0.01)
	Population 65+	-0.00	(0.14)	-0.00	(0.14)	-0.06	(0.14)
	Fertility rate	-1.22**	(0.41)	-1.22**	(0.41)	-0.99*	(0.44)
	Unemployment	-0.00	(0.01)	-0.00	(0.01)	-0.00	(0.01)
	Urban population	0.11*	(0.05)	0.11*	(0.05)	0.11*	(0.05)
	Democracy	0.01	(0.01)	0.01	(0.01)	0.02	(0.01)
	Excluded minority pop.	0.11	(0.19)	0.11	(0.19)	-0.15	(0.26)
Level-2 controls	GDP	-0.02	(0.08)	-0.02	(0.08)	-0.01	(0.09)
	GINI	3.92	(7.14)	3.92	(7.14)	1.91	(8.17)
	Homicide rate	0.11+	(0.07)	0.11+	(0.07)	0.05	(0.06)
	Population 65+	-0.10	(0.24)	-0.10	(0.24)	-0.19	(0.26)
	Fertility rate	-1.06*	(0.46)	-1.06*	(0.46)	-1.25*	(0.51)
	Unemployment	-0.07	(0.11)	-0.07	(0.11)	0.05	(0.11)
	Urban population	-0.04	(0.03)	-0.04	(0.03)	-0.05	(0.03)
	Democracy	0.31**	(0.10)	0.31**	(0.10)	0.28**	(0.10)
	Excluded minority pop.	-4.85*	(2.24)	-4.85*	(2.24)	-3.89*	(1.85)
	Hospital beds	1.25***	(0.30)	1.25***	(0.30)	1.36***	(0.30)
	Health expenditure	-0.14	(0.09)	-0.14	(0.09)	-0.12	(0.09)
	Government health exp.	-0.07*	(0.03)	-0.07*	(0.03)	-0.05	(0.03)
	Prison conditions (with US)	-1.78**	(0.64)	-1.78**	(0.64)	-1.55*	(0.72)
	Social protection exp.	0.08	(0.15)	0.08	(0.15)	0.03	(0.15)
	Government decentral.	0.29***	(0.08)	0.29***	(0.08)	0.27***	(0.08)
	Ethnic fraction.	1.47	(1.60)	1.47	(1.60)	2.07	(1.72)
	Gun availability	0.06	(0.04)	0.06	(0.04)	0.05	(0.04)
Region	Africa	-0.72	(2.73)	-0.72	(2.73)	-0.62	(2.82)
	Americas	-4.17	(2.62)	-4.17	(2.62)	-3.46	(2.57)
	Asia	-2.76	(2.48)	-2.76	(2.48)	-2.91	(2.58)
	Oceania	-7.89**	(3.03)	-7.89**	(3.03)	-7.18*	(3.09)
	Model fit						
	AIC	4638.6		4638.6		4096.5	
	BIC	4883.1		4883.1		4333.9	
	Observations (Level-1)	1912		1912		1630	
	Countries (Level-2)	128		128		129	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

Table 13. Direct Effects of Incarceration on Suicide Rate (with 5-Year Data)

		Model 1.6C Full Model		**Model 1.7C Contextual Model**	
		b	se	b	se
	Fixed effects				
	Constant	13.45***	(1.97)	12.57***	(1.95)
	Year - pre-peak (1990-95)	0.00	(.)	0.00	(.)
	Year - post-peak (1995-2019)	-0.65**	(0.23)	-0.65**	(0.23)
	Inc. rate (lagged 1 period)	0.46+	(0.26)		
	Inc. rate (lagged 1 period raw)			0.46+	(0.26)
	Avg. incarceration rate	1.29**	(0.49)	0.83	(0.51)
Level-1 controls	GDP	-0.02	(0.01)	-0.02	(0.01)
	GINI	0.91	(4.28)	0.91	(4.28)
	Homicide rate	0.04+	(0.02)	0.04+	(0.02)
	Population 65+	-0.25	(0.16)	-0.25	(0.16)
	Fertility rate	-1.00*	(0.41)	-1.00*	(0.41)
	Unemployment	0.05+	(0.03)	0.05+	(0.03)
	Urban population	0.06	(0.05)	0.06	(0.05)
	Democracy	0.05	(0.03)	0.05	(0.03)
	Excluded minority pop.	-0.82	(1.77)	-0.82	(1.77)
Level-2 controls	GDP	0.02	(0.09)	0.02	(0.09)
	GINI	1.15	(7.56)	1.15	(7.56)
	Homicide rate	0.03	(0.06)	0.03	(0.06)
	Population 65+	0.03	(0.27)	0.03	(0.27)
	Fertility rate	-0.91	(0.56)	-0.91	(0.56)
	Unemployment	0.06	(0.11)	0.06	(0.11)
	Urban population	-0.05	(0.03)	-0.05	(0.03)
	Democracy	0.29**	(0.11)	0.29**	(0.11)
	Excluded minority pop.	-4.00*	(2.01)	-4.00*	(2.01)
	Hospital beds	1.23***	(0.28)	1.23***	(0.28)
	Health expenditure	-0.16+	(0.09)	-0.16+	(0.09)
	Government health exp.	-0.04	(0.03)	-0.04	(0.03)
	Prison conditions (with US)	-1.42*	(0.67)	-1.42*	(0.67)
	Social protection exp.	-0.00	(0.15)	-0.00	(0.15)
	Government decentral.	0.20**	(0.08)	0.20**	(0.08)
	Ethnic fraction.	1.51	(1.94)	1.51	(1.94)
	Gun availability	0.05	(0.04)	0.05	(0.04)
Region	Africa	-0.13	(2.68)	-0.13	(2.68)
	Americas	-2.62	(2.48)	-2.62	(2.48)
	Asia	-2.32	(2.54)	-2.32	(2.54)
	Oceania	-5.76*	(2.87)	-5.76*	(2.87)
	Model fit				
	AIC	2455.5		2455.5	
	BIC	2639.5		2639.5	
	Observations (Level-1)	534		534	
	Countries (Level-2)	132		132	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

One additional homicide that year is associated with .03 additional suicides (as both rates are per 100,000 population). At Level 2, democracy levels, hospital beds, and government decentralization were positively associated with suicide rates, and fertility rate (annual data only), excluded minority population, government percentage of health expenditure (annual data only), and prison conditions were negatively associated with suicide rates. A one-unit more decentralized government is associated with .29 higher suicide rates on average using annual data. Oceania has significantly lower suicide rates than Europe. Again, some of these findings may be counterintuitive and worth future research in their own right.

Multivariate Multilevel Model Results for HIV Prevalence

The full multilevel model results for HIV prevalence are presented in Table 14 (annual data) and Table 15 (5-year data). The constant for Model 1.3D is .39, meaning that, for the average country in 1990 the mean HIV prevalence is less than half of a percent of the population aged 15-49. The time variables are piecewise for this dependent variable, with both trends (from 1990-2001 and from 2001-2019) showing a positive trend; however, the earlier trend is stronger, with a one-year increase being associated with double (.02) the increase of the later trend (.01), controlling for other variables. The one-year lagged incarceration rate with annual data is significantly related to HIV prevalence changes, but the 5-year lagged variable with annual data and the 5-year-averaged data are not. An incarceration rate increase of 1 per 1,000 population is associated with a .01 percent decrease in HIV prevalence in the following year. However, a country's average incarceration rate was found to be significantly positively related to HIV prevalence in all models. An increase in average incarceration rate of 1 per 1,000

Table 14. Direct Effects of Incarceration on HIV Prevalence (with Annual Data)

		Model 1.3D Full Model		Model 1.4D Contextual Model		Model 1.5D 5-Year Lag	
		b	se	b	Se	b	se
	Fixed effects						
	Constant	0.39***	(0.10)	0.40***	(0.10)	0.44***	(0.13)
	Year - pre-peak (1990-2001)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
	Year - post-peak (2001-19)	0.01**	(0.00)	0.01**	(0.00)	0.01*	(0.00)
	Inc. rate (lagged 1 year)	-0.01*	(0.00)				
	Inc. rate (lagged 1 yr. raw)			-0.01*	(0.00)		
	Inc. rate (lagged 5 years)					-0.00	(0.01)
	Avg. incarceration rate	0.14***	(0.04)	0.15***	(0.04)	0.18***	(0.04)
Level-1 controls	GDP	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
	GINI	-0.24*	(0.10)	-0.24*	(0.10)	-0.21+	(0.12)
	Homicide rate	-0.00***	(0.00)	-0.00***	(0.00)	-0.00	(0.00)
	Population 65+	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)
	Fertility rate	0.01	(0.02)	0.01	(0.02)	0.03	(0.03)
	Unemployment	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
	Urban population	-0.01*	(0.01)	-0.01*	(0.01)	-0.01*	(0.01)
	Democracy	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
	Excluded minority pop.	0.01	(0.01)	0.01	(0.01)	-0.01	(0.01)
Level-2 controls	GDP	-0.00	(0.01)	-0.00	(0.01)	-0.00	(0.01)
	GINI	2.24**	(0.71)	2.24**	(0.71)	3.10***	(0.92)
	Homicide rate	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
	Population 65+	0.02+	(0.01)	0.02+	(0.01)	0.03**	(0.01)
	Fertility rate	-0.01	(0.05)	-0.01	(0.05)	0.06	(0.06)
	Unemployment	-0.01	(0.01)	-0.01	(0.01)	0.00	(0.01)
	Urban population	-0.01**	(0.00)	-0.01**	(0.00)	-0.01**	(0.00)
	Democracy	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
	Excluded minority pop.	-0.37	(0.25)	-0.37	(0.25)	-0.76*	(0.35)
	Hospital beds	-0.04+	(0.02)	-0.04+	(0.02)	-0.04*	(0.02)
	Health expenditure	0.00	(0.01)	0.00	(0.01)	0.01	(0.01)
	Government health exp.	-0.01*	(0.00)	-0.01*	(0.00)	-0.01**	(0.00)
	Prison conditions (with US)	-0.05	(0.05)	-0.05	(0.05)	-0.08	(0.05)
	Social protection exp.	0.02*	(0.01)	0.02*	(0.01)	0.02***	(0.01)
	Government decentral.	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)
	Ethnic fraction.	-0.01	(0.17)	-0.01	(0.17)	0.11	(0.18)
	Gun availability	-0.01*	(0.00)	-0.01*	(0.00)	-0.01***	(0.00)
Region	Africa	5.35***	(1.18)	5.35***	(1.18)	5.17***	(1.27)
	Americas	0.01	(0.23)	0.01	(0.23)	-0.02	(0.24)
	Asia	-0.21+	(0.11)	-0.21+	(0.11)	-0.20	(0.14)
	Oceania	0.00	(0.09)	0.00	(0.09)	0.03	(0.10)
	Model fit						
	AIC	-2307.5		-2305.5		-2067.6	
	BIC	-2078.3		-2071.2		-1840.9	
	Observations (Level-1)	1206		1206		1020	
	Countries (Level-2)	90		90		91	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

Table 15. Direct Effects of Incarceration on HIV Prevalence (with 5-Year Data)

		Model 1.6D Full Model		**Model 1.7D Contextual Model**	
		b	se	b	se
	Fixed effects				
	Constant	0.58***	(0.12)	0.60***	(0.12)
	Year - pre-peak (1990-2001)	0.09***	(0.02)	0.09***	(0.02)
	Year - post-peak (2001-19)	0.05**	(0.02)	0.05**	(0.02)
	Inc. rate (lagged 1 period)	-0.01	(0.02)		
	Inc. rate (lagged 1 period raw)			-0.01	(0.02)
	Inc. rate (lagged 5 years)				
	Avg. incarceration rate	0.21***	(0.04)	0.22***	(0.05)
Level-1 controls	GDP	-0.00	(0.00)	-0.00	(0.00)
	GINI	-0.11	(0.34)	-0.11	(0.34)
	Homicide rate	-0.00	(0.00)	-0.00	(0.00)
	Population 65+	-0.01	(0.01)	-0.01	(0.01)
	Fertility rate	0.06	(0.04)	0.06	(0.04)
	Unemployment	-0.00	(0.00)	-0.00	(0.00)
	Urban population	-0.01*	(0.01)	-0.01*	(0.01)
	Democracy	-0.00	(0.00)	-0.00	(0.00)
	Excluded minority pop.	0.01	(0.10)	0.01	(0.10)
Level-2 controls	GDP	-0.01	(0.01)	-0.01	(0.01)
	GINI	4.00***	(0.87)	4.00***	(0.88)
	Homicide rate	0.00	(0.01)	0.00	(0.01)
	Population 65+	0.04***	(0.01)	0.04***	(0.01)
	Fertility rate	0.04	(0.05)	0.04	(0.05)
	Unemployment	-0.00	(0.01)	-0.00	(0.01)
	Urban population	-0.01*	(0.00)	-0.01*	(0.00)
	Democracy	0.01	(0.01)	0.01	(0.01)
	Excluded minority pop.	-0.94*	(0.38)	-0.94*	(0.38)
	Hospital beds	-0.06***	(0.02)	-0.06***	(0.02)
	Health expenditure	0.01	(0.01)	0.01	(0.01)
	Government health exp.	-0.01***	(0.00)	-0.01***	(0.00)
	Prison conditions (with US)	-0.05	(0.05)	-0.05	(0.05)
	Social protection exp.	0.02***	(0.00)	0.02***	(0.00)
	Government decentral.	-0.01	(0.00)	-0.01	(0.00)
	Ethnic fraction.	0.22	(0.16)	0.22	(0.16)
	Gun availability	-0.01***	(0.00)	-0.01***	(0.00)
Region	Africa	4.95***	(1.23)	4.95***	(1.23)
	Americas	-0.19	(0.26)	-0.19	(0.26)
	Asia	-0.29*	(0.15)	-0.29*	(0.15)
	Oceania	-0.04	(0.10)	-0.04	(0.10)
	Model fit				
	AIC	180.4		180.4	
	BIC	358.9		358.9	
	Observations (Level-1)	358		358	
	Countries (Level-2)	94		94	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

population is related to a mean increase of suicide rate of .14 to .21 percentage points, depending on the model. Contextual effects of incarceration were also found for HIV prevalence, suggesting that if we took two countries that differed 1 unit on average incarceration rate and observed them on an occasion when they have the same incarceration rate, the contextual effect of being the higher incarceration country would be +.15 or +.22 HIV prevalence, for annual data and 5-year data, respectively.

Again, there are some significant Level-1 and Level-2 control variables. Over time, changes in GINI (income inequality), homicide rate, and urban population are negatively associated with HIV prevalence (the first two only for annual data). A 1% increase in urban population is associated with .01 lower HIV prevalence that year or period, using annual or 5-year estimates. On average, GINI, population 65+, and social protection expenditure are positively related to HIV prevalence, while urban population, hospital beds, percentage government health expenditure, and gun availability are negatively related to HIV prevalence. Going from complete equality to complete inequality on average is associated with 2.24 percent higher HIV prevalence among 15-49-year-olds on average using annual estimates and 4.00 percent higher HIV prevalence with 5-year data. Africa has significantly higher HIV prevalence than Europe, while Asia has marginally or significantly lower HIV prevalence than Europe, depending on the dataset and model.

Multivariate Multilevel Model Results for TB Incidence

The full multilevel model results for TB incidence are presented in Table 16 (annual data) and Table 17 (5-year data). The constant for Model 1.3E is 99.29, meaning that, for the average country in 2000 the mean TB incidence is about 100 per 100,000

Table 16. Direct Effects of Incarceration on TB Incidence (with Annual Data)

		Model 1.3E Full Model		Model 1.4E Contextual Model		Model 1.5E 5-Year Lag	
		b	se	b	se	b	se
	Fixed effects						
	Constant	99.29***	(21.52)	94.34***	(21.65)	98.39***	(21.38)
	Year	-0.49+	(0.30)	-0.49+	(0.30)	-0.47	(0.30)
	Year - squared	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)
	Inc. rate (lagged 1 yr)	2.89**	(0.97)				
	Inc. rate (lagged 1 yr. raw)			2.89**	(0.97)		
	Inc. rate (lagged 5 yrs)					1.47*	(0.62)
	Avg. inc. rate	10.39+	(6.04)	7.50	(6.17)	10.18+	(5.98)
Level-1 controls	GDP	0.02+	(0.01)	0.02+	(0.01)	0.02+	(0.01)
	GINI	-1.72	(6.25)	-1.72	(6.25)	-5.22	(6.95)
	Homicide rate	0.01	(0.05)	0.01	(0.05)	0.01	(0.07)
	Population 65+	1.22	(0.86)	1.22	(0.86)	0.69	(0.88)
	Fertility rate	-2.64	(2.36)	-2.64	(2.36)	-3.66	(2.63)
	Unemployment	0.00	(0.06)	0.00	(0.06)	-0.02	(0.05)
	Urban population	-1.17*	(0.52)	-1.17*	(0.52)	-1.21*	(0.57)
	Democracy	0.16	(0.14)	0.16	(0.14)	0.02	(0.22)
	Exc. minority pop.	3.72	(2.39)	3.72	(2.39)	0.35	(2.89)
Level-2 controls	GDP	0.36	(0.46)	0.36	(0.46)	0.36	(0.46)
	GINI	132.52	(85.24)	132.49	(85.24)	138.84	(84.87)
	Homicide rate	-0.61	(0.42)	-0.61	(0.42)	-0.53	(0.41)
	Population 65+	3.25+	(1.67)	3.25+	(1.67)	3.28*	(1.66)
	Fertility rate	47.96**	(15.01)	47.96**	(15.01)	46.42**	(14.74)
	Unemployment	0.17	(1.14)	0.17	(1.14)	0.06	(1.15)
	Urban population	-1.13***	(0.27)	-1.13***	(0.27)	-1.13***	(0.27)
	Democracy	2.18*	(1.03)	2.18*	(1.03)	2.10*	(1.02)
	Exc. minority pop.	-49.39	(51.10)	-49.38	(51.10)	-56.38	(50.74)
	Hospital beds	3.50*	(1.68)	3.50*	(1.68)	3.34*	(1.69)
	Health expenditure	-0.32	(0.54)	-0.32	(0.54)	-0.36	(0.54)
	Gov't health exp.	0.03	(0.46)	0.03	(0.46)	0.00	(0.46)
	Prison cond. (w US)	12.12+	(7.10)	12.12+	(7.10)	12.01+	(7.02)
	Social protect. exp.	0.67	(0.97)	0.67	(0.97)	0.72	(0.98)
	Gov't decentral.	1.01*	(0.41)	1.01*	(0.41)	1.00*	(0.41)
	Ethnic fraction.	43.31*	(17.12)	43.31*	(17.12)	42.95*	(17.26)
	Gun availability	-1.03***	(0.27)	-1.03***	(0.27)	-1.01***	(0.27)
Region	Africa	162.47*	(70.30)	162.47*	(70.30)	134.04*	(68.23)
	Americas	-11.31	(17.31)	-11.31	(17.31)	-12.85	(17.75)
	Asia	75.72*	(29.68)	75.72*	(29.68)	74.87*	(29.57)
	Oceania	93.35	(63.71)	93.35	(63.71)	94.21	(64.04)
	Model fit						
	AIC	10865.2		10865.2		9966.5	
	BIC	11107.0		11107.0		10203.5	
	Observations (Level-1)	1593		1593		1430	
	Countries (Level-2)	128		128		129	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

Table 17. Direct Effects of Incarceration on TB Incidence (with 5-Year Data)

		Model 1.6E Full Model		**Model 1.7E Contextual Model**	
		b	se	B	se
	Fixed effects				
	Constant	96.96***	(23.40)	82.40***	(23.95)
	Year	-5.41*	(2.16)	-5.41*	(2.16)
	Year - squared	-0.17	(0.52)	-0.17	(0.52)
	Inc. rate (lagged 1 period)	7.61***	(1.74)		
	Inc. rate (lagged 1 period raw)			7.61***	(1.74)
	Inc. rate (lagged 5 years)				
	Avg. incarceration rate	7.14	(6.82)	-0.47	(7.41)
Level-1 controls	GDP	0.16*	(0.07)	0.16*	(0.07)
	GINI	-22.05	(28.36)	-22.05	(28.36)
	Homicide rate	0.19+	(0.10)	0.19+	(0.10)
	Population 65+	1.35	(0.94)	1.35	(0.94)
	Fertility rate	-5.62	(4.94)	-5.62	(4.94)
	Unemployment	0.13	(0.11)	0.13	(0.11)
	Urban population	-0.94*	(0.48)	-0.94*	(0.48)
	Democracy	0.53	(0.71)	0.53	(0.71)
	Excluded minority pop.	0.08	(12.53)	0.08	(12.53)
Level-2 controls	GDP	0.27	(0.55)	0.27	(0.55)
	GINI	114.28	(81.22)	114.26	(81.22)
	Homicide rate	-0.51	(0.40)	-0.51	(0.40)
	Population 65+	2.21	(1.84)	2.21	(1.84)
	Fertility rate	38.64*	(15.47)	38.64*	(15.47)
	Unemployment	-0.25	(1.18)	-0.25	(1.18)
	Urban population	-1.11***	(0.26)	-1.11***	(0.26)
	Democracy	2.29*	(0.97)	2.29*	(0.97)
	Excluded minority pop.	-33.87	(48.61)	-33.87	(48.61)
	Hospital beds	3.43+	(1.84)	3.43+	(1.84)
	Health expenditure	-0.18	(0.56)	-0.18	(0.56)
	Government health exp.	0.19	(0.50)	0.19	(0.50)
	Prison conditions (with US)	15.82*	(7.12)	15.82*	(7.12)
	Social protection exp.	1.05	(1.02)	1.05	(1.02)
	Government decentral.	0.93*	(0.45)	0.93*	(0.45)
	Ethnic fraction.	41.95*	(16.35)	41.95*	(16.35)
	Gun availability	-0.99***	(0.27)	-0.99***	(0.27)
Region	Africa	157.63*	(68.28)	157.65*	(68.28)
	Americas	-12.17	(18.02)	-12.16	(18.02)
	Asia	74.94*	(29.17)	74.94*	(29.17)
	Oceania	100.00	(66.21)	100.00	(66.21)
	Model fit				
	AIC	4340.8		4338.8	
	BIC	4530.2		4524.1	
	Observations (Level-1)	454		454	
	Countries (Level-2)	132		132	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects.

population. Only the linear time variable is marginally significant, suggesting a weak negative trend (that may lessen over time). The one-year lagged incarceration rate is significantly related to TB incidence changes. An incarceration rate increase of 1 per 1,000 population is associated with a 1.5 to 7.6 unit increase in TB incidence, depending on the model and data type. A country's average incarceration rate was found to be only marginally (but also positively) related to average TB incidence for annual data only. No contextual effects were found for TB incidence.

Only a couple Level-1 control variables were associated with TB incidence, while many more were found at Level 2. Urban population changes were negatively associated with TB incidence, while GDP was positively associated (for 5-year-averaged models only). A 1% increase in urban population is related to a 1.17 per 100,000 population drop in TB incidence that year. At Level 2, fertility rate, democracy, hospital beds (annual data only), prison conditions (5-year data only), government decentralization, and ethnic fractionalization were positively associated with TB incidence. Going from a completely homogenous population to a completely racially diverse one is associated with an increase in average TB incidence of 42-43 per 100,000 population, depending on 1- or 5-year estimates. Urban population and gun availability were negatively associated with TB incidence. Africa and, less so, Asia have significantly higher TB incidence than Europe.

Summary of Multivariate Multilevel Modeling Results for RQ1

Table 18 provides a simplified representation of the findings related to incarceration rate for all dependent variables. A negative relationship was found between incarceration rate and life expectancy, although this effect was only marginally significant between countries. For annual data, an increase in incarceration rate of 1 per

Table 18. Overall Simplified Results for Incarceration Rate Direct Effects on Population Health Outcomes

	Models 1.3A-E **Full Model**	**Models 1.4A-E** **Full Contextual Model**	**Models 1.5A-E** **Full Model, 5-Year Lag**	**Models 1.6A-E** **5-Year Full Model**	**Models 1.7A-E** **5-Year Contextual Model**
Life expectancy					
Inc. rate (1 yr lag)	-*			-**	
Inc. rate (raw, lag)		-*			-**
Inc. rate (5 yr lag)			NS		
Avg. inc. rate	-†	NS	-†	-†	NS
Infant mortality rate					
Inc. rate (1 yr lag)	NS			NS	
Inc. rate (raw, lag)		NS			NS
Inc. rate (5 yr lag)			NS		
Avg. inc. rate	-†	-†	-†	-*	-†
Suicide rate					
Inc. rate (1 yr lag)	NS			+†	
Inc. rate (raw, lag)		NS			+†
Inc. rate (5 yr lag)			+*		
Avg. inc. rate	+†	NS	+*	+**	NS
HIV prevalence					
Inc. rate (1 yr lag)	-*			NS	
Inc. rate (raw, lag)		-*			NS
Inc. rate (5 yr lag)			NS		
Avg. inc. rate	+***	+***	+***	+***	+***
TB incidence					
Inc. rate (1 yr lag)	+**			+***	
Inc. rate (raw, lag)		+**			+***
Inc. rate (5 yr lag)			+*		
Avg. inc. rate	+†	NS	+†	NS	NS

Notes. † p<.1; * p<.05; ** p < .01; *** p < .001; + = positive association, - = negative association.

1,000 population is associated with a decrease in life expectancy of .09 years in the following year. No contextual effects were discovered. A negative relationship was also found between incarceration and infant mortality rate. This relationship is in the opposite direction as hypothesized (therefore a protective effect); however, the relationship is mostly weak (marginal), except in the 5-year-averaged full model where it is significant at the $p<.05$ level. An increase in average incarceration rate of 1 per 1,000 population is related to a mean decrease of infant mortality rate of .94 deaths per 1,000 live births. Marginal negative contextual effects were found. For suicide rate, there may be a longer-term relationship with incarceration rates, as significant positive effects were found over time for the 5-year lag and marginally for the 5-year dataset. An incarceration rate increase of 1 per 1,000 population 5 years previous is associated with a .15 increase in suicide rate. On average, there were significant positive effects at the country level with the 5-year lag and 5-year dataset, although no contextual effects were found. An increase in average incarceration rate of 1 per 1,000 population is related to a mean increase of suicide rate of .9 to 1.29 deaths per 100,000 population, respectively. HIV prevalence was related to incarceration rates in opposing directions based on level; at Level 1 there was a significant negative relationship found in the annual data, while at Level 2 there were strong significant positive relationships found in all models (suggesting contextual effects as well). For instance, using annual data, an incarceration rate increase of 1 per 1,000 population is associated with a .01 percent decrease in HIV prevalence in the following year; however, an increase in average incarceration rate of 1 per 1,000 population is related to a mean increase of HIV prevalence of .14 to .18 percentage points. Incarceration rates were positively related to TB incidence across all models over

time, but only marginally related at the country level in certain models. An incarceration rate increase of 1 per 1,000 population is associated with a 2.9 per 100,000 population increase in TB incidence in the following year. These results suggest that incarceration rates are related to population health outcomes, although these relationships are not always straightforward or in the hypothesized direction. Therefore, it is worth examining these relationships further.

Sensitivity Analyses

Before moving on, it is worth noting that these results may be influenced by outliers, as mentioned early in this section. Residuals were examined to find outliers at Level 1 and Level 2 and determine whether these were influential. There were many observations that had Level-1 standardized residuals above the traditional z>3 cut-off (Osborne & Overbay, 2004); however, these were not seen to be outliers in the traditional sense but rather an effect of the skewed data, so these were kept in the models. Level-2 residuals were examined graphically and models were run without countries that appeared to stray from the q-q plot line substantially. There were at least 2 countries that seemed to be outliers for each dependent variable, listed below.

- Life expectancy: Albania, Australia, New Zealand, and Switzerland
- Infant mortality rate: Qatar and United Arab Emirates (UAE)
- Suicide rate: India and Kyrgyzstan
- HIV prevalence: Spain, Thailand, and Ukraine
- TB incidence: Haiti, Netherlands, Norway, Romania, Spain, and Ukraine

Results of the full models (Models 1.3A-E) run without these potentially influential country observations (not shown) will only be discussed for incarceration rate variables,

although there were some changes in other control variables. For life expectancy, the only difference resulted from the exclusion of New Zealand, in that now there was a significant negative country-level relationship, which was only marginal before. For infant mortality rate, country-level incarceration rate was no longer marginally significant when excluding either Qatar or UAE. Similarly, country-level incarceration rate was no longer marginally significant when excluding India from suicide rate models. For HIV prevalence, without Thailand there was a stronger relationship with incarceration rate over time but no country-level. Finally, excluding Romania, there was a significant positive country-level relationship with TB incidence and incarceration rates. These sensitivities will be discussed later and may offer opportunities for further research; however, these results showed that incarceration rate findings were mainly robust to exclusion of potential outlying observations.

The United States. Although the U.S. was not shown to be an outlier based on residuals, it still could have been influential, as shown by the Wildeman (2016) research and what we know about incarceration levels there as compared to most other countries. Therefore, the main models with annual data were run without the U.S. to determine whether there were any differences in findings. These results are shown in the Appendix G. Findings are mostly similar to those shown above, with the exception of the following: marginally significant ($p<.1$) average effects of incarceration are non-significant for both life expectancy and TB incidence, while marginally significant average effects of incarceration are highly significant for infant mortality rate, suggesting that the U.S. likely has a positive relationship between incarceration and infant mortality that diminished a strong negative relationship seen in the rest of the sample.

CHAPTER 6: RQ2 RESULTS – INVESTIGATION OF MODERATING EFFECTS

RQ2) Are the effects of incarceration rates on population health (2A: life expectancy; 2B: infant mortality; 2C: suicide rates; 2D: HIV prevalence; 2E: TB incidence) moderated by specific country contexts (racial/ethnic diversity; social protection expenditure; or prison conditions)?

This section looks at results for models attempting to answer the question of whether certain variables may moderate the relationship between incarceration and population health outcomes. These models explore this question in two ways: through interactions and subsamples. Interactions allow for explorations of different levels of the moderating variables with different levels of the incarceration rate variables, while the subsamples, of countries with below or above average estimates of each moderator, examine which characteristics are driving overall associations.[9] The next subsections are broken out by dependent variable. Each subsection includes a review of moderation models based on interactions (.i models) and subsamples (.s models). Interaction models and full subsample models are shown in Appendix H (interaction models are odd numbers, subsamples are even numbers) due to space constraints; only graphs of average marginal effects of incarceration for significant relationships in the interaction models, that are significant for models with and without the U.S., are shown and discussed below. Also, as a reminder, subsample membership is in Appendix B. This section ends with an overview of the results by moderator (EP=excluded population; EF=ethnic fractionalization; SP=social protection expenditure; PC=prison conditions).

[9] It is important to note up front that not all of the subsample models converged (indicated by "DNC" (did not converge) in tables), likely due to the complexity of the models with a reduced sample size. A majority of the models, though, did successfully converge and therefore the results are shown below.

Life Expectancy Moderation Models

Interactions

Interaction model results show one significant moderating interaction for the life expectancy analyses: country-average incarceration rate by country-average social protection expenditure. This significant interaction suggests that incarceration is significantly negatively related to life expectancy at high levels of social protection expenditure, over 14% of GDP on average. However, when this model was run without the U.S., which has an average social protection expenditure of 17.5% of GDP using this measure, the interaction became non-significant (not shown). This suggests that, rather than an overall relationship between incarceration and life expectancy that is moderated by high levels of social expenditure, there is a strong negative relationship between incarceration and life expectancy in the U.S. (which has a fairly high social protection expenditure level according to this measure) that was driving this overall result.

Subsamples

Results from the subsample models are shown in Table 19 (full subsample models shown in Appendix Table 36). The full model shows a significant negative relationship over time and a marginally significant negative country-level relationship. These tables show that the significant negative relationship between incarceration and life expectancy does not occur across all subsamples. This relationship is only significant in subsamples of countries that have above average excluded minority population or ethnic fractionalization, below average social protection expenditure, and above average prison

Table 19. Moderated Effects of Incarceration on Life Expectancy (using Subsamples)

	Model 1.3A Full Model		**Model 2.1A.s EP Below Average**		**Model 2.2A.s EP Above Average**		**Model 2.3A.s EF Below Average**		**Model 2.4A.s EF Above Average**		**Model 2.5A.s SP Below Average**	
	b	se	b	se	b	se	b	Se	b	se	b	se
Fixed effects												
Constant	64.07***	(0.92)	64.96***	(1.22)	64.87***	(3.83)	64.77***	(1.29)	66.88***	(2.28)	64.54***	(3.52)
Year	0.24***	(0.02)	0.22***	(0.01)	0.24***	(0.02)	0.23***	(0.01)	0.22***	(0.02)	0.21***	(0.01)
Inc. rate (1 yr lag)	-0.09*	(0.04)	-0.04	(0.03)	-0.10*	(0.04)	-0.05	(0.04)	-0.08*	(0.04)	-0.11**	(0.03)
Avg. inc. rate	-0.45+	(0.26)	-0.06	(0.46)	-0.18	(1.04)	-0.99	(0.64)	0.02	(0.71)	0.48	(0.79)
Model fit												
AIC	1593.40		1061.08		602.99		744.16		923.71		1087.59	
BIC	1837.85		1295.30		785.21		966.37		1118.25		1284.35	
Obs. (L-1)	1912		1346		566		1153		759		800	
Countries (L-2)	128		88		40		68		60		71	
	Model 1.3A Full Model		**Model 2.6A.s SP Above Average**		**Model 2.7A.s PC (no US) Below Average**		**Model 2.8A.s PC (no US) Above Average**		**Model 2.9A.s PC (with US) Below Average**		**Model 2.10A.s PC (with US) Above Average**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Constant	64.07***	(0.92)	66.66***	(1.85)	64.42***	(1.44)	66.03***	(2.44)	64.41***	(1.44)	66.41***	(2.44)
Year	0.24***	(0.02)	0.24***	(0.01)	0.21***	(0.01)	0.24***	(0.01)	0.21***	(0.01)	0.24***	(0.01)
Inc. rate (1 yr lag)	-0.09*	(0.04)	-0.01	(0.04)	-0.03	(0.04)	-0.08*	(0.03)	-0.03	(0.04)	-0.07*	(0.03)
Avg. inc. rate	-0.45+	(0.26)	-0.48	(0.47)	0.01	(0.60)	0.60	(0.57)	0.01	(0.60)	0.61	(0.58)
Model fit												
AIC	1593.40		589.37		677.13		970.28		677.13		972.49	
BIC	1837.85		815.00		896.84		1186.98		896.84		1190.41	
Obs. (L-1)	1912		1112		975		912		975		937	
Countries (L-2)	128		57		56		71		56		72	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Level-1, Level-2, and region controls are still included but not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

condition scores (indicating worse prison conditions), both with and without the U.S. While not significant, the other subsamples still suggest this relationship is negative over time. Coefficients do not differ greatly, but the largest coefficient for incarceration rate over time is within the "below average social protection expenditure" sample, suggesting that an increase in incarceration rate of 1 per 1,000 population in these countries is associated with an expected decrease in life expectancy by .11 years. None of these subsamples show a significant effect of average incarceration rate on life expectancy.

Overall, moderation results suggest that country-level racial diversity, social protection, and prison conditions can affect the relationship between incarceration rates and life expectancy based on a combination of country contexts. The subsample analyses revealed that the negative relationship found in the full model (Model 1.3A) over time was primarily driven by countries that had a higher proportion of excluded minority populations, higher ethnic fractionalization, lower social protection expenditure, and/or worse prison conditions. The other subsamples also showed a negative relationship, but not strong enough to be significant. The interaction analyses found a significant interaction between average incarceration rate and social protection expenditure, but this was driven by high average expenditure in the U.S. Low social protection expenditure may allow changes in incarceration to affect life expectancy over time, but the comparatively high level of protection in the U.S. does not mitigate negative outcomes.

Infant Mortality Rate Moderation Models

Interactions

There were three significant interactions found in models with infant mortality rate as the outcome: lagged incarceration by social protection, average incarceration by

social protection, and average incarceration by prison conditions (including the U.S.). However, similar to life expectancy, the interactions between incarceration and social protection expenditure were driven by the U.S. These relationships suggested a significant protective effect on infant mortality rates at low levels of social protection expenditure (over time and on average) and an increase of infant mortality rates at high levels of social protection (over time). However, these interactions were not significant when the U.S. was removed from the models, and are therefore not shown or further discussed below. Prison conditions were also only found to affect the relationship between incarceration and infant mortality rate (average incarceration rates are significantly negatively related to infant mortality rates when prison conditions are good) when the U.S. was included and therefore are also not further discussed.

Subsamples

Results from the subsample models for infant mortality rates are shown in Table 20 (full subsample models shown in Appendix Table 38). Model 1.3B shows a non-significant relationship between incarceration rates and infant mortality rates over time, and a marginally significant negative relationship at the country level. Subsample analyses generally look similar to the full model, except in the case of countries with above-average excluded minority population and prison conditions (i.e. worse). The former is only marginally significant over time, while the latter shows a significant positive relationship (and a marginally significant negative one at the country level). Models 2.8B.s and 2.10B.s suggest that an increase in incarceration rate of 1 per 1,000 population in countries with worse than average prison conditions is associated with an increase in infant mortality rate by .35 per 1,000 live births excluding the U.S. or

Table 20. Moderated Effects of Incarceration on Infant Mortality Rate (using Subsamples)

	Model 1.3B Full Model		**Model 2.1B.s EP Below Average**		**Model 2.2B.s EP Above Average**		**Model 2.3B.s EF Below Average**		**Model 2.4B.s EF Above Average**		
	b	se	b	se	b	se	b	Se	b	se	
Fixed effects											
Constant	23.94***	(1.23)	28.13***	(3.42)	27.53*	(13.59)	22.49***	(3.96)	19.52**	(6.31)	
Year	-0.36***	(0.02)	-0.34***	(0.01)	-0.61***	(0.06)	-0.37***	(0.01)	-0.35***	(0.03)	
Year - squared	0.01***	(0.00)	0.01***	(0.00)	0.00+	(0.00)	0.01***	(0.00)	0.01***	(0.00)	
Inc. rate (1 yr lag)	0.00	(0.03)	-0.03	(0.04)	0.14+	(0.08)	-0.04	(0.04)	0.03	(0.04)	
Avg. inc. rate	-0.81+	(0.42)	-1.62	(1.08)	-0.50	(3.95)	-0.61	(1.46)	-0.95	(2.30)	
Model fit											
AIC	4197.54		2452.29		1633.44		1879.12		2415.52		
BIC	4442.00		2681.30		1820.00		2101.33		2614.70		
Obs. (L-1)	1912		1346		566		1153		759		
Countries (L-2)	128		88		40		68		60		
	Model 1.3B Full Model		**Model 2.6B.s SP Above Average**		**Model 2.7B.s PC (no US) Below Average**		**Model 2.8B.s PC (no US) Above Average**		**Model 2.9B.s PC (with US) Below Average**		**Model 2.10B.s PC (with US) Above Average**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Constant	23.94***	(1.23)	15.19***	(2.76)	19.93***	(2.34)	32.16***	(8.97)	19.93***	(2.34)	29.91**	(9.09)
Year	-0.36***	(0.02)	-0.34***	(0.01)	-0.36***	(0.01)	-1.10***	(0.08)	-0.36***	(0.01)	-0.94***	(0.08)
Year - squared	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.00	(0.00)	0.01***	(0.00)	-0.00	(0.00)
Inc. rate (1 yr lag)	0.00	(0.03)	0.06	(0.05)	-0.02	(0.03)	0.35*	(0.14)	-0.02	(0.03)	0.48***	(0.14)
Avg. inc. rate	-0.81+	(0.42)	-0.49	(1.08)	-1.29	(0.92)	-3.49+	(2.01)	-1.29	(0.92)	-3.40+	(1.99)
Model fit												
AIC	4197.54		760.59		625.22		3222.31		625.22		3307.29	
BIC	4442.00		976.19		840.05		3429.38		840.05		3520.37	
Obs. (L-1)	1912		1112		975		912		975		937	
Countries (L-2)	128		57		56		71		56		72	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse; Model 2.5B.s (below average social protection expenditure) did not converge and the results are therefore not shown here.

a .48 increase including the U.S. Average incarceration rates are marginally significantly related to infant mortality rates in the opposite direction, suggesting that a one unit increase in average incarceration rate was related to lower average infant mortality rates by 3.4-3.5 per 1,000 live births, which, though still only marginally significant is a larger effect than in the full sample. Therefore, increases in incarceration rates were associated with higher infant mortality rates over time in countries with worse prison conditions, including the U.S., but on average higher incarceration rates were (marginally) associated with lower infant mortality rates in these countries.

Overall, moderation results suggest that prison conditions and racial diversity may influence the way incarceration relates to infant mortality rates, over time and across countries. The subsample models showed that increases in incarceration over time were associated with increases in infant mortality rates in countries with worse than average prison conditions, but marginally related to better infant mortality rates on average. Countries with above average excluded minority populations (n=40) also had a marginal positive relationship with incarceration and infant mortality rates over time.

Suicide Rate Moderation Models

Interactions

Two significant interactions were found for the suicide rate models: average incarceration by ethnic fractionalization and average incarceration by social protection expenditure. These held even when the U.S. was excluded from the models. Figure 19 and Figure 20 show the average marginal effects of country-level incarceration on suicide rate, at all values of ethnic fractionalization and social protection expenditure, respectively, controlling for the main effects, other Level-1 and Level-2 variables, and

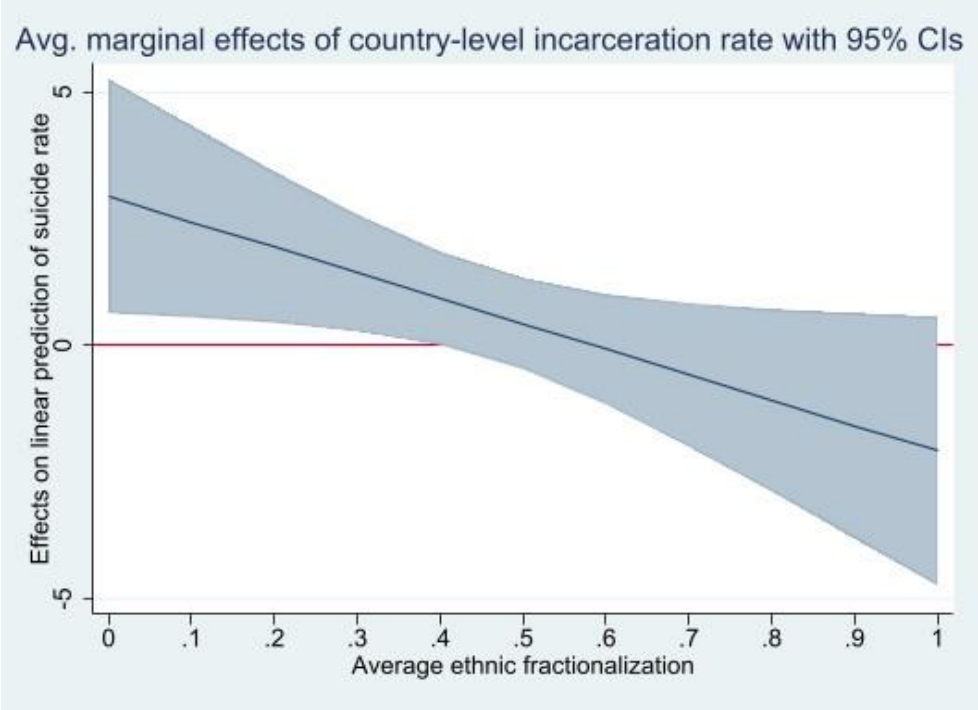

Figure 19. Average Marginal Effects of Country-Level Incarceration Rate on Suicide Rate Across All Levels of Ethnic Fractionalization

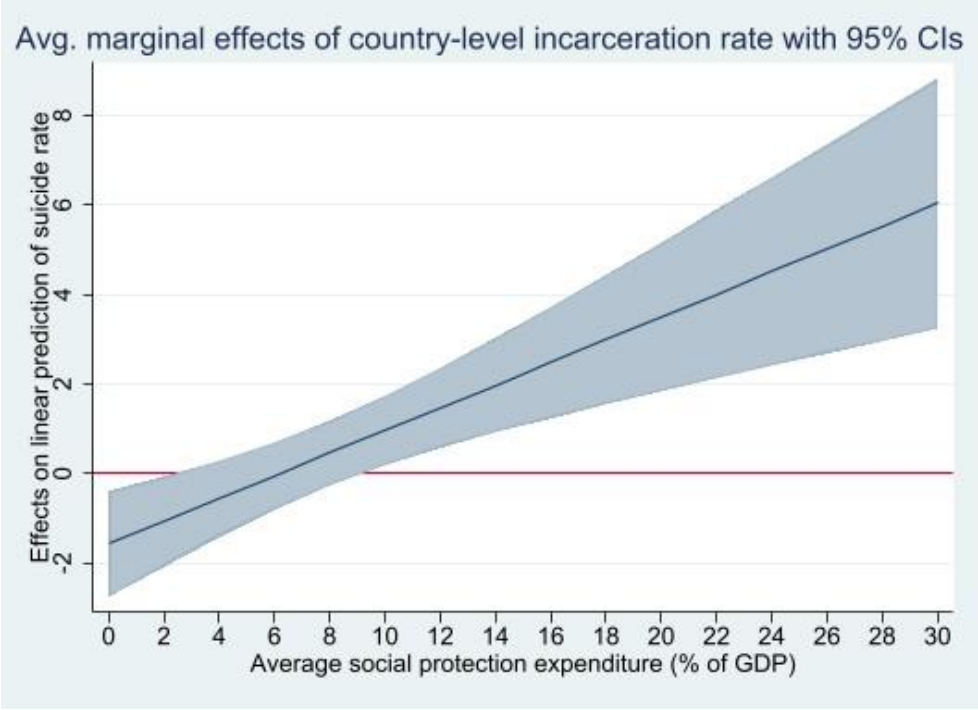

Figure 20. Average Marginal Effects of Country-Level Incarceration Rate on Suicide Rate Across All Levels of Social Protection Expenditure

region.[10] Countries with average ethnic fractionalization levels .4 or below (which corresponds to the probability that two randomly selected individuals from the population belong to different groups) have a significant and positive relationship between average incarceration rate and suicide rate. For example, for a country with an average ethnic fractionalization score of .2 (fairly homogeneous ethnically), an increase in average incarceration rate of 1 per 1,000 population (about 1 SD from the mean) is associated with an increase in suicide rate by almost 2 per 100,000 population. For more ethnically homogeneous populations, higher incarceration levels correspond to higher suicide rates. This relates to 60 countries in this sample, from Albania to Zimbabwe (alphabetically).

Similar to the effects of social protection on life expectancy and infant mortality rates, but across the whole sample even when excluding the U.S., at very low levels of social protection expenditure average incarceration is negatively related to suicide rates, but at higher expenditure percentages this relationship is positive (Figure 20). To illustrate this, a country with an average social protection expenditure at 2% of their GDP finds a significant relationship such that an increase in average incarceration rate by 1 per 1,000 corresponds to a decrease in suicide rate by 1 per 100,000; for a country that spends 26% of their GDP on social protection, an increase in average incarceration by 1 per 1,000 corresponds to an increase in suicide rate by 5 per 100,000. Therefore, again, incarceration may be protective at low levels of social protection but appears to exacerbate suicide rates at high levels of social protection. There are only 10 countries in the sample with social protection expenditure averages of less than or equal to 2% of

[10] All models with significant interactions were rerun without centering the moderator variable in the interaction to facilitate interpretation of the average marginal effects. Relationships look the same with or without centering, only the scale changes to be more interpretable.

their GDP, primarily in Asia and Africa, while there are 58 countries that spend 10% or greater of their GDP on social protection, primarily concentrated in Europe but including countries from all continents.

Subsamples

The full model (Model 1.3C in Table 21) shows a non-significant relationship between incarceration and suicide rates over time and a marginally significant positive relationship on average. Subsample models show relationships that look somewhat different. For example, subsample models including countries measured to have below average ethnic fractionalization or above average social protection expenditure have a significant positive relationship between suicide and incarceration on average. An increase in average incarceration of 1 per 1,000 population corresponds to higher average suicide rates by 4.71 and 4.09 per 100,000 population in the subsamples, respectively. For countries with worse-than-average prison conditions, an increase in incarceration of 1 per 1,000 population over time leads to an increase in suicide rates of .21 and .23 per 100,000 population, without and with the U.S. in the sample.

Overall, these models provide evidence of some level of moderation for the relationship between incarceration and suicide rates through racial diversity/exclusion, social protection expenditure, and prison conditions. Interactions and subsample models showed moderation by ethnic fractionalization and social protection expenditure. In the full sample, lower levels ethnic fractionalization are related to higher suicide rates with higher levels of incarceration. Within the subsample of countries with below average ethnic fractionalization, higher average incarceration is also related to higher suicide rates. The same is true for countries with above average social protection – instead of

Table 21. Moderated Effects of Incarceration on Suicide Rate (using Subsamples)

	Model 1.3C Full Model		**Model 2.1C.s EP Below Average**		**Model 2.2C.s EP Above Average**		**Model 2.3C.s EF Below Average**		**Model 2.4C.s EF Above Average**		**Model 2.5C.s SP Below Average**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Constant	14.46***	(2.00)	9.94***	(2.83)	25.30***	(7.16)	11.20**	(3.75)	17.94***	(3.56)	3.54	(5.25)
Year - pre-peak	-0.06	(0.07)	-0.12***	(0.04)	0.04	(0.04)	-0.17***	(0.04)	0.05	(0.04)	0.17***	(0.04)
Year - post-peak	-0.18***	(0.04)	-0.20***	(0.02)	-0.13***	(0.03)	-0.24***	(0.03)	-0.13***	(0.02)	-0.09***	(0.02)
Inc. rate (1 yr lag)	0.09	(0.08)	-0.00	(0.08)	0.06	(0.05)	0.08	(0.10)	0.12+	(0.06)	0.06	(0.06)
Avg. inc. rate	0.80+	(0.45)	1.61+	(0.96)	-1.69	(1.46)	4.71**	(1.63)	0.01	(0.84)	-0.80	(0.88)
Model fit												
AIC	4638.63		3154.01		1415.60		2840.48		1863.46		1711.12	
BIC	4883.09		3383.02		1602.16		3062.68		2062.63		1907.87	
Obs. (L-1)	1912		1346		566		1153		759		800	
Countries (L-2)	128		88		40		68		60		71	
	Model 1.3C Full Model		**Model 2.6C.s SP Above Average**		**Model 2.7C.s PC (no US) Below Average**		**Model 2.8C.s PC (no US) Above Average**		**Model 2.9C.s PC (with US) Below Average**		**Model 2.10C.s PC (with US) Above Average**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Constant	14.46***	(2.00)	20.90***	(5.38)	18.30***	(4.51)	18.58**	(6.43)	18.29***	(4.52)	17.28**	(6.60)
Year - pre-peak	-0.06	(0.07)	-0.23***	(0.04)	-0.22***	(0.04)	0.16***	(0.05)	-0.22***	(0.04)	0.10*	(0.05)
Year - post-peak	-0.18***	(0.04)	-0.26***	(0.03)	-0.28***	(0.03)	-0.09***	(0.02)	-0.28***	(0.03)	-0.07**	(0.02)
Inc. rate (1 yr lag)	0.09	(0.08)	0.25+	(0.14)	-0.01	(0.09)	0.23**	(0.07)	-0.01	(0.09)	0.21**	(0.07)
Avg. inc. rate	0.80+	(0.45)	4.09**	(1.38)	1.72	(1.85)	0.32	(0.94)	1.72	(1.85)	0.37	(0.97)
Model fit												
AIC	4638.63		2755.17		2278.72		2382.75		2278.72		2405.27	
BIC	4883.09		2975.79		2493.55		2594.64		2493.55		2613.50	
Obs. (L-1)	1912		1112		975		912		975		937	
Countries (L-2)	128		57		56		71		56		72	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Time is modeled using piecewise linear trends before and after a peak determined within the data; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

mitigating any negative effects of incarceration, countries with high social expenditure seem to do worse in terms of suicide rates at high levels of incarceration, as compared to their counterparts with very low social protection expenditure. Finally, subsample models showed that, in countries with worse-than-average prison conditions, increases in incarceration rates can correspond to significant increases in suicide rates.

HIV Prevalence Moderation Models

Interactions

Three significant interactions were found for the HIV prevalence models: average incarceration by ethnic fractionalization, lagged incarceration by prison conditions (no U.S.), and average incarceration by prison conditions (with U.S.). Figures 21 through 23 show the predicted HIV prevalence based on different levels of these combined variables, controlling for the main effects, other level-1 and level-2 variables, and region.

As seen in Figure 21, countries with higher ethnic fractionalization (over .3) have a significantly positive relationship between average incarceration rate and HIV prevalence. This is a majority of the countries in the sample (66 out of 90). Higher levels of incarceration are associated with increases in HIV prevalence in more ethnically heterogeneous populations. For instance, a country with an average ethnic fractionalization score of .4 has a relationship between incarceration and HIV such that an increase of 1 per 1,000 population in average incarceration rate is associated with an increase of .1% HIV prevalence for the population aged 15-49; for a country with an average ethnic fractionalization score of .9 (very ethnically heterogeneous), this same increase in average incarceration is related to an almost .3% increase in HIV prevalence.

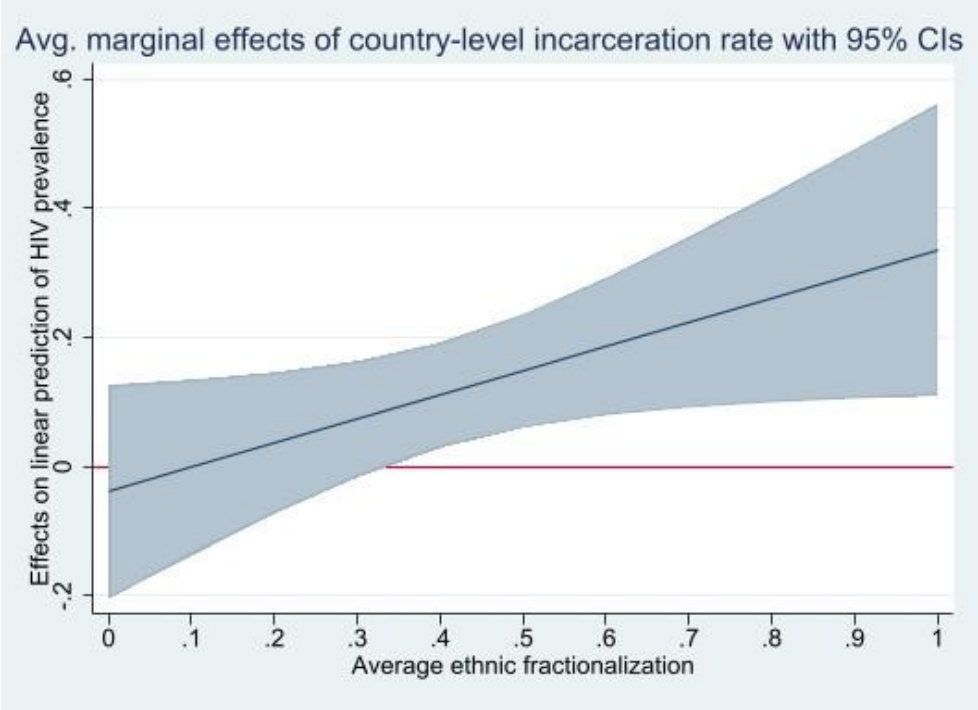

Figure 21. Average Marginal Effects of Country-Level Incarceration Rate on HIV Prevalence Across All Levels of Ethnic Fractionalization

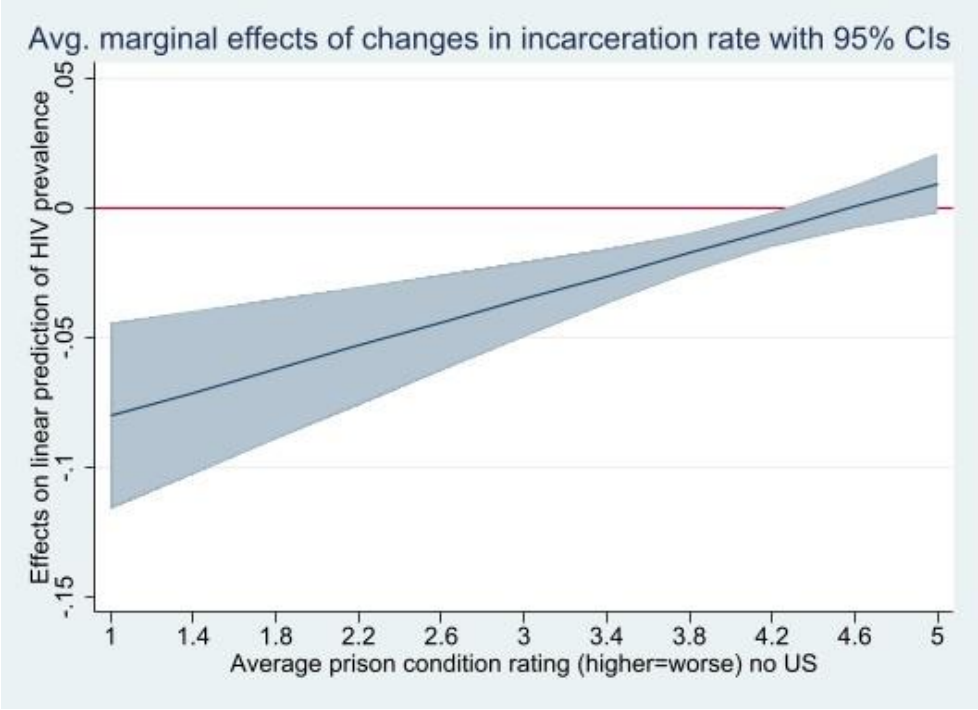

Figure 22. Average Marginal Effects of Changes in Incarceration Rate on HIV Prevalence Across All Levels of Prison Conditions (without the U.S.)

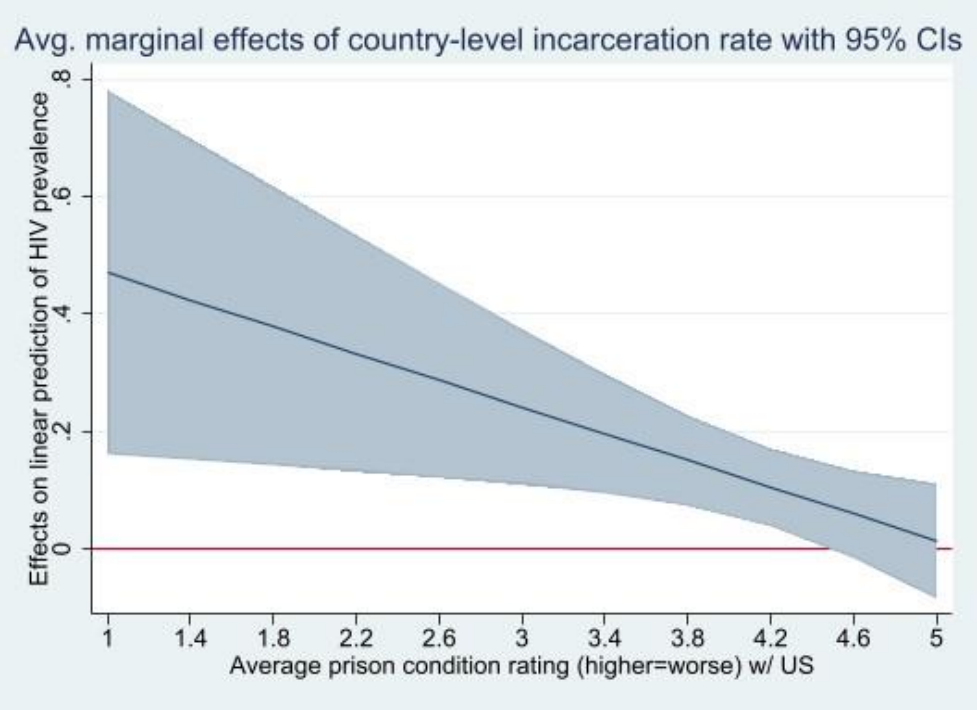

Figure 23. Average Marginal Effects of Country-Level Incarceration Rate on HIV Prevalence Across All Levels of Prison Conditions (with the U.S.)

There are smaller, yet still significant, effects when examining the influence of lagged incarceration rates and prison conditions on HIV prevalence in a sample excluding the U.S. (Figure 22). Increases in incarceration one year are significantly related to decreases in HIV prevalence in the following year for countries and observations associated with better prison conditions (without violence and life-threatening conditions). Forty-eight countries have prison condition ratings that meet the threshold in the region of significance. For a country with an average prison condition rating of 3 (prison conditions below minimum standards), an increase in incarceration rate by 1 per 1,000 population (about 2 SDs above the mean) in one year is associated with a decrease in HIV prevalence in the next year by .04% of 15-49 year-olds. When including the U.S., this interaction effect is non-significant but in the same direction.

Finally, there is a significant positive relationship between incarceration and HIV prevalence on average in countries with better prison conditions, in the sample including the U.S. (Figure 23). While changes in incarceration were negatively related to changes in HIV prevalence, this relationship is positive when examining the country level, for countries with better prison conditions (the relationship is non-significant for countries with the worst prison conditions). For that country with an average prison condition rating of 3 (prison conditions below minimum standards), an increase in average incarceration rate by 1 per 1,000 population is associated with an increase in HIV prevalence by .24% of 15-49 year-olds, when including the U.S. (this model without the U.S. did not converge). Therefore, there is a negative relationship between incarceration rate and HIV prevalence over time, that is obscured when including the U.S., but a positive relationship on average.

Subsamples

The full model (Model 1.3D) shows a significant negative relationship between incarceration and HIV prevalence over time and a highly significant positive relationship on average. The subsamples (Table 22) show more non-significant results, although this may be due to the smaller sample sizes in the HIV models overall and therefore among the subsample analyses. However, there are some significant results. For example, the significant negative relationship over time appears to be driven by countries in the below-average ethnic fractionalization subsample, where an increase in incarceration rate of 1 per 1,000 population is associated with a .02 decrease in HIV prevalence in the following year (the only subsample with this relationship being significant). The overall positive relationship on average may be driven by countries with below average social protection

Table 22. Moderated Effects of Incarceration on HIV Prevalence (using Subsamples)

	Model 1.3D Full Model		**Model 2.1D.s EP Below Average**		**Model 2.2D.s EP Above Average**		**Model 2.3D.s EF Below Average**		**Model 2.4D.s EF Above Average**		**Model 2.5D.s SP Below Average**	
	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects												
Constant	0.39***	(0.10)	0.17	(0.25)	5.70	(3.82)	0.72**	(0.22)	0.99*	(0.48)	-0.40	(33.44)
Year - pre-peak	0.02***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.03***	(0.00)	0.04***	(0.01)
Year - post-peak	0.01**	(0.00)	0.01**	(0.00)	0.01**	(0.00)	0.00+	(0.00)	0.01***	(0.00)	0.00	(0.00)
Inc. rate (1 yr lag)	-0.01*	(0.00)	-0.01	(0.01)	-0.01	(0.01)	-0.02**	(0.01)	-0.01	(0.01)	-0.01	(0.01)
Avg. inc. rate	0.14***	(0.04)	0.16+	(0.09)	0.00	(0.84)	0.16	(0.12)	0.15	(0.19)	0.42*	(0.20)
Model fit												
AIC	-2307.54		-1319.47		-717.52		-1348.00		-596.06		-166.42	
BIC	-2078.26		-1103.01		-547.08		-1142.99		-409.27		26.55	
Obs. (L-1)	1206		817		389		637		569		657	
Countries (L-2)	90		61		29		43		47		60	

	Model 1.3D Full Model		**Model 2.8D.s PC (no US) Above Average**		**Model 2.10D.s PC (with US) Above Average**	
	b	se	b	se	b	se
Fixed effects						
Constant	0.39***	(0.10)	0.66+	(0.34)	1.04*	(0.42)
Year - pre-peak	0.02***	(0.00)	0.02***	(0.00)	0.03***	(0.00)
Year - post-peak	0.01**	(0.00)	0.00+	(0.00)	0.01***	(0.00)
Inc. rate (1 yr lag)	-0.01*	(0.00)	-0.01	(0.01)	-0.01	(0.01)
Avg. inc. rate	0.14***	(0.04)	-0.01	(0.09)	0.04	(0.11)
Model fit						
AIC	-2307.54		-744.47		-999.52	
BIC	-2078.26		-532.50		-786.02	
Obs. (L-1)	1206		741		766	
Countries (L-2)	90		62		63	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Models 2.6D.s, 2.7D.s, and 2.9D.s (above average SP, below average prison conditions without US, and with US) did not converge and the results are therefore not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

expenditure. For this subsample (the only one in which this relationship is significant), an increase in average incarceration rates by 1 per 1,000 population corresponded to average HIV prevalence that is .42 higher. It is worth noting, though, that there were some computational issues with these subsample models when country and observation counts were lower, such as those above average social protection expenditure (country n=30) and worse-than-average prison conditions (country n=27), so there are no results presented for these subsamples as they relate to HIV prevalence.

Overall, there is evidence that the relationship between incarceration rates and HIV prevalence is moderated in some way by racial diversity, social protection expenditure, and prison conditions. For the full sample, average incarceration rates are positively related to HIV prevalence for countries with high ethnic fractionalization. For the subsamples, though, it appears that there is a protective effect of incarceration for countries with below average ethnic fractionalization over time. Therefore, in highly diverse countries, incarceration is associated with higher HIV prevalence on average, while in countries with lower racial diversity, changes in incarceration may be protective. Prison conditions moderated this relationship in interaction models only. Incarceration rates were negatively related to HIV prevalence over time and positively related to HIV prevalence on average, for all but those with the worst prison conditions. Those with the best prison conditions, meeting international standards, saw the biggest decreases in HIV prevalence over time but the highest HIV prevalence on average. This could be related to testing and treatment in prisons. Finally, social protection expenditure was found to be important in the subsample analyses, with the subsample of countries with below average social protection expenditure showing a positive average relationship between

incarceration and HIV prevalence on average, whereas no other subsample showed this significant relationship. Countries with lower social protection may not be able to mitigate the effects of higher average prison population on HIV in their populations.

TB Incidence Moderation Models

Interactions

Two significant interactions were found for models examining TB incidence: average incarceration by prison conditions, with and without the U.S. Figure 24 and Figure 25 show the average marginal effect of country-level incarceration rate on TB incidence at the entire range of prison condition ratings, both without and with the U.S., controlling for the main effects, other Level-1 and Level-2 variables, and region.

The relationships look similar for the graphs with and without the U.S.: there is a positive relationship between average incarceration rate and TB incidence for countries with the very worst prison conditions (harsh to life-threatening). For a country with an average prison condition rating of 5 (life-threatening), an increase in average incarceration rate by 1 per 1,000 population is associated with an increase in estimated TB incidence of 15.1 per 100,000 population, in the sample without the U.S. With the U.S., that relationship is slightly bolstered, such that a similar increase in average incarceration rate is related to an increase in estimated TB incidence of 15.7 per 100,000. Without the U.S., the regions of significance includes about 25 countries with harsh prison conditions; with the U.S. in the model, it expands to 44.

Subsamples

The full model (Model 1.3E) shows a strong, significant, positive relationship between incarceration and TB incidence over time and a marginally significant positive

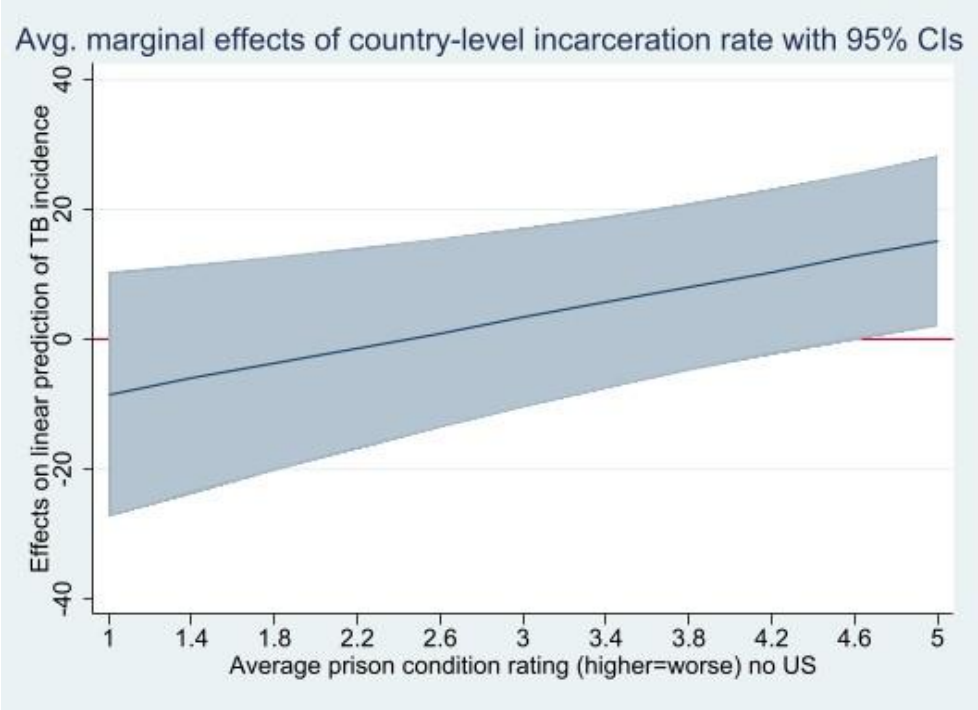

Figure 24. Average Marginal Effects of Country-Level Incarceration Rate on TB Incidence Across All Levels of Prison Conditions (without the U.S.)

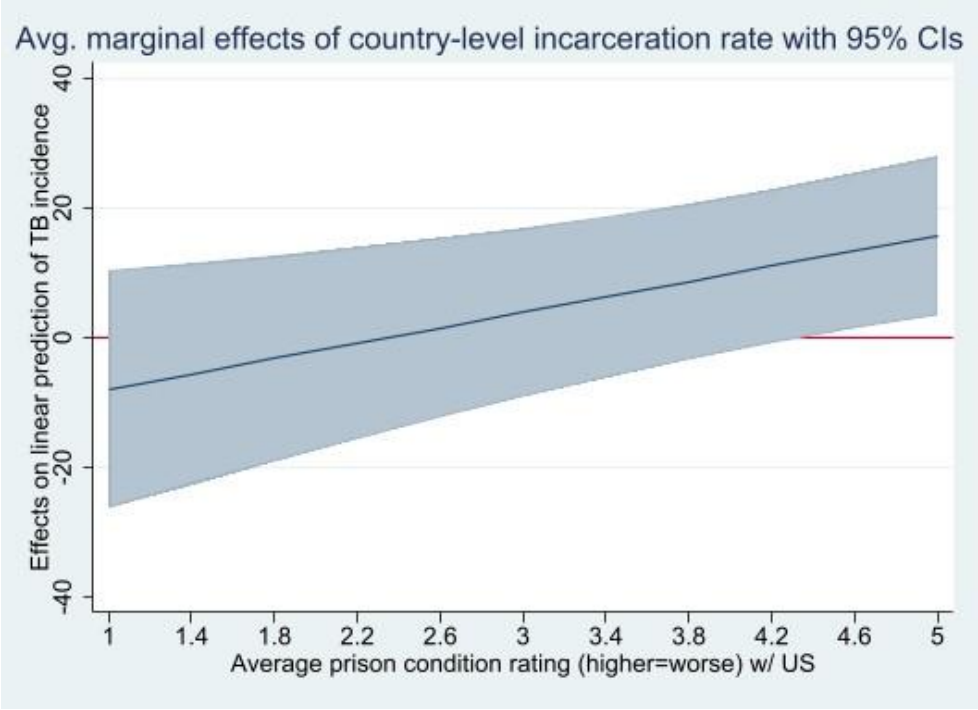

Figure 25. Average Marginal Effects of Country-Level Incarceration Rate on TB Incidence Across All Levels of Prison Conditions (with the U.S.)

Table 23. Moderated Effects of Incarceration on TB Incidence (using Subsamples)

	Model 1.3E Full Model		**Model 2.1E.s EP Below Average**		**Model 2.2E.s EP Above Average**		**Model 2.3E.s EF Below Average**		**Model 2.4E.s EF Above Average**	
	b	se	b	se	b	se	b	se	b	se
Fixed effects										
Constant	9.29***	(21.52)	123.55***	(30.19)	127.52	(128.93)	156.30***	(41.22)	37.11	(37.56)
Year - pre-peak	-0.49+	(0.30)	-0.54**	(0.18)	-1.01	(0.65)	-0.58**	(0.19)	-0.50	(0.52)
Year - post-peak	-0.02	(0.02)	-0.02+	(0.01)	-0.01	(0.03)	-0.01	(0.01)	-0.03	(0.02)
Inc. rate (1 yr lag)	2.89**	(0.97)	3.42***	(0.67)	1.72+	(1.02)	3.52***	(0.71)	1.75+	(0.99)
Avg. inc. rate	10.39+	(6.04)	10.79	(10.43)	-17.21	(29.81)	31.34*	(14.55)	-17.94	(13.30)
Model fit										
AIC	10865.24		7125.16		3402.54		5809.16		4730.13	
BIC	11107.04		7350.95		3581.74		6032.85		4921.78	
Obs. (L-1)	1593		1116		477		956		637	
Countries (L-2)	128		88		40		68		60	

	Model 1.3E Full Model		**Model 2.6E.s SP Above Average**		**Model 2.7E.s PC (no US) Below Average**		**Model 2.8E.s PC (no US) Above Average**		**Model 2.9E.s PC (with US) Below Average**	
	b	se					b	se		
Fixed effects										
Constant	9.29***	(21.52)	36.37	(23.74)	58.00**	(19.52)	71.20	(70.52)	58.01**	(19.49)
Year - pre-peak	-0.49+	(0.30)	-0.41*	(0.19)	-0.81***	(0.18)	-0.38	(0.29)	-0.81***	(0.18)
Year - post-peak	-0.02	(0.02)	0.00	(0.01)	0.02**	(0.01)	-0.04*	(0.01)	0.02**	(0.01)
Inc. rate (1 yr lag)	2.89**	(0.97)	2.68***	(0.54)	1.53*	(0.71)	3.14**	(0.98)	1.53*	(0.71)
Avg. inc. rate	10.39+	(6.04)	2.59	(5.08)	4.52	(9.50)	2.89	(15.90)	4.52	(9.50)
Model fit										
AIC	10865.24		4675.59		4264.96		5956.97		4266.96	
BIC	11107.04		4891.75		4475.32		6171.41		4481.99	
Obs. (L-1)	1593		901		792		782		792	
Countries (L-2)	90		57		56		71		56	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Models 2.5E.s and 2.10E.s (below average SP and above average prison conditions with US) did not converge and the results are therefore not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

relationship on average. This relationship over time is fairly stable across subsamples (Table 23), with just those that have higher-than-average racial diversity and exclusion showing non-significant results. The strongest relationship appears in the subsample of countries with below average ethnic fractionalization: an increase in incarceration rate by 1 in 1,000 population is associated with an increase in TB incidence of 3.52 per 100,000 population in the following year in these countries. This subsample of countries also has a significant positive relationship with TB and incarceration on average – a 1 per 1,000 population difference in incarceration rates between countries is related to a 31.34 difference in TB incidence. No other subsample shows a significant relationship between incarceration and TB on average. Though significant in both samples, increases in incarceration rates are related to higher increases in TB incidence the next year in countries with worse-than-average prison conditions as compared to those with better-than-average prison conditions.

Overall, there is evidence of moderating relationship between incarceration, TB incidence, racial diversity and exclusion, and prison conditions. Interaction models just show significant moderation by prison conditions. Similar trends occur based on prison conditions; there is a positive relationship between incarceration and TB incidence for countries with harsh prison conditions, and the highest increases are related to the worst prison conditions. However, the average marginal effect estimates depend on whether or not the U.S. is included in the sample. Prison conditions in the subsample models affected the strength of the relationship, but not the significance or the direction: similar to the interaction models, larger increases in TB incidence were found for countries with worse-than-average prison conditions. Differences in the significance of the relationship

between incarceration rate changes and TB incidence were found for subsamples that had higher or lower than average racial diversity (ethnic fractionalization) and exclusion (excluded minority population). The relationship was strong and positive for subsamples with low diversity and exclusion, but marginal for countries with high diversity and exclusion. Rather than diversity exacerbating the relationship as predicted, outcomes seem to be worse in more homogenous countries.

Overall Results by Moderator

The following sections provide an overview of the RQ2 results presented by moderator. These are the same results as shown above, but synthesized by each moderator. There is one table in each section that provides a simplified version of the results for both types of models compared to the full model (1.3) from RQ1.

Racial Diversity and Exclusion

The results for the moderation analyses related to variables measuring a country's racial diversity (ethnic fractionalization) and exclusion (excluded minority population) are presented in Table 24. Racial diversity and exclusion only moderates the relationships between incarceration and population health in some cases. In terms of interactions, the significance and direction of the incarceration variables stay the same across most of the models, even after controlling for interactions. There is a significant negative interaction between ethnic fractionalization and average incarceration rates when predicting suicide rate; higher average incarceration rates are associated with higher suicide rates in the context of lower ethnic fractionalization. There were also strong effects seen for HIV prevalence, where higher levels of ethnic fractionalization are associated with significant

Table 24. Overview of Results for Moderation Models Based on Excluded Minority Population and Ethnic Fractionalization

	Models 1.3A-E Full Model	**Models 2.1A-E.i Lagged inc. x EP**	**Models 2.2A-E.i Average inc. x EP**	**Models 2.3A-E.i Lagged inc. x EF**	**Models 2.4A-E.i Average inc. x EF**	**Model 2.1A-E.s EP Below Average**	**Model 2.2A-E.s EP Above Average**	**Model 2.3A-E.s EF Below Average**	**Model 2.4A-E.s EF Above Average**
		Interactions				**Subsamples**			
Life expectancy									
Inc. rate (lagged 1 yr)	-*	-*	-*	DNC	-*	NS	-*	NS	-*
Avg. inc. rate	-†	-†	-†		NS	NS	NS	NS	NS
Interaction		NS	NS		NS				
Infant mortality rate									
Inc. rate (lagged 1 yr)	NS	NS	NS	NS	NS	NS	+†	NS	NS
Avg. inc. rate	-†	-†	-†	-†	-†	NS	NS	NS	NS
Interaction		NS	NS	NS	NS				
Suicide rate									
Inc. rate (lagged 1 yr)	NS	NS	NS	NS	NS	NS	NS	NS	+†
Avg. inc. rate	+†	+†	+†	+†	NS	+†	NS	+**	NS
Interaction		NS	NS	NS	-*				
HIV prevalence									
Inc. rate (lagged 1 yr)	-*	-**	-*	-*	-*	NS	NS	-**	NS
Avg. inc. rate	+***	+***	+***	+***	+**	+†	NS	NS	NS
Interaction		-†	NS	NS	+*				
TB incidence									
Inc. rate (lagged 1 yr)	+**	+**	+**	+**	+**	+***	+†	+***	+†
Avg. inc. rate	+†	+†	+†	+†	+†	NS	NS	+*	NS
Interaction		NS	NS	NS	NS				

Notes. † p<.1; * p<.05; ** p < .01; *** p < .001; EP=Excluded minority population; EF=Ethnic fractionalization; NS=Non-significant; DNC=Did not converge (the model failed to produce reliable estimates).

associations between higher average incarceration levels and HIV prevalence. These interactions show that incarceration rates matter more for suicide rate outcomes in countries with low ethnic fractionalization and for HIV prevalence outcomes in countries with high ethnic fractionalization, among a broad sample of countries.

As for subsamples, there are some examples of significant moderation based on these variables. For example, the negative relationship between incarceration rates over time and life expectancy seems to be driven by countries that have above average racial diversity and exclusion, while the negative relationship over time for HIV prevalence is seen to be strongest among countries with below average racial diversity. The positive relationship between incarceration and TB incidence over time is much stronger in countries with below average racial diversity and exclusion than those above (still positive but only marginally significant). The positive relationships between incarceration rates on average and two population health outcomes – suicide rates and TB incidence – are both driven by significant associations among countries with below average racial diversity. These findings suggest that countries with higher racial diversity and exclusion may be more vulnerable to incarceration effects on overall life expectancy, while more homogenous countries could see more negative outcomes related to incarceration and suicide and TB. These results are similar to relationships found among the interactions for suicide rate, but there are effects on HIV prevalence found in the interactions that are not revealed among the subsamples, and the subsamples revealed important contexts for life expectancy and TB not shown to be significant interactions, highlighting the benefit of examining both.

Social Protection

The results for the moderation analyses related to social protection expenditure are presented in Table 25. There were multiple instances of social protection expenditure moderating the relationship between incarceration and population health outcomes. In terms of interactions, social protection expenditure significantly interacted with incarceration variables across multiple outcomes. There were significant interactions with average incarceration for life expectancy (negative), infant mortality (positive), and suicide (positive), and over time as well for infant mortality rates (positive). However, only the interaction with suicide rates held if the U.S. was excluded from the model (not shown). These interactions show that incarceration rates could be protective at very low levels of social protection expenditure (on average for suicide rate) but were associated with negative outcomes at high levels of social expenditure (over time for infant mortality and on average for life expectancy and suicide rates), primarily due to the relationship in the U.S. Even at the relatively high levels of social support spending that the U.S. expends, it is not enough to mitigate negative effects of physical and mental health outcomes.

Subsample analyses help explore moderation by looking at groups of countries with similar characteristics and seeing which ones are driving overall associations. For instance, Table 25 shows that countries with below average social protection have a strong ($p<.01$) negative relationship between incarceration rates over time and life expectancy, which may be partially driving the association seen in the full model. In addition, there is a positive relationship between incarceration rates over time (marginally) and on average (significant at $p<.01$) in relation to suicide rates that is

Table 25. Overview of Results for Moderation Models Based on Social Protection Expenditure

	Models 1.3A-E Full Model	**Models 2.5A-E.i Lagged incarceration x SP**	**Models 2.6A-E.i Average incarceration x SP**	**Models 2.5A-E.s SP Below Average**	**Models 2.6A-E.s SP Above Average**
		Interactions		**Subsamples**	
Life expectancy					
Inc. rate (lagged 1 yr)	-*	-*	-*	-**	NS
Avg. inc. rate	-†	-†	NS	NS	NS
Interaction		NS	-*		
Infant mortality rate					
Inc. rate (lagged 1 yr)	NS	NS	NS	DNC	NS
Avg. inc. rate	-†	-†	-**		NS
Interaction		+*	+*		
Suicide rate					
Inc. rate (lagged 1 yr)	NS	NS	NS	NS	+†
Avg. inc. rate	+†	+†	+†	NS	+**
Interaction		NS	+***		
HIV prevalence					
Inc. rate (lagged 1 yr)	-*	-**	-*	NS	DNC
Avg. inc. rate	+***	+*	+*	+*	
Interaction		NS	NS		
TB incidence					
Inc. rate (lagged 1 yr)	+**	+*	+**	DNC	+***
Avg. inc. rate	+†	+†	NS		NS
Interaction		NS	NS		

Notes. † p<.1; * p<.05; ** p < .01; *** p < .001; SP=Social protection expenditure; NS=Non-significant; DNC=Did not converge (the model failed to produce reliable estimates); Estimates in red were not found to be significant when the U.S. was excluded from the sample.

present in the subsample of countries with above average social protection that is obscured in the full sample. Though the comparison is limited by models that did not converge, there is also an indication of a positive relationship between incarceration on average and HIV prevalence for countries with below average social protection expenditure, and a strong positive relationship between incarceration over time and TB incidence for countries with above average social protection expenditure. These results show that lack of social support could lead to negative outcomes, but just spending a certain amount, especially for a country like the U.S. with a high level of incarceration, may not be enough to mitigate negative effects.

Prison Conditions

The results for the moderation analyses related to prison conditions (with and without the U.S.) are presented in Table 26. Prison conditions seem to moderate the relationship between incarceration and health outcomes in certain circumstances. Models 2.7 and 2.8 A-E.i also show the change that excluding the United States can have on the results. For instance, the negative relationship between average incarceration and infant mortality rates and the negative relationship with incarceration rates over time and HIV prevalence is stronger when excluding the U.S. There were also significant interactions with average incarceration for infant mortality (positive – only when U.S. included), HIV prevalence (negative), and TB incidence (positive) for samples including the U.S. and on average for TB incidence (positive) and over time for HIV prevalence (positive) when excluding the U.S. The interactions show that average incarceration rates can exacerbate (increase) TB incidence when conditions are harsh. For HIV prevalence, changes in incarceration are protective for HIV prevalence when prison conditions are good, but on

Table 26. Overview of Results for Moderation Models Based on Prison Conditions

	Models 1.3A-E Full Model	**Models 2.7A-E.i Lagged inc. x PC (no US)**	**Models 2.8A-E.i Average inc. x PC (no US)**	**Models 2.9A-E.i Lagged inc. x PC (w/ US)**	**Models 2.10A-E.i Average inc. x PC (w/ US)**	**Models 2.7A-E.s PC (no US) Below Average**	**Models 2.8A-E.s PC (no US) Above Average**	**Models 2.9A-E.s PC (w/ US) Below Average**	**Models 2.10A-E.s PC (w/ US) Above Average**
		Interactions				**Subsamples**			
Life expectancy									
Inc. rate (lagged 1 yr)	-*	-*	DNC	-*	-*	NS	-*	NS	-*
Avg. inc. rate	-†	NS		-†	NS	NS	NS	NS	NS
Interaction		NS		NS	NS				
Infant mortality rate									
Inc. rate (lagged 1 yr)	NS	NS	NS	NS	NS	NS	+*	NS	+***
Avg. inc. rate	-†	-***	-**	-†	-†	NS	-†	NS	-†
Interaction		NS	NS	NS	+*				
Suicide rate									
Inc. rate (lagged 1 yr)	NS	NS	NS	NS	NS	NS	+**	NS	+**
Avg. inc. rate	+†	NS	NS	+†	NS	NS	NS	NS	NS
Interaction		NS	NS	NS	NS				
HIV prevalence									
Inc. rate (lagged 1 yr)	-*	-***	DNC	-*	-*	DNC	NS	DNC	NS
Avg. inc. rate	+***	+**		+***	+***		NS		NS
Interaction		+***		NS	-*				
TB incidence									
Inc. rate (lagged 1 yr)	+**	+**	+**	+**	+**	+*	+**	+*	DNC
Avg. inc. rate	+†	NS	NS	+†	NS	NS	NS	NS	
Interaction		NS	+**	NS	+**				

Notes. † p<.1; * p<.05; ** p < .01; *** p < .001; PC=Prison conditions; NS=Non-significant; DNC=Did not converge (the model failed to produce reliable estimates).

average, when prison conditions are good, incarceration rate increases can exacerbate HIV prevalence.

Subsample analyses show which sets of countries may be driving overall results based on different average prison conditions. With or without the U.S., countries with worse prison conditions seem to be driving the overall negative relationship between incarceration rates over time and life expectancy and the overall (and marginal) negative relationship between incarceration rates on average and infant mortality rates. Non-significant overall relationships between incarceration rates over time and both infant mortality rates and suicide rates are obscuring positive relationships with incarceration over time and these outcomes among countries with worse-than-average prison conditions. This relationship is the same for suicide rates with and without the U.S. but much stronger for infant mortality rates with the U.S. Countries with worse-than-average prison conditions also have stronger relationships between incarceration rates over time and TB incidence than those with better-than-average prison conditions, although all are positive and significant (except for worse-than-average prison conditions including the U.S. because this model did not converge). For the subsample models overall, countries with worse prison conditions do seem to have worse outcomes, especially over time. HIV prevalence may be the only outcome in which countries with better-than-average prison conditions do worse, but this is only speculation based on non-significant relationships for worse-than-average subsamples because the other models did not converge yet there are significant relationships overall. These infectious disease subsample results are similar to interaction results.

To summarize, there is evidence that racial diversity and exclusion, social protection expenditure, and prison conditions at the average country level moderate relationships between incarceration (over time and on average) and population health outcomes. Some effects were found to be consistent with the literature and hypotheses that suggests racial diversity and exclusion and harsh prison conditions could exacerbate negative health effects of incarceration while social protection could mitigate them. For example, life expectancy was found to be negatively related to incarceration rate changes over time in subsamples of countries that had above average racial diversity and exclusion, below average social protection expenditure, and worse than average prison conditions. Other consistent effects were the following: in countries with worse than average prison conditions incarceration rates were positively related to infant mortality rate (over time) and suicide rate (on average); TB incidence was positively related to incarceration rates on average at the harshest prison conditions, with and without the U.S. included in the sample; and HIV prevalence was positively related to average incarceration rates at high levels of ethnic fractionalization in the full sample and in the subsample with below average social protection expenditure.

However, other results were found that complicated the support established above. For instance, incarceration was found to be protective at low levels of social protection expenditure for suicide rate, and exacerbate negative outcomes at high levels of social protection (suicide rate on average, TB incidence over time in subsample with above average social protection). In addition, there were some outcomes that were worse for more racially homogenous or inclusive countries, like average suicide rate and TB incidence (over time and on average). Better prison conditions allowed incarceration rate

to decrease negative health outcomes in some instances (HIV prevalence over time), but these conditions also exacerbated HIV prevalence on average. It is also important to note that some evidence was hindered by models that were too complex for their sample size to have reliable results, and the U.S. played a large role in some of the overall moderating relationships found (such as for life expectancy and infant mortality rate). However, these results do provide interesting directions for future research that will be discussed in a later chapter.

CHAPTER 7: RQ3 RESULTS – EXAMINATION OF MEDIATING EFFECTS

RQ3) Is the relationship between incarceration and population health (3A: life expectancy; 3B: infant mortality; 3C: suicide rates 3D: HIV prevalence; 3E: TB incidence) mediated by factors associated with barriers to social integration, as measured by social capital and its elements (civic participation, institutional trust, interpersonal trust, personal and family relationships, and social networks)?

The following section provides results of basic models exploring the potential for social capital to act as a mediator in the relationship between incarceration and population health outcomes. The sample used in the mediation models is different from the one used in analyses for RQ1 and RQ2. The social capital variable only has data from 2007-2019 for 167 countries, so this shifts the time frame and the country sample that is available for the mediation models. The descriptive statistics of this sample are provided in Appendix I. As compared to the full sample, this sample has higher mean life expectancy, HIV prevalence, and TB incidence, and lower mean infant mortality, suicide, and incarceration rates.

This analysis follows the steps laid out by Zhang and colleagues (2009) in their article on multilevel mediation models. This includes first (Step 1: X → Y)[11] looking at the relationships between various levels of incarceration and population health outcomes (which may be different than in RQ1 because the sample and methods are different, discussed below). Step 2 (X → M) analyzes the relationship between incarceration rates over time and on average with social capital and its elements. Finally, Step 3 (X and M → Y) puts those relations together in models with incarceration rate and social capital

[11] X = independent variable (here, incarceration rate); M = mediation variable; Y = dependent variable.

variables as well, which is examined alongside results from Step 1 to see whether partial mediation occurred. Because of the multilevel nature of the data, there are different mediating relationships that could occur. Figure 26 shows these potential multilevel mediation relationships. Mediation model numbers correspond to the level at which the X (incarceration), M (social capital), and Y (population health) variables are measured (X-M-Y). For example, Level-2 incarceration predicting a Level-1 social capital predicting a Level-1 population health outcome is notated as a 2-1-1 model.

Zhang and colleagues (2009) use random intercept models, which is also the method used in this section, as opposed to more complicated random slope models or marginal models used in the previous sections. Random intercept models allow the overall level of the outcome to vary between countries, after controlling for covariates, but the effects of the covariates are constrained to have similar relationships across all countries, unlike random slope models (Rabe-Hesketh & Skrondal, 2022). This allows for modeling of subject-specific relationships, which is not the primary interest in marginal

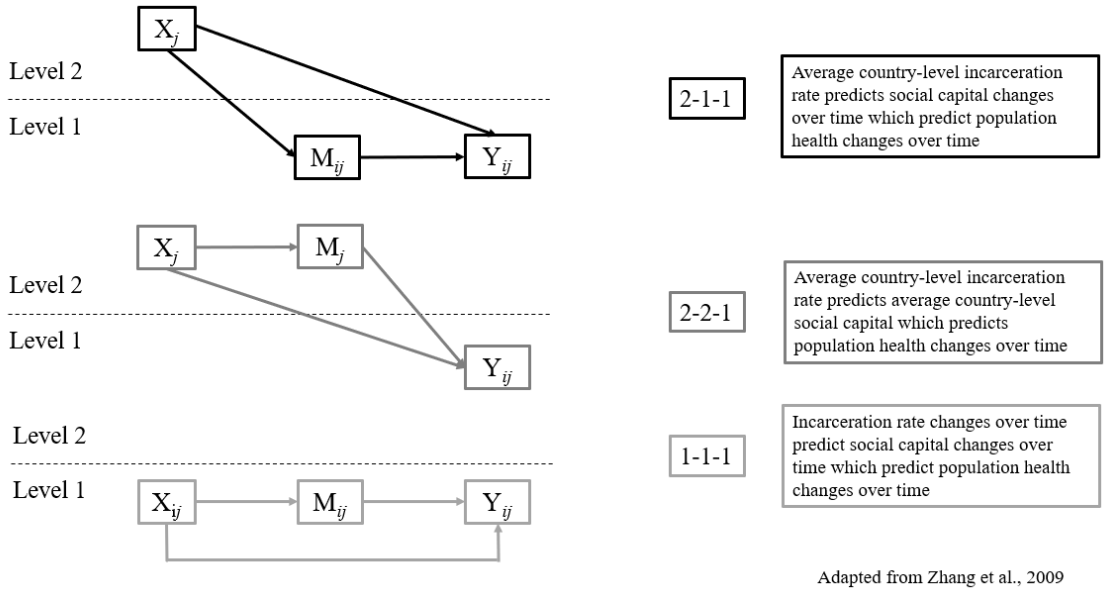

Figure 26. Multilevel Mediation Pathways (adapted from Zhang et al., 2009)

models (Rabe-Hesketh & Skrondal, 2022). With the complexity of using different outcomes (population health variables and social capital and its elements), the simplest models are best in this initial look at potential mediation.

Step 1 Results: Incarceration and Population Health Outcomes

The simplified results for the random-intercept incarceration and population health models for the mediation sample are presented in Table 27. Three types of models were run for each outcome: with average incarceration only as a predictor, with average incarceration and incarceration rates over time lagged by one year, and with average incarceration and incarceration rates over time lagged by two years. These models allow multiple levels of mediation to be explored and different timing of relationships for social capital and incarceration rate variables (either simultaneous or also one year lagged). The "A-E" designation relates to each outcome (A=life expectancy; B=infant mortality; C=suicide; D=HIV; E=TB).

As seen in the table, most relationships were non-significant in this sample with a random intercept model, especially over time. Only one model (3.1.3C for suicide) showed significant effects of incarceration rates over time on the outcome and this was the model where incarceration rates were lagged two years, which allows for one year between incarceration rate and the social capital variable and one year between that and the population health outcome. An increase of 1 per 1,000 incarceration rate two years prior is related to a .98 increase in suicide rates per 100,000 population. More significant effects were found for incarceration results on average, such as a significant negative effect related to life expectancy and infant mortality rates and a significant positive effect on suicide rates. For example, an increase in average incarceration rates is associated

Table 27. Mediation Step 1 Simplified Results for the Relationship Between Incarceration and Population Health Outcomes in Mediation Sample

	Models 3.1.1A-E **Average only** b	**Models 3.1.2A-E** **Avg + 1 year lag** b	**Models 3.1.3A-E** **Avg + 2 year lag** B
Life expectancy			
Incarceration rate (lagged 1 year)		NS	
Incarceration rate (lagged 2 years)			NS
Average incarceration rate	-0.36+	NS	-0.37*
Infant mortality rate			
Incarceration rate (lagged 1 year)		NS	
Incarceration rate (lagged 2 years)			NS
Average incarceration rate	-1.50*	-1.58*	-1.10*
Suicide rate			
Incarceration rate (lagged 1 year)		NS	
Incarceration rate (lagged 2 years)			0.98*
Average incarceration rate	1.04*	0.97*	0.95*
HIV prevalence			
Incarceration rate (lagged 1 year)		NS	
Incarceration rate (lagged 2 years)			NS
Average incarceration rate	0.57+	NS	NS
TB incidence			
Incarceration rate (lagged 1 year)		NS	
Incarceration rate (lagged 2 years)			NS
Average incarceration rate	NS	NS	NS

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; Coefficient values are only shown for marginally significant or significant values; NS=Non-significant; Models include random intercepts and robust standard errors.

with .37 years of lower average life expectancy, 1.1 lower average infant mortality rates per 1,000 live births, and .95 higher mean suicide rates per 100,000 population, controlling for incarceration rates over time lagged two years and other covariates. As there was no effect found on TB incidence, this outcome will not be further examined.

Step 2 Results: Incarceration and Social Capital

The next step is understanding the potential relationships between incarceration and social capital variables as outcomes. In order to mediate the relationship with population health variables there would need to be a significant association between

incarceration and social capital. The simplified results of these models are presented in Table 28. Each model was run to understand potential mediating relationships of different types. Because there are multiple ways that multilevel mediation can occur (2-1-1, 2-2-1, and 1-1-1 relationships based on incarceration-social capital-population health outcome) it is necessary to explore the relationships between incarceration and social capital variables at multiple levels, described in the notes for Table 28. The "F-K" designation relates to each outcome, which is different here as we are looking at social capital variables as the outcomes (F corresponds to the whole social capital index, while the following letters relate to individual elements: G=civic participation; H=institutional trust; I= interpersonal trust; J=personal and family relationships; and K=social networks).

Most of these relationships are non-significant, analyzed using random intercept models with robust standard errors. As a general note, though, most of the average relationships between incarceration and social capital were positive and most of the relationships over time were negative, and some significant results will be discussed below. The only variables for which average relationships were not positive were for interpersonal trust and social networks (though not significant at $p<.05$). A significant negative relationship is found between incarceration rates and the social capital index scores in the same year: an increase of 1 per 1,000 population in the incarceration is associated with a .92 lower social capital score for that year (on a scale from 0 to 100). An increase of 1 per 1,000 population in average incarceration rates is associated with a higher civic participation score on average by 2.28 to 2.76 (on a scale from 0 to 100), depending on the model. Therefore, changes in incarceration relate to decreases in social capital over time, but elements of social capital, such as civic participation, are higher

Table 28. Mediation Step 2 Simplified Results for the Relationship Between Incarceration and Social Capital Outcomes in Mediation Sample

	Models 3.2.1F-K **Pred L1 - L2 inc** b	**Models 3.2.2F-K** **L2 only** b	**Models 3.2.3F-K** **Pred L1 - sim inc** b	**Models 3.2.4F-K** **Pred L1 - lagged inc** b
Social capital index				
Incarceration rate (simultaneous)			-0.92*	
Incarceration rate (lagged 1 year)				NS
Average incarceration rate	NS	NS	NS	NS
Civic participation element				
Incarceration rate (simultaneous)			NS	
Incarceration rate (lagged 1 year)				NS
Average incarceration rate	2.28*	2.15+	2.76*	2.42*
Institutional trust element				
Incarceration rate (simultaneous)			NS	
Incarceration rate (lagged 1 year)				NS
Average incarceration rate	NS	NS	NS	NS
Interpersonal trust element				
Incarceration rate (simultaneous)			-1.41+	
Incarceration rate (lagged 1 year)				-1.18+
Average incarceration rate	NS	NS	NS	NS
Personal and family relationships element				
Incarceration rate (simultaneous)			NS	
Incarceration rate (lagged 1 year)				NS
Average incarceration rate	NS	NS	NS	NS
Social networks element				
Incarceration rate (simultaneous)			NS	
Incarceration rate (lagged 1 year)				NS
Average incarceration rate	-1.62+	NS	NS	NS

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; L1=Level-1; L2=Level-2; Coefficient values are only shown for marginally significant or significant values; NS=Non-significant; Models include random intercepts and robust standard errors; Models 3.2.1F-K predicted the social capital outcome at Level-1 based only on average incarceration rates (plus controls); Models 3.2.2F-K predicted average social capital outcomes (Level-2) based only on average incarceration rates (plus Level-2 controls); Models 3.2.3F-K predicted the social capital outcome at Level-1 based on average incarceration rates and incarceration rates in the same year (plus controls); Models 3.2.4F-K predicted the social capital outcome at Level-1 based on average incarceration rates and incarceration rates in the previous year (plus controls).

with higher levels of incarceration on average. Marginally significant negative relationships were found between incarceration rates over time and interpersonal trust and between incarceration rates on average and social networks, not controlling for changes over time or looking at the country-level model only. No significant or marginally significant relationships were found between incarceration rates and institutional trust or personal and family relationships in this sample.

Step 3 Results: Incarceration and Population Health Outcomes Mediated By Social Capital

This section looks at results from the final step in the mediation analyses: models that include both incarceration rates and social capital variables predicting population health outcomes. The exact composition of these models was determined based on results from the first two steps, with only significant or marginally significant relationships included in Step 3. Based on non-significant Step 1 results, TB incidence is not examined in this section. Additionally, the exact social capital variables included in these Step 3 models were determined based on significant relationships between incarceration and each social capital measure, as well as the level of the significant relationship between incarceration and the population health outcome. Therefore, only if a social capital variable was significantly related to incarceration at the level of incarceration that would indicate a 2-1-1, 2-2-1, or 1-1-1 mediation relationship would that social capital variable be included. This includes marginal significance to fully explore these potential relationships. For example, for the life expectancy models, shown in Table 22, potential mediating relationships are examined for the average effect of incarceration on life expectancy over time and looks at 2-1-1 models with the civic participation and social

network elements, because in a multilevel model predicting social capital variables over time these had significant or marginally significant relationships with incarceration rates on average (L-2 incarceration rates → L-1 social capital elements) and examines a 2-2-1 model with civic participation, because this element had a marginally significant relationship when examining a Level-2 model only (L-2 incarceration rates → L-2 social capital element) (see Table 27 and Table 28 for these relationships).

Life Expectancy Step 3 Mediation Results

As described above, Table 29 provides the results for mediation analyses with life expectancy as the outcome. Only 2-1-1 and 2-2-1 models are analyzed as there were no significant relationships found between incarceration rates over time and life expectancy in this sample, which would be required for a 1-1-1 mediation model (see Table 27).

Adding in the potential mediators does not change the coefficients of average incarceration or its significance, except for in the 2-1-1 model with social networks (Model 3.3.2A). The indicator for average social networks is significantly related to life expectancy and the relationship is positive – a one-unit increase in the average social network element score is associated with a .05 year increase in average life expectancy. The relationship between average incarceration and life expectancy is no longer even marginally significant, suggesting a potential mediation (although in this model the mediation should be through the social network variable over time rather than the average). Zhang and colleagues (2009) suggest two ways that the mediation effect can be tested to see if the effect is significant, originally developed by Sobel (1982) and Freedman & Schatzkin (1992). The mediation effect can either be found by multiplying the coefficient of the X variable in Step 2 and the M variable in Step 3 (*a*b*) or

Table 29. Step 3 Mediation Model Results for Life Expectancy

	Model 3.1.3A Pre-Mediation (Sig L-2 Inc)		**Model 3.3.1A Civic Participation**		**Model 3.3.2A Social Networks**		**Model 3.3.3A Civic Participation**	
			2-1-1 Models				**2-2-1 Model**	
	b	se	b	se	b	se	b	se
Fixed effects								
Constant	66.41***	(0.90)	66.36***	(0.90)	66.35***	(0.93)	66.44***	(0.90)
Year	0.49***	(0.06)	0.51***	(0.07)	0.50***	(0.07)	0.49***	(0.06)
Year - squared	-0.02***	(0.00)	-0.02***	(0.00)	-0.02***	(0.00)	-0.02***	(0.00)
Average incarceration rate	-0.36+	(0.20)	-0.34+	(0.20)	-0.26	(0.20)	-0.39+	(0.21)
Civic/social participation (lagged 1 year)			0.00	(0.01)				
Avg. civic/social participation			0.01	(0.02)			0.01	(0.02)
Social networks (lagged 1 year)					0.01	(0.01)		
Avg. social networks					0.05*	(0.02)		
Model fit								
ICC	0.92		0.93		0.93		0.92	
AIC	3194.65		2783.25		2773.97		3196.26	
BIC	3377.89		2973.27		2963.98		3384.59	
Observations (Level-1)	1200		1097		1097		1200	
Countries (Level-2)	123		123		123		123	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered and all Level-2 variables are grand-mean centered; As opposed to models for the previous RQs, only a random intercept is included in these models, to match examples from Zhang et al. (2009); Random effects, in addition to Level-1, Level-2, and regional controls, are not shown here.

subtracting the coefficient of the X variable in Step 3 from the coefficient of the X variable in Step 1 (c-c'). Sobel's (1982) calculation is for a z-test to determine if the former multiplicand is significantly different from 0 and Freedman and Schatzkin (1992) have a formula for a t-test to determine if the latter remainder from the subtraction is significantly different from 0 (Zhang et al., 2009). These mediation effects ($a*b$ or c-c') can be different in a multilevel model if multiple mediators are present as c-c'shows the full mediation effect but $a*b$ shows a unique effect of one mediator (Zhang et al., 2009).

Sobel (1982): $z = \frac{ab}{\sqrt{a^2\sigma_b^2 + b^2\sigma_a^2}}$

Freedman & Schatzkin (1992): $t_{N-2} = \frac{c-c\prime}{\sqrt{\sigma_c^2 + \sigma_{c\prime}^2 - 2\sigma_c\sigma_{c\prime}\sqrt{1-\rho_{XM}^2}}}$

a = effect of X on M; b = effect of M on Y; c = effect of X on Y without M; c'= effect of X on Y with M; σ = standard error of parameter; ρ_{XM} = correlation between X and M.

For the life expectancy results, the Sobel tests show a marginally significant mediation effect of $a*b$ (z= 1.30; p<.10) for social networks; the other tests are non-significant. The Freedman & Schatzkin tests show a significant overall mediation effect of civic participation (t= 3.04; p<.01) and social networks (t= 25.12; p<.001) in the 2-1-1 models. Overall effects may be significant when unique effects are not, especially in 2-1-1 models, because both Level-1 and Level-2 predictors are included to separate between- and within-effects, though only one of these is of interest. These results suggest partial mediation of the relationship between average incarceration and life expectancy by civic participation and especially social networks. For example, average incarceration rates are negatively related to changes in social networks which are positively associated with changes in life expectancy (though some of these relationships are weak). In other words,

countries with higher incarceration rates have lower social networks over time and, partially due to a positive relationship between them, lower life expectancy over time.

Infant Mortality Rate Step 3 Mediation Results

Table 30 provides the mediation results for infant mortality rates. Again, 2-1-1 and 2-2-1 models only are analyzed as there were no significant relationships found between incarceration rates over time and infant mortality rates in this sample, which would be required for a 1-1-1 mediation model (see Table 27).

The results show that the negative effect of average incarceration rates stays consistent across mediation models and even strengthens in the social network model. Again, significant effects are found related to social networks, this time both over time and on average. A one unit increase in social network score is associated with a decrease in infant mortality rates of .07 per 1,000 births in the following year. An average social network score one unit higher is associated with an infant mortality rate .21 lower on average. There were no significant effects of civic/social participation scores found.

For the infant mortality rate results, the Sobel and Freedman & Schatzkin tests show marginally significant and significant *z* and *t* values; however, these are negative. For Model 3.3.1B and Model 3.3.2B, including the social capital variables strengthens the relationship between incarceration rates and infant mortality rates. These results suggest that civic participation and social networks might have a suppressive effect rather than a mediating one, because their inclusion in the models increases the predictive validity of incarceration (Conger, 1974). However, this effect may be difficult to disentangle due to having many control variables involved in the mediation models, not just the incarceration and social capital variables (Conger, 1974). It does suggest, though,

Table 30. Step 3 Mediation Model Results for Infant Mortality Rates

	Model 3.1.2B Pre-Mediation (Sig L-2 Inc)		**Model 3.3.1B Civic Participation**		**Model 3.3.2B Social Networks**		**Model 3.3.3B Civic Participation**	
			2-1-1 Models				**2-2-1 Model**	
	b	se	b	se	b	se	b	se
Fixed effects								
Constant	29.18***	(2.40)	29.36***	(2.42)	29.07***	(2.18)	29.17***	(2.42)
Year	-0.98***	(0.13)	-0.96***	(0.12)	-0.87***	(0.12)	-0.98***	(0.13)
Year - squared	0.01+	(0.01)	0.01+	(0.01)	0.01	(0.01)	0.01+	(0.01)
Average incarceration rate	-1.50*	(0.66)	-1.53*	(0.68)	-1.80**	(0.64)	-1.49*	(0.69)
Civic/social participation (lagged 1 year)			-0.00	(0.02)				
Avg. civic/social participation			-0.00	(0.05)			-0.00	(0.05)
Social networks (lagged 1 year)					-0.07***	(0.02)		
Avg. social networks					-0.21**	(0.07)		
Model fit								
ICC	0.94		0.95		0.95		0.94	
AIC	5433.05		4853.49		4796.01		5435.05	
BIC	5616.29		5043.50		4986.02		5623.38	
Observations (Level-1)	1200		1097		1097		1200	
Countries (Level-2)	123		123		123		123	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered and all Level-2 variables are grand-mean centered; As opposed to models for the previous RQs, only a random intercept is included in these models, to match examples from Zhang et al. (2009); Random effects, in addition to Level-1, Level-2, and regional controls, are not shown here.

that there is some effect of social networks on the relationship between incarceration and infant mortality rates, such that controlling for social networks (at the average) level strengthens this negative relationship.

Suicide Rate Step 3 Mediation Results

Table 31 (2-1-1 and 2-2-1 models) and Table 32 (1-1-1 models) provide the mediation results for suicide rates. Unlike the previous two sections, all three types of mediation models are analyzed, as significant effects of incarceration both on average and over time were found on suicide rates in Step 1 (Table 27). The same 2-1-1 and 2-2-1 models are examined as in the previous sections, but in addition, 1-1-1 models with the social capital index and interpersonal trust element are also examined, as these were shown to significantly relate to incarceration rates over time; whether these are simultaneous or lagged relationships are determined by whether these were found significant in Step 2 (Table 28).

The relationships between incarceration and suicide rates are largely unchanged when taking social capital variables into account. The coefficient drops by .1 when social networks are incorporated into the model, but actually increases by .1 when interpersonal trust variables are included in the models. The relationships between the social capital variables and suicide rates are mostly non-significant, with only civic participation over time and interpersonal trust on average reaching marginal significance.

According to Sobel and Freedman & Schatzkin tests, these mediation effects are mostly non-significant (including all of the results for the 1-1-1 models). Only the overall effects of the 2-1-1 models for civic participation (t= 1.94; p<.05) and social networks (t= 4.66; p<.001) were found to be significant. This suggests that, for the most part, social

Table 31. Step 3 Mediation Model Results for Suicide Rates (2-1-1, 2-2-1 Models)

	Model 3.1.1C Pre-Mediation (Sig L-2 Inc)		**Model 3.3.1C Civic Participation**		**Model 3.3.2C Social Networks**		**Model 3.3.3C Civic Participation**	
			2-1-1 Models				**2-2-1 Model**	
	b	se	b	Se	b	se	b	se
Fixed effects								
Constant	15.01***	(1.81)	14.93***	(1.76)	14.95***	(1.80)	15.02***	(1.79)
Year	-0.34***	(0.07)	-0.40***	(0.08)	-0.38***	(0.08)	-0.34***	(0.07)
Year - squared	0.01*	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01*	(0.00)
Average incarceration rate	1.04*	(0.45)	1.03*	(0.45)	0.94*	(0.43)	1.03*	(0.46)
Civic/social participation (lagged 1 year)			-0.02+	(0.01)				
Avg. civic/social participation			0.01	(0.04)			0.01	(0.04)
Social networks (lagged 1 year)					-0.01	(0.01)		
Avg. social networks					-0.09	(0.07)		
Model fit								
ICC	0.94		0.95		0.95		0.94	
AIC	4381.69		3876.58		3874.63		4383.66	
BIC	4564.93		4066.59		4064.65		4571.99	
Observations (Level-1)	1200		1097		1097		1200	
Countries (Level-2)	123		123		123		123	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered and all Level-2 variables are grand-mean centered; As opposed to models for the previous RQs, only a random intercept is included in these models, to match examples from Zhang et al. (2009); Random effects, in addition to Level-1, Level-2, and regional controls, are not shown here.

Table 32. Step 3 Mediation Model Results for Suicide Rates (1-1-1 Models)

	Model 3.1.3C Pre-Mediation (Sig L-1 Inc)		**Model 3.3.4C Social Capital (Simultaneous)**		**Model 3.3.5C Interpersonal Trust (Simultaneous)**		**Model 3.3.6C Interpersonal Trust (Lagged)**	
			1-1-1 Models					
	b	se	b	Se	b	se	b	se
Fixed effects								
Constant	13.94***	(1.77)	13.92***	(1.72)	13.73***	(1.67)	13.73***	(1.67)
Year	-0.39***	(0.07)	-0.39***	(0.07)	-0.39***	(0.07)	-0.38***	(0.07)
Year - squared	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
Incarceration rate (lagged 2 years)	0.98*	(0.45)	0.96*	(0.45)	0.98*	(0.45)	0.98*	(0.45)
Average incarceration rate	0.95*	(0.44)	0.93*	(0.44)	1.04*	(0.42)	1.04*	(0.42)
Social capital (lagged 2 years)			-0.02	(0.02)				
Average social capital			0.03	(0.09)				
Interpersonal trust (lagged 1 year)							0.00	(0.01)
Interpersonal trust (lagged 2 years)					-0.00	(0.01)		
Avg. interpersonal trust					0.10+	(0.05)	0.10+	(0.05)
Model fit								
ICC	0.96		0.96		0.96		0.96	
AIC	2901.30		2902.30		2902.13		2901.77	
BIC	3077.65		3088.18		3088.02		3087.65	
Observations (Level-1)	868		868		868		868	
Countries (Level-2)	117		117		117		117	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered and all Level-2 variables are grand-mean centered; As opposed to models for the previous RQs, only a random intercept is included in these models, to match examples from Zhang et al. (2009); Random effects, in addition to Level-1, Level-2, and regional controls, are not shown here.

capital does not mediate the relationship between incarceration and suicide rates, although there are significant relationships between all of these components. There may be some weak mediation happening through civic participation and/or social networks, but the interpretation is not straightforward from these results.

HIV Prevalence Step 3 Mediation Results

Table 33 provides the mediation results for HIV prevalence. Similar to life expectancy and infant mortality rates, only 2-1-1 and 2-2-1 models are analyzed as there were no significant relationships found between incarceration rates over time and HIV prevalence in this sample, which would be required for a 1-1-1 mediation model (see Table 27). The coefficients in all models are strengthened in the mediation models, and none of the social capital variables are significant. The Sobel and Freedman & Schatzkin test results also suggest a lack of mediating relationship between incarceration, social capital variables, and HIV prevalence. Most of the test results are non-significant, but those that are have negative *t* values, indicating that the coefficients were larger in the models testing for mediation than those without. Similar to infant mortality rates, these findings suggest that these social capital variables may have a suppressive effect on the relationship between incarceration and HIV prevalence (Conger, 1974). Holding civic participation and social networks at their average, the positive relationship between average incarceration rate and HIV prevalence, though still marginal, is stronger.

Overall Step 3 Mediation Results

Table 34 shows simplified results from the Step 3 mediation tables for each outcome. These findings are a synthesis of the Step 3 results shown by dependent variable above. Only results from the 2-1-1 and 2-2-1 models are shown here, as all four

Table 33. Step 3 Mediation Model Results for HIV Prevalence

	Model 3.1.1D Pre-Mediation (Sig L-2 Inc)		**Model 3.3.1D Civic Participation**		**Model 3.3.2D Social Networks**		**Model 3.3.3D Civic Participation**	
			2-1-1 Models				**2-2-1 Model**	
	b	se	b	se	b	se	b	se
Fixed effects								
Constant	4.77***	(1.29)	4.59***	(1.28)	4.85***	(1.32)	4.59***	(1.28)
Year - pre-peak	0.03+	(0.02)	0.02+	(0.01)	0.02	(0.01)	0.03+	(0.02)
Year - post-peak	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
Average incarceration rate	0.57+	(0.33)	0.63+	(0.33)	0.59+	(0.34)	0.63+	(0.33)
Civic/social participation (lagged 1 year)			-0.00	(0.00)				
Avg. civic/social participation			-0.03	(0.03)			-0.03	(0.03)
Social networks (lagged 1 year)					-0.00	(0.00)		
Avg. social networks					0.01	(0.03)		
Model fit								
ICC	1.00		1.00		1.00		1.00	
AIC	148.25		-1.56		1.22		149.01	
BIC	316.58		172.72		175.50		322.01	
Observations	793		725		725		793	
Countries	86		86		86		86	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered and all Level-2 variables are grand-mean centered; As opposed to models for the previous RQs, only a random intercept is included in these models, to match examples from Zhang et al. (2009); Random effects, in addition to Level-1, Level-2, and regional controls, are not shown here.

outcomes had relevant models, as opposed to the 1-1-1 models that were only run for suicide rates and did not show any significant results or mediating relationships. The coefficient values and their significance levels are provided in Table 34, along with significance results from the Sobel tests of the unique effect of each moderator variable and the Freedman & Schatzkin tests of overall mediation effect.

These results show evidence of significant mediation of the relationship between average incarceration and both life expectancy and suicide rates over time by civic participation and social network scores, looking at overall mediation when those variables are included over time and as country averages. However, these relationships are complex and deserving of further analysis to tease out exactly how these effects flow, potentially through structural equation modeling. Some significant effects were also found for infant mortality rates and HIV prevalence; yet inclusion of the social capital variables in these models produced effects in the opposite direction to mediation – actually strengthening the relationship between incarceration and these outcomes, suggesting a suppressive effect. Further analysis is also worthwhile here to understand the nature of this suppression and why this might be occurring.

Table 34. Step 3 Simplified Model Results for 2-1-1 and 2-2-1 Mediation Models

	Models 3.1.3A-D Pre-Mediation (Sig L-2 Inc)	**Models 3.3.1A-D Civic Participation**	**Models 3.3.2A-D Social Networks**	**Models 3.3.3A-D Civic Participation**
		2-1-1 Models		**2-2-1 Model**
	b	b	b	b
Life expectancy				
Average incarceration rate	-0.36+	-0.34+	-0.26	-0.39+
Civic/social participation (lagged 1 yr)		NS		
Avg. civic/social participation		NS		NS
Social networks (lagged 1 year)			NS	
Avg. social networks			0.05*	
Sobel test (unique effect)		**NS**	**+**	**NS**
Freedman & Schatzkin (overall)		******	*******	**NS**
Infant mortality rate				
Average incarceration rate	-1.50*	-1.53*	-1.80**	-1.49*
Civic/social participation (lagged 1 yr)		NS		
Avg. civic/social participation		NS		NS
Social networks (lagged 1 year)			-0.07***	
Avg. social networks			-0.21**	
Sobel test (unique effect)		**NS**	**+**	**NS**
Freedman & Schatzkin (overall)		**+ (SE)**	***** (SE)**	**NS**
Suicide rate				
Average incarceration rate	1.04*	1.03*	0.94*	1.03*
Civic/social participation (lagged 1 yr)		-0.02+		
Avg. civic/social participation		NS		NS
Social networks (lagged 1 year)			NS	
Avg. social networks			NS	
Sobel test (unique effect)		**NS**	**NS**	**NS**
Freedman & Schatzkin (overall)		*****	*******	**NS**
HIV prevalence				
Average incarceration rate	0.57+	0.63+	0.59+	0.63+
Civic/social participation (lagged 1 yr)		NS		
Avg. civic/social participation		NS		NS
Social networks (lagged 1 year)			NS	
Avg. social networks			NS	
Sobel test (unique effect)		**NS**	**NS**	**NS**
Freedman & Schatzkin (overall)		***** (SE)**	*** (SE)**	***** (SE)**

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; NS=Non-significant; (SE)=evidence of a suppressive effect rather than mediation (effect went in opposite direction); Sobel test involves coefficients from Step 2 models which are not shown here.

CHAPTER 8: DISCUSSION

The goal of this dissertation was to examine the relationship between incarceration levels and population health at the country level using the broadest sample of countries possible over multiple years, exploring direct, moderated, and mediated effects. This chapter briefly discusses the main findings for each research question, the study limitations, and implications for theory, research, policy, and practice.

Main Findings

Preliminary Analyses: Univariate, Bivariate, and Simple Multivariate Results

To begin, this research examined the simpler relationships between the study variables, found in Chapter 4, before turning to more complex methods to address the research questions. Because these analyses were univariate, bivariate, or simple multivariate, the largest possible sample was used. Univariate analyses showed skewed dependent variables (left skewed for life expectancy, right skewed for all others) with linear average time trends over the 30 years (positive for life expectancy; negative for infant mortality rates and TB incidence), except for suicide rates and HIV prevalence – both had a positive trend until a peak and then a negative trend; the former had the peak in 1995, the latter had the peak in 2001. World maps provided a different data visualization; showing average estimates and changes from first to last observation (e.g. 1990 to 2019) over the time period for incarceration rates and the population health outcomes. Examining them individually, estimates of each variable varied, sometimes regionally, on average; in many parts of the world incarceration rates increased, while many of the health outcomes improved or stayed stable, except for HIV prevalence in Southern Africa.

Bivariate analyses revealed significant relationships between each of the dependent variables and incarceration rates (with the exception of HIV prevalence on average). There was a positive relationship found between incarceration and life expectancy, suicide rates, and HIV prevalence, and a negative relationship between incarceration and infant mortality rates and TB incidence. These relationships were among over 6,000 observations for four dependent variables and incarceration, and over 3,500 observations for HIV prevalence and incarceration over time. On average, these significant relationships were found in 203 countries with available data for incarceration and life expectancy, 190 countries for infant mortality rates, 199 for suicide rates, and 208 for TB incidence. Three of these relationships are in the opposite direction than hypothesized, with incarceration being associated with better outcomes for life expectancy, infant mortality, and tuberculosis.

However, the above relationships do not control for any other variables. It was possible that country income level was confounding these bivariate findings, as development level has been found to be related to incarceration level (Clark & Herbolsheimer, 2021), so relationships between dependent variables and incarceration rates were explored by country income groups. In fact, Table 5 shows that the largest number of countries in each income group follow that inverted U-shaped association between incarceration rates and development found in the study above, which displays low levels of incarceration being the most common among low income countries (n=30), medium levels of incarceration among lower-middle income countries (n=34), medium or high levels of incarceration among upper-middle income countries (n=19 or 20, respectively), and medium levels of incarceration among high-income countries (n=34).

By splitting out the countries by income group, more complex relationships between the dependent variables and incarceration rates were observed, for average levels and changes over time. For example, although there was a significant positive correlation between incarceration rates and life expectancy, Figure 9 shows that countries with high incarceration rates do slightly worse than those with medium incarceration rates across all income groups; those with low incarceration rates have lower average life expectancy except for in high-income countries, where the lowest incarceration rates are associated with the highest life expectancy. This was also true in Figure 11 for infant mortality, where low levels of incarceration were associated with higher levels of infant mortality, except in the high-income group. This suggests that some level of incarceration may be protective in less developed nations, but in the most developed nations higher incarceration rates may stifle life expectancy levels or exacerbate infant mortality rates.

The opposite was true for average suicide rates. In Figure 13 there is a positive relationship between incarceration rate levels and suicide rates across most income groups, similar to the bivariate relationship. However, for high-income countries, low and medium incarceration rates are associated with higher mean suicide rates than high incarceration levels. The protective effects of incarceration on life expectancy and infant mortality for less developed countries may be related to a trade-off when it comes to a society's mental health (captured by suicide rates); meanwhile, in high-income countries, high incarceration, while related to worse life expectancy and infant mortality outcomes than similarly wealthy countries, appears to be protective in terms of suicide rates.

Finally, the story for mean HIV prevalence and TB incidence for income groups appears more complicated. Overall positive (HIV prevalence) and negative (TB

incidence) relationships obscure different relationships between incarceration and these outcomes among each income group. For instance, the highest mean HIV prevalence is associated with medium incarceration rates among low-income countries, but is associated with high incarceration rates among upper-middle-income countries. Each income group has a different level of incarceration associated with the highest levels of TB incidence as well. There may be a complex interplay between country income level, incarceration levels, and infectious diseases that cannot be captured within these basic analyses, and could relate to the health policies and practices within prisons.

The charts that show changes over the 30-year period tell a slightly different story (even-numbered figures). Countries were compared based on whether their last recorded incarceration rate was higher than their first recorded incarceration rate (increase) or whether it was lower or about the same (decrease/stable). This is a fairly simplistic analysis of change, and does not account for the rate of change or any fluctuations (e.g. quadratic or cubic change which returns to earlier levels). While changes in life expectancy and infant mortality rates were mostly similar comparing countries that had decreased their incarceration over this period or were fairly stable to those that had increased their incarceration over this period, an increase in incarceration rates was associated with larger increases in life expectancy and larger decreases in infant mortality rates for low-income countries, similar to the mean protective effects shown above but only for the least wealthy countries. For suicide rates, overall changes were also similar between the two groups, but decreasing incarceration rates were related to higher suicide rates for lower-middle-income countries yet lower suicide rates for the two wealthier country groups. So, in high-income countries, low or medium incarceration levels were

associated with higher suicide rates on average, but decreasing incarceration was associated with greater decreases in suicide rates. For infectious diseases, decreasing incarceration rates over this period were related to higher HIV prevalence but lower TB incidence. Therefore, the effects of changing a country's incarceration levels may not be straightforward, and could interact with the country's level of wealth. That being said, this discussion now turns to analyses for RQ1, which seek to understand the direct of effect of incarceration while controlling for other relevant variables at both levels.

RQ1: Investigation of Direct Effects

RQ1) Controlling for other relevant predictors, are incarceration rates related to population health, as measured by life expectancy (1A), infant mortality rates (1B), suicide rates (1C), HIV prevalence (1D), and TB incidence (1E)?

H1: *Overall, incarceration rates will have a negative relationship with life expectancy and a positive relationship with the other population health measures.*

Analyses to answer RQ1 (Chapter 5) used multilevel models that first examined mean outcomes and models looking at growth/time only, then incarceration, then full models with controls at both annual observation level (Level 1) and the country level (Level 2). Models were also run with 5-year-averaged data and to explore the contextual effects of incarceration rates. Full model RQ1 results showed that H1 (see above) was primarily supported – across multiple model configurations (annual vs. 5-year-averaged estimates) and with incarceration measured over time, on average, or both – with the exception of the relationship between incarceration rates and infant mortality rates.

To start, null and growth multilevel models showed most of the variation in outcomes was at the country level (based on ICCs close to 1) and significant time trends

that were similar to those described in the univariate analyses above. Incarceration rates were added to the models, and examined with either random intercepts and random slopes for the time variables, as had been done for the null and growth models, or with an autoregressive residual structure – which was shown in later analyses to be the best fitting structure for the models with full covariates. These two types of models showed similar results for life expectancy (non-significant over time; positive average relationship) and especially TB incidence (positive relationship over time; negative average relationship), but there were some differences between the two models for the other variables. This shows that the results could be sensitive to model specification, which is why the models shown to be the best fitting, in terms of AIC and BIC values, were selected for the rest of the RQ1 and RQ2 models.

Full models were summarized at the end of Chapter 5. Briefly, the following relationships were found:

- Life expectancy: Significant negative relationship over time; marginally significant ($p<.10$) negative average relationship; no contextual effects
- Infant mortality rate: Non-significant relationship over time; marginal to significant negative average relationship; marginal contextual effects
- Suicide rate: Marginal to significant positive relationship over time (especially 5-year periods); marginal to significant positive average relationship; no contextual effects
- HIV prevalence: Significant negative relationship over time (for annual periods only); significant positive relationship on average; significant positive contextual effects

- TB incidence: Significant positive relationship over time; marginally significant positive average relationship; no contextual effects

These results mostly support H1, which posited that the analyses would find a negative relationship between incarceration and life expectancy, and a positive relationship between incarceration and all other outcomes. In practical terms, H1 suggests that more negative population health outcomes will be associated with higher incarceration rates. This was found to be generally true for life expectancy, suicide rate, and TB incidence.

The relationship between life expectancy and incarceration rates over time provides some evidence for the aggregation of the short-term effects of incarceration on mortality that are strongly supported in the individual-level literature; in addition, the fact that this relationship was found in the 5-year data as well, but not the 5-year lagged data, also supports the evidence in the literature of long-term effects driven by short-term effects on mortality (Massoglia & Pridemore, 2015). These results also correspond to evidence from lower units of analysis, like counties, that incarceration rates relate to life expectancy (Weidner & Schultz, 2019; Nosrati & King, 2021) and infectious disease incidence (Nowotny et al., 2020). The positive relationship between TB incidence and incarceration rates are consistent with findings from Stuckler and colleagues' (2008) research in Eastern Europe and Central Asia.

Unlike H1 suggests, the significant relationships between incarceration and infant mortality were negative – indicating a protective effect of incarceration on infant mortality rates. Although state- and individual-level analyses from the U.S. have shown a positive relationship between incarceration on infant mortality (Wildeman, 2012a), these results are not unlike Wildeman's (2016) findings from the study on wealthy

democracies, which showed a significant protective effect of incarceration on infant mortality rates on all countries in the sample except for the United States from 1981-2007. In fact, sensitivity analyses excluding the U.S. found a strong negative relationship between incarceration and infant mortality rate on average. As discussed in Wildeman's (2016) research, incarceration can have an incapacitation effect on people who may be the most likely to have high-risk births. Although this connection was not proven in either study, the congruous findings from each would suggest that it would be important to further investigate this mechanism.

In addition, while there was a positive average relationship between HIV prevalence and incarceration rates found, there was also a significant negative relationship over time. This finding highlights the importance of multilevel models that examine these relationships among both levels of this nested data, because these could have been obscured if the nested nature was not taken into account. In fact, this may explain some of the conflicting results from the simpler bivariate and multivariate analyses. The results suggest that, on average, countries with higher levels of incarceration also have higher HIV prevalence, but increases in incarceration over time were related to decreases in HIV prevalence. These decreases over time could be due, like Uggen and colleagues (2023) suggest at the state level, to identification of and treatment for HIV within prisons, while holding higher prison populations in general may relate to higher prevalence on average.

Robustness of estimates based on missing data. There is the question of how reliable these results are, especially comparing the models using annual data to those with 5-year averages. The latter were run to increase the level of available data for countries,

but could also relate to slower mechanisms. It is helpful to compare these estimates with the 2-year-averaged data models in Appendix F, which has a time frame closer to the annual data but a lower proportion of missing data. The models for each outcome are discussed below.

Life expectancy models showed negative effects of incarceration on life expectancy over time in annual models, which was strengthened in the 5-year models. These significant negative trends were also present in the 2-year models, suggesting that the underlying relationship is the same, but incorporating more data points helped to find an even stronger relationship.

Infant mortality rate models found non-significant average effects using annual data, but a significant effect with the 2-year and 5-year averages; these estimates look similar across both models, and therefore less missing data proportionally may have allowed for the relationship to be found significant.

For suicide rate, significant 5-year findings could be due to less missing data (as 2-year models find significant average effects of incarceration as well, but annual ones do not); however based on the significant 5-year lag model with annual data, it may also be due to a mechanism that works over longer periods of time.

HIV prevalence has significant country-level effects across all models, suggesting a robust positive average effect of incarceration on HIV. Yet, the annual estimates, which find a significant negative effect, are non-significant in the 2- and 5-year-averaged data models. This could be due to mechanisms that work over shorter periods of time, or less precision in the averaged estimates, as actual coefficients are similar but the standard errors are larger for these models.

For TB incidence, the relationship over time was strengthened in the 2- and 5-year-averaged models, suggesting a robust positive effect of incarceration changes on TB. Average effects were marginally significant in the annual models, but non-significant in the other models, suggesting any effect is likely non-significant.

Overall, these comparisons suggest that most of the underlying relationships are consistent regardless of time period and missing data level; however, whether the relationship is strong enough to reach statistical significance is dependent on the missing datal level and the precision of the estimates. There was also some evidence that mechanisms were working over more short-term (annual) or long-term (2-5 year) periods. For example, the relationship between incarceration and HIV prevalence may be relayed through a more short-term mechanism (e.g. exposure to infection in prison and then population spread after release) whereas the relationship with suicide rates may have a longer-term mechanism (e.g. aggregation of negative psychological outcomes in prison and mental health challenges upon release combined with spillover effects to the larger healthcare system could take longer to result in higher suicide rates).

Differences in samples. It is also worth noting, when thinking about these results as compared to earlier results, that these full multilevel models had a more restricted sample than the univariate, bivariate, and simple multivariate analyses. Because missing data were handled through listwise deletion, as more variables were added to the models, observations were dropped that had missing estimates for these additional variables. So, for example, while the correlations and charts examining the relationship between incarceration rate and life expectancy used observations from 203 and 205 countries, respectively, the full models using annual data were limited to a sample of 128.

Differing results from Chapters 4 and 5, therefore, could be due to controlling for more factors and the multilevel nature of the data or could be due to sample composition. For instance, when looking at pairwise correlations for countries included in these full RQ1 models only, the correlations between incarceration and life expectancy over time is negative and with TB incidence is positive (not shown here), which is the opposite of the significant relationships found in the fuller sample in Table 4. The full models are dropping many lower-income countries, which found protective effects of incarceration on life expectancy in the full dataset, but have less data availability across the suite of variables included in the full models. The sensitivity analyses presented in Chapter 5 also showed how important sample composition can be, with findings of some influential countries for each of the dependent variables.

RQ2: Investigation of Moderating Effects

RQ2) Are the effects of incarceration rates on population health (2A: life expectancy; 2B: infant mortality; 2C: suicide rates; 2D: HIV prevalence; 2E: TB incidence) moderated by specific country contexts (racial/ethnic diversity; social protection expenditure; or prison conditions)?

H2: *At least one, but potentially all, of the above factors moderates the relationship between incarceration and five population health outcomes.*

Chapter 6 examines models to understand whether the relationships between incarceration and population health outcomes are moderated by factors related to racial/ethnic diversity and exclusion, social protection expenditure, and prison conditions. The results show moderating relationships between each of the dependent variables and at least one of the moderators, supporting H2. Interaction models revealed significant

relationships, over time and on average, that were obscured in the direct effect models (as in Gottlieb, 2017), while subsample analyses allowed for examination of country subgroups that were driving overall effects.

As in the last section, the moderation results were summarized at the end of the relevant chapter and therefore will be only briefly described here. In terms of life expectancy, which had a significant negative relationship with incarceration over time and a marginal negative relationship on average in the full model, there was one significant interaction – between average incarceration rate and social protection expenditure. A graph of this relationship showed that, at high levels of social protection expenditure, average incarceration has significant negative effects on life expectancy. However, this relationship was driven by the U.S.; it was non-significant when the U.S. was excluded from the model. In the subsample models, there was more to understand about the negative relationship between incarceration and life expectancy over time. This relationship appeared to be driven by countries that had above average ethnic fractionalization or excluded populations, below average social protection, or above average (worse) prison conditions. This suggests that country context matters for the relationship between life expectancy and incarceration, which can be negative in the presence of higher racial diversity/exclusion, lower levels of social protection, and harsh prison conditions. Some of these were suggested by Wildeman (2016) as reasons why the U.S. had a negative relationship with incarceration and life expectancy while other wealthy democracies did not, which provides evidence for this suggestion but also shows this is not a uniquely American problem when looking at a broader sample of countries.

For infant mortality rates, there was some evidence of moderation of the overall non-significant relationship over time and marginal negative average relationship. There were three significant interactions: lagged incarceration x average social protection expenditure, average incarceration x average social protection expenditure, and average incarceration x average prison conditions, though these were only significant with the U.S. In addition, despite a non-significant relationship over time in the full model, there were marginal and significant positive relationships in countries with above average excluded minority populations and worse than average prison conditions. This suggests that, while incarceration can be protective for infant mortality rates overall (via birth suppression/incapacitation) and when countries provide less social protection, there are certain country contexts, like those with highly marginalized populations or harsh prison conditions, that can outweigh the protective elements of incarceration. These results align with Wildeman's (2016) hypothesis that there is a trade-off related to incarceration and infant mortality rate, between suppressing births and putting children in riskier situations, and that harmful effects are mostly limited to the U.S. The balance with other institutions, like welfare, may determine whether this association is net positive or negative.

Suicide rates, which had only a marginal positive relationship to average incarceration rates in the full model, showed some level of moderation by most of the potential moderators. Significant interactions were found for average incarceration and both ethnic fractionalization and social protection expenditure. Average incarceration rates were positively related to suicide rates at low levels of ethnic fractionalization, meaning a more homogeneous society, and high levels of social protection expenditure, but negatively related to suicide rates at very low levels of social protection expenditure.

The subsample results look similar, with significant positive average effects of incarceration found in countries with below average ethnic fractionalization and above average social protection expenditure. Perhaps the stigma of incarceration is harder to handle in more homogenous and supportive societies. In addition, a positive relationship over time was found within the subsample of countries with worse than average prison conditions, with and without the U.S., suggesting that the mental strain of incarceration could be affecting populations over time as countries with harsh prison conditions increase incarceration levels.

HIV prevalence showed a negative relationship with incarceration over time and a positive relationship on average in the full model, and there was evidence of moderation by most of the potential moderators as well. There were three significant interactions, which showed moderation based on ethnic fractionalization and prison conditions, which were differentially affected based on whether or not the U.S. was included in the sample, but did not change the direction of the relationships revealed in the direct effect models. Countries with higher levels of racial diversity had a significant positive relationship between average incarceration and HIV prevalence. This suggests that the incarcerated population may be closely linked to HIV transmission in countries with high racial diversity – which would follow if countries are imprisoning more of their minority populations and there are larger minority populations in highly diverse countries, leading to a link between these populations and HIV at the societal level. Incarceration rate changes were negatively related to HIV prevalence for countries with better prison conditions, without the U.S. included, and average incarceration rate was positively related to HIV prevalence for countries with better prison conditions (this was found in

the sample with the U.S. but could not be compared to results without the U.S. because that model did not converge). This counterintuitive finding is similar to the results from the full models, and would support a hypothesis that relates these findings to prison testing or treatment, as suggested before, and should be further examined.

Subsample models showed that the negative relationship over time may be driven by countries with below average ethnic fractionalization and the positive average relationship may be driven by countries with below average social protection expenditure. These results suggest that there may be something happening in more racially homogeneous societies as it relates to HIV transmission over time, but lower social protection at the country level could lead to higher prevalence on average.

The other infectious disease, TB, showed a strong positive relationship to incarceration over time and a marginal positive relationship on average in the full model. There was evidence of moderation for all potential variables, though only prison conditions showed evidence of this through interactions. A significant interaction was found between average incarceration and prison conditions, both with and without the U.S. In both samples, the harshest prison conditions are related to a positive relationship between average incarceration rates and TB incidence, though the effects are higher in the sample with the U.S., suggesting this relationship may be particularly strong there. In addition, the positive relationship with incarceration over time was stronger in subsamples with below average ethnic fractionalization or excluded populations, above average social protection expenditure, and harsher than average prison conditions, although comparing some of these with their counterparts was made more difficult because some models did not converge. However, the moderation relationship with the

racial diversity and exclusion variables was strong, as all models converged, and the relationship over time was significant at the .001 level for below average ethnic fractionalization and excluded population subsamples and only marginally significant for the above average counterpart. Additionally, the relationship to average incarceration was also significant for the below average ethnic fractionalization subsample only. This suggests that there is a pathway between incarceration and TB that is more common in more racially homogenous and inclusive nations, which deserves further research.

As discussed at the conclusion of Chapter 6, some of these results support the hypotheses that racial diversity and exclusion and harsh prison conditions can exacerbate negative health effects of incarceration while social protection can help mitigate these effects. For example, higher levels of racial diversity and exclusion, lower levels of social protection expenditure, and worse prison conditions do seem to be driving the negative relationship between incarceration and life expectancy over time, which is the overall indicator of population health.

Yet, when looking at more specific indicators of physical and mental health, the relationships become less straightforward. Worse outcomes were associated with lower levels of racial diversity, higher levels of social protection, and better prison conditions for each of the indicators in some way. This could be due to different underlying relationships; for instance, the pathways with suicide rates and infectious diseases could be different for more homogeneous or diverse populations.

However, these contradictions could also be related to the measures used in this research. The social protection expenditure measure captured the proportion of spending countries were committing as a part of their overall GDP, but overlooks the types of

social support countries are spending on. Generally, countries focus the most on programs for the elderly (ILO, 2021), which may not provide support for most of the formerly-incarcerated population and could be taking away from spending in other areas that would actually mitigate negative effects of incarceration. A measure that captured support for populations most likely to be incarcerated or transitioning out of prison, such as young men, minority populations, or those unemployed, may provide a stronger link for the potential mitigating effects of social protection support. Similarly, the prison conditions measure, while capturing important differences in country prison system conditions, would benefit greatly if supplemented by a measure which showed supportive practices in prisons, such as healthcare, rather than the ways in which prisons conditions were at a deficit. Understanding more about infectious disease testing and treatment in prisons could, for example, help tease out the contradictory findings for HIV prevalence over time and on average. These questions provide directions for future research to further tease out the way country contexts can influence these relationships between incarceration and health.

RQ3: Investigation of Mediating Effects

RQ3) Is the relationship between incarceration and population health (3A: life expectancy; 3B: infant mortality; 3C: suicide rates 3D: HIV prevalence; 3E: TB incidence) mediated by factors associated with barriers to social integration, as measured by social capital and its elements (civic participation, institutional trust, interpersonal trust, personal and family relationships, and social networks)?

H3: *Population health estimates are partially mediated by measures of social integration*.

Finally, Chapter 7 investigates potential mediation of the relationship between incarceration and population health outcomes. However, the mediator of interest, social capital, is available for a slightly different sample of countries over less than half the original time period of interest (2007-2019). Therefore, this chapter first investigated the incarceration and population health outcomes for this sample (Step 1: X → Y), then the relationship between incarceration rate and the mediator and its components (Step 2: X → M), and then finally put those pieces together for full mediation models (Step 3: X and M → Y) for relationships that were found to be significant in the earlier steps. This process was based off of one modeled by Zhang and colleagues (2009), which incorporates the multiple pathways through which multilevel mediation could occur. Because these analyses were complicated by different outcomes in Steps 1 and 3 compared to Step 2, all models were run with random intercepts only, as compared to the more complicated residual structures used in Chapters 5 and 6. Therefore, due to sample and analysis adjustments for this initial examination of mediation relationships, the relationships found in Chapter 5 and those shown in Chapter 7 are not exactly the same, in terms of significance, but do generally align in terms of directionality. Chapter 7 results showed some support for H3, but this was complex, as will be discussed below.

In Step 1, different models were run to examine the potential relationships between incarceration rates and population health outcomes in this sample. Based on the different ways multilevel mediation could occur, incarceration was incorporated into models as just a Level-2 predictor (country average), a Level-1 (lagged 1 year) and Level-2 predictor, and a Level-1 (lagged 2 years) and Level-2 predictor. Again, Figure 26 (Chapter 7) shows these potential multilevel mediation relationships. Step 1 results

(shown in Table 27) found a significant country-level relationship for life expectancy (negative), infant mortality (negative), and suicide rate (positive), a marginal country-level relationship for HIV prevalence (positive), and a significant relationship with incarceration rate changes over time with suicide rate (positive with the 2-year lag).[12] No significant relationship was found for this sample and time period between incarceration and TB incidence.

Step 2 results (shown in Table 28) found a significant relationship between incarceration rate changes over time with the social capital index (negative) and the interpersonal trust element (negative), and a significant country-level relationship with the civic participation element (positive), and a marginal country-level relationship with the social networks element (negative). The surprising directionality for the civic participation element and incarceration is worth noting. Countries with higher incarceration on average also have higher civic participation on average, controlling for other variables. In contrast with significant social capital effects, which relate negatively to incarceration rates over time, potentially based on disruption of interpersonal trust especially, higher levels of incarceration on average could signify some level of government and justice system legitimacy based on populations' "penal attitudes", or the public's punitiveness, aligning with incarceration levels (e.g. Young & Brown, 1993) and therefore promoting higher levels of participation among the general public. This relationship should be further explored as there are multiple studies that confirm that incarceration can limit the civic participation of prisoners and formerly incarcerated

[12] As a reminder, a 2-year lag between incarceration rate and the population health outcome was tested in these models to allow for a potential 1-year lag between incarceration and the social capital mediator and then a further 1-year lag between the mediator and the outcome.

persons (Manza & Uggen, 2006; Shannon & Uggen, 2012), so it is important to understand why this process is working in the opposite direction at the country level.

Based on the results from the first two steps, full mediation models were run for four population health outcomes. These included 2-2-1 and 2-1-1 models for life expectancy, infant mortality rate, and HIV prevalence, with suicide rate also including 1-1-1 models. Tables 29 through 33 present these results, with a full summary in Table 34. Using the Freedman & Schatzkin (1992) test of an overall mediation effect, there was evidence of 2-1-1 mediation for life expectancy and suicide rates through civic participation and social networks. For example, for suicide rates, including civic participation over time (although only a marginal effect itself) or social networks over time (non-significant) decreases the effect of average incarceration .01 and .1 suicides per 100,000 population, respectively. Therefore, some (small amount) of the effect of incarceration rate on life expectancy and suicide rate may be through its effect on civic participation and social networks.

There was the opposite of a mediation effect – a suppressive effect – found for these variables, incarceration, and infant mortality rate and HIV prevalence. The effect of a one-unit change in average incarceration rate, for instance, went from decreasing infant mortality rates by 1.5 per 1,000 live births to decreasing infant mortality rates by 1.8, once social networks (also significant and negatively related to infant mortality rate) were controlled for. This suggests not that the effects of incarceration are partially flowing through social networks or civic participation, for infant mortality rate and HIV prevalence, but that controlling for these differences strengthens the original relationship. The interplay between incarceration, social capital, and these population health measures

is not straightforward; future research should entangle these relationships, potentially using other methods to test mediation such as structural equation modeling.

Taken together, these results suggest that the barriers to social integration, found to be an important mechanism in individual- and community-level literature (e.g. Schnittker & John, 2007; Schnittker, 2014), are somewhat present at the country level, but there may be better macro-level indicators to explain the relationship between incarceration and health at this level, such as spending related to other institutions.

Limitations

This research has limitations related, particularly, to the use and availability of comparative data. First, comparative data come with drawbacks. For example, "crime and criminal justice data are strongly dependent on national legal, statistical, and substantive characteristics that negatively affect comparability and cannot be fully controlled for, even with the aid of international surveys" (Harrendorf, 2018, p. 164). International surveys such as the UN-CTS, which is primarily relied upon for the incarceration data utilized in this research, use standard definitions to promote comparability, but may not fully succeed in this task. Moreover, some of these variables (like suicide rate and unemployment) are not directly measured annually but estimated using averages by international organizations, which may bias the data (Babones, 2013). Trend data is used in this research where possible, which is thought to be more reliable than just comparing rates across countries (Harrendorf, 2018), although these data are still subject to changing definitions and data collection processes over time. Especially with the incarceration rate measure, which was combined from two sources, there could be some introduction of error over time and between countries; however, estimates used were deemed to be fairly

consistent, either between estimates or with later trends, so the error is likely to be minimal. In addition, only intentional homicide rates are used as a measure of crime in this research, as scholars have found these estimates to be more accurate and comparable than overall crime rates (e.g., Monkkonen, 1989; Harrendorf, 2018).

Another limitation to this research is related to sample composition – for Level 2 (countries) and Level 1 (years). The country sample of this research is driven almost entirely by cross-national data availability; therefore, it may not be representative of populations across the globe. Quality national data is often lacking from low- and middle-income countries, even for broad international surveys such as the UN-CTS that can have issues with non-response bias (Bennett, 2009), which skews available data towards high-income countries from specific world regions. This is an issue for comparative research generally, and within this topic Kinner and Young (2018) have noted a critical evidence gap related to incarceration and health among low- and middle-income countries. A strong effort has been made to compile data from the broadest sample of countries possible to mitigate this limitation. To my knowledge, this study uses the broadest sample yet to date in an investigation involving both incarceration and public health measures.

Data are also not available for every year (Level 1) in the time period of interest for each variable of interest. An unbalanced panel approach was therefore used, due to the listwise deletion method for handling data, and so years included in the analyses were not necessarily every year for each country but instead every year that had available data for all relevant variables. For the direct effect models in Chapter 5, time periods were also collapsed to measure 5 years per estimate (and 2 years per estimate, in Appendix F), which decreases the specificity of measures involved, but ultimately allows for

estimation, and may be a better indicator than an annual time period for macro-level changes (Babones, 2013). Modern missing data techniques, such as multiple imputation and full information maximum likelihood, were explored but ultimately listwise deletion was determined to be the most feasible method given the data structure and software. To minimize the effect of missing data, each type of analysis was run using all available relevant data. However, sample composition did change across models, and therefore results may not be generalizable across chapters. In addition, each sample should not be thought of as a representative sample of countries worldwide over this period, and results cannot be generalized to all countries (although it is worth noting that analyses in Chapter 4 include data on almost all countries globally). The limited generalizability, to the world and also across chapters, is seen as a worthwhile trade-off for the ability to answer these questions among a more representative sample of countries than previous research has been able to examine, across multiple decades, but future research should explore more advanced methods to better address the limitation of missing data at Level 1.

Finally, this research is unable to demonstrate a causal relationship between incarceration rate and population health, given the data and analyses which have been conducted. Similar to Wildeman (2016), there is no exogenous shock in the data which could better show causality. To best approximate causal evidence, multiple types of analysis were conducted (without and with control variables) to understand the overall relationships, moderations, and mediating processes at play. The research may also be subject to omitted variable bias, which is "the difference between the expected value of an estimator and the true value of the underlying parameter due to failure to control for a relevant explanatory variable or variables" (Jargowsky, 2005, p. 919). This research

attempts to include relevant predictor variables, as suggested by the literature, and use appropriate analytic techniques that allow unbiased estimates to be obtained, but the possibility than an important control variable may be left out should be acknowledged. For instance, the relationship between incarceration and health may be intrinsically tied to the prison health system, as well as the general health system, because research has found prison to be individually protective of health for some groups (Schnittker & John, 2007; Porter & DeMarco, 2019) and transmission of diseases linked to prison healthcare systems and spending in the U.S. (Uggen et al., 2023). However, there was no internationally comparable measure available for a large number of countries that I could find that tracked prison health spending and infrastructure, so only general health spending variables were included. In addition, these analyses only examined linear relationships between incarceration and population, and there could be more complex patterns at work, similar to the "Kuznets Curve" relationship between incarceration and wealth (Clark & Herbolsheimer, 2021). There was also some evidence that the results were sensitive to analytic technique, so further work should be done to understand how the method could affect results in cross-national longitudinal samples. These limitations should all be considered when considering the results of this research and could be used as opportunities for future research.

Implications

The above limitations notwithstanding, this research has a broad range of theoretical, research-related, and practical implications.

For Theory and Research

First, there are implications of this study for theory and research. The results of this research could inform theoretical discussions surrounding micro-level events and macro-level consequences, in addition to promoting more theory around incarceration as an institution related to other social realities. In terms of research, this study builds upon a small, yet important, body of literature examining cross-national effects of incarceration. These findings help guide future researchers in areas for more data collection and study, especially examining mechanisms for significant relationships.

In terms of theory, the results suggest that further theoretical development around incarceration and health at the nation level would be useful, as this relationship is not only relevant in the U.S. Some relationships, such as a positive one between incarceration and infant mortality rate, do seem to be stronger in the U.S. This is similar to Wildeman's (2016) findings that negative health outcomes related to incarceration were only found in the U.S. However, the broader sample in this research revealed that other countries are feeling the consequences of incarceration on population health as well. These results should be an impetus for further theoretical development around this macro-level relationship, potentially linked to more micro-level theorizing, such as coercive mobility (Clear et al., 2003) and the aggregating mechanisms suggested by Nosrati and King (2021). Coercive mobility theory, articulated by Rose, Clear, and colleagues (Rose & Clear, 1998; Clear et al., 2003; Clear, 2007), proposes that incarceration levels likely have a "tipping point" at which high levels of incarceration, concentrated among poor neighborhoods, would increase rather than decrease crime. This could also be true for other outcomes such as population health. Although only some evidence of contextual

effects were found and a “tipping point” was not examined in particular, simple analyses and moderation models suggested that incarceration can have different effects at different levels. There may be something about the aggregation or accumulation of incarceration, even at the level of nations, that has detrimental impacts, which is what Rose and colleagues argued about neighborhoods that were disproportionately affected by incarceration. Although the mediation analyses examining social capital variables did not find straightforward effects, future research should also examine the three aggregation mechanisms proposed by Nosrati and King (2021) (relegation, amplification, and corrosion) in more detail to understand whether these effects on communities have country-level counterparts. It is also worth noting that not all of the effects of incarceration were found to be detrimental – in terms of infant mortality rates in particular, incarceration was protective (though some trade-offs need to be considered), and more work could be done to explore how potentially positive and negative effects of incarceration interrelate.

In addition, more theorizing could occur at the macro-level. Research has shown how spillover effects from the prison system could affect the healthcare system (Schnittker et al., 2015), and there may be more ways in which these variables are related through purely macro-level mechanisms. The lack of clear evidence around the mechanisms suggested for an individual-level relationship suggests that more theorizing and research should be done to connect the size of a country’s prison system to their citizenry’s health in ways that flow primarily through nation-level mechanisms, such as spending and culture.

A macro-level framework that may be helpful for this work is general systems theory. Criminal justice agencies, including corrections, have been described as a system, with varying levels of support, since the 1960s (Bernard et al., 2005). However, what may be more important than the criminal justice system, with agencies and organizations as subsystems, is that the criminal justice system has been described as itself "a subsystem within larger political, economic, educational, and technical systems" (Bernard et al., 2005, p. 204; Van Gigch, 1978). This view highlights the interconnected nature of incarceration/corrections within a social system. In fact, Munro (1971) discusses corrections as an open system, or supersystem, that receives inputs from the environment and produces output which leaves the system; this involves feedback loops which can overload systems and cause a system disruption (Bernard et al., 2005), which could be occurring in relation to incarceration, population health, and welfare. Future research could use the "supersystem" framework of the human services delivery system, which includes mental health, social welfare, health, education, and criminal justice (Sauber, 1983), to examine broad effects of criminal justice at the nation level and place them in context. These components are all interconnected and, as Harshbarger (1974) described, "deal with those bio-social problems that arise from the vagaries and complexities of being human" (as cited in Sauber, 1983, p. 17).

In terms of scholarship, this research further strengthens the evidence base for the relationship between incarceration and health. Reviews of research have generally concluded that there is some relationship between incarceration and health outcomes, but at the nation-level this has only been demonstrated to occur broadly in the U.S. This research suggests that, while some aspects may be particularly American, there are

effects of incarceration in countries beyond the U.S. In addition, certain contexts exacerbate or mitigate these effects; one context which was fairly consistently related to negative outcomes was harsh prison conditions, as suggested by Wildeman (2016). These findings indicate that, while the U.S. especially may want to focus on this issue due to high rates of incarceration within the country, it is worth taking a broader perspective and examining these relationships worldwide.

Second, the moderation and mediation analyses provide direction for future research in terms of which contexts and processes may be important in this relationship and where there may be room for other explanations. This is especially important because of the larger, more diverse sample that was used here as compared to previous research. One study examining predictors of incarceration rates found that the sample composition clearly mattered in terms of which variables were found to be significant for samples of different income levels (Ruddell, 2005). If we only examine small samples of "developed" countries, we may miss larger trends occurring globally. This is especially crucial as many countries have followed the U.S. in growing their use of incarceration. In fact, the findings here suggest that country context, in terms of racial diversity/exclusion, social protection, and prison conditions, can all affect the relationship between incarceration and population health – and there may be other important contexts not investigated herein that do so as well. While the mediation results were not straightforward, they did find that components of social capital are related to both incarceration and population health at the country level, and future research could look deeper into these mechanisms or explore other individual-level and macro-level processes potentially at work here. Future research may also want to further explore whether these

effects at the country level are created by the aggregation of individual-, family-, and community-level effects (Pathway 1) or if there are stronger macro-level mechanisms at play (Pathway 2) (Figure 1).

Third, as mentioned above, this research is one of the only studies that I am aware that uses random effects and marginal models to understand comparative macro-level effects of incarceration. While the hesitancy in certain fields to use these models is valid, this study shows the benefit of exploring incarceration effects at both the country level and over time, using a method that separates out these effects at each level. This research, and its limitations, can provide direction for future research utilizing these techniques, and the results found here also suggest that it might be valuable to more explicitly compare the different analytic techniques to understand how analysis choice could affect findings in cross-national longitudinal research in particular.

Finally, this research provides some implications related to additional data that would be helpful for this topic of study. While modern missing-data-handling techniques may mitigate some of the limitations of sporadic data availability over time, enhanced efforts to fill these gaps would also bolster research into the societal relationship between incarceration and population health. International organizations like the U.N. and WHO should continue to increase data collection programs, across all countries and expanding on relevant metrics, to help further examine these relationships globally. For instance, these organizations should promote expanded data collection efforts in low- and lower-middle-income countries across a range of metrics, such as poverty and government sector spending, and ensure they are comparable to those in upper-middle- and high-income countries. They should also enhance comparative data collection specifically in

the areas of social protection, broken down into categories of coverage, and prison healthcare spending and provision, such as disease testing and treatment, to better understand protective elements of society. This topic of research could also benefit from other international data collection projects, such as the World Values Survey, consistently gathering data on cultural aspects, such as public opinion related to punishment and the justice system, as these may be involved in the macro-level processes connecting incarceration and population health.

For Policy and Practice

There are also implications of the research for policy and practice. First, this study shows that there is a relationship between incarceration and population health across a broad sample of countries, which means there are potential implications for the use of incarceration, especially if future research confirms this link. This study found detrimental relationships between incarceration and life expectancy and suicide, as a mental health proxy, in particular, and mostly negative relationships with infectious disease indicators. These findings suggest that the size of the incarceration population has real, and negative, effects on societies as a whole, at least within the sample of countries and years considered here. However, the study also found positive effects of incarceration on infant mortality rates, which could potentially be due to the incapacitation of people potentially involved in high-risk births. Analyses also found that country contexts, like harsh prison conditions, could exacerbate negative effects, even negating the positive effects of incarceration on infant mortality rates. Other country contexts, like racial diversity/exclusion and social protection spending levels, created environments more conducive to negative health effects for some outcomes, while doing the opposite for

others; for example, while countries with high racial diversity and exclusion had negative relationships between incarceration and life expectancy, those with low diversity had stronger relationships between incarceration and infectious disease.

At a minimum, this research should be an impetus for policymakers and high-level practitioners to call for further research in their countries to understand what is occurring within their society and evaluate the trade-offs of their current level of incarceration. As mentioned early in this dissertation, incarceration levels are the results of policy and practice decisions, not necessarily just levels of crime, and can be evaluated and revised to create the best outcomes for citizens and residents. Countries with high levels of incarceration, especially, should examine the relationship between incarceration and health in their nation, which has been shown to exist here cross-nationally and in other research at lower levels. Down the line, national governments and corrections agencies may want to consider national prison system reform, or even abolition in favor of an alternative framework (Davis, 2003), if there is sufficient evidence of societal consequences in the use (or overuse) of incarceration. At the very least, having prison conditions meet international standards seems important to the health of the general population as it relates to the prison population, and countries, regardless of their levels of incarceration, should prioritize safe and clean conditions within prisons. More research is needed to understand potential mitigation efforts as they relate to social capital.

Governments may also want to consider how their incarceration levels are affecting healthcare and justice costs. In 2019, the U.S. spent the most per capita on healthcare out of all the OECD countries, especially for government spending and compulsory health insurance, which may be true for a multitude of reasons, but shows

that there could be money to be saved by rethinking levels of incarceration in the U.S. (OECD, 2020). Other countries outside of the OECD could also cut down on healthcare spending by reforming prison systems, especially in terms of physical and mental health, but should consider bolstering pregnancy and early motherhood support to offset the lost incapacitation effects on infant mortality rate.

As infant mortality rate was the only consistent health outcome that was positively related to incarceration, countries may also want to consider reducing prison populations (or abolishing the prison system altogether), which would save money as well. As the NRC (2014) notes,

> Another major societal consequence is that the penal system has been consuming larger portions of many government budgets. As a result, less money is available to spend on education, health care, economic development, state and local police, and other key government interventions and services to aid historically disadvantaged groups and improve the health and well-being of the population as a whole. (p. 304)

To illustrate, the U.S. increased its spending on corrections by 548% from 1982 to 2009 (Shannon & Uggen, 2012). Global criminal justice expenditure was estimated to cost $360 billion in 1997 (Farrell & Clark, 2004) and that estimate is likely to have increased in the past two decades as prison populations have increased (PRI &TIJ, 2020). Although policing costs accounted for a majority of this budget (Farrell & Clark, 2004), if prison costs were lowered this could save governments a significant amount of money, likely without corresponding increases in costs of crime (Durlauf & Nagin, 2011). Again, these trade-offs would need to be extensively researched for countries to inform these decisions, but this research suggests that there could be societal benefits to lowering incarcerated populations.

Conclusion

The present research examined the relationship between incarceration and population health among a broad sample of countries over multiple years and decades. This relationship has a broad evidence base at more micro levels, such as individuals, families, and communities, but most of this is from the U.S. Utilizing multilevel models, examination of direct, moderating, and mediating effects was possible across years (Level 1) and countries (Level 2) for samples of developed and developing countries. Results showed that incarceration is associated with population health outcomes in a large sample of countries; for the most part these relationships were negative (life expectancy, suicide rates, HIV prevalence over time, TB incidence) but occasionally they were found to be protective as well (infant mortality rates and HIV prevalence over time). Moderation analyses revealed complex relationships between country contexts and these incarceration/health relationships – sometimes the contexts revealed a negative relationship while in other cases the contexts were protective. Initial mediation analyses, among a more limited sample of countries and years, found some evidence of mediation due to social capital elements, while other elements displayed a suppressive effect.

Overall, while limited due to data quality and availability, this research adds to the small yet important body of literature examining the effects of incarceration on nations and supports further study of, and theorizing on, these relationships at the nation level. With more evidence, there may be practical implications of this study for incarceration use across the globe. If nothing else, governments should think more about how their policy and practice around incarceration may be affecting the lives and health of the population at large.

REFERENCES

Albertson, E. M., Scannell, C., Ashtari, N., & Barnert, E. (2020). Eliminating gaps in Medicaid coverage during reentry after incarceration. *American Journal of Public Health, 110*(3), 317-321.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., & Wacziarg, R. (2002). Fractionalization. *NBER Working Paper Series, WP9411*, 1-70.

Alex, B., Weiss, D. B., Kaba, F., Rosner, Z., Lee, D., Lim, S., Venters, H., & MacDonald, R. (2017). Death after jail release: matching to improve care delivery. *Journal of Correctional Health Care, 23*(1), 83-87.

Allison, P. D. (2002). *Missing data.* SAGE Publications, Inc.

Altice, F. L., Azbel, L., Stone, J., Brooks-Pollock, E., Smyrnov, P., Dvoriak, S., Taxman, F. S., El-Bassel, N., Martin, N. K., Booth, R., Stöver, H., Dolan, K., & Vickerman, P. (2016). The perfect storm: Incarceration and the high-risk environment perpetuating transmission of HIV, hepatitis C virus, and tuberculosis in Eastern Europe and Central Asia. *Lancet (London, England), 388*(10050), 1228–1248. https://doi.org/10.1016/S0140-6736(16)30856-X

Andersen, L. M., Harden, S. R., Sugg, M. M., Runkle, J. D., & Lundquist, T. E. (2021). Analyzing the spatial determinants of local Covid-19 transmission in the United States. *The Science of the Total Environment, 754*, 142396. https://doi.org/10.1016/j.scitotenv.2020.142396

Archibong, B., & Obikili, N. (2020). Prison labor: The price of prisons and the lasting effects of incarceration. *African Economic History Working Paper Series,* (52), 1-91.

Arditti, J. A., Lambert-Shute, J., & Joest, K. (2003). Saturday morning at the jail: Implications of incarceration for families and children. *Family Relations, 52*(3), 195-204. https://doi.org/10.1111/j.1741-3729.2003.00195.x

Assari, S., Miller, R. J., Taylor, R. J., Mouzon, D., Keith, V., & Chatters, L. M. (2018). Discrimination fully mediates the effects of incarceration history on depressive symptoms and psychological distress among African American men. *Journal of Racial and Ethnic Health Disparities, 5*(2), 243-252.

Atlas Narodov Mira. (1964). Miklukho-Maklai Ethnological Institute at the Department of Geodesy and Cartography of the State Geological Committee of the Soviet Union: Moscow.

Babones, S. J. (2013). *Methods for quantitative macro-comparative research*. Sage Publications.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Bauer, D. J., & Curran, P. J. (2005). Probing interactions in fixed and multilevel regression: Inferential and graphical techniques. *Multivariate Behavioral Research, 40*(3), 373-400. https://doi.org/10.1207/s15327906mbr4003_5

Bauer, D. J. & Curran, P. J. (2022). *Multilevel modeling* [Lecture notes]. Retrieved from CenterStat's Multilevel Modeling workshop.

Bell, A., & Jones, K. (2015). Explaining fixed effects: Random effects modeling of time-series cross-sectional and panel data. *Political Science Research and Methods, 3*(1), 133-153.

Bennett, R. R. (2009). Comparative criminological and criminal justice research and the data that drive them. *International Journal of Comparative and Applied Criminal Justice, 33*(2), 171-192.

Bernard, T. J., Paoline III, E. A., & Pare, P. P. (2005). General systems theory and criminal justice. *Journal of Criminal Justice*, *33*(3), 203-211.

Bernier, J., Feng, Y., & Asakawa, K. (2011). Strategies for handling normality assumptions in multi-level modeling: a case study estimating trajectories of Health Utilities Index Mark 3 scores. *Health Rep, 22*, 45-51.

Binswanger, I. A., Stern, M. F., Deyo, R. A., Heagerty, P. J. Cheadle, A., Elmore, J. G., & Koepsell, T. D. (2007). Release from prison-a high risk of death for former inmates. *The New England Journal of Medicine, 356*, 157-65.

Birkbeck, C. (2011). Imprisonment and internment: Comparing penal institutions North and South. *Punishment and Society*, *13*(3), 307-332.

Blumstein, A., & Beck, A. J. (2005). Reentry as a transient state between liberty and recommitment. In J. Travis & C. Visher (Eds.), *Prisoner reentry and crime in America* (pp. 50-79). Cambridge University Press.

Braman, D. (2004). Families and the moral economy of incarceration. *Journal of Religion and Spirituality in Social Work, 23*(1/2), 27-50. https://doi.org/10.1300/J377v23n01_03

Carson, A. E. (2021, December). *Mortality in state and federal prisons, 2001-2019 – Statistical tables.* U.S. Department of Justice, Bureau of Justice Statistics. https://bjs.ojp.gov/content/pub/pdf/msfp0119st.pdf

Castaneda Aguilar, R. A., Lakner, C., Prydz, E. B., Soler Lopez, J., Wu, R., & Zhao, Q. (2019). Estimating global poverty in Stata: The povcalnet command. *Global*

Poverty Monitoring Technical Note, 9. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/32477

Center for Systemic Peace. (2021). Polity5 [Dataset]. Retrieved on October 14, 2021, from http://www.systemicpeace.org/polityproject.html

Chacowry Pala, K., Baggio, S., Tran, N. T., Girardin, F., Wolff, H., & Gétaz, L. (2018). Blood-borne and sexually transmitted infections: A cross-sectional study in a Swiss prison. *BMC Infectious Diseases, 18*(1), 1-9.

Cingolani, M., Caraceni, L., Cannovo, N., & Fedeli, P. (2021). The COVID-19 epidemic and the prison system in Italy. *Journal of Correctional Health Care, 27*(1), 3-7. https://doi.org/10.1089/jchc.20.04.0026

Clark, R., & Herbolsheimer, C. (2021). The iron cage of development: A cross-national analysis of incarceration, 2000 – 2015. *Sociological Forum, 36*(2), 381-404. https://doi.org/10.1111/socf.12683

Clear, T. R. (2007). *Imprisoning communities: How mass incarceration makes disadvantaged neighborhoods worse*. Oxford University Press.

Clear, T. R., Rose, D. R., Waring, E., & Scully, K. (2003). Coercive mobility and crime: A preliminary examination of concentrated incarceration and social disorganization. *Justice Quarterly, 20*(1), 33-64.

Comfort, M. (2007). Punishment beyond the legal offender. *Annual Review of Law and Social Science, 3*(1), 271-296. https://doi.org/10.1146/annurev.lawsocsci.3.081806.112829

Condry, R., & Minson, S. (2021). Conceptualizing the effects of imprisonment on families: Collateral consequences, secondary punishment, or symbiotic harms? *Theoretical Criminology, 25*(4), 540-558.

Conger, A. J. (1974). A revised definition for suppressor variables: A guide to their identification and interpretation. *Educational and psychological measurement, 34*(1), 35-46.

Conway, J. M. (2021). Mass incarceration and children's health: a state-level analysis of adverse birth outcomes and infant, child, and teen mortality. *Family and Community Health, 44*(3), 194-205.

Croll, P. R. (2012). Ethnocentrism. In H. K. Anheier & M. Juergensmeyer (eds.), *Encyclopedia of Global Studies* (pp. 524-526). Sage.

D'Amico, D. J., & Williamson, C. R. (2019). An empirical examination of institutions and cross-country incarceration rates. *Public Choice, 180*(3-4), 217-242.

Davis, A. P., & Gibson-Light, M. (2020). Difference and punishment: Ethno-political exclusion, colonial institutional legacies, and incarceration. *Punishment and Society, 22*(1), 3-27. https://doi.org/10.1177/1462474518816643

Davis, A. Y. (2003). *Are prisons obsolete?* Seven Stories Press.

DeHart, D., Shapiro, C., & Clone, S. (2018). "The pill line is longer than the chow line": The impact of incarceration on prisoners and their families. *The Prison Journal, 98*(2), 188-212. https://doi.org/10.1177/0032885517753159

Dikötter, F. (2007). Introduction. In F. Dikötter & I. Brown (Eds.), *Cultures of confinement: a history of the prison in Africa, Asia, and Latin America* (pp. 1-13). Cornell University Press.

Dirkzwager, A., Nieuwbeerta, P., & Blokland, A. (2012). Effects of first-time imprisonment on postprison mortality: a 25-year follow-up study with a matched control group. *Journal of Research in Crime and Delinquency, 49*(3), 383-419.

Downes, D., & Hansen, K. (2006). Welfare and punishment in comparative perspective. *Perspectives on punishment: The contours of control, 2*, 133-154.

Dudeck, M., Drenkhahn, K., Spitzer, C., Barnow, S., Kopp, D., Kuwert, P., Freyberger, H. J., & Dünkel, F. (2011). Traumatization and mental distress in long-term prisoners in Europe. *Punishment and Society, 13*(4), 403-423.

Dudeck, M., Kopp, D., Kuwert, P., Drenkhahn, K., Orlob, S., Lüth, H. J., Freyberger, H. J., & Spitzer, C. (2009). Prevalence of psychiatric disorders in prisoners with a short imprisonment: results from a prison in north Germany. *Psychiatrische Praxis, 36*(5), 219-224.

Durlauf, S. N., & Nagin, D. S. (2011). Imprisonment and crime. *Criminology and Public Policy*, *10*(1), 13-54. https://doi.org/10.1111/j.1745-9133.2010.00680.x

Dye, M. H. (2010). Deprivation, importation, and prison suicide: Combined effects of institutional conditions and inmate composition. *Journal of Criminal Justice*, *38*(4), 796-806.

Enders, C. K. (2011). Analyzing longitudinal data with missing values. *Rehabilitation psychology*, *56*(4), 267.

Escobar, N., & Plugge, E. (2020). Prevalence of human papillomavirus infection, cervical intraepithelial neoplasia and cervical cancer in imprisoned women worldwide: A systematic review and meta-analysis. *Journal of Epidemiology and Community Health*, *74*(1), 95-102. https://doi.org/10.1136/jech-2019-212557

[ETHzürich] Eidgenössische Technische Hochschule Zürich. (2021). *EPR Core* [Dataset]. Retrieved on October 14, 2021, from https://icr.ethz.ch/data/epr/

Farrell, G., & Clark, K. (2004). What does the world spend on criminal justice? *HEUNI Paper No. 20*, 1-29.

Farrell, G., Tilley, N., & Tseloni, A. (2014). Why the crime drop? *Crime and Justice, 43*(1), 421-490.

Farrell, M., & Marsden, J. (2008). Acute risk of drug-related death among newly released prisoners in England and Wales. *Addiction, 103*(2), 251-255. https://doi.org/10.1111/j.1360-0443.2007.02081.x

Fazel, S., & Baillargeon, J. (2011). The health of prisoners. *The Lancet, 377*(9769), 956-965.

Fazel, S., Grann, M., Kling, B., & Hawton, K. (2011). Prison suicide in 12 countries: an ecological study of 861 suicides during 2003–2007. *Social Psychiatry and Psychiatric Epidemiology, 46*(3), 191-195.

Frank, J. W., Linder, J. A., Becker, W. C., Fiellin, D. A., & Wang, E. A. (2014). Increased hospital and emergency department utilization by individuals with recent criminal justice involvement: results of a national survey. *Journal of General Internal Medicine, 29*(9), 1226-1233.

Freedman, L. S., & Schatzkin, A. (1992). Sample size for studying intermediate endpoints within intervention trials of observational studies. *American Journal of Epidemiology, 136*, 1148-1159.

Geerlings, S. W., Beekman, A. T., Deeg, D. J., & Van Tilburg, W. (2000). Physical health and the onset and persistence of depression in older adults: an eight-wave prospective community-based study. *Psychological Medicine, 30*(2), 369-380.

Geller, A., & Curtis, M. A. (2011). A sort of homecoming: Incarceration and the housing security of urban men. *Social Science Research, 40*(4), 1196-1213.

Geller, A., Garfinkel, I., & Western, B. (2011). Paternal incarceration and support for children in fragile families. *Demography, 48*(1), 25-47.

Global Burden of Disease Collaborative Network. (2020). *Global Burden of Disease Study 2019 (GBD 2019) results.* Seattle, United States: Institute for Health Metrics and Evaluation (IHME). http://ghdx.healthdata.org/gbd-results-tool.

Gottlieb, A. (2017). Incarceration and relative poverty in cross-national perspective: The moderating roles of female employment and the welfare state. *Social Service Review, 91*(2), 293-318.

Gowan, T. (2002). The nexus: Homelessness and incarceration in two American cities. *Ethnography, 3*(4), 500-534.

Grund, S., Lüdtke, O., & Robitzsch, A. (2018). Multiple imputation of missing data for multilevel models: Simulations and recommendations. *Organizational Research Methods, 21*(1), 111-149.

Grund, S., Lüdtke, O., & Robitzsch, A. (2019). Missing data in multilevel research. In S. E. Humphrey & J. M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 365–386). American Psychological Association.

Hamaker, E. L., & Muthén, B. (2020). The fixed versus random effects debate and how it relates to centering in multilevel modeling. *Psychological Methods, 25*(3), 365–379. https://doi.org/10.1037/met0000239

Hammett, T. M. (2009). Sexually transmitted diseases and incarceration. *Current Opinion in Infectious Diseases, 22*(1), 77-81.

Hammett, T. M., Harmon, M. P., & Rhodes, W. (2002). The burden of infectious disease among inmates of and releasees from US correctional facilities, 1997. *American Journal of Public Health, 92*(11), 1789-1794.

Harrendorf, S. (2018). Prospects, problems, and pitfalls in comparative analyses of criminal justice data. *Crime and Justice, 47*(1), 159-207.

Hatzenbuehler, M. L., Keyes, K., Hamilton, A., Uddin, M., & Galea, S. (2015). The collateral damage of mass incarceration: Risk of psychiatric morbidity among nonincarcerated residents of high-incarceration neighborhoods. *American Journal of Public Health, 105*(1), 138-143.

Hawkins, H., & Thomas, R. (1991). White policing of black populations: A history of race and social control in America. In E. Cashmore & E. McLaughlin (Eds.), *Out of order?* (pp. 65-86). Routledge.

Hox, J. J. (2000). Multilevel analysis of grouped and longitudinal data. In T.D. Little, K. U. Schnabel & J.E. Baumert (Eds.), *Modeling longitudinal and multilevel data: Practical issues, applied approaches, and specific examples* (pp. 6-22). Lawrence Erlbaum Associates Publishers.

Hox, J. J., Moerbeek, M., & Van de Schoot, R. (2017). *Multilevel analysis: Techniques and applications* (3rd Ed.). Routledge.

Hu, X., Zheng, J., Fan, T., Su, N., Yang, C., & Luo, L. (2020). Using multilevel mediation model to measure the contribution of beliefs to judgments of learning. *Frontiers in psychology, 11*, 637. https://doi.org/10.3389/fpsyg.2020.00637

Huey, M. P., & McNulty, T. L. (2005). Institutional conditions and prison suicide: Conditional effects of deprivation and overcrowding. *The Prison Journal, 85*(4), 490-514.

[IHME] Institute for Health Metrics and Evaluation. (2021). *About the GHDx data.* http://ghdx.healthdata.org/about-ghdx

[ILO] International Labour Organization. (2017). *World social protection report 2017-19: Universal social protection to achieve the Sustainable Development Goals.* International Labour Office. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_604882.pdf

[ILO] International Labour Organization. (2021). *World social protection report 2020-22: Social protection at the crossroads – in pursuit of a better future.* International Labour Office. https://www.ilo.org/wcmsp5/groups/public/@ed_protect/@soc_sec/documents/publication/wcms_817572.pdf

Ivanyna, M. & Shah, A. (2014). How close is your government to its people? Worldwide indicators on localization and decentralization. *Economics: The Open-Access, Open-Assessment E-Journal, 8*, 1-61.

Jacobs, D., & Kleban, R. (2003). Political institutions, minorities, and punishment: A pooled cross-national analysis of imprisonment rates. *Social Forces, 82*(2), 725-755.

Jahn, J. L., Chen, J. T., Agénor, M., & Krieger, N. (2020). County-level jail incarceration and preterm birth among non-Hispanic Black and white U.S. women, 1999–2015. *Social Science and Medicine, 250*, 112856. https://doi.org/10.1016/j.socscimed.2020.112856

Jargowsky, P. A. (2005). Omitted variable bias. *Encyclopedia of Social Measurement, 2*, 919-924.

Javanbakht, M., Murphy, R., Harawa, N. T., Smith, L. V., Hayes, M., Chien, M., & Kerndt, P. R. (2009). Sexually transmitted infections and HIV prevalence among incarcerated men who have sex with men, 2000–2005. *Sexually Transmitted Diseases, 36*(2), S17-S21. https://doi.org/10.1097/OLQ.0b013e31815e4152

Joesoef, M. R., Kahn, R. H., & Weinstock, H. S. (2006). Sexually transmitted diseases in incarcerated adolescents. *Current Opinion in Infectious Diseases, 19*(1), 44-48. https://doi.org/10.1097/01.qco.0000199020.58075.1a

Johnson, D. T., & Zimring, F. E. (2009). *The next frontier: National development, political change, and the death penalty in Asia*. Oxford University Press.

Johnson, R. C., & Raphael, S. (2009). The effects of male incarceration dynamics on acquired immune deficiency syndrome infection rates among African American women and men. *The Journal of Law and Economics, 52*(2), 251-293.

JuriGlobe. (2008). *Alphabetical index of the political entities and corresponding legal systems.* http://www.juriglobe.ca/eng/.

Karstedt, S. (2011a). Our sense of justice: Values, justice and punishment. In S. Parmentier, L. Walgrave, I. Aertsen, J. Maesschalck, & L. Paoli (Eds.), *A sparking discipline: The contribution of criminology to social justice and sustainable development* (pp. 33-58). Leuven University Press.

Karstedt, S. (2011b). Liberty, equality and justice: Democratic culture and punishment. In A. Crawford (Ed.), *International and comparative criminal justice and urban governance: Convergence and divergence in global, national and local settings* (pp. 356-385). Cambridge University Press.

Karstedt, S. (2015). Cultural peers and penal policies: A configurational approach toward mapping penal landscapes. *Punishment and Society*, *17*(3), 374-396.

Karstedt, S. (2021). Inequality and punishment: The idiosyncrasies of the political economy of punishment. In N. Lacey, D. Soskice, L. K. Cheliotis, & S. Xenakis (Eds.) *Tracing the relationship between inequality, crime and punishment: space, time and politics* (pp. 22-40). Oxford University Press.

Kim, D., Baum, C. F., Ganz, M. L., Subramanian, S. V., & Kawachi, I. (2011). The contextual effects of social capital on health: a cross-national instrumental variable analysis. *Social Science and Medicine, 73*(12), 1689-1697.

Kinner, S. A., & Young, J. T. (2018). Understanding and improving the health of people who experience incarceration: an overview and synthesis. *Epidemiologic Reviews, 40*(1), 4-11.

Kjelsberg, E., & Laake, P. (2010). Is the high mortality risk in sentenced offenders independent of previous imprisonment? *European Journal of Epidemiology*, *25*(4), 237-243.

Knief, U., Forstmeier, W. (2021). Violating the normality assumption may be the lesser of two evils. *Behavioral Research Methods, 53*, 2576–2590. https://doi-org.libproxy.temple.edu/10.3758/s13428-021-01587-5

Kuper, J., & Turanovic, J. (2021). The consequences are black and white: Race and poor health following incarceration. *Race and Justice,* 215336872199805. https://doi.org/10.1177/2153368721998053

LaFree, G. (2021). Progress and obstacles in the internationalization of criminology. *International Criminology, 1*(1), 58-69.

Lappi-Seppälä, T. (2007). Penal policy in Scandinavia. *Crime and Justice, 36*(1), 217-295.

Lappi-Seppälä, T. (2011). Explaining imprisonment in Europe. *European Journal of Criminology, 8*(4), 303-328.

Lee, H., Porter, L. C., & Comfort, M. (2014). Consequences of family member incarceration: Impacts on civic participation and perceptions of the legitimacy and fairness of government. *The ANNALS of the American Academy of Political and Social Science, 651*(1), 44-73.

Lee, H., Wildeman, C., Wang, E. A., Matusko, N., & Jackson, J. S. (2014). A heavy burden: the cardiovascular health consequences of having a family member incarcerated. *American Journal of Public Health, 104*(3), 421-427.

Legatum Institute. (2020*). The Legatum Prosperity Index: A tool for transformation (14th ed.).* The Legatum Institute Foundation.

Legatum Institute. (2020). *Summary.* Retrieved from https://www.prosperity.com/about/summary.

Legatum Institute. (2021). *2021 Full Data Set – Legatum Prosperity Index* [Dataset]. Retrieved on February 22, 2022, from https://www.prosperity.com/about/resources

Liem, M., & Kunst, M. (2013). Is there a recognizable post-incarceration syndrome among released "lifers"? *International journal of law and psychiatry, 36*(3-4), 333-337.

Light, M. T., & Marshall, J. (2018). On the weak mortality returns of the prison boom: comparing infant mortality and homicide in the incarceration ledger. *Journal of Health and Social Behavior, 59*(1), 3-19.

Lim, S., Seligson, A. L., Parvez, F. M., Luther, C. W., Mavinkurve, M. P., Binswanger, I. A., & Kerker, B. D. (2012). Risks of drug-related death, suicide, and homicide during the immediate post-release period among people released from New York City jails, 2001–2005. *American Journal of Epidemiology, 175*(6), 519-526.

Link, N. W., Ward, J. T., & Stansfield, R. (2019). Consequences of mental and physical health for reentry and recidivism: Toward a health-based model of desistance. *Criminology, 57*(3), 544-573.

Liu, S. (2020). Incarceration of African American men and the impacts on women and children. *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.3601259

Lochner, K. A., Kawachi, I., Brennan, R. T., & Buka, S. L. (2003). Social capital and neighborhood mortality rates in Chicago. *Social Science and Medicine, 56*(8), 1797-1805.

Lopoo, L. M., & Western, B. (2005). Incarceration and the formation and stability of marital unions. *Journal of Marriage and Family, 67*(3), 721-734.

Luke, D. A. (2020). *Multilevel modeling: second edition*. SAGE Publications, Inc.

Lynch, J. P., & Pridemore, W. A. (2011). Crime in international perspective. In J. Q. Wilson & J. Petersilia (Eds.), *Crime and Public Policy* (pp. 5-52). Oxford University Press.

Lynch, J. P., & Sabol, W. J. (2004). Assessing the effects of mass incarceration on informal social control in communities. *Criminology and Public Policy, 3*(2), 267-294.

Maguire, E. R., Howard, G. J., & Newman, G. (1998). Measuring the performance of national criminal justice systems. *International Journal of Comparative and Applied Criminal Justice, 22*(1), 31-59.

Mallik-Kane, K., & Visher, C. A. (2008). *Health and prisoner reentry: How physical, mental, and substance abuse conditions shape the process of reintegration.* Urban Institute Justice Policy Center. https://www.fmhac.org/uploads/1/2/4/4/124447122/prisoner_re-entry_the_urban_institute_feb_08.pdf

Manza, J., & Uggen, C. (2006). *Locked out: Felon disenfranchisement and American democracy*. Oxford University Press.

Marier, C. J. (2020). *Cross-national incarceration rates as behavior of law* (Publication No. 27830046) [Doctoral Dissertation, University of South Florida]. ProQuest Dissertations Publishing.

Massoglia, M. (2008). Incarceration as exposure: the prison, infectious disease, and other stress-related illnesses. *Journal of Health and Social Behavior, 49*(1), 56-71.

Massoglia, M., Pare, P.-P., Schnittker, J., & Gagnon, A. (2014). The relationship between incarceration and premature adult mortality: Gender specific evidence. *Social Science Research, 46*, 142–154. https://doi.org/10.1016/j.ssresearch.2014.03.002

Massoglia, M., & Pridemore, W. A. (2015). Incarceration and health. *Annual Review of Sociology, 41*, 291-310.

Massoglia, M., & Remster, B. (2019). Linkages between incarceration and health. *Public Health Reports, 134*(1_suppl), 8S-14S.

Massoglia, M., Remster, B., & King, R. D. (2011). Stigma or separation? Understanding the incarceration-divorce relationship. *Social Forces, 90*(1), 133-155.

Mauer, M. (2003). Comparative international rates of incarceration: An examination of causes and trends presented to the US Commission on Civil Rights. *The Sentencing Project*, 1-16.

McNeish, D., & Kelley, K. (2019). Fixed effects models versus mixed effects models for clustered data: Reviewing the approaches, disentangling the differences, and making recommendations. *Psychological Methods, 24*(1), 20-35.

Mendlein, A. K. (2021). The relationship between justice system size and punishment across nations. *International Criminology, 1*(2), 107-122.

Michaud, C. M. (2009). Global burden of infectious diseases. *Encyclopedia of Microbiology*, 444-454. https://doi.org/10.1016/B978-012373944-5.00185-1

Mitchell, R. J., & Bates, P. (2011). Measuring health-related productivity loss. *Population Health Management, 14*(2), 93-98.

Monkkonen, E. H. (1989). Diverging homicide rates: England and the United States, 1850–1875. *Violence in America, 1*, 80-101.

Mueller-Smith, M. (2015). The criminal and labor market impacts of incarceration. *Unpublished Working Paper, 18*.

Muller, C., & Schrage, D. (2014). Mass imprisonment and trust in the law. *The ANNALS of the American Academy of Political and Social Science, 651*(1), 139-158.

Mumola, C. J. (2005, August). *Suicide and homicide in state prisons and local jails.* U.S. Department of Justice, Bureau of Justice Statistics. https://bjs.ojp.gov/content/pub/pdf/shsplj.pdf

Mumola, C. J. (2007). *Medical causes of death in state prisons, 2001–2004*. Bureau of Justice Statistics. http://www.bjs.gov/content/pub/pdf/mcdsp04.pdf.

Mundlak, Y. (1978). Pooling of time-series and cross-section data. *Econometrica*, *46*(1), 69-85.

Munro, J. L. (1971). Towards a theory of criminal justice administration: A general systems perspective. *Public Administration Review, 31*(6), 621-631. https://doi.org/10.2307/974254

Neapolitan, J. L. (2001). An examination of cross-national variation in punitiveness. *International Journal of Offender Therapy and Comparative Criminology, 45*(6), 691-710.

Nosrati, E., & King, L. P. (2021). Punitive social policy and vital inequality. *International Journal of Health Services, 51*(4), 545-558.

Nowotny, K. M., Omori, M., McKenna, M., & Kleinman, J. (2020). Incarceration rates and incidence of sexually transmitted infections in US counties, 2011–2016. *American Journal of Public Health, 110*(S1), S130–S136. https://doi.org/10.2105/AJPH.2019.305425

[NRC] National Research Council. (2014). *The growth of incarceration in the United States: Exploring causes and consequences*. Washington, DC: The National Academies Press.

Nurse, J., Woodcock, P., & Ormsby, J. (2003). Influence of environmental factors on mental health within prisons: focus group study. *BMJ, 327*(7413), 480.

O'Brien, T. L. (2020). Arresting confidence: Mass incarceration and black–white differences in perceptions of legal authorities. *Social Science Quarterly*, *101*(5), 1905-1919.

[OECD] Organization for Economic Co-operation and Development. (2020). *Health spending.* https://data.oecd.org/healthres/health-spending.htm

Osborne, J. W., & Overbay, A. (2004). The power of outliers (and why researchers should always check for them). *Practical Assessment, Research, and Evaluation, 9*(6), 1-8. http://PAREonline.net/getvn.asp?v=9&n=6.

Patterson, E. J. (2010). Incarcerating death: Mortality in US state correctional facilities, 1985–1998. *Demography*, *47*(3), 587-607.

Pearlin, L. I. (1989). The sociological study of stress. *Journal of health and social behavior, 30*(3), 241-256.

Pease, K., & Ignatans, D. (2016). The global crime drop and changes in the distribution of victimization. *Crime Science, 5*(1), 1-6.

Peterson, R. D., & Krivo, L. J. (2010). *Divergent social worlds: Neighborhood crime and the racial-spatial divide.* Russell Sage Foundation.

Porter, L. C., & DeMarco, L. M. (2019). Beyond the dichotomy: Incarceration dosage and mental health. *Criminology, 57*(1), 136-156.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, and Computers, 36*(4), 717-731.

Preacher, K. J., Zhang, Z., & Zyphur, M. J. (2011). Alternative methods for assessing mediation in multilevel data: The advantages of multilevel SEM. *Structural Equation Modeling, 18*(2), 161-182. https://doi.org/10.1080/10705511.2011.557329

Pridemore, W. A. (2014). The mortality penalty of incarceration: Evidence from a population-based case-control study of working-age males. *Journal of Health and Social Behavior*, *55*(2), 215-233.

[PRI & TIJ] Penal Reform International & Thailand Institute of Justice. (2020). *Global prison trends 2020 (6th edition).* https://www.penalreform.org/resource/global-prison-trends-2020/

[PRI & TIJ] Penal Reform International & Thailand Institute of Justice. (2021). *Global prison trends 2021 (7th edition).* https://cdn.penalreform.org/wp-content/uploads/2021/05/Global-prison-trends-2021.pdf

Rabe-Hesketh, S. & Skrondal, A. (2022). *Multilevel and longitudinal modeling using Stata* (4th ed.). STATA press.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). Sage.

Rich, J. D., Chandler, R., Williams, B. A., Dumont, D., Wang, E. A., Taxman, F. S., Allen, S. A., Clarke, J. G., Greifinger, R. B., Wildeman, C., Osher, F. C., Rosenberg, S., Haney, C., Mauer, M., & Western, B. (2014). How health care reform can transform the health of criminal justice–involved individuals. *Health Affairs, 33*(3), 462-467. https://doi.org/10.1377/hlthaff.2013.1133

Rights, J. D., & Sterba, S. K. (2019). Quantifying explained variance in multilevel models: An integrative framework for defining R-squared measures. *Psychological methods, 24*(3), 309.

Rose, D. R., & Clear, T. R. (1998). Incarceration, social capital, and crime: Implications for social disorganization theory. *Criminology, 36*(3), 441-480.

Rosen, D. L., Wohl, D. A., & Schoenbach, V. J. (2011). All-cause and cause-specific mortality among black and white North Carolina state prisoners, 1995–2005. *Annals of Epidemiology, 21*(10), 719-726.

Rubin, D. B. (1976). Inference and missing data. *Biometrika, 63*, 581–592.

Ruddell, R. (2005). Social disruption, state priorities, and minority threat: A cross-national study of imprisonment. *Punishment and Society, 7*(1), 7-28.

Ruddell, R., & Urbina, M. G. (2004). Minority threat and punishment: A cross-national analysis. *Justice Quarterly, 21*(4), 903-931.

Sauber, S. R. (1983). *The human services delivery system: Mental health, criminal justice, social welfare, education, health services.* Columbia University Press.

Schnittker, J. (2014). The psychological dimensions and the social consequences of incarceration. *The ANNALS of the American Academy of Political and Social Science, 651*(1), 122-138.

Schnittker, J., & John, A. (2007). Enduring stigma: the long-term effects of incarceration on health. *Journal of Health and Social Behavior, 48*(2), 115-130.

Schnittker, J., Massoglia, M., & Uggen, C. (2012). Out and down: Incarceration and psychiatric disorders. *Journal of Health and Social Behavior, 53*(4), 448-464.

Schnittker, J., Uggen, C., Shannon, S. K., & McElrath, S. M. (2015). The institutional effects of incarceration: Spillovers from criminal justice to health care. *The Milbank Quarterly, 93*(3), 516-560.

Schultz, J., O'Brien, A. M., & Tadesse, B. (2008). Social capital and self-rated health: Results from the US 2006 social capital survey of one community. *Social Science and Medicine, 67*(4), 606-617.

Schwartz-Soicher, O., Geller, A., & Garfinkel, I. (2011). The effect of paternal incarceration on material hardship. *Social Service Review, 85*(3), 447-473. https://doi.org/10.1086/661925

Shannon, S., & Uggen, C. (2012). Incarceration as a political institution. In E. Amenta, K. Nash, & A. Scott (Eds.), *The Wiley-Blackwell Companion to Political Sociology* (pp. 214-225). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781444355093.ch19

Small Arms Survey. (2018). *Civilian firearms holdings, 2017* [Dataset]. Retrieved on June 1, 2021, from https://www.smallarmssurvey.org/database/global-firearms-holdings

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural models. In S. Leinhardt (ed.), *Sociological Methodology 1982* (pp. 290-312). Jossey-Bass.

Song, L., Son, J., & Lin, N. (2010). Social capital and health. In W.C. Cockerham (Ed.), *The New Blackwell Companion to Medical Sociology* (pp. 184-2010). Blackwell Publishing Ltd.

Spaulding, A. C., Seals, R. M., McCallum, V. A., Perez, S. D., Brzozowski, A. K., & Steenland, N. K. (2011). Prisoner survival inside and outside of the institution: implications for health-care planning. *American Journal of Epidemiology, 173*(5), 479-487.

Stewart, L. M., Henderson, C. J., Hobbs, M. S., Ridout, S. C., & Knuiman, M. W. (2004). Risk of death in prisoners after release from jail. *Australian and New Zealand Journal of Public Health, 28*(1), 32-36.

Stuckler, D., Basu, S., McKee, M., & King, L. (2008). Mass incarceration can explain population increases in TB and multidrug-resistant TB in European and central Asian countries. *Proceedings of the National Academy of Sciences, 105*(36), 13280-13285.

Sutton, J. R. (2000). Imprisonment and social classification in five common-law democracies, 1955–1985. *American Journal of Sociology, 106*(2), 350-386.

Sykes, G. M. (1958). *The society of captives*. Princeton University Press.

Taylor, A., Payer, H., & Barnes, T. (2018). The missing mobile: Impacts from the incarceration of Indigenous Australians from remote communities. *Applied Mobilities, 3*(2), 150-167. https://doi.org/10.1080/23800127.2017.1347027

Testa, A., Rennó Santos, M., & Weiss, D. B. (2020). Incarceration rates and hospital beds per capita: A cross-national study of 36 countries, 1971–2015. *Social Science and Medicine, 263,* 113262. https://doi.org/10.1016/j.socscimed.2020.113262

Thomas, J. C., Levandowski, B. A., Isler, M. R., Torrone, E., & Wilson, G. (2008). Incarceration and sexually transmitted infections: a neighborhood perspective. *Journal of Urban Health, 85*(1), 90-99.

Tonry, M. (2014). Why crime rates are falling throughout the Western world. *Crime and Justice, 43*(1), 1-63.

Turner, R. J., & Noh, S. (1988). Physical disability and depression: A longitudinal analysis. *Journal of Health and Social Behavior, 29*(1), 23-37.

Turney, K. (2014). Stress proliferation across generations? Examining the relationship between parental incarceration and childhood health. *Journal of Health and Social Behavior, 55*(3), 302-319.

Turney, K., Wildeman, C., & Schnittker, J. (2012). As fathers and felons: Explaining the effects of current and recent incarceration on major depression. *Journal of Health and Social Behavior, 53*(4), 465-481.

Uggen, C., Schnittker, J., Shannon, S., & Massoglia, M. (2023). The contingent effect of incarceration on state health outcomes. *SSM - Population Health, 21*, 101322. https://doi.org/10.1016/j.ssmph.2022.101322

United Nations Office at Vienna. Crime Prevention and Criminal Justice Branch. (2010). *United Nations Surveys of Crime Trends and Operations of Criminal Justice Systems Series, Waves 1-10, 1970-2006*. Inter-university Consortium for Political and Social Research [distributor].

United Nations Statistics Division. (2022). *Methodology: Standard country or area codes for statistical use (M49)*. United Nations. https://unstats.un.org/unsd/methodology/m49/

[UNODC] United Nations Office on Drugs and Crime. (n.d.). *Crime data* [Dataset]. https://dataunodc.un.org/crime

[UNODC] United Nations Office on Drugs and Crime. (2018a). *United Nations Surveys on Crime Trends and the Operations of Criminal Justice Systems (UN-CTS).* https://www.unodc.org/unodc/en/data-and-analysis/United-Nations-Surveys-on-Crime-Trends-and-the-Operations-of-Criminal-Justice-Systems.html

[UNODC] United Nations Office on Drugs and Crime. (2018b). *United Nations Survey of Crime Trends and Operations of Criminal Justice Systems (UN-CTS) – 2018* [Questionnaire]. https://www.unodc.org/unodc/en/data-and-analysis/statistics/crime/cts-data-collection.html

U.S.A. v. State of Alabama and Alabama Department of Corrections, 2:20-cv-01971-JHE (U.S. District Court N.D. of Alabama 2020). https://www.justice.gov/opa/press-release/file/1344011/download

Van Gigch, J. P. (1978). *Applied general systems theory* (2nd ed.). Harper and Row Publishers.

Villalonga-Olives, E., & Kawachi, I. (2015). The measurement of social capital. *Gaceta Sanitaria, 29*, 62-64.

Vogt, M., Bormann, N. C., Rüegger, S., Cederman, L. E., Hunziker, P., & Girardin, L. (2015). Integrating data on ethnicity, geography, and conflict: The ethnic power relations data set family. *Journal of Conflict Resolution, 59*(7), 1327-1342.

Wakefield, S., & Wildeman, C. (2013). *Children of the prison boom: Mass incarceration and the future of American inequality*. Oxford University Press.

Wallace, D., Eason, J. M., Walker, J., Towers, S., Grubesic, T. H., & Nelson, J. R. (2021). Is there a temporal relationship between COVID-19 infections among prison staff, incarcerated persons and the larger community in the United States? *International Journal of Environmental Research and Public Health, 18*(13), 6873. https://doi.org/10.3390/ijerph18136873

Walmsley, R. (2018). *World prison population list (12th ed.)*. World Prison Brief & The Institute for Criminal Policy Research. https://www.prisonstudies.org/sites/default/files/resources/downloads/wppl_12.pdf

Wang, E. A., Wang, Y., & Krumholz, H. M. (2013). A high risk of hospitalization following release from correctional facilities in Medicare beneficiaries: a retrospective matched cohort study, 2002 to 2010. *JAMA Internal Medicine, 173*(17), 1621-1628.

Weidner, R. R., & Schultz, J. (2019). Examining the relationship between US incarceration rates and population health at the county level. *SSM-Population Health, 9*, 100466.

Weidner, R. R., & Schultz, J. (2021). Examining the relationship between incarceration and population health: The roles of region and urbanicity. *Criminal Justice Policy Review, 32*(4), 403-426.

Welch, C., Bartlett, J., & Petersen, I. (2014). Application of multiple imputation using the two-fold fully conditional specification algorithm in longitudinal clinical data. *The Stata Journal, 14*(2), 418-431.

West, B. T., Welch, K. B., & Galecki, A. T. (2006). *Linear mixed models: a practical guide using statistical software.* Chapman and Hall/CRC.

Western, B., Kling, J. R., & Weiman, D. F. (2001). The labor market consequences of incarceration. *Crime and Delinquency, 47*(3), 410-427.

[WHO] World Health Organization. (2020, May 13). UNODC, WHO, UNAIDS and OHCHR joint statement on COVID-19 in prisons and other closed settings. https://www.who.int/news/item/13-05-2020-unodc-who-unaids-and-ohchr-joint-statement-on-covid-19-in-prisons-and-other-closed-settings

[WHO] World Health Organization. (2021). *Global Tuberculosis Report* [Dataset]. Retrieved October 14, 2021, from https://www.who.int/teams/global-tuberculosis-programme/data

[WHO] World Health Organization. (2022a). *Global Tuberculosis Programme*. Retrieved February 21, 2022, from https://www.who.int/teams/global-tuberculosis-programme/data

[WHO] World Health Organization. (2022b). *Global Health Expenditure Database* [Data set]. https://apps.who.int/nha/database

Wildeman, C. (2012a). Imprisonment and infant mortality. *Social Problems, 59*(2), 228-257.

Wildeman, C. (2012b). Imprisonment and (inequality in) population health. *Social Science Research, 41*(1), 74-91.

Wildeman, C. (2016). Incarceration and population health in wealthy democracies. *Criminology, 54*(2), 360-382.

Wildeman, C., Andersen, S. H., Lee, H., & Karlson, K. B. (2014). Parental incarceration and child mortality in Denmark. *American Journal of Public Health, 104*(3), 428-433.

Wildeman, C., & Wang, E. A. (2017). Mass incarceration, public health, and widening inequality in the USA. *The Lancet, 389*(10077), 1464-1474.

Williams, R. M. (1975). Relative deprivation. In L. A. Coser (Ed.), *The idea of social structure: Papers in honor of Robert K. Merton* (pp. 355-378). Routledge.

Willmott, D., & Van Olphen, J. (2005). Challenging the health impacts of incarceration: The role for community health workers. *Californian Journal of Health Promotion, 3*(2), 38-48. https://doi.org/10.32398/cjhp.v3i2.1762

Wood, G., & Gough, I. (2006). A comparative welfare regime approach to global social policy. *World Development, 34*(10), 1696–1712. https://doi.org/10.1016/j.worlddev.2006.02.001

World Bank. (2006). *World development report 2006: Equity and development.* The World Bank and Oxford University Press. https://openknowledge.worldbank.org/handle/10986/5988

World Bank. (2021a). *DataBank: World Development Indicators* [Dataset]. https://databank.worldbank.org/reports.aspx?source=world-development-indicators#

World Bank. (2021b). *World Development Indicators* [Dataset]. https://datatopics.worldbank.org/world-development-indicators/

World Bank. (2022). *World Bank country and lending groups: Historical classification by income group* [Data set]. World Bank.

World Inequality Database. (2022). *World Inequality Database* [Data set]. https://wid.world/data/

[WPB, ICPR] World Prison Brief, Institute for Crime & Justice Police Research. (2021). *World Prison Brief data* [Dataset]. https://www.prisonstudies.org/world-prison-brief-data

Young, W., & Brown, M. (1993). Cross-national comparisons of imprisonment. *Crime and Justice, 17*, 1-49.

Zachariah, R., Harries, A. D., Chantulo, A. S., Yadidi, A. E., Nkhoma, W., & Maganga, O. (2002). Sexually transmitted infections among prison inmates in a rural district of Malawi. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *96*(6), 617-619.

Zhang, Z., Zyphur, M. J., & Preacher, K. J. (2009). Testing multilevel mediation using hierarchical linear models: Problems and solutions. *Organizational Research Methods*, *12*(4), 695-719.

Zigler, C. K., & Ye, F. (2019). A comparison of multilevel mediation modeling methods: recommendations for applied researchers. *Multivariate Behavioral Research, 54*(3), 338-359.

APPENDIX A. SOCIAL CAPITAL COMPONENTS AND SOURCES

Social Capital Element (Weight %)	Indicators	Original sources
Personal and Family Relationships (20%)	Help from family and friends when in trouble	Gallup
	Family give positive energy	Gallup
Social Networks (20%)	Respect	Gallup
	Opportunity to make friends	Gallup
	Helped another household	Gallup
Interpersonal Trust (20%)	Generalised interpersonal trust	IVS&Bar
	Helped a stranger	Gallup
Institutional Trust (20%)	Confidence in local police	Gallup
	Public trust in politicians	WEF
	Confidence in financial institutions and banks	Gallup
	Confidence in judicial systems and courts	Gallup
	Confidence in national government	Gallup
	Confidence in military	Gallup
Civic and Social Participation (20%)	Donated money to charity	Gallup
	Voter turnout	IDEA
	Volunteering	Gallup
	Voiced opinion to a public official	Gallup

Notes. From "The Legatum Prosperity Index: A tool for transformation," by the Legatum Institute, 2020, p. 46. Acronyms: IVS&Bar=Integrated Values Survey, Afrobarometer, Arab Barometer, and Latinobarómetro; WEF=World Economic Forum Global Competitiveness Index; IDEA=International Institute for Democracy and Electoral Assistance. Sources: Gallup=https://www.gallup.com/home.aspx; IVS&Bar=http://www.worldvaluessurvey.org/wvs.jsp; https://europeanvaluesstudy.eu/; http://www.afrobarometer.org/; https://www.arabbarometer.org/; http://www.latinobarometro.org/lat.jsp; WEF=http://reports.weforum.org/global-competitiveness-report-2018/; IDEA=https://www.idea.int/

APPENDIX B. FULL MODEL SAMPLE COUNTRIES AND THEIR REGIONS, INCOME GROUPS, AND SUBSAMPLES

	Relevant for RQ1			*Relevant for RQ2: Subsamples*					*Relevant for RQ3*
Country	**In HIV models**	**Region**	**Income group**	**EP**	**EF**	**SP**	**PC (no US)**	**PC (w/ US)**	**Included in mediation models**
Afghanistan	Yes	Asia	Low	Below	Above	Below	Above	Above	Yes
Albania	Yes	Europe	Lower middle	Below	Below	Above	Above	Above	Yes
Algeria	Yes	Africa	Lower middle	Above	Below	Below	Below	Below	Yes
Angola	Yes	Africa	Lower middle	Above	Above	Below	Above	Above	No
Armenia	Yes	Asia	Lower middle	Below	Below	Below	Above	Above	Yes
Australia	Yes	Oceania	High	Below	Below	Above	Below	Below	Yes
Austria	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
Azerbaijan	Yes	Asia	Lower middle	Below	Below	Below	Above	Above	Yes
Bahrain	No	Asia	High	Above	Above	Below	Below	Below	Yes (except HIV)
Bangladesh	No	Asia	Low	Below	Below	Below	Above	Above	Yes (except HIV)
Belarus	Yes	Europe	Lower middle	Below	Below	Above	Above	Above	Yes
Belgium	No	Europe	High	Below	Above	Above	Below	Below	Yes (except HIV)
Bhutan	No	Asia	Low	Above	Above	Below	Below	Below	No
Bolivia (Plurinational State of)	Yes	Americas	Lower middle	Above	Above	Below	Above	Above	Yes
Botswana	Yes	Africa	Upper middle	Below	Below	Below	Below	Below	Yes
Brazil	Yes	Americas	Lower middle	Above	Above	Above	Above	Above	Yes
Bulgaria	Yes	Europe	Lower middle	Below	Below	Above	Above	Above	Yes
Burkina Faso	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Burundi	Yes	Africa	Low	Above	Below	Below	Above	Above	Yes
Cabo Verde	Yes	Africa	Lower middle	Below	Below	Below	Below	Below	Yes
Cambodia	Yes	Asia	Low	Below	Below	Below	Above	Above	Yes
Cameroon	Yes	Africa	Lower middle	Below	Above	Below	Above	Above	Yes
Canada	No	Americas	High	Below	Above	Above	Below	Below	Yes (except HIV)
Central African Republic	Yes	Africa	Low	Above	Above	Below	Above	Above	Yes

	Relevant for RQ1			*Relevant for RQ2: Subsamples*					*Relevant for RQ3*
Country	**In HIV models**	**Region**	**Income group**	**EP**	**EF**	**SP**	**PC (no US)**	**PC (w/ US)**	**Included in mediation models**
Chile	Yes	Americas	Upper middle	Below	Below	Above	Above	Above	Yes
China	Yes	Asia	Lower middle	Below	Below	Below	Above	Above	Yes (except HIV)
Colombia	Yes	Americas	Lower middle	Above	Above	Above	Above	Above	Yes
Costa Rica	Yes	Americas	Upper middle	Below	Below	Above	Below	Below	Yes
Croatia	Yes	Europe	Upper middle	Below	Below	Above	Below	Below	Yes
Cuba	Yes	Americas	Lower middle	Below	Above	Above	Above	Above	Yes
Cyprus	No	Asia	High	Above	Below	Above	Below	Below	Yes (except HIV)
Czechia	No	Europe	Upper middle	Below	Below	Above	Below	Below	Yes (except HIV)
Denmark	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
Dominican Republic	Yes	Americas	Lower middle	Below	Below	Below	Above	Above	Yes
Ecuador	Yes	Americas	Lower middle	Above	Above	Below	Below	Below	Yes
Egypt	Yes	Africa	Lower middle	Below	Below	Above	Above	Above	Yes
El Salvador	Yes	Americas	Lower middle	Below	Below	Above	Above	Above	Yes
Estonia	No	Europe	Upper middle	Above	Above	Above	Below	Below	Yes (except HIV)
Eswatini	Yes	Africa	Lower middle	Below	Below	Below	Above	Above	Yes
Finland	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
France	Yes	Europe	High	Below	Below	Above	Below	Below	Yes
Georgia	Yes	Asia	Lower middle	Above	Above	Below	Above	Above	Yes
Germany	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
Ghana	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Greece	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
Guatemala	Yes	Americas	Lower middle	Above	Above	Below	Above	Above	Yes
Guinea-Bissau	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Guyana	Yes	Americas	Lower middle	Above	Above	Below	Above	Above	Yes
Haiti	Yes	Americas	Low	Below	Below	Below	Above	Above	Yes
Honduras	Yes	Americas	Lower middle	Below	Below	Below	Above	Above	Yes
Hungary	No	Europe	Upper middle	Below	Below	Above	Below	Below	Yes (except HIV)

	Relevant for RQ1			*Relevant for RQ2: Subsamples*					*Relevant for RQ3*
Country	**In HIV models**	**Region**	**Income group**	**EP**	**EF**	**SP**	**PC (no US)**	**PC (w/ US)**	**Included in mediation models**
India	No	Asia	Low	Below	Below	Below	Above	Above	Yes (except HIV)
Indonesia	No	Asia	Lower middle	Below	Above	Below	Above	Above	Yes (except HIV)
Iran (Islamic Republic of)	Yes	Asia	Lower middle	Above	Above	Above	Above	Above	Yes
Ireland	Yes	Europe	High	Below	Below	Above	Below	Below	Yes
Israel	No	Asia	High	Above	Below	Above	Below	Below	Yes (except HIV)
Italy	Yes	Europe	High	Below	Below	Above	Below	Below	Yes
Jamaica	Yes	Americas	Lower middle	Below	Below	Below	Below	Below	Yes
Japan	No	Asia	High	Below	Below	Above	Below	Below	Yes (except HIV)
Jordan	No	Asia	Lower middle	Above	Above	Above	Below	Below	Yes (except HIV)
Kazakhstan	Yes	Asia	Lower middle	Above	Above	Below	Above	Above	Yes
Kenya	Yes	Africa	Low	Above	Above	Below	Above	Above	Yes
Kuwait	No	Asia	High	Below	Above	Above	Below	Below	Yes (except HIV)
Kyrgyzstan	Yes	Asia	Low	Above	Above	Below	Above	Above	Yes
Latvia	Yes	Europe	Upper middle	Above	Above	Above	Below	Below	Yes
Lebanon	Yes	Asia	Upper middle	Below	Below	Below	Above	Above	Yes
Lesotho	Yes	Africa	Lower middle	Below	Below	Above	Below	Below	No
Liberia	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Lithuania	Yes	Europe	Upper middle	Below	Below	Above	Above	Above	Yes
Luxembourg	No	Europe	High	Below	Above	Above	Below	Below	Yes (except HIV)
Malawi	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Malaysia	Yes	Asia	Upper middle	Below	Above	Below	Above	Above	Yes
Mauritius	Yes	Africa	Upper middle	Below	Above	Below	Below	Below	Yes
Mexico	No	Americas	Upper middle	Above	Above	Above	Above	Above	Yes (except HIV)
Moldova (Republic of)	Yes	Europe	Lower middle	Above	Above	Above	Above	Above	Yes
Mongolia	Yes	Asia	Low	Below	Below	Above	Above	Above	Yes
Morocco	Yes	Africa	Lower middle	Above	Above	Below	Above	Above	Yes
Mozambique	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes

	Relevant for RQ1			*Relevant for RQ2: Subsamples*					*Relevant for RQ3*
Country	**In HIV models**	**Region**	**Income group**	**EP**	**EF**	**SP**	**PC (no US)**	**PC (w/ US)**	**Included in mediation models**
Namibia	Yes	Africa	Lower middle	Below	Above	Below	Below	Below	Yes
Nepal	Yes	Asia	Low	Above	Above	Below	Below	Below	Yes
Netherlands	Yes	Europe	High	Below	Below	Above	Below	Below	Yes
New Zealand	Yes	Oceania	High	Below	Below	Above	Below	Below	Yes
Nicaragua	Yes	Americas	Lower middle	Below	Above	Below	Above	Above	No
Niger	Yes	Africa	Low	Above	Above	Below	Above	Above	Yes
Norway	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
Oman	Yes	Asia	Upper middle	Below	Below	Below	Below	Below	No
Pakistan	Yes	Asia	Low	Above	Above	Below	Above	Above	Yes
Panama	No	Americas	Upper middle	Above	Above	Below	Above	Above	Yes (except HIV)
Papua New Guinea	Yes	Oceania	Low	Below	Below	Below	Above	Above	No
Paraguay	Yes	Americas	Lower middle	Below	Below	Below	Above	Above	Yes
Peru	Yes	Americas	Lower middle	Above	Above	Below	Above	Above	Yes
Philippines	Yes	Asia	Lower middle	Below	Below	Below	Above	Above	Yes
Poland	No	Europe	Upper middle	Below	Below	Above	Below	Below	Yes (except HIV)
Portugal	No	Europe	High	Below	Below	Above	Above	Above	Yes (except HIV)
Qatar	No	Asia	High	Below	Above	Below	Below	Below	Yes (except HIV)
Republic of (South) Korea	No	Asia	High	Below	Below	Below	Below	Below	Yes (except HIV)
Romania	Yes	Europe	Upper middle	Below	Below	Above	Above	Above	Yes
Russian Federation	No	Europe	Upper middle	Above	Below	Above	Above	Above	Yes (except HIV)
Rwanda	Yes	Africa	Low	Above	Below	Below	Above	Above	Yes
Saudi Arabia	No	Asia	High	Above	Below	Below	Below	Below	No
Senegal	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Serbia	Yes	Europe	Upper middle	Below	Above	Above	Below	Below	Yes
Sierra Leone	Yes	Africa	Low	Below	Above	Below	Above	Above	No
Singapore	Yes	Asia	High	Below	Below	Below	Below	Below	Yes
Slovakia	No	Europe	Upper middle	Below	Below	Above	Below	Below	Yes (except HIV)

	Relevant for RQ1			*Relevant for RQ2: Subsamples*					*Relevant for RQ3*
Country	**In HIV models**	**Region**	**Income group**	**EP**	**EF**	**SP**	**PC (no US)**	**PC (w/ US)**	**Included in mediation models**
Slovenia	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
South Africa	Yes	Africa	Upper middle	Above	Above	Below	Above	Above	Yes
Spain	Yes	Europe	High	Above	Below	Above	Below	Below	Yes
Sri Lanka	Yes	Asia	Lower middle	Above	Below	Below	Below	Below	Yes
Sweden	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
Switzerland	Yes	Europe	High	Below	Above	Above	Below	Below	Yes
Syrian Arab Republic	Yes	Asia	Lower middle	Above	Above	Below	Above	Above	No
Tanzania (United Republic of)	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Thailand	Yes	Asia	Lower middle	Below	Above	Below	Below	Below	Yes
Trinidad and Tobago	Yes	Americas	Upper middle	Below	Above	Below	Below	Below	Yes
Tunisia	Yes	Africa	Lower middle	Below	Below	Below	Below	Below	Yes
Turkey	No	Asia	Upper middle	Above	Below	Above	Below	Below	Yes (except HIV)
Uganda	Yes	Africa	Low	Above	Above	Below	Above	Above	Yes
Ukraine	Yes	Europe	Lower middle	Below	Above	Above	Above	Above	Yes
United Arab Emirates	No	Asia	High	Below	Above	Below	Below	Below	Yes (except HIV)
United Kingdom	No	Europe	High	Below	Below	Above	Below	Below	Yes (except HIV)
United States of America	Yes	Americas	High	Above	Above	Above	-	Above	Yes
Uruguay	No	Americas	Upper middle	Below	Below	Above	Above	Above	Yes (except HIV)
Uzbekistan	Yes	Asia	Low	Below	Below	Above	Above	Above	Yes
Venezuela (Bolivarian Rep. of)	Yes	Americas	Upper middle	Below	Above	Below	Above	Above	Yes
Vietnam	Yes	Asia	Low	Below	Below	Below	Above	Above	Yes
Zambia	Yes	Africa	Low	Below	Above	Below	Above	Above	Yes
Zimbabwe	Yes	Africa	Low	Below	Below	Below	Above	Above	No

Notes. List of countries from full models (Models 1.3A-E) from annual dataset; Acronyms: EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Above = moderator level above average; Below=moderator level below average.

APPENDIX C. COUNTS AND MEANS OF OBSERVATIONS INCLUDED AND EXCLUDED FROM FULL MODELS (1.3A-E) DUE TO MISSING DATA

	LE, IM, SU (country n=128)				HV (country n=90)				TB (country n=128)			
	Included		Excluded		Included		Excluded		Included		Excluded	
Variable	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**
Life expectancy	1912	72.94	3979	66.49								
Infant mortality rate	1912	18.20	3848	41.48								
Suicide rate	1912	13.59	4148	10.30								
HIV prevalence					1206	1.88	2453	2.14				
TB incidence									1593	109.79	2584	137.29
Incarceration rate (lagged 1 year)	1912	1.70	1610	1.79	1206	1.89	2316	1.66	1593	1.72	1929	1.75
GDP	1912	16.02	4002	10.57	1206	10.79	4708	12.72	1593	16.99	4321	10.61
GINI	1912	0.54	3338	0.58	1206	0.56	4044	0.57	1593	0.55	3657	0.58
Homicide rate	1912	7.72	1861	8.32	1206	10.41	2567	6.89	1593	7.52	2180	8.38
65+ population	1912	10.25	3840	5.79	1206	8.77	4546	6.88	1593	10.33	4159	6.11
Fertility rate	1912	2.28	3982	3.59	1206	2.53	4688	3.33	1593	2.27	4301	3.49
Unemployment	1912	7.91	3453	8.25	1206	8.45	4159	8.03	1593	7.73	3772	8.29
Urban population	1912	63.11	4440	54.20	1206	57.54	5146	56.72	1593	63.07	4759	54.81
Democracy	1912	6.28	2721	1.22	1206	5.68	3427	2.47	1593	6.24	3040	1.77
Excluded population	1912	0.11	3165	0.16	1206	0.12	3871	0.14	1593	0.11	3484	0.15
Hospital bed rate	1456	4.58	1474	3.81	803	4.18	2127	4.20	1225	4.22	1705	4.17
Health expenditure	1588	13.88	2186	5.12	1018	9.68	2756	8.48	1588	13.88	2186	5.12
% gov't health expenditure	1588	55.96	2186	46.66	1018	49.77	2756	50.87	1588	55.96	2186	46.66
Prison conditions (no U.S.)	1774	3.34	2295	3.82	1116	3.73	2953	3.57	1574	3.44	2495	3.72
Prison conditions (with U.S.)	1797	3.36	2297	3.82	1139	3.76	2955	3.57	1593	3.46	2501	3.72
Social protection expenditure	539	14.16	472	6.53	326	11.85	685	10.00	495	14.21	516	7.13
Gov't decentralization	1912	4.07	3338	1.28	1206	2.71	4044	2.17	1593	3.87	3657	1.60
Ethnic fractionalization	1912	0.37	3728	0.48	1206	0.43	4434	0.45	1593	0.38	4047	0.47
Gun ownership	1912	12.51	4658	8.45	1206	11.15	5364	9.29	1593	12.24	4977	8.80

Notes. LE=Life expectancy; IM=Infant mortality rate; SU=Suicide rate; HV=HIV prevalence; TB=TB incidence.

APPENDIX D. COUNTRY GROUPINGS FOR FIGURES 9-18

Country	Income Group	Incarceration Rate	Incarceration Rate Change
Afghanistan	Low	Low	Increasing
Albania	Lower-mid	Medium	Increasing
Algeria	Lower-mid	Medium	Increasing
American Samoa	Upper-mid	High	Increasing
Andorra	High	Low	Decreasing or stable
Angola	Lower-mid	Low	Increasing
Antigua and Barbuda	High	High	Decreasing or stable
Argentina	Upper-mid	Medium	Increasing
Armenia	Lower-mid	Medium	Decreasing or stable
Aruba	High	High	Decreasing or stable
Australia	High	Medium	Increasing
Austria	High	Medium	Decreasing or stable
Azerbaijan	Lower-mid	Medium	Decreasing or stable
Bahamas	High	High	Decreasing or stable
Bahrain	High	Medium	Increasing
Bangladesh	Low	Low	Increasing
Barbados	Upper-mid	High	Increasing
Belarus	Lower-mid	High	Increasing
Belgium	High	Medium	Increasing
Belize	Upper-mid	High	Increasing
Benin	Low	Low	Increasing
Bermuda	High	High	Decreasing or stable
Bhutan	Low	Medium	Increasing
Bolivia (Plurinational State of)	Lower-mid	Medium	Increasing
Bosnia and Herzegovina	Lower-mid	Low	Increasing
Botswana	Upper-mid	High	Decreasing or stable
Brazil	Lower-mid	High	Increasing
British Virgin Islands	High	High	Increasing
Brunei Darussalam	High	Medium	Increasing
Bulgaria	Lower-mid	Medium	Decreasing or stable
Burkina Faso	Low	Low	Increasing
Burundi	Low	Medium	Decreasing or stable
Cabo Verde	Lower-mid	High	Increasing
Cambodia	Low	Medium	Increasing
Cameroon	Lower-mid	Medium	Decreasing or stable
Canada	High	Medium	Increasing
Cayman Islands	High	High	Decreasing or stable
Central African Republic	Low	Low	Decreasing or stable
Chad	Low	Low	Increasing
Chile	Upper-mid	High	Increasing
China	Lower-mid	Medium	Increasing
Colombia	Lower-mid	Medium	Increasing
Comoros	Low	Low	Decreasing or stable

Country	Income Group	Incarceration Rate	Incarceration Rate Change
Congo	Lower-mid	Low	Decreasing or stable
Costa Rica	Upper-mid	Medium	Increasing
Côte d'Ivoire	Low	Low	Decreasing or stable
Croatia	Upper-mid	Medium	Increasing
Cuba	Lower-mid	High	Increasing
Curaçao	High	High	Decreasing or stable
Cyprus	High	Low	Increasing
Czechia	Upper-mid	Medium	Decreasing or stable
Democratic Republic of the Congo	Low	Low	Decreasing or stable
Denmark	High	Low	Decreasing or stable
Djibouti	Lower-mid	Low	Decreasing or stable
Dominica	Upper-mid	High	Decreasing or stable
Dominican Republic	Lower-mid	Medium	Increasing
Ecuador	Lower-mid	Medium	Increasing
Egypt	Lower-mid	Medium	Increasing
El Salvador	Lower-mid	High	Increasing
Equatorial Guinea	Upper-mid	Low	Decreasing or stable
Eritrea	Low	High	Increasing
Estonia	Upper-mid	High	Decreasing or stable
Eswatini	Lower-mid	High	Increasing
Ethiopia	Low	Medium	Increasing
Faeroe Islands	High	Low	Decreasing or stable
Fiji	Lower-mid	Medium	Increasing
Finland	High	Low	Decreasing or stable
France	High	Medium	Increasing
French Polynesia	High	Medium	Increasing
Gabon	Upper-mid	Medium	Decreasing or stable
Gambia	Low	Low	Increasing
Georgia	Lower-mid	High	Increasing
Germany	High	Medium	Increasing
Ghana	Low	Low	Decreasing or stable
Gibraltar	High	Medium	Increasing
Greece	High	Medium	Increasing
Greenland	High	Medium	Increasing
Grenada	Upper-mid	High	Increasing
Guam	High	High	Increasing
Guatemala	Lower-mid	Medium	Increasing
Guinea	Low	Low	Decreasing or stable
Guinea-Bissau	Low	Low	Increasing
Guyana	Lower-mid	High	Increasing
Haiti	Low	Low	Increasing
Honduras	Lower-mid	Medium	Increasing
Hong Kong SAR, China	High	Medium	Decreasing or stable
Hungary	Upper-mid	Medium	Decreasing or stable
Iceland	High	Low	Decreasing or stable

Country	Income Group	Incarceration Rate	Incarceration Rate Change
India	Low	Low	Increasing
Indonesia	Lower-mid	Low	Increasing
Iran (Islamic Republic of)	Lower-mid	High	Increasing
Iraq	Lower-mid	Medium	Increasing
Ireland	High	Medium	Increasing
Isle of Man	High	Medium	Increasing
Israel	High	Medium	Increasing
Italy	High	Medium	Increasing
Jamaica	Lower-mid	Medium	Decreasing or stable
Japan	High	Low	Decreasing or stable
Jordan	Lower-mid	Medium	Increasing
Kazakhstan	Lower-mid	High	Decreasing or stable
Kenya	Low	Medium	Decreasing or stable
Kiribati	Lower-mid	Medium	Increasing
Kosovo	Lower-mid	Medium	Increasing
Kuwait	High	Medium	Increasing
Kyrgyzstan	Low	High	Decreasing or stable
Lao People's Democratic Republic	Low	Medium	Decreasing or stable
Latvia	Upper-mid	High	Decreasing or stable
Lebanon	Upper-mid	Medium	Increasing
Lesotho	Lower-mid	Medium	Decreasing or stable
Liberia	Low	Low	Increasing
Libya	Upper-mid	Medium	Decreasing or stable
Liechtenstein	High	Medium	Increasing
Lithuania	Upper-mid	High	Increasing
Luxembourg	High	Medium	Increasing
Macao SAR, China	High	Medium	Increasing
Madagascar	Low	Medium	Decreasing or stable
Malawi	Low	Low	Increasing
Malaysia	Upper-mid	Medium	Increasing
Maldives	Lower-mid	High	Decreasing or stable
Mali	Low	Low	Decreasing or stable
Malta	High	Medium	Increasing
Marshall Islands	Lower-mid	Low	Decreasing or stable
Mauritania	Low	Low	Decreasing or stable
Mauritius	Upper-mid	Medium	Decreasing or stable
Mexico	Upper-mid	Medium	Increasing
Micronesia (Federated States of)	Lower-mid	Medium	Increasing
Moldova (Republic of)	Lower-mid	High	Increasing
Monaco	High	Medium	Increasing
Mongolia	Low	High	Decreasing or stable
Montenegro	Upper-mid	Medium	Increasing
Morocco	Lower-mid	Medium	Increasing
Mozambique	Low	Medium	Increasing
Myanmar	Low	Medium	Increasing

Country	Income Group	Incarceration Rate	Incarceration Rate Change
Namibia	Lower-mid	High	Increasing
Nauru	High	Medium	Increasing
Nepal	Low	Low	Increasing
Netherlands	High	Medium	Increasing
New Caledonia	High	Medium	Increasing
New Zealand	High	Medium	Increasing
Nicaragua	Lower-mid	Medium	Increasing
Niger	Low	Low	Decreasing or stable
Nigeria	Low	Low	Decreasing or stable
North Macedonia	Lower-mid	Medium	Increasing
Northern Mariana Islands	Upper-mid	High	Increasing
Norway	High	Low	Increasing
Oman	Upper-mid	Low	Decreasing or stable
Pakistan	Low	Low	Decreasing or stable
Palau	Upper-mid	High	Increasing
Panama	Upper-mid	High	Increasing
Papua New Guinea	Low	Low	Decreasing or stable
Paraguay	Lower-mid	Medium	Increasing
Peru	Lower-mid	Medium	Increasing
Philippines	Lower-mid	Medium	Increasing
Poland	Upper-mid	Medium	Increasing
Portugal	High	Medium	Increasing
Puerto Rico	High	High	Decreasing or stable
Qatar	High	Low	Decreasing or stable
Republic of (South) Korea	High	Medium	Increasing
Romania	Upper-mid	Medium	Increasing
Russian Federation	Upper-mid	High	Increasing
Rwanda	Low	High	Increasing
Saint Kitts and Nevis	Upper-mid	High	Increasing
Saint Lucia	Upper-mid	High	Increasing
Saint Vincent and the Grenadines	Upper-mid	High	Increasing
Samoa	Lower-mid	Medium	Increasing
San Marino	High	Low	Increasing
Sao Tome and Principe	Low	Medium	Increasing
Saudi Arabia	High	Medium	Increasing
Senegal	Low	Medium	Increasing
Serbia	Upper-mid	Medium	Increasing
Seychelles	Upper-mid	High	Increasing
Sierra Leone	Low	Low	Increasing
Singapore	High	High	Increasing
Sint Maarten (Dutchpart)	High	High	Decreasing or stable
Slovakia	Upper-mid	Medium	Decreasing or stable
Slovenia	High	Low	Increasing
Solomon Islands	Low	Low	Decreasing or stable
Somalia	Low	High	Increasing

Country	Income Group	Incarceration Rate	Incarceration Rate Change
South Africa	Upper-mid	High	Decreasing or stable
South Sudan	Lower-mid	Low	Decreasing or stable
Spain	High	Medium	Increasing
Sri Lanka	Lower-mid	Medium	Increasing
State of Palestine	Lower-mid	Low	Decreasing or stable
Sudan	Low	Low	Increasing
Suriname	Lower-mid	Medium	Increasing
Sweden	High	Low	Increasing
Switzerland	High	Medium	Increasing
Syrian Arab Republic	Lower-mid	Low	Decreasing or stable
Taiwan (Province of China)	High	High	Increasing
Tajikistan	Low	Medium	Increasing
Tanzania (United Republic of)	Low	Medium	Decreasing or stable
Thailand	Lower-mid	High	Increasing
Timor-Leste	Low	Low	Increasing
Togo	Low	Low	Decreasing or stable
Tonga	Lower-mid	Medium	Increasing
Trinidad and Tobago	Upper-mid	High	Increasing
Tunisia	Lower-mid	Medium	Decreasing or stable
Turkey	Upper-mid	Medium	Increasing
Turkmenistan	Lower-mid	High	Increasing
Tuvalu	Lower-mid	Medium	Increasing
Uganda	Low	Medium	Increasing
Ukraine	Lower-mid	High	Decreasing or stable
United Arab Emirates	High	Medium	Decreasing or stable
United Kingdom	High	Medium	Increasing
United States of America	High	High	Increasing
United States Virgin Islands	High	High	Increasing
Uruguay	Upper-mid	Medium	Increasing
Uzbekistan	Low	Medium	Decreasing or stable
Vanuatu	Lower-mid	Low	Decreasing or stable
Venezuela (Bolivarian Republic of)	Upper-mid	Medium	Increasing
Vietnam	Low	Medium	Increasing
Yemen	Low	Low	Decreasing or stable
Zambia	Low	Medium	Decreasing or stable
Zimbabwe	Low	Medium	Decreasing or stable

APPENDIX E. R-SQUARED FOR GROWTH MODELS AND INCARCERATION-RATE-ONLY MODELS WITH RANDOM INTERCEPTS

	Life Expectancy		Infant Mortality		Suicide Rate		HIV Prevalence		TB Incidence	
	Growth	**Inc Rate**	**Growth**	**Inc Rate**	**Growth**	**Inc Rate**	**Growth**	**Inc Rate**	**Growth**	**Inc Rate**
Random effects										
Level-2 Variance	81.96	70.53	829.11	544.75	83.09	76.21	17.70	20.44	33349.93	33990.94
Level-1 Variance	4.29	2.84	79.43	41.58	5.64	5.88	2.05	1.41	2610.17	2301.99
Coefficients of determination										
R^2_2		0.14		0.34		0.08		-0.16		-0.02
R^2_1		0.34		0.48		-0.04		0.31		0.12

APPENDIX F. DIRECT EFFECTS OF INCARCERATION ON POPULATION HEALTH OUTCOMES (WITH 2-YEAR DATA)

	Life Expectancy						Infant Mortality Rate						TB Incidence					
	Model 1.8A		**Model 1.9A**		**Model 1.10A**		**Model 1.8B**		**Model 1.9B**		**Model 1.10B**		**Model 1.8E**		**Model 1.9E**		**Model 1.10E**	
	Full Model		**Contextual Model**		**3-Period Lag**		**Full Model**		**Contextual Model**		**3-Period Lag**		**Full Model**		**Contextual Model**		**3-Period Lag**	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																		
Constant	64.10***	(0.94)	64.29***	(0.93)	63.99***	(0.93)	23.81***	(1.36)	23.79***	(1.34)	22.48***	(1.33)	93.00***	(22.02)	160.84***	(23.35)	95.86***	(21.80)
Year	0.50***	(0.03)	0.50***	(0.03)	0.52***	(0.03)	-0.73***	(0.05)	-0.73***	(0.05)	-0.60***	(0.05)	-0.68+	(0.38)	-0.54	(0.33)	-1.08*	(0.52)
Year - squared							0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	-0.07	(0.05)	-0.06	(0.05)	-0.02	(0.05)
Inc. rate (lagged 1 period)	-0.11*	(0.06)					0.01	(0.06)					3.74***	(0.95)				
Inc. rate (lagged raw)			-0.11*	(0.06)					0.01	(0.06)					3.66***	(0.95)		
Inc. rate (lagged 3 periods)					-0.07*	(0.03)					-0.02	(0.05)					2.49**	(0.76)
Avg. incarceration rate	-0.44+	(0.26)	-0.33	(0.26)	-0.52*	(0.26)	-0.85*	(0.42)	-0.86*	(0.42)	-0.86+	(0.44)	9.21	(6.24)	7.12	(6.99)	9.57	(6.21)
Model fit																		
AIC	2053.2		2053.2		1633.3		4296.2		4296.2		3627.0		7576.3		7604.4		7226.3	
BIC	2278.8		2278.8		1852.5		4521.8		4521.8		3846.1		7796.0		7824.1		7448.2	
Observations	1246		1246		1076		1246		1246		1076		976		976		921	
Countries	131		131		130		131		131		130		131		131		130	
	Suicide Rate						**HIV Prevalence**											
	Model 1.8C		**Model 1.9C**		**Model 1.10C**		**Model 1.8D**		**Model 1.9D**		**Model 1.10D**							
	Full Model		**Contextual Model**		**3-Period Lag**		**Full Model**		**Contextual Model**		**3-Period Lag**							
	b	se	b	se	b	se	b	se	b	se	b	se						
Fixed effects																		
Constant	14.17***	(1.94)	13.93***	(1.94)	15.04***	(2.06)	0.48***	(0.12)	0.49***	(0.12)	0.48***	(0.13)						
Year - pre-peak	-0.18	(0.13)	-0.18	(0.13)	-0.36*	(0.17)	0.03***	(0.01)	0.03***	(0.01)	0.03***	(0.01)						
Year - post-peak	-0.30***	(0.09)	-0.30***	(0.09)	-0.34***	(0.09)	0.02*	(0.01)	0.02*	(0.01)	0.02**	(0.01)						
Inc. rate (lagged 1 period)	0.15	(0.15)					-0.01	(0.01)										
Inc. rate (lagged raw)			0.15	(0.15)					-0.01	(0.01)								
Inc. rate (lagged 3 periods)					0.14	(0.11)					-0.00	(0.01)						
Avg. incarceration rate	1.06*	(0.46)	0.92*	(0.44)	1.43*	(0.58)	0.18***	(0.04)	0.19***	(0.04)	0.20***	(0.05)						
Model fit																		
AIC	4147.6		4147.6		3486.4		-907.3		-907.3		-880.5							
BIC	4373.2		4373.2		3705.6		-691.5		-691.5		-671.6							
Observations	1246		1246		1076		806		806		694							
Countries	131		131		130		93		93		92							

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; Level-1, Level-2, and region controls are still included but not shown here.

APPENDIX G. DIRECT EFFECTS OF INCARCERATION ON POPULATION HEALTH OUTCOMES WITHOUT THE U.S. (WITH ANNUAL DATA)

	Life Expectancy						Infant Mortality Rate						TB Incidence					
	Model 1.3A.nUS		**Model 1.4A.nUS**		**Model 1.5A.nUS**		**Model 1.3B.nUS**		**Model 1.4B.nUS**		**Model 1.5B.nUS**		**Model 1.3E.nUS**		**Model 1.4E.nUS**		**Model 1.5E.nUS**	
	Full Model		**Contextual Model**		**5-Year Lag**		**Full Model**		**Contextual Model**		**5-Year Lag**		**Full Model**		**Contextual Model**		**5-Year Lag**	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																		
Constant	64.15***	(0.96)	64.30***	(0.96)	64.12***	(0.99)	24.20***	(1.22)	24.21***	(1.22)	22.40***	(1.15)	100.14***	(22.15)	95.13***	(22.27)	99.68***	(21.98)
Year	0.24***	(0.02)	0.24***	(0.02)	0.25***	(0.02)	-0.37***	(0.02)	-0.37***	(0.02)	-0.33***	(0.03)	-0.49	(0.30)	-0.49	(0.30)	-0.47	(0.30)
Year - squared							0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)
Inc. rate (lagged 1 period)	-0.09*	(0.04)					-0.01	(0.02)					2.93**	(0.99)				
Inc. rate (lagged raw)			-0.09*	(0.04)					-0.01	(0.02)					2.93**	(0.99)		
Inc. rate (lagged 5 years)					-0.03	(0.03)					-0.04*	(0.02)					1.44*	(0.62)
Avg. incarceration rate	-0.30	(0.26)	-0.21	(0.27)	-0.33	(0.26)	-1.80***	(0.52)	-1.79***	(0.52)	-1.74***	(0.48)	9.34	(6.33)	6.41	(6.48)	8.74	(6.27)
Model fit																		
AIC	1588.6		1588.6		1341.9		4222.1		4222.1		3737.1		10769.5		10771.5		9873.2	
BIC	1832.4		1832.4		1578.8		4466.0		4466.0		3974.0		11005.4		11012.8		10109.6	
Observations	1887		1887		1609		1887		1887		1609		1574		1574		1412	
Countries	127		127		128		127		127		128		127		127		128	
	Suicide Rate						**HIV Prevalence**											
	Model 1.3C.nUS		**Model 1.4C.nUS**		**Model 1.5C.nUS**		**Model 1.3D.nUS**		**Model 1.4D.nUS**		**Model 1.5D.nUS**							
	Full Model		**Contextual Model**		**5-Year Lag**		**Full Model**		**Contextual Model**		**5-Year Lag**							
	b	se	b	se	b	se	b	se	b	se	b	se						
Fixed effects																		
Constant	14.50***	(2.02)	14.34***	(2.01)	14.52***	(2.06)			0.40***	(0.10)	0.44***	(0.13)						
Year - pre-peak	-0.05	(0.07)	-0.05	(0.07)	-0.19*	(0.09)			0.02***	(0.00)	0.02***	(0.00)						
Year - post-peak	-0.18***	(0.04)	-0.18***	(0.04)	-0.17***	(0.04)			0.01**	(0.00)	0.01*	(0.00)						
Inc. rate (lagged 1 period)	0.10	(0.08)																
Inc. rate (lagged raw)			0.10	(0.08)					-0.01*	(0.00)								
Inc. rate (lagged 5 years)					0.14+	(0.07)					-0.00	(0.01)						
Avg. incarceration rate	0.80	(0.49)	0.70	(0.50)	0.98*	(0.50)			0.17**	(0.06)	0.18**	(0.06)						
Model fit																		
AIC	4614.3		4614.3		4074.3				-907.3		-880.5							
BIC	4858.2		4858.2		4311.2				-691.5		-671.6							
Observations	1887		1887		1609				806		694							
Countries	127		127		128				93		92							

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are mean centered; In all models, residuals are allowed to vary by region or income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects; Level-1, Level-2, and region controls are still included but not shown here; Model 1.3D.nUS did not converge and therefore the results are not shown here.

APPENDIX H. SUPPLEMENTAL TABLES FOR CHAPTER 6

Table 35. Life Expectancy Model Interaction Results

	Model 1.3A		Model 2.1A.i		Model 2.2A.i		Model 2.4A.i		Model 2.5A.i		Model 2.6A.i		Model 2.7A.i		Model 2.9A.i		Model 2.10A.i	
	Full Model		Lagged incarceration x EP		Average incarceration x EP		Average incarceration x EF		Lagged incarceration x SP		Average incarceration x SP		Lagged incarceration x PC (no US)		Lagged incarceration x PC (with US)		Average incarceration x PC (with US)	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																		
Constant	64.07***	(0.92)	64.06***	(0.92)	64.22***	(0.92)	64.07***	(0.98)	64.05***	(0.92)	64.57***	(1.01)	64.16***	(0.96)	64.07***	(0.92)	64.24***	(0.93)
Year	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)	0.24***	(0.02)
Incarceration rate (lagged 1 year)	-0.09*	(0.04)	-0.08*	(0.04)	-0.09*	(0.04)	-0.09*	(0.04)	-0.09*	(0.04)	-0.09*	(0.04)	-0.08*	(0.04)	-0.08*	(0.04)	-0.09*	(0.04)
Average incarceration rate	-0.45+	(0.26)	-0.45+	(0.26)	-0.46+	(0.24)	-0.45	(0.27)	-0.45+	(0.26)	-0.15	(0.29)	-0.30	(0.26)	-0.45+	(0.26)	-0.39	(0.25)
Inc. rate (lagged) x Excluded minority population			-0.07	(0.36)														
Avg. inc. rate x Excluded minority population					-1.68	(1.78)												
Inc. rate (lagged) x Ethnic fractionalization							0.03	(1.13)										
Inc. rate (lagged) x Social protection expenditure									-0.00	(0.01)								
Avg. inc. rate x Social protection expenditure											-0.07*	(0.03)						
Inc. rate (lagged) x Prison conditions (no U.S.)													-0.04	(0.04)				
Inc. rate (lagged) x Prison conditions (with U.S.)															-0.04	(0.04)		
Avg. inc. rate x Prison conditions (with U.S.)																	-0.28	(0.17)
Model fit																		
AIC	1593.4		1595.3		1594.4		1595.4		1592.8		1592.4		1588.8		1593.5		1594.0	
BIC	1837.9		1845.3		1844.4		1845.4		1837.3		1842.4		1838.2		1843.5		1844.0	
Observations (Level-1)	1912		1912		1912		1912		1912		1912		1887		1912		1912	
Countries (Level-2)	128		128		128		128		128		128		127		128		128	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Moderation variables are all country-averaged; Level-1, Level-2, and region controls are still included but not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Models 2.3a.i and 2.8a.i (lagged incarceration x EF and average incarceration x PC no US) did not converge and the results are therefore not shown here.

Table 36. Full Life Expectancy Model Subsample Results

	Model 1.3A		Model 2.1A.s		Model 2.2A.s		Model 2.3A.s		Model 2.4A.s		Model 2.5A.s		Model 2.6A.s		Model 2.7A.s		Model 2.8A.s		Model 2.9A.s		Model 2.10A.s	
	Full Model		EP Below Average		EP Above Average		EF Below Average		EF Above Average		SP Below Average		SP Above Average		PC (no US) Below Average		PC (no US) Above Average		PC (with US) Below Average		PC (with US) Above Average	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																						
Constant	64.07***	(0.92)	64.96***	(1.22)	64.87***	(3.83)	64.77***	(1.29)	66.88***	(2.28)	64.54***	(3.52)	66.66***	(1.85)	64.42***	(1.44)	66.03***	(2.44)	64.41***	(1.44)	66.41***	(2.44)
Year	0.24***	(0.02)	0.22***	(0.01)	0.24***	(0.02)	0.23***	(0.01)	0.22***	(0.02)	0.21***	(0.01)	0.24***	(0.01)	0.21***	(0.01)	0.24***	(0.01)	0.21***	(0.01)	0.24***	(0.01)
Incarceration rate (lagged 1 year)	-0.09*	(0.04)	-0.04	(0.03)	-0.10*	(0.04)	-0.05	(0.04)	-0.08*	(0.04)	-0.11**	(0.03)	-0.01	(0.04)	-0.03	(0.04)	-0.08*	(0.03)	-0.03	(0.04)	-0.07*	(0.03)
Average incarceration rate	-0.45+	(0.26)	-0.06	(0.46)	-0.18	(1.04)	-0.99	(0.64)	0.02	(0.71)	0.48	(0.79)	-0.48	(0.47)	0.01	(0.60)	0.60	(0.57)	0.01	(0.60)	0.61	(0.58)
Level-1 controls																						
GDP	0.00	(0.00)	0.00+	(0.00)	-0.01	(0.01)	0.01+	(0.00)	0.00	(0.00)	-0.00	(0.01)	0.00	(0.00)	0.01*	(0.00)	0.00	(0.01)	0.01*	(0.00)	-0.01	(0.01)
GINI	-0.36	(0.45)	0.22	(0.52)	-1.39	(1.06)	0.27	(0.54)	-1.39	(0.96)	-0.38	(0.98)	-0.05	(0.54)	0.72	(0.68)	-0.30	(0.69)	0.72	(0.68)	-0.44	(0.69)
Homicide rate	-0.00+	(0.00)	-0.00	(0.00)	-0.01	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00**	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Population 65+	-0.18**	(0.06)	-0.11**	(0.04)	-0.34***	(0.08)	-0.11**	(0.04)	-0.30***	(0.07)	-0.11+	(0.07)	-0.15***	(0.04)	0.04	(0.04)	-0.37***	(0.06)	0.04	(0.04)	-0.39***	(0.05)
Fertility rate	-0.42+	(0.24)	-0.40***	(0.11)	-0.83***	(0.20)	-0.23+	(0.12)	-1.10***	(0.17)	-1.02***	(0.15)	0.43**	(0.13)	-0.10	(0.15)	-0.85***	(0.13)	-0.10	(0.15)	-0.84***	(0.13)
Unemployment	0.01	(0.01)	0.01+	(0.01)	-0.01	(0.01)	0.01+	(0.01)	0.00	(0.01)	-0.02*	(0.01)	0.02***	(0.01)	0.02***	(0.01)	-0.00	(0.01)	0.02***	(0.01)	-0.01	(0.01)
Urban population	0.03	(0.03)	0.03*	(0.01)	0.09*	(0.04)	0.02	(0.01)	0.08**	(0.03)	0.06***	(0.02)	0.03+	(0.02)	-0.01	(0.02)	0.06***	(0.02)	-0.01	(0.02)	0.06***	(0.02)
Democracy	0.00	(0.01)	0.01	(0.01)	-0.01	(0.01)	0.01	(0.01)	0.00	(0.01)	0.00	(0.01)	0.02	(0.01)	-0.01	(0.01)	0.00	(0.01)	-0.01	(0.01)	0.01	(0.01)
Excluded minority population	-0.29*	(0.14)	-0.17	(0.50)	-0.19	(0.14)	0.33	(0.67)	-0.22+	(0.13)	-0.50**	(0.19)	-0.09	(0.16)	-0.18	(0.34)	-0.21	(0.13)	-0.18	(0.34)	-0.21+	(0.12)
Level-2 controls																						
GDP	-0.05	(0.04)	-0.07	(0.06)	-0.14	(0.34)	0.05	(0.14)	0.02	(0.11)	0.12	(0.20)	-0.01	(0.06)	-0.04	(0.05)	-0.46	(0.51)	-0.04	(0.05)	-0.07	(0.34)
GINI	-8.91+	(4.70)	-5.30	(6.46)	-30.66+	(17.49)	-7.27	(7.05)	-29.12*	(12.80)	-26.20**	(10.06)	-0.40	(8.15)	1.90	(6.73)	-28.59**	(11.06)	1.90	(6.73)	-26.15*	(10.87)
Homicide rate	-0.02	(0.03)	-0.02	(0.05)	-0.03	(0.07)	-0.02	(0.06)	-0.06	(0.05)	0.03	(0.06)	-0.05	(0.03)	-0.23*	(0.11)	-0.02	(0.04)	-0.23*	(0.11)	-0.02	(0.04)
Population 65+	0.17	(0.12)	0.20	(0.16)	0.02	(0.44)	-0.16	(0.23)	-0.08	(0.28)	0.74	(0.46)	0.24	(0.17)	0.31+	(0.17)	-0.01	(0.23)	0.31+	(0.17)	0.11	(0.21)
Fertility rate	-2.63***	(0.41)	-2.77***	(0.59)	-2.48*	(0.99)	-3.50***	(1.00)	-2.13**	(0.76)	-0.96	(0.81)	-1.63	(1.46)	-1.99*	(0.92)	-2.20**	(0.68)	-1.99*	(0.92)	-2.07**	(0.68)
Unemployment	0.01	(0.06)	0.07	(0.09)	0.16	(0.19)	0.06	(0.11)	0.09	(0.12)	-0.12	(0.13)	0.19+	(0.10)	0.18+	(0.10)	-0.06	(0.12)	0.18+	(0.10)	-0.06	(0.12)
Urban population	0.09***	(0.01)	0.08***	(0.02)	0.10*	(0.05)	0.10***	(0.03)	0.08*	(0.04)	0.10*	(0.04)	0.02	(0.03)	0.06*	(0.02)	0.11**	(0.04)	0.06*	(0.02)	0.10**	(0.04)
Democracy	-0.07	(0.05)	-0.06	(0.08)	-0.02	(0.22)	-0.09	(0.09)	-0.04	(0.13)	0.05	(0.12)	-0.12	(0.09)	-0.03	(0.12)	-0.09	(0.09)	-0.03	(0.12)	-0.09	(0.09)
Excluded minority population	3.13	(1.95)	-1.11	(7.86)	3.79	(3.96)	5.01	(5.23)	1.24	(2.83)	4.74	(2.88)	-2.82	(4.33)	-4.52	(3.02)	8.74**	(2.87)	-4.52	(3.02)	8.81**	(2.88)
Hospital beds	-0.43***	(0.11)	-0.48***	(0.14)	-0.62	(0.57)	-0.43**	(0.15)	-0.48	(0.42)	-0.59	(0.47)	-0.37*	(0.15)	-0.30*	(0.14)	-0.78*	(0.32)	-0.30*	(0.14)	-0.92**	(0.28)
Health expenditure	0.10*	(0.04)	0.14*	(0.06)	0.43	(0.27)	0.02	(0.12)	0.03	(0.13)	-0.16	(0.48)	0.12*	(0.05)	0.14*	(0.06)	0.61	(0.56)	0.14*	(0.06)	0.10	(0.27)
Government health exp.	0.03	(0.02)	0.02	(0.03)	0.02	(0.05)	0.04	(0.03)	0.06	(0.04)	0.13**	(0.05)	-0.02	(0.03)	-0.01	(0.03)	0.06	(0.04)	-0.01	(0.03)	0.05	(0.04)
Prison conditions (with U.S.)	-0.70+	(0.36)	-0.64	(0.47)	1.54	(1.54)	-0.09	(0.51)	-0.47	(0.91)	-0.65	(0.88)	-0.52	(0.53)					-0.43	(0.48)	-3.09*	(1.41)
Prison conditions (without U.S.)															-0.43	(0.48)	-3.00*	(1.40)				
Social protection expenditure	0.02	(0.06)	-0.07	(0.09)	-0.18	(0.22)	0.13	(0.10)	-0.10	(0.16)	-0.05	(0.38)	0.03	(0.08)	-0.01	(0.11)	-0.08	(0.17)	-0.01	(0.11)	0.03	(0.13)
Government decentralization	-0.10*	(0.05)	-0.11*	(0.04)	-0.52	(0.36)	-0.18***	(0.05)	0.09	(0.16)	-0.34	(0.34)	-0.09*	(0.04)	-0.10*	(0.04)	0.01	(0.27)	-0.10*	(0.04)	-0.09	(0.25)
Ethnic fractionalization	-2.16+	(1.17)	-2.19	(1.55)	-12.89**	(4.66)	-4.23+	(2.48)	-16.28**	(5.44)	-5.67*	(2.47)	-2.87+	(1.74)	-2.21	(1.74)	-3.84+	(2.27)	-2.21	(1.74)	-4.50*	(2.19)
Gun availability	0.03	(0.02)	0.06+	(0.03)	-0.15+	(0.08)	0.07*	(0.03)	-0.02	(0.04)	0.08	(0.09)	-0.02	(0.03)	0.01	(0.03)	-0.03	(0.08)	0.01	(0.03)	-0.03	(0.08)
Region																						
Africa	-1.55	(1.59)	-3.92+	(2.13)	-1.82	(4.61)	-2.38	(3.16)	-0.25	(3.48)	0.81	(3.12)	-10.01	(8.45)	-2.49	(3.08)	-2.56	(2.91)	-2.49	(3.08)	-2.02	(2.88)
Americas	3.44**	(1.32)	1.77	(1.76)	4.66	(4.02)	2.19	(2.24)	4.95+	(2.78)	4.17	(3.26)	4.10*	(1.67)	6.65*	(2.77)	2.14	(2.24)	6.65*	(2.77)	2.47	(2.25)
Asia	3.27**	(1.20)	2.32	(1.50)	3.60	(3.20)	2.15	(1.87)	3.18	(2.99)	5.43*	(2.59)	2.46	(1.78)	4.67**	(1.60)	1.72	(2.04)	4.67**	(1.60)	2.49	(1.93)
Oceania	0.84	(0.67)	0.27	(0.99)			0.60	(0.96)			0.00	(.)	2.16	(1.48)	1.34	(1.23)	-0.78	(2.77)	1.34	(1.23)	-0.17	(2.72)
Model fit																						
AIC	1593.40		1061.08		602.99		744.16		923.71		1087.59		589.37		677.13		970.28		677.13		972.49	
BIC	1837.85		1295.30		785.21		966.37		1118.25		1284.35		815.00		896.84		1186.98		896.84		1190.41	
Observations	1912		1346		566		1153		759		800		1112		975		912		975		937	
Countries	128		88		40		68		60		71		57		56		71		56		72	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

Table 37. Infant Mortality Rate Model Interaction Results

	Model 1.3B		Model 2.1B.i		Model 2.2B.i		Model 2.3B.i		Model 2.4B.i		Model 2.5B.i		Model 2.6B.i		Model 2.7B.i		Model 2.8B.i		Model 2.9B.i		Model 2.10B.i	
	Full Model		Lagged incarceration x EP		Average incarceration x EP		Lagged incarceration x EF		Average incarceration x EF		Lagged incarceration x SP		Average incarceration x SP		Lagged incarceration x PC (no US)		Average incarceration x PC (no US)		Lagged incarceration x PC (with US)		Average incarceration x PC (with US)	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																						
Constant	23.94***	(1.23)	23.95***	(1.23)	23.94***	(1.26)	23.93***	(1.23)	23.91***	(1.37)	24.02***	(1.24)	22.25***	(1.22)	24.20***	(1.22)	24.22***	(1.22)	23.96***	(1.24)	23.51***	(1.16)
Year	-0.36***	(0.02)	-0.36***	(0.02)	-0.36***	(0.02)	-0.36***	(0.02)	-0.36***	(0.02)	-0.37***	(0.02)	-0.36***	(0.02)	-0.37***	(0.02)	-0.37***	(0.02)	-0.36***	(0.02)	-0.36***	(0.02)
Year - squared	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
Incarceration rate (lagged 1 year)	0.00	(0.03)	-0.00	(0.03)	0.00	(0.03)	0.00	(0.03)	0.00	(0.03)	0.04	(0.03)	0.00	(0.03)	-0.01	(0.04)	-0.01	(0.02)	0.03	(0.05)	0.00	(0.03)
Average incarceration rate	-0.81+	(0.42)	-0.81+	(0.42)	-0.81+	(0.42)	-0.81+	(0.42)	-0.82+	(0.45)	-0.81+	(0.43)	-1.50**	(0.49)	-1.80***	(0.52)	-1.51**	(0.53)	-0.81+	(0.42)	-0.76+	(0.39)
Inc. rate (lagged) x Excluded minority population			0.09	(0.11)																		
Avg. inc. rate x Excluded minority population					-0.60	(4.50)																
Inc. rate (lagged) x Ethnic fractionalization							0.04	(0.22)														
Avg. inc. rate x Ethnic fractionalization									-0.19	(2.55)												
Inc. rate (lagged) x Social protection expenditure											0.01*	(0.00)										
Avg. inc. rate x Social protection expenditure													0.15*	(0.06)								
Inc. rate (lagged) x Prison conditions (no U.S.)															-0.00	(0.03)						
Avg. inc. rate x Prison conditions (no U.S.)																	0.37	(0.31)				
Inc. rate (lagged) x Prison conditions (with U.S.)																			0.03	(0.03)		
Avg. inc. rate x Prison conditions (with U.S.)																					0.73*	(0.33)
Model fit																						
AIC	4197.5		4199.2		4199.5		4199.5		4199.5		4194.5		4196.0		4224.1		4223.5		4196.4		4195.7	
BIC	4442.0		4449.2		4449.5		4449.5		4449.5		4444.5		4446.1		4473.6		4472.9		4440.9		4445.7	
Observations (Level-1)	1912		1912		1912		1912		1912		1912		1912		1887		1887		1912		1912	
Countries (Level-2)	128		128		128		128		128		128		128		127		127		128		128	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Moderation variables are all country-averaged; Level-1, Level-2, and region controls are still included but not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions.

Table 38. Full Infant Mortality Rate Model Subsample Results

	Model 1.3B		Model 2.1B.s		Model 2.2B.s		Model 2.3B.s		Model 2.4B.s		Model 2.6B.s		Model 2.7B.s		Model 2.8B.s		Model 2.9B.s		Model 2.10B.s	
	Full Model		EP Below Average		EP Above Average		EF Below Average		EF Above Average		SP Above Average		PC (no US) Below Average		PC (no US) Above Average		PC (with US) Below Average		PC (with US) Above Average	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																				
Constant	23.94***	(1.23)	28.13***	(3.42)	27.53*	(13.59)	22.49***	(3.96)	19.52**	(6.31)	15.19***	(2.76)	19.93***	(2.34)	32.16***	(8.97)	19.93***	(2.34)	29.91**	(9.09)
Year	-0.36***	(0.02)	-0.34***	(0.01)	-0.61***	(0.06)	-0.37***	(0.01)	-0.35***	(0.03)	-0.34***	(0.01)	-0.36***	(0.01)	-1.10***	(0.08)	-0.36***	(0.01)	-0.94***	(0.08)
Year - squared	0.01***	(0.00)	0.01***	(0.00)	0.00+	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.00	(0.00)	0.01***	(0.00)	-0.00	(0.00)
Incarceration rate (lagged 1 year)	0.00	(0.03)	-0.03	(0.04)	0.14+	(0.08)	-0.04	(0.04)	0.03	(0.04)	0.06	(0.05)	-0.02	(0.03)	0.35*	(0.14)	-0.02	(0.03)	0.48***	(0.14)
Average incarceration rate	-0.81+	(0.42)	-1.62	(1.08)	-0.50	(3.95)	-0.61	(1.46)	-0.95	(2.30)	-0.49	(1.08)	-1.29	(0.92)	-3.49+	(2.01)	-1.29	(0.92)	-3.40+	(1.99)
Level-1 controls																				
GDP	0.00	(0.00)	-0.00	(0.00)	0.06**	(0.02)	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.05*	(0.02)	-0.00	(0.00)	0.13***	(0.03)
GINI	0.60+	(0.35)	0.24	(0.50)	2.44	(2.42)	0.46	(0.56)	1.23	(1.44)	0.37	(0.44)	0.69	(0.52)	-1.70	(2.26)	0.69	(0.52)	-0.65	(2.52)
Homicide rate	0.01+	(0.01)	0.00	(0.01)	0.01	(0.02)	0.01	(0.01)	0.01	(0.02)	0.02*	(0.01)	0.00	(0.01)	0.01	(0.01)	0.00	(0.01)	0.01	(0.01)
Population 65+	0.09	(0.07)	0.01	(0.03)	0.56**	(0.20)	0.05	(0.04)	0.08	(0.10)	-0.04	(0.03)	0.05	(0.03)	2.32***	(0.17)	0.05	(0.03)	1.81***	(0.19)
Fertility rate	1.29***	(0.29)	0.85***	(0.11)	2.50***	(0.51)	1.08***	(0.12)	2.15***	(0.33)	0.66***	(0.11)	1.08***	(0.12)	2.39***	(0.50)	1.08***	(0.12)	2.73***	(0.56)
Unemployment	0.00	(0.01)	-0.00	(0.01)	0.05*	(0.02)	-0.00	(0.01)	0.04+	(0.02)	-0.00	(0.00)	-0.00	(0.01)	0.06**	(0.02)	-0.00	(0.01)	0.08**	(0.03)
Urban population	-0.03	(0.05)	-0.03+	(0.02)	-0.48***	(0.11)	-0.02	(0.02)	-0.15*	(0.07)	0.02	(0.02)	0.02	(0.02)	0.08	(0.07)	0.02	(0.02)	-0.02	(0.08)
Democracy	-0.05*	(0.02)	-0.04	(0.02)	-0.07+	(0.04)	-0.00	(0.03)	-0.08*	(0.03)	-0.03	(0.02)	-0.01	(0.02)	-0.06	(0.04)	-0.01	(0.02)	-0.07	(0.04)
Excluded minority population	-0.11	(0.15)	-0.30	(0.68)	0.94+	(0.56)	-0.49	(1.33)	0.19	(0.36)	-0.20	(0.24)	-0.03	(0.78)	1.77+	(0.90)	-0.03	(0.78)	0.49	(0.68)
Level-2 controls																				
GDP	0.08+	(0.05)	0.18	(0.11)	-0.42	(1.15)	-0.63*	(0.25)	0.12	(0.23)	-0.06	(0.08)	-0.02	(0.09)	-0.79	(1.61)	-0.02	(0.09)	-0.33	(1.20)
GINI	-10.48	(8.61)	-12.09	(13.68)	-7.52	(57.95)	-19.82	(14.41)	47.93	(42.09)	9.44	(14.69)	-2.45	(13.19)	29.67	(40.22)	-2.45	(13.19)	33.70	(38.75)
Homicide rate	0.26***	(0.07)	0.17	(0.12)	0.08	(0.25)	0.21	(0.15)	0.26	(0.19)	0.29*	(0.13)	0.68***	(0.17)	0.02	(0.12)	0.68***	(0.17)	0.01	(0.12)
Population 65+	0.31+	(0.18)	0.47	(0.35)	0.16	(1.32)	0.16	(0.43)	0.84	(0.97)	-0.40	(0.31)	0.16	(0.29)	-0.20	(0.96)	0.16	(0.29)	0.00	(0.85)
Fertility rate	5.80***	(0.82)	8.11***	(1.59)	7.11*	(3.42)	3.36+	(2.04)	5.99*	(2.89)	-0.48	(1.92)	2.94*	(1.37)	5.62*	(2.79)	2.94*	(1.37)	5.66*	(2.75)
Unemployment	-0.04	(0.12)	-0.05	(0.23)	-0.40	(0.71)	0.33	(0.26)	-0.56	(0.38)	-0.15	(0.19)	0.09	(0.16)	0.04	(0.42)	0.09	(0.16)	0.09	(0.41)
Urban population	-0.11***	(0.03)	-0.15**	(0.06)	-0.10	(0.18)	-0.15*	(0.07)	-0.19	(0.12)	-0.00	(0.05)	-0.07	(0.05)	-0.29*	(0.12)	-0.07	(0.05)	-0.29*	(0.13)
Democracy	-0.42***	(0.10)	-0.60*	(0.24)	-0.19	(0.65)	-0.59**	(0.19)	-0.23	(0.41)	0.05	(0.26)	-0.36+	(0.19)	-0.03	(0.36)	-0.36+	(0.19)	-0.01	(0.35)
Excluded minority population	-1.00	(3.36)	12.96	(21.55)	-15.35	(14.29)	-9.51	(9.94)	8.20	(9.69)	2.16	(9.92)	-0.70	(4.93)	-13.46	(9.72)	-0.70	(4.93)	-13.36	(9.66)
Hospital beds	0.10	(0.14)	0.25	(0.32)	-0.15	(2.11)	-0.12	(0.32)	0.60	(1.58)	-0.01	(0.24)	-0.03	(0.25)	2.26+	(1.25)	-0.03	(0.25)	2.02+	(1.14)
Health expenditure	-0.10*	(0.05)	-0.18	(0.11)	-0.38	(0.92)	0.59*	(0.23)	0.02	(0.31)	0.01	(0.07)	0.01	(0.10)	0.57	(1.69)	0.01	(0.10)	-0.18	(0.95)
Government health exp.	-0.05+	(0.03)	-0.10+	(0.05)	-0.01	(0.17)	-0.09	(0.07)	-0.30+	(0.16)	0.01	(0.04)	0.01	(0.05)	-0.24+	(0.14)	0.01	(0.05)	-0.23+	(0.13)
Prison conditions (with U.S.)	1.33**	(0.51)	1.24	(0.88)	1.13	(6.28)	2.08*	(1.00)	2.37	(3.18)	0.90	(0.95)					0.18	(0.70)	6.66	(5.61)
Prison conditions (without U.S.)													0.18	(0.70)	6.22	(5.72)				
Social protection expenditure	-0.01	(0.10)	0.04	(0.22)	0.79	(0.82)	-0.13	(0.22)	0.41	(0.47)	0.04	(0.17)	-0.08	(0.17)	0.17	(0.56)	-0.08	(0.17)	0.29	(0.48)
Government decentralization	0.02	(0.05)	0.04	(0.09)	0.48	(1.18)	0.18+	(0.10)	-0.51	(0.33)	0.04	(0.05)	-0.01	(0.07)	0.30	(0.98)	-0.01	(0.07)	0.22	(0.92)
Ethnic fractionalization	4.61**	(1.62)	4.18	(3.38)	19.90	(14.30)	12.98+	(7.04)	48.36**	(15.74)	1.64	(2.70)	2.40	(2.94)	15.63+	(8.18)	2.40	(2.94)	14.58+	(7.86)
Gun availability	-0.01	(0.03)	-0.10	(0.07)	0.18	(0.26)	-0.05	(0.06)	-0.03	(0.10)	-0.00	(0.04)	-0.00	(0.05)	0.18	(0.28)	-0.00	(0.05)	0.19	(0.28)
Region																				
Africa	15.08***	(3.11)	12.39**	(4.52)	18.79	(15.29)	11.03*	(5.23)	10.19	(9.48)	38.34***	(9.49)	10.23*	(4.05)	15.85	(10.32)	10.23*	(4.05)	15.95	(10.23)
Americas	2.83+	(1.67)	4.39	(2.99)	2.30	(13.95)	3.94	(4.18)	-1.22	(6.72)	-1.79	(2.81)	-0.67	(2.93)	7.07	(8.16)	-0.67	(2.93)	7.24	(8.11)
Asia	-2.09	(1.47)	-3.74	(3.86)	4.19	(10.90)	5.03	(4.55)	-0.17	(8.79)	-2.70	(2.97)	-0.35	(2.71)	4.01	(7.78)	-0.35	(2.71)	4.44	(7.42)
Oceania	2.63*	(1.08)	3.98	(2.62)			4.38+	(2.45)			-0.19	(2.09)	1.32	(2.21)	9.73	(20.05)	1.32	(2.21)	10.33	(19.91)
Model fit																				
AIC	4197.54		2452.29		1633.44		1879.12		2415.52		760.59		625.22		3222.31		625.22		3307.29	
BIC	4442.00		2681.30		1820.00		2101.33		2614.70		976.19		840.05		3429.38		840.05		3520.37	
Observations	1912		1346		566		1153		759		1112		975		912		975		937	
Countries	128		88		40		68		60		57		56		71		56		72	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

Table 39. Suicide Rate Model Interaction Results

	Model 1.3C		**Model 2.1C.i**		**Model 2.2C.i**		**Model 2.3C.i**		**Model 2.4C.i**		**Model 2.5C.i**		**Model 2.6C.i**		**Model 2.7C.i**		**Model 2.8C.i**		**Model 2.9C.i**		**Model 2.10C.i**	
	Full Model		**Lagged incarceration x EP**		**Average incarceration x EP**		**Lagged incarceration x EF**		**Average incarceration x EF**		**Lagged incarceration x SP**		**Average incarceration x SP**		**Lagged incarceration x PC (no US)**		**Average incarceration x PC (no US)**		**Lagged incarceration x PC (with US)**		**Average incarceration x PC (with US)**	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																						
Constant	14.46***	(2.00)	14.45***	(2.00)	14.71***	(2.01)	14.45***	(2.00)	13.82***	(1.88)	14.52***	(2.00)	13.54***	(1.81)	14.48***	(2.02)	14.45***	(2.04)	14.44***	(2.00)	14.42***	(2.01)
Year - pre-peak	-0.06	(0.07)	-0.06	(0.07)	-0.06	(0.07)	-0.06	(0.07)	-0.06	(0.07)	-0.07	(0.07)	-0.06	(0.07)	-0.05	(0.07)	-0.05	(0.07)	-0.06	(0.07)	-0.06	(0.07)
Year - post-peak	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)	-0.18***	(0.04)
Incarceration rate (lagged 1 year)	0.09	(0.08)	0.09	(0.08)	0.09	(0.08)	0.09	(0.08)	0.09	(0.08)	0.12	(0.08)	0.10	(0.08)	0.09	(0.07)	0.10	(0.08)	0.09	(0.07)	0.09	(0.08)
Average incarceration rate	0.80+	(0.45)	0.78+	(0.45)	1.00+	(0.52)	0.80+	(0.45)	0.72	(0.45)	0.81+	(0.45)	0.74+	(0.38)	0.79	(0.49)	0.76	(0.53)	0.79+	(0.45)	0.76	(0.50)
Inc. rate (lagged) x Excluded minority population			0.36	(0.58)																		
Avg. inc. rate x Excluded minority population					-1.58	(1.85)																
Inc. rate (lagged) x Ethnic fractionalization							0.13	(0.48)														
Avg. inc. rate x Ethnic fractionalization									-5.03*	(2.36)												
Inc. rate (lagged) x Social protection expenditure											0.02	(0.02)										
Avg. inc. rate x Social protection expenditure													0.25***	(0.06)								
Inc. rate (lagged) x Prison conditions (no U.S.)															0.07	(0.06)						
Avg. inc. rate x Prison conditions (no U.S.)																	0.09	(0.53)				
Inc. rate (lagged) x Prison conditions (with U.S.)																			0.07	(0.06)		
Avg. inc. rate x Prison conditions (with U.S.)																					0.09	(0.52)
Model fit																						
AIC	4638.6		4639.9		4639.9		4640.5		4636.8		4637.2		4630.9		4614.6		4616.3		4639.0		4640.6	
BIC	4883.1		4889.9		4889.9		4890.5		4886.8		4887.3		4880.9		4864.0		4865.7		4889.0		4890.6	
Observations (Level-1)	1912		1912		1912		1912		1912		1912		1912		1887		1887		1912		1912	
Countries (Level-2)	128		128		128		128		128		128		128		127		127		128		128	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Moderation variables are all country-averaged; Level-1, Level-2, and region controls are still included but not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions.

Table 40. Full Suicide Rate Model Subsample Results

	Model 1.3C		Model 2.1C.s		Model 2.2C.s		Model 2.3C.s		Model 2.4C.s		Model 2.5C.s		Model 2.6C.s		Model 2.7C.s		Model 2.8C.s		Model 2.9C.s		Model 2.10C.s	
	Full Model		EP Below Average		EP Above Average		EF Below Average		EF Above Average		SP Below Average		SP Above Average		PC (no US) Below Average		PC (no US) Above Average		PC (with US) Below Average		PC (with US) Above Average	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																						
Constant	14.46***	(2.00)	9.94***	(2.83)	25.30***	(7.16)	11.20**	(3.75)	17.94***	(3.56)	3.54	(5.25)	20.90***	(5.38)	18.30***	(4.51)	18.58**	(6.43)	18.29***	(4.52)	17.28**	(6.60)
Year - pre-peak	-0.06	(0.07)	-0.12***	(0.04)	0.04	(0.04)	-0.17***	(0.04)	0.05	(0.04)	0.17***	(0.04)	-0.23***	(0.04)	-0.22***	(0.04)	0.16***	(0.05)	-0.22***	(0.04)	0.10*	(0.05)
Year - post-peak	-0.18***	(0.04)	-0.20***	(0.02)	-0.13***	(0.03)	-0.24***	(0.03)	-0.13***	(0.02)	-0.09***	(0.02)	-0.26***	(0.03)	-0.28***	(0.03)	-0.09***	(0.02)	-0.28***	(0.03)	-0.07**	(0.02)
Incarceration rate (lagged 1 year)	0.09	(0.08)	-0.00	(0.08)	0.06	(0.05)	0.08	(0.10)	0.12+	(0.06)	0.06	(0.06)	0.25+	(0.14)	-0.01	(0.09)	0.23**	(0.07)	-0.01	(0.09)	0.21**	(0.07)
Average incarceration rate	0.80+	(0.45)	1.61+	(0.96)	-1.69	(1.46)	4.71**	(1.63)	0.01	(0.84)	-0.80	(0.88)	4.09**	(1.38)	1.72	(1.85)	0.32	(0.94)	1.72	(1.85)	0.37	(0.97)
Level-1 controls																						
GDP	-0.01+	(0.00)	-0.00	(0.01)	0.01	(0.01)	-0.00	(0.01)	-0.01	(0.01)	0.01	(0.02)	-0.00	(0.00)	-0.00	(0.00)	-0.02	(0.04)	-0.00	(0.00)	-0.00	(0.03)
GINI	-1.45	(1.15)	-1.90	(1.34)	-0.37	(1.53)	-1.47	(1.56)	-1.25	(1.38)	-1.50	(1.36)	-2.11	(1.56)	-2.76	(1.71)	-0.20	(1.41)	-2.76	(1.71)	-0.37	(1.40)
Homicide rate	0.03***	(0.01)	0.02**	(0.01)	0.04*	(0.02)	0.03**	(0.01)	0.02	(0.01)	0.01+	(0.01)	0.04**	(0.01)	0.05*	(0.02)	0.03**	(0.01)	0.05*	(0.02)	0.03**	(0.01)
Population 65+	-0.00	(0.14)	0.00	(0.08)	0.29*	(0.12)	0.14	(0.09)	-0.10	(0.13)	0.07	(0.13)	0.11	(0.09)	0.14	(0.10)	-0.05	(0.14)	0.14	(0.10)	0.03	(0.12)
Fertility rate	-1.22**	(0.41)	-1.79***	(0.24)	-0.33	(0.23)	-1.99***	(0.30)	-0.55**	(0.20)	-0.28	(0.21)	-1.65***	(0.36)	-2.44***	(0.34)	-0.35	(0.22)	-2.44***	(0.34)	-0.38+	(0.21)
Unemployment	-0.00	(0.01)	-0.01	(0.01)	0.01	(0.01)	-0.01	(0.02)	-0.00	(0.02)	0.04*	(0.02)	-0.02	(0.01)	-0.03	(0.02)	0.02	(0.02)	-0.03	(0.02)	0.02	(0.02)
Urban population	0.11*	(0.05)	0.11**	(0.04)	0.08	(0.07)	0.15**	(0.05)	0.10*	(0.05)	0.01	(0.04)	0.21***	(0.05)	0.25***	(0.06)	0.02	(0.04)	0.25***	(0.06)	-0.01	(0.04)
Democracy	0.01	(0.01)	-0.00	(0.01)	0.02	(0.01)	0.00	(0.02)	0.01	(0.01)	0.01	(0.01)	-0.07	(0.06)	0.03	(0.03)	-0.00	(0.01)	0.03	(0.03)	-0.00	(0.01)
Excluded minority population	0.11	(0.19)	-0.01	(0.55)	-0.05	(0.22)	-1.67	(1.90)	0.12	(0.20)	0.20	(0.21)	-0.42	(0.80)	0.15	(0.82)	0.05	(0.27)	0.15	(0.82)	-0.01	(0.25)
Level-2 controls																						
GDP	-0.02	(0.08)	0.10	(0.16)	0.28	(0.60)	-0.42	(0.33)	-0.02	(0.15)	0.14	(0.29)	0.09	(0.22)	0.01	(0.21)	2.58*	(1.31)	0.01	(0.21)	1.14	(0.88)
GINI	3.92	(7.14)	1.71	(12.19)	43.82	(34.04)	-6.85	(18.67)	13.45	(10.13)	9.00	(10.82)	14.82	(29.24)	-16.87	(24.04)	13.71	(14.41)	-16.87	(24.04)	9.80	(14.92)
Homicide rate	0.11+	(0.07)	0.02	(0.08)	0.13	(0.18)	-0.01	(0.12)	0.11	(0.08)	0.11	(0.09)	0.01	(0.10)	0.21	(0.25)	0.04	(0.07)	0.21	(0.25)	0.02	(0.07)
Population 65+	-0.10	(0.24)	-0.27	(0.33)	0.82	(0.88)	0.55	(0.54)	0.73+	(0.43)	-0.31	(0.67)	0.72	(0.57)	-0.23	(0.63)	0.58	(0.53)	-0.23	(0.63)	0.19	(0.47)
Fertility rate	-1.06*	(0.46)	-1.59+	(0.90)	0.06	(1.20)	1.43	(1.84)	-0.65	(0.71)	-1.52*	(0.76)	7.42+	(3.96)	2.40	(2.87)	-1.15	(0.93)	2.40	(2.87)	-1.17	(0.97)
Unemployment	-0.07	(0.11)	-0.01	(0.14)	0.56	(0.41)	0.23	(0.23)	-0.07	(0.14)	0.12	(0.15)	0.05	(0.30)	-0.12	(0.32)	0.02	(0.17)	-0.12	(0.32)	0.02	(0.17)
Urban population	-0.04	(0.03)	-0.10*	(0.05)	-0.19	(0.12)	-0.13+	(0.08)	-0.03	(0.04)	-0.11*	(0.05)	-0.08	(0.10)	-0.08	(0.09)	-0.16*	(0.06)	-0.08	(0.09)	-0.15*	(0.06)
Democracy	0.31**	(0.10)	0.38**	(0.12)	-0.04	(0.28)	0.40*	(0.18)	-0.01	(0.15)	0.28*	(0.14)	0.47*	(0.21)	0.18	(0.37)	0.20	(0.14)	0.18	(0.37)	0.17	(0.14)
Excluded minority population	-4.85*	(2.24)	-12.52	(13.18)	2.18	(8.89)	-25.46**	(9.41)	-2.44	(3.96)	0.15	(3.87)	-26.53*	(11.38)	-9.42	(10.08)	-5.42	(4.36)	-9.42	(10.08)	-5.06	(4.42)
Hospital beds	1.25***	(0.30)	0.96**	(0.37)	2.56*	(1.07)	0.94+	(0.49)	1.27*	(0.50)	0.79	(0.57)	1.50**	(0.49)	1.71**	(0.54)	1.03+	(0.59)	1.71**	(0.54)	1.44**	(0.54)
Health expenditure	-0.14	(0.09)	-0.23	(0.17)	0.01	(0.50)	0.26	(0.28)	-0.11	(0.19)	-0.10	(0.74)	-0.32	(0.20)	-0.17	(0.21)	-2.78*	(1.31)	-0.17	(0.21)	-0.93	(0.60)
Government health exp.	-0.07*	(0.03)	-0.09+	(0.06)	-0.13+	(0.07)	-0.07	(0.08)	-0.08+	(0.05)	-0.05	(0.05)	-0.06	(0.09)	-0.03	(0.09)	-0.03	(0.07)	-0.03	(0.09)	-0.00	(0.07)
Prison conditions (with U.S.)	-1.78**	(0.64)	-1.63+	(0.97)	-0.51	(2.58)	-2.68+	(1.43)	-1.90*	(0.95)	-1.16	(0.99)	-3.57+	(1.85)					-1.98	(1.65)	-0.73	(1.83)
Prison conditions (without U.S.)															-1.98	(1.65)	-0.78	(1.72)				
Social protection expenditure	0.08	(0.15)	0.55*	(0.24)	-0.93*	(0.47)	-0.01	(0.29)	-0.16	(0.26)	0.38	(0.46)	0.12	(0.32)	0.25	(0.39)	0.50	(0.36)	0.25	(0.39)	0.18	(0.30)
Government decentralization	0.29***	(0.08)	0.32*	(0.15)	-0.38	(0.97)	0.41*	(0.19)	-0.07	(0.23)	0.63	(0.53)	0.38*	(0.16)	0.36*	(0.16)	-0.56	(0.57)	0.36*	(0.16)	-0.27	(0.54)
Ethnic fractionalization	1.47	(1.60)	2.52	(3.36)	-6.13	(4.07)	12.01+	(7.28)	0.33	(5.42)	0.50	(2.61)	10.94+	(5.97)	10.93+	(6.06)	3.18	(3.16)	10.93+	(6.06)	3.28	(3.27)
Gun availability	0.06	(0.04)	0.02	(0.09)	0.12	(0.17)	0.06	(0.11)	0.12+	(0.06)	0.02	(0.11)	0.01	(0.07)	-0.03	(0.11)	0.23	(0.14)	-0.03	(0.11)	0.25+	(0.15)
Region																						
Africa	-0.72	(2.73)	4.06	(3.62)	-18.00+	(9.81)	1.98	(4.71)	-5.00	(5.17)	10.56*	(4.19)	-3.47	(8.60)	-2.13	(6.45)	4.54	(5.79)	-2.13	(6.45)	2.46	(5.68)
Americas	-4.17	(2.62)	0.70	(3.60)	-9.24	(8.52)	-0.27	(5.40)	-6.47	(4.34)	7.56+	(4.55)	-3.99	(4.96)	-4.83	(5.92)	1.95	(5.27)	-4.83	(5.92)	0.49	(5.20)
Asia	-2.76	(2.48)	2.01	(3.13)	-15.65*	(7.29)	4.80	(4.59)	-7.97	(4.91)	8.67*	(3.81)	-3.17	(4.40)	-2.99	(5.21)	1.85	(4.92)	-2.99	(5.21)	-0.58	(4.68)
Oceania	-7.89**	(3.03)	-2.80	(3.74)			-3.86	(4.13)			0.00	(.)	-3.67	(5.00)	-1.55	(4.94)	-8.79	(6.66)	-1.55	(4.94)	-11.24+	(6.68)
Model fit																						
AIC	4638.63		3154.01		1415.60		2840.48		1863.46		1711.12		2755.17		2278.72		2382.75		2278.72		2405.27	
BIC	4883.09		3383.02		1602.16		3062.68		2062.63		1907.87		2975.79		2493.55		2594.64		2493.55		2613.50	
Observations	1912		1346		566		1153		759		800		1112		975		912		975		937	
Countries	128		88		40		68		60		71		57		56		71		56		72	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by income group and have a first-order autoregressive structure; Europe is the reference region for the fixed effects; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

Table 41. HIV Prevalence Model Interaction Results

	Model 1.3D		Model 2.1D.i		Model 2.2D.i		Model 2.3D.i		Model 2.4D.i		Model 2.5D.i		Model 2.6D.i		Model 2.7D.i		Model 2.9D.i		Model 2.10D.i	
	Full Model		Lagged incarceration x EP		Average incarceration x EP		Lagged incarceration x EF		Average incarceration x EF		Lagged incarceration x SP		Average incarceration x SP		Lagged incarceration x PC (no US)		Lagged incarceration x PC (with US)		Average incarceration x PC (with US)	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																				
Constant	0.39***	(0.10)	0.39***	(0.10)	0.38***	(0.10)	0.39***	(0.10)	0.39***	(0.10)	0.54***	(0.14)	0.47***	(0.13)	0.55***	(0.14)	0.39***	(0.10)	0.39***	(0.09)
Year - pre-peak	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
Year - post-peak	0.01**	(0.00)	0.01**	(0.00)	0.01**	(0.00)	0.01**	(0.00)	0.01**	(0.00)	0.00*	(0.00)	0.01**	(0.00)	0.00*	(0.00)	0.01**	(0.00)	0.01**	(0.00)
Incarceration rate (lagged 1 year)	-0.01*	(0.00)	-0.01**	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.02**	(0.01)	-0.01*	(0.00)	-0.02***	(0.00)	-0.01*	(0.01)	-0.01*	(0.00)
Average incarceration rate	0.14***	(0.04)	0.14***	(0.04)	0.14***	(0.04)	0.14***	(0.04)	0.13**	(0.04)	0.18*	(0.07)	0.18*	(0.07)	0.26**	(0.09)	0.14***	(0.04)	0.17***	(0.04)
Inc. rate (lagged) x Excluded minority population			-0.08+	(0.04)																
Avg. inc. rate x Excluded minority population					-0.11	(0.18)														
Inc. rate (lagged) x Ethnic fractionalization							-0.00	(0.04)												
Avg. inc. rate x Ethnic fractionalization									0.37*	(0.18)										
Inc. rate (lagged) x Social protection expenditure											0.00	(0.00)								
Avg. inc. rate x Social protection expenditure													-0.01	(0.01)						
Inc. rate (lagged) x Prison conditions (no U.S.)															0.02***	(0.01)				
Inc. rate (lagged) x Prison conditions (with U.S.)																	0.01	(0.01)		
Avg. inc. rate x Prison conditions (with U.S.)																			-0.11*	(0.05)
Model fit																				
AIC	-2307.5		-2305.5		-2305.8		-2305.5		-2308.9		-1950.2		-2303.9		-1876.1		-2305.7		-2309.4	
BIC	-2078.3		-2066.0		-2071.4		-2071.2		-2074.5		-1715.9		-2064.4		-1642.6		-2066.3		-2075.0	
Observations (Level-1)	1206		1206		1206		1206		1206		1206		1206		1181		1206		1206	
Countries (Level-2)	90		90		90		90		90		90		90		89		90		90	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Moderation variables are all country-averaged; Level-1, Level-2, and region controls are still included but not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Model 2.8d.i (average incarceration x PC no US) did not converge and the results are therefore not shown here.

Table 42. Full HIV Prevalence Model Subsample Results

	Model 1.3D		Model 2.1D.s		Model 2.2D.s		Model 2.3D.s		Model 2.4D.s		Model 2.5D.s		Model 2.8D.s		Model 2.10D.s	
	Full Model		EP Below Average		EP Above Average		EF Below Average		EF Above Average		SP Below Average		PC (no US) Above Average		PC (with US) Above Average	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																
Constant	0.39***	(0.10)	0.17	(0.25)	5.70	(3.82)	0.72**	(0.22)	0.99*	(0.48)	-0.40	(33.44)	0.66+	(0.34)	1.04*	(0.42)
Year - pre-peak	0.02***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.03***	(0.00)	0.04***	(0.01)	0.02***	(0.00)	0.03***	(0.00)
Year - post-peak	0.01**	(0.00)	0.01**	(0.00)	0.01**	(0.00)	0.00+	(0.00)	0.01***	(0.00)	0.00	(0.00)	0.00+	(0.00)	0.01***	(0.00)
Incarceration rate (lagged 1 year)	-0.01*	(0.00)	-0.01	(0.01)	-0.01	(0.01)	-0.02**	(0.01)	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)
Average incarceration rate	0.14***	(0.04)	0.16+	(0.09)	0.00	(0.84)	0.16	(0.12)	0.15	(0.19)	0.42*	(0.20)	-0.01	(0.09)	0.04	(0.11)
Level-1 controls																
GDP	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00***	(0.00)	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
GINI	-0.24*	(0.10)	-0.25*	(0.10)	0.06	(0.14)	-0.10	(0.09)	-0.35+	(0.21)	-0.18	(0.24)	-0.27*	(0.12)	-0.23+	(0.12)
Homicide rate	-0.00***	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Population 65+	-0.01	(0.01)	-0.01	(0.01)	-0.00	(0.01)	0.00	(0.00)	-0.01	(0.01)	-0.03	(0.02)	0.00	(0.01)	-0.01	(0.01)
Fertility rate	0.01	(0.02)	0.00	(0.02)	0.01	(0.02)	0.02	(0.02)	0.03	(0.04)	0.05	(0.04)	0.04**	(0.01)	0.06*	(0.03)
Unemployment	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00+	(0.00)	-0.00	(0.00)	-0.01+	(0.00)	0.00	(0.00)	-0.00	(0.00)
Urban population	-0.01*	(0.01)	-0.01*	(0.00)	-0.01	(0.01)	-0.01*	(0.00)	-0.03***	(0.01)	-0.02***	(0.01)	-0.01**	(0.00)	-0.01***	(0.00)
Democracy	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00+	(0.00)
Excluded minority population	0.01	(0.01)	0.05	(0.07)	0.01	(0.03)	-0.04	(0.08)	0.01	(0.04)	-0.02	(0.06)	0.00	(0.04)	0.02	(0.04)
Level-2 controls																
GDP	-0.00	(0.01)	-0.00	(0.02)	0.23	(0.17)	0.03	(0.03)	0.03	(0.06)	-0.01	(0.08)	0.11*	(0.06)	0.02	(0.06)
GINI	2.24**	(0.71)	2.34	(1.52)	7.69	(11.01)	1.20	(2.20)	5.48	(4.05)	2.33	(1.93)	6.20***	(1.69)	5.27*	(2.27)
Homicide rate	0.00	(0.01)	0.00	(0.01)	0.00	(0.03)	-0.01	(0.01)	0.00	(0.01)	-0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
Population 65+	0.02+	(0.01)	0.02	(0.03)	-0.49	(0.32)	0.02	(0.04)	-0.03	(0.06)	-0.08	(0.09)	0.04	(0.03)	-0.01	(0.03)
Fertility rate	-0.01	(0.05)	-0.09	(0.10)	0.31	(0.74)	0.12	(0.26)	0.03	(0.20)	-0.31	(0.28)	-0.01	(0.08)	-0.03	(0.11)
Unemployment	-0.01	(0.01)	-0.02	(0.02)	0.35+	(0.19)	-0.03	(0.02)	-0.01	(0.03)	0.05	(0.03)	-0.00	(0.02)	0.00	(0.02)
Urban population	-0.01**	(0.00)	-0.01*	(0.00)	-0.03	(0.03)	-0.00	(0.00)	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)
Democracy	0.00	(0.00)	0.01	(0.01)	0.23	(0.17)	0.01	(0.01)	0.00	(0.03)	-0.02	(0.02)	0.00	(0.01)	-0.00	(0.01)
Excluded minority population	-0.37	(0.25)	-2.65+	(1.40)	-0.20	(2.09)	-0.56	(1.02)	-0.54	(0.58)	-0.87	(0.55)	-0.68+	(0.37)	-0.73	(0.50)
Hospital beds	-0.04+	(0.02)	-0.02	(0.05)	0.18	(0.25)	-0.05	(0.06)	0.06	(0.08)	-0.02	(0.09)	0.04	(0.04)	0.07	(0.05)
Health expenditure	0.00	(0.01)	0.00	(0.02)	0.14	(0.15)	-0.03	(0.03)	-0.03	(0.05)	-0.05	(0.16)	-0.17+	(0.09)	0.01	(0.04)
Government health exp.	-0.01*	(0.00)	-0.01*	(0.01)	-0.00	(0.03)	-0.02*	(0.01)	-0.00	(0.01)	-0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)
Prison conditions (with U.S.)	-0.05	(0.05)	-0.11	(0.13)	1.37	(0.89)	-0.03	(0.14)	-0.17	(0.26)	0.01	(0.19)			-0.04	(0.22)
Prison conditions (without U.S.)													-0.08	(0.15)		
Social protection expenditure	0.02*	(0.01)	0.01	(0.02)	-0.37+	(0.21)	0.04	(0.03)	-0.02	(0.04)	-0.17*	(0.08)	-0.00	(0.02)	-0.04	(0.03)
Government decentralization	-0.01	(0.01)	-0.02	(0.02)	0.23	(0.28)	-0.06+	(0.04)	0.01	(0.05)	-0.00	(0.08)	-0.08**	(0.03)	-0.01	(0.04)
Ethnic fractionalization	-0.01	(0.17)	0.15	(0.37)	2.87	(3.20)	0.33	(0.81)	-0.12	(1.27)	0.52	(0.96)	0.29	(0.34)	0.35	(0.47)
Gun availability	-0.01*	(0.00)	-0.00	(0.01)	-0.14	(0.09)	0.01	(0.01)	0.01	(0.01)	-0.01	(0.01)	-0.00	(0.01)	-0.01	(0.01)
Region																
Africa	5.35***	(1.18)	6.42***	(1.86)	-4.29	(5.44)	7.30*	(3.48)	3.79**	(1.34)	4.82	(33.46)	4.42**	(1.36)	4.08**	(1.40)
Americas	0.01	(0.23)	0.04	(0.40)	-5.88+	(3.46)	0.09	(0.51)	-0.63	(0.68)	0.05	(33.44)	-0.16	(0.34)	-0.43	(0.44)
Asia	-0.21+	(0.11)	-0.21	(0.27)	-4.46	(3.01)	-0.43	(0.38)	-0.64	(0.73)	-0.77	(33.44)	-0.58+	(0.33)	-0.92*	(0.43)
Oceania	0.00	(0.09)	-0.04	(0.23)			-0.12	(0.27)			0.00	(.)	-0.81	(74.13)	-1.10	(44.48)
Model fit																
AIC	-2307.54		-1319.47		-717.52		-1348.00		-596.06		-166.42		-744.47		-999.52	
BIC	-2078.26		-1103.01		-547.08		-1142.99		-409.27		26.55		-532.50		-786.02	
Observations	1206		817		389		637		569		657		741		766	
Countries	90		61		29		43		47		60		62		63	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects; Models 2.6d.s, 2.7d.s, and 2.9d.s (above average SP, below average PC without US, and with US) did not converge and the results are therefore not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

Table 43. TB Incidence Model Interaction Results

	Model 1.3E		**Model 2.1E.i**		**Model 2.2E.i**		**Model 2.3E.i**		**Model 2.4E.i**		**Model 2.5E.i**		**Model 2.6E.i**		**Model 2.7E.i**		**Model 2.8E.i**		**Model 2.9E.i**		**Model 2.10E.i**	
	Full Model		**Lagged incarceration x EP**		**Average incarceration x EP**		**Lagged incarceration x EF**		**Average incarceration x EF**		**Lagged incarceration x SP**		**Average incarceration x SP**		**Lagged incarceration x PC (no US)**		**Average incarceration x PC (no US)**		**Lagged incarceration x PC (with US)**		**Average incarceration x PC (with US)**	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																						
Constant	99.29***	(21.52)	99.30***	(21.52)	98.65***	(20.61)	99.43***	(21.50)	101.02***	(22.64)	99.15***	(21.49)	97.64***	(20.73)	100.05***	(22.16)	94.09***	(22.16)	99.22***	(21.53)	93.55***	(21.46)
Year	-0.49+	(0.30)	-0.50+	(0.30)	-0.49+	(0.30)	-0.49+	(0.29)	-0.49+	(0.30)	-0.50+	(0.30)	-0.49+	(0.30)	-0.48	(0.31)	-0.49	(0.30)	-0.49	(0.30)	-0.50+	(0.30)
Year - squared	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.01)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)
Incarceration rate (lagged 1 year)	2.89**	(0.97)	2.86**	(0.97)	2.89**	(0.97)	2.70**	(0.97)	2.90**	(0.97)	2.40*	(0.99)	2.90**	(0.98)	2.88**	(0.98)	2.93**	(0.99)	2.85**	(0.97)	2.90**	(0.97)
Average incarceration rate	10.39+	(6.04)	10.41+	(6.05)	10.12+	(5.98)	10.31+	(6.05)	10.78+	(6.27)	10.40+	(6.05)	3.48	(6.17)	9.34	(6.33)	6.95	(6.67)	10.39+	(6.04)	7.63	(6.21)
Inc. rate (lagged) x Excluded minority population			3.16	(7.91)																		
Avg. inc. rate x Excluded minority population					9.67	(33.66)																
Inc. rate (lagged) x Ethnic fractionalization							-4.68	(5.92)														
Avg. inc. rate x Ethnic fractionalization									9.37	(15.61)												
Inc. rate (lagged) x Social protection expenditure											0.14	(0.11)										
Avg. inc. rate x Social protection expenditure													1.00	(0.63)								
Inc. rate (lagged) x Prison conditions (no U.S.)															0.41	(0.75)						
Avg. inc. rate x Prison conditions (no U.S.)																	5.90**	(2.17)				
Inc. rate (lagged) x Prison conditions (with U.S.)																			0.37	(0.73)		
Avg. inc. rate x Prison conditions (with U.S.)																					5.93**	(2.20)
Model fit																						
AIC	10865.2		10864.8		10867.2		10867.7		10869.0		10863.0		10867.2		10773.1		10772.5		10866.9		10866.1	
BIC	11107.0		11106.6		11114.3		11120.2		11121.5		11104.8		11119.8		11019.7		11024.5		11114.0		11118.7	
Observations (Level-1)	1593		1593		1593		1593		1593		1593		1593		1574		1574		1593		1593	
Countries (Level-2)	128		128		128		128		128		128		128		127		127		128		128	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Moderation variables are all country-averaged; Level-1, Level-2, and region controls are still included but not shown here; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions.

Table 44. Full TB Incidence Model Subsample Results

	Model 1.3E		Model 2.1E.s		Model 2.2E.s		Model 2.3E.s		Model 2.4E.s		Model 2.6E.s		Model 2.7E.s		Model 2.8E.s		Model 2.9E.s	
	Full Model		EP Below Average		EP Above Average		EF Below Average		EF Above Average		SP Above Average		PC (no US) Below Average		PC (no US) Above Average		PC (with US) Below Average	
	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se	b	se
Fixed effects																		
Constant	99.29***	(21.52)	123.55***	(30.19)	127.52	(128.93)	156.30***	(41.22)	37.11	(37.56)	36.37	(23.74)	58.00**	(19.52)	71.20	(70.52)	58.01**	(19.49)
Year	-0.49+	(0.30)	-0.54**	(0.18)	-1.01	(0.65)	-0.58**	(0.19)	-0.50	(0.52)	-0.41*	(0.19)	-0.81***	(0.18)	-0.38	(0.29)	-0.81***	(0.18)
Year - squared	-0.02	(0.02)	-0.02+	(0.01)	-0.01	(0.03)	-0.01	(0.01)	-0.03	(0.02)	0.00	(0.01)	0.02**	(0.01)	-0.04*	(0.01)	0.02**	(0.01)
Incarceration rate (lagged 1 year)	2.89**	(0.97)	3.42***	(0.67)	1.72+	(1.02)	3.52***	(0.71)	1.75+	(0.99)	2.68***	(0.54)	1.53*	(0.71)	3.14**	(0.98)	1.53*	(0.71)
Average incarceration rate	10.39+	(6.04)	10.79	(10.43)	-17.21	(29.81)	31.34*	(14.55)	-17.94	(13.30)	2.59	(5.08)	4.52	(9.50)	2.89	(15.90)	4.52	(9.50)
Level-1 controls																		
GDP	0.02+	(0.01)	0.02	(0.02)	0.06	(0.24)	0.02	(0.03)	0.03	(0.08)	-0.00	(0.03)	0.01	(0.02)	0.16	(0.26)	0.01	(0.02)
GINI	-1.72	(6.25)	-5.12	(6.70)	1.94	(25.69)	-6.60	(7.20)	-0.86	(20.90)	-0.27	(6.25)	2.15	(6.21)	-33.64+	(19.14)	2.15	(6.21)
Homicide rate	0.01	(0.05)	-0.00	(0.04)	0.05	(0.14)	-0.01	(0.04)	0.08	(0.11)	-0.05+	(0.03)	0.21**	(0.08)	-0.00	(0.05)	0.21**	(0.08)
Population 65+	1.22	(0.86)	1.65**	(0.61)	-1.87	(2.18)	1.28+	(0.67)	0.84	(1.67)	-0.46	(0.60)	-1.12*	(0.55)	1.84	(1.45)	-1.12*	(0.55)
Fertility rate	-2.64	(2.36)	-0.53	(1.66)	-12.67*	(5.15)	-0.38	(1.74)	-11.56*	(4.56)	-4.36*	(1.70)	-1.10	(1.60)	-7.03+	(3.95)	-1.10	(1.60)
Unemployment	0.00	(0.06)	0.02	(0.08)	-0.15	(0.23)	0.03	(0.08)	-0.09	(0.19)	-0.03	(0.07)	0.00	(0.06)	-0.04	(0.21)	0.00	(0.06)
Urban population	-1.17*	(0.52)	-1.06***	(0.27)	-3.06*	(1.21)	-0.93**	(0.30)	-3.09***	(0.86)	-0.13	(0.25)	0.03	(0.26)	-2.20***	(0.50)	0.03	(0.26)
Democracy	0.16	(0.14)	0.17	(0.20)	-0.00	(0.33)	-0.01	(0.26)	0.17	(0.25)	0.30	(0.26)	-0.02	(0.21)	0.21	(0.29)	-0.02	(0.21)
Excluded minority population	3.72	(2.39)	8.74	(6.69)	2.72	(4.54)	6.99	(8.28)	2.82	(4.00)	0.10	(2.57)	8.39	(5.35)	2.65	(4.82)	8.39	(5.35)
Level-2 controls																		
GDP	0.36	(0.46)	0.51	(0.95)	7.80	(10.19)	0.12	(3.27)	-0.05	(2.27)	0.46	(0.81)	0.31	(0.57)	-12.86	(15.92)	0.31	(0.57)
GINI	132.52	(85.24)	154.88	(145.68)	864.55+	(506.46)	129.85	(154.59)	111.19	(261.56)	-20.83	(94.84)	-18.73	(90.76)	852.52*	(395.46)	-18.72	(90.79)
Homicide rate	-0.61	(0.42)	-0.59	(0.67)	-1.55	(1.22)	-1.41+	(0.75)	-1.66***	(0.39)	0.17	(0.27)	-0.72	(0.59)	-0.49	(0.90)	-0.72	(0.59)
Population 65+	3.25+	(1.67)	3.96	(3.10)	-13.88	(13.06)	9.74*	(4.37)	1.40	(5.75)	1.73	(2.08)	2.55	(2.50)	2.06	(6.73)	2.55	(2.51)
Fertility rate	47.96**	(15.01)	65.56***	(18.15)	-23.00	(31.58)	92.65***	(25.34)	0.50	(21.99)	19.61	(21.02)	28.66	(19.15)	38.68	(26.71)	28.67	(19.16)
Unemployment	0.17	(1.14)	-1.36	(1.86)	4.62	(5.59)	-0.62	(2.23)	7.00**	(2.29)	-0.18	(1.44)	-0.14	(1.04)	1.93	(4.65)	-0.14	(1.04)
Urban population	-1.13***	(0.27)	-1.32**	(0.47)	-0.55	(1.25)	-2.36***	(0.69)	-0.29	(0.54)	-0.66	(0.44)	-0.74*	(0.36)	-1.51	(1.06)	-0.74*	(0.36)
Democracy	2.18*	(1.03)	2.29	(1.71)	21.17**	(6.55)	3.01	(2.17)	3.36*	(1.57)	3.87**	(1.46)	0.64	(2.30)	3.99	(3.40)	0.64	(2.30)
Excluded minority population	-49.39	(51.10)	-67.36	(141.47)	128.24	(104.99)	-93.60	(130.33)	51.97	(42.79)	3.44	(52.34)	60.61	(59.60)	-228.22*	(104.18)	60.60	(59.62)
Hospital beds	3.50*	(1.68)	4.30	(2.99)	19.39	(17.86)	0.07	(3.90)	10.39	(12.31)	5.95**	(2.22)	1.34	(2.12)	15.24	(11.05)	1.34	(2.12)
Health expenditure	-0.32	(0.54)	-0.65	(0.92)	-4.87	(8.16)	0.29	(2.79)	2.47	(2.72)	-0.37	(0.70)	-0.38	(0.57)	9.17	(15.64)	-0.38	(0.57)
Government health exp.	0.03	(0.46)	0.04	(0.43)	0.59	(1.14)	-0.75	(0.72)	0.63	(0.52)	0.13	(0.31)	-0.09	(0.35)	0.94	(1.09)	-0.09	(0.35)
Prison conditions (with U.S.)	12.12+	(7.10)	11.77	(9.97)	4.05	(45.76)	3.31	(10.98)	65.65**	(23.13)	16.93**	(6.09)					0.77	(7.83)
Prison conditions (without U.S.)													0.78	(7.83)	-30.29	(52.46)		
Social protection expenditure	0.67	(0.97)	0.60	(1.52)	-13.61*	(6.18)	0.76	(2.40)	-4.74*	(2.07)	0.18	(1.03)	0.09	(1.04)	-2.28	(5.36)	0.09	(1.04)
Government decentralization	1.01*	(0.41)	1.03	(0.68)	11.33	(8.46)	1.64+	(0.92)	-0.82	(2.75)	0.62	(0.62)	0.36	(0.45)	10.48	(8.71)	0.36	(0.45)
Ethnic fractionalization	43.31*	(17.12)	39.75	(29.31)	422.03**	(154.30)	145.74	(91.20)	331.09***	(79.60)	30.99	(21.03)	28.08	(18.26)	17.14	(82.90)	28.09	(18.26)
Gun availability	-1.03***	(0.27)	-0.85	(0.54)	1.29	(2.56)	-1.54*	(0.70)	-1.26	(0.82)	-0.63+	(0.37)	-0.34	(0.35)	-0.94	(2.61)	-0.34	(0.35)
Region																		
Africa	162.47*	(70.30)	145.46	(91.80)	144.85	(158.50)	141.10	(143.55)	175.35*	(83.06)	488.88	(486.32)	366.39*	(177.62)	128.21	(109.70)	366.39*	(177.67)
Americas	-11.31	(17.31)	-29.35	(36.84)	-216.76	(132.22)	-15.05	(45.25)	-24.76	(43.21)	8.96	(19.74)	2.57	(18.42)	-25.30	(71.90)	2.57	(18.43)
Asia	75.72*	(29.68)	81.51+	(46.84)	-11.36	(108.14)	79.58	(50.60)	65.56	(58.39)	62.26	(44.08)	37.95	(28.47)	106.06	(66.98)	37.95	(28.48)
Oceania	93.35	(63.71)	70.58	(64.43)			65.74	(59.89)			19.76	(15.40)	5.59	(15.96)	128.64	(13170.45)	5.59	(15.96)
Model fit																		
AIC	10865.24		7125.16		3402.54		5809.16		4730.13		4675.59		4264.96		5956.97		4266.96	
BIC	11107.04		7350.95		3581.74		6032.85		4921.78		4891.75		4475.32		6171.41		4481.99	
Observations	1593		1116		477		956		637		901		792		782		792	
Countries	128		88		40		68		60		57		56		71		56	

Notes. + p<.1; * p<.05; ** p < .01; *** p < .001; All Level-1 variables are group-mean centered (except where noted as raw) and all Level-2 variables are grand-mean centered; In all models, residuals are allowed to vary by region and have a first-order autoregressive structure; Europe is the reference region for the fixed effects; EP=Excluded population; EF=Ethnic fractionalization; SP=Social protection expenditure; PC=Prison conditions; Higher prison condition ratings are worse.

APPENDIX I. DESCRIPTIVE STATISTICS OF STUDY VARIABLES FOR MEDIATING MODELS' SAMPLE

	Observations							
	Per nation per year (L-1)	Per country (L-2)	Mean	SD	Median	IQR	Min	Max
Dependent variables								
Total life expectancy at birth (years)	2158	166	70.62	8.82	72.91	13.03	42.85	85.08
Infant mortality rate (per 1,000 live births)	2145	165	26.03	24.03	16.60	34.90	1.60	118.20
Self-harm death (suicide) rate (per 100k pop.)	2158	166	10.37	7.29	7.87	7.96	1.72	48.41
Prevalence of HIV (% of pop. ages 15-49)	1546	119	2.20	4.77	0.40	1.30	0.10	28.90
Estimated TB incidence (per 100k pop.)	2154	166	132.83	189.92	56.00	164.00	0.75	1590.00
Independent variable of interest								
Incarceration rate (per 1000 pop.)	1467	163	1.66	1.25	1.31	1.36	0.16	8.84
Control variables (trend and/or country-level)								
GDP per capita (per 1000 current US$)	2119	166	13.80	19.61	5.18	14.86	0.17	118.82
GINI	2171	167	0.57	0.09	0.58	0.12	0.37	0.87
Intentional homicide rate (per 100k pop.)	1410	148	7.38	12.28	2.56	6.13	0.00	105.23
Population 65+ (% of pop.)	2150	166	8.17	5.92	5.75	10.11	0.69	28.00
Fertility rate (births per woman)	2158	166	2.89	1.46	2.39	2.25	0.92	7.57
Unemployment (% of total labor force)	2145	165	7.66	5.70	6.14	6.24	0.11	34.93
Urban population (% of pop.)	2150	166	58.53	22.47	59.15	35.35	9.86	100.00
Democracy	1899	160	4.09	6.18	7.00	10.00	-10.00	10.00
Excluded minority population	2128	164	0.13	0.17	0.06	0.17	0.00	0.86
Hospital beds (per 1,000)	1214	154	3.49	2.54	2.89	3.38	0.01	13.87
Health expenditure (per capita/100 in US$)	2095	164	10.64	18.09	2.90	9.37	0.10	109.21
Government health exp. (% of total)	2095	164	49.17	22.20	50.12	37.73	3.35	91.80
Prison conditions (without U.S.)	2101	162	3.85	1.31	4.00	2.00	1.00	5.00
Prison conditions (with U.S.)	2114	163	3.86	1.30	4.00	2.00	1.00	5.00
Social protection expenditure (% of GDP)	512	152	12.69	8.58	11.61	14.56	0.10	31.68

	Observations							
	Per nation per year (L-1)	Per country (L-2)	Mean	SD	Median	IQR	Min	Max
Mediating variables								
Social capital index	2171	167	51.25	9.74	49.95	11.84	19.83	81.65
Civic and social participation element	2171	167	42.66	15.88	41.26	21.60	3.46	85.30
Institutional trust element	2171	167	48.40	15.30	48.07	22.36	9.15	93.23
Interpersonal trust element	2171	167	37.46	13.27	34.80	15.63	6.74	87.14
Personal and family relationships element	2171	167	67.05	15.95	69.87	21.20	4.24	93.68
Social networks element	2171	167	60.70	14.01	63.08	18.53	3.14	85.08
Only country-level (Level-2) variables								
Government closeness (decentralization) index	2132	164	2.45	5.07	0.24	2.40	0.00	31.96
Ethnic fractionalization	2132	164	0.46	0.26	0.49	0.44	0.00	0.93
Civilian firearms per 100 persons	2171	167	10.24	13.02	6.50	12.00	0.00	120.50
Region								
Africa			0.32					
Americas			0.16					
Asia			0.26					
Europe			0.23					
Oceania			0.02					

Notes. 0's in this table are real zeros. Region "Mean" shows the proportion of countries included in the total dataset. L-1=Level 1; L-2=Level-2; SD=Standard deviation; IQR=Interquartile range; Min=Minimum value; Max=Maximum value.