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Type 2 Diabetes (T2DM) and low physical activity (PA) are key risk factors for cardiovascular morbidity and mortality in the United States (U.S.). An emerging body of evidence in public health research suggests that state-level policies shape health in immigrant and racial/ ethnic marginalized groups. For immigrants, state-level policies can be inclusive and create contexts that expand immigrants' eligibility and rights, or they can be restrictive and limit access to public services, education, employment, and healthcare and even criminalize immigrants by linking local criminal justice systems with immigration enforcement.

The present dissertation examined the association between state-level criminalizing and inclusive immigrant policies and prevalence of type 2 diabetes and physical activity for Latino and Asian American groups, the two largest immigrant groups and fastest-growing segments of the population in the U.S. Individual-level characteristics, diabetes status and meeting recommendations for physical activity were obtained from the Behavioral Risk Factor Surveillance System (BRFSS) (T2DM: *n*=201,824; PA: *n*=80,516). Existing policy datasets were used to classify the state immigrant policy context as low, medium, and high, and census data used to obtain the percent of foreign-born individuals in each state. Weighted multilevel models examined variability in T2DM and PA across state-level criminalizing and inclusive policy contexts after accounting for the complex survey design of BRFSS.

Results indicated that Latinos living in low inclusion immigrant policy contexts had significantly higher odds of T2DM (Odds Ratio [OR]: 1.21, 95% confidence interval [CI]: 1.03-1.43, *p*-value <0.05) than those living in high inclusion contexts. Criminalizing policy contexts

did not show significant associations with type 2 diabetes for either population group. The physical activity models showed that a high-criminalizing immigrant policy context was associated with significantly lower odds of meeting the recommended levels of physical activity among Latinos (OR: 0.79, 95% CI: 0.62-1.01, *p*-value = 0.05), while inclusive policy contexts did not have significant associations with physical activity for either group.

In conclusion, state-level policies appear to shape health in distinct ways. Higher criminalizing policies were associated with health behaviors (i.e., short-term effect) while low inclusion policy contexts were associated with diabetes (i.e., long-term effect). Public health professionals, immigrants, advocates, and policymakers must work together to improve the health of vulnerable but resilient populations that represent this country's future.

# STATE-LEVEL IMMIGRANT POLICIES, DIABETES PREVALENCE, AND CARDIOVASCULAR HEALTH BEHAVIORS IN PEOPLE OF LATIN AMERICAN AND ASIAN AMERICAN ORIGIN

by

Md Towfiqul Alam

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Approved by

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DEDICATION

*To my parents, my wife Quazi Rahman and child Sarah*

APPROVAL PAGE

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# CHAPTER I: INTRODUCTION

## Statement of the Problem

Cardiovascular disease and associated comorbid conditions, such as type 2 diabetes mellitus (T2DM) are the leading causes of death in the United States (U.S.) (Ahmad & Anderson, 2021; Case & Deaton, 2015; Global Burden of Cardiovascular Diseases Collaboration, 2018; Tsao et al., 2022). In 2019, an estimated 37.3 million (11.3%) people in the U.S. were living with diabetes (American Diabetes Association [ADA], 2022; Centers for Disease Control and Prevention [CDC], 2022). Of these prevalent cases, 28.7 million were diagnosed and an estimated 8.5 million were undiagnosed (ADA, 2022). While the incidence of diabetes appears to have plateaued in the U.S., 1.4 million new cases of diabetes (5.9 per 1000 persons) were diagnosed in 2019 (ADA, 2022; CDC, 2022). Diabetes is the seventh leading cause of death in the U.S. (ADA, 2022; Murphy, 2021) and has a high healthcare and financial burden, contributing to approximately $327 billion in healthcare expenditures annually (Yang, 2018).

There is also a disproportionate burden of diabetes in racial/ethnic marginalized groups such as people of Asian and Latin American origin (herein Latino) (Cheng et al., 2019; Golden et al., 2019). For example, national data show that from 2017 to 2020, the prevalence of total diabetes was higher in Asian Americans (16.7%) and Latin American origin adults (15.5%) than non-Latino White adults (13.6%) (CDC, 2022). The prevalence of diagnosed diabetes was higher also in Latin (11.8%) and Asian American (9.5%) than non-Latino White (7.4%) (CDC, 2022).

For people who have diabetes, the benefits of physical activity have been extensively documented (Colberg et al., 2016). Physical activity (PA) is considered one of the most important health-promoting behaviors associated with significant health benefits (Durstine et al.,

2013; van der Ploeg & Bull, 2020; Warburton et al., 2006b). The latest *Physical Activity Guidelines for Americans* recommends adults engage in at least 150 minutes a week of moderate-intensity or 75 minutes a week of vigorous-intensity physical activity or an equivalent combination of the two (Piercy et al., 2018). A vast amount of literature has shown that PA has significant direct and indirect effects on health (Piercy et al., 2018; van der Ploeg & Bull, 2020; Vuori et al., 2013). For instance, consistent physical activity appears to directly protect against depression, hypertension, diabetes, and heart disease, as well as indirectly promote heart health by protecting against obesity (Blair, 2009; Lobelo et al., 2018; Piercy et al., 2018; Vuori et al., 2013). Furthermore, according to the CDC, physical inactivity contributes to 1 in 10 premature deaths in the U.S. (CDC, 2022; Piercy et al., 2018), and inadequate physical activity is associated with $117 billion in annual healthcare costs (Piercy et al., 2018).

Lack of physical activity is more common among racial and ethnic marginalized groups in the U.S. (Fulton, 2020). In the U.S., people of Latin American origin have the highest prevalence of not meeting recommended physical activity (31.7%) (Fulton, 2020; Johnson & Fulp, 2002). Additionally, Asian Americans have lower physical activity levels compared to other racial and ethnic groups but data are sparse (Chen et al., 2017; Yi et al., 2015). For example, in California, only 30% of young Asian Americans (18 to 44 years) engage in regular physical activity compared to 41% of non-Latino White young adults (Chen et al., 2017; Maxwell et al., 2012).

Over the years, a growing literature has highlighted the importance of contextual effects in understanding social inequities in health (Diez-Roux, 1998). More recently, a burgeoning body of research has indicated that contextual characteristics, such as immigrant policies, are associated with self-rated health, mental health, preterm-birth, infectious diseases, healthcare

access, poverty, or food security (Alberto et al., 2020; Almeida et al., 2016; De Trinidad Young et al., 2018; Galeucia & Hirsch, 2016; Hatzenbuehler et al., 2017; Potochnick et al., 2017; Sudhinaraset et al., 2021; Vargas et al., 2017; Young et al., 2020, 2022). However, little is known about the influence of the immigrant policy context on T2DM or meeting recommneded physical activity, two leading cardiovascular risk and behavior in the United States, disproportioantely affecting Latino and Asian American groups.

Understanding diabetes and physical activity patterns in Latino and Asian American adults is important for two reasons. First, these two racial/ethnic groups represent the largest immigrant groups in the U.S. There are about 62.5 million Latinos in the U.S., representing 19% of the U.S. population. By 2060, they are projected to increase to 111.2 million, representing 28% of the U.S. population (Zong, 2022). The Asian population is also on the rise in the U.S. Approximately 19 million Asians live in the U.S., currently representing 7% of the U.S population. By 2060, they are projected to increase to 36 million, representing 9% of the U.S. population (Budiman & Ruiz, 2021a). Second, a focus on these groups provides an opportunity to examine potential differences in health due to their distinct cultural and social backgrounds (Alegria et al., 2004; Kiang et al., 2017). For example, census data indicates that only 53% of Latino immigrants (only 40% of Mexican immigrants) had completed a high school degree or higher compared to nearly 84% of Asian immigrants (Grieco et al., 2012; Mora, 2022). Similarly, immigrants from Latin America had a median family income of $38,238 ($35,254 for Mexican immigrants), approximately $25,000 less than Asian immigrants, whose median family income was $63,777 (Grieco et al., 2012). Higher educational attainment is associated with better income and linked to a greater likelihood of having health insurance coverage and access to preventive healthcare, screening, and chronic disease management and health-promoting

behavior (Bartley & Plewis, 2002; P. Braveman et al., 2011; Chasens et al., 2020). Moreover, the 6 largest groups of Asian Americans in the U.S. represent a multitude of cultural and language backgrounds, while adults of Latin American origin largely speak Spanish (Budiman & Ruiz, 2021b; Holland & Palaniappan, 2012; Krogstad & Lopez, n.d.; Zhang, 2017). The role of other social characteristics, such as immigrant policies, in shaping health for these groups has received less attention in the literature and forms the basis of the present study.

## Immigrant Policies as Contextual Drivers of Health

Immigrant policies can be defined as laws, regulations, and court rulings within a variety of areas of public policy that generate different rights and opportunities based on an immigrant's legal status (De Trinidad Young et al., 2018; Wallace et al., 2019; Wallace & Young, 2018). Most states possess a mixture of immigrant policies. Some of these policies are *inclusive* and potentially protect immigrants by expanding their eligibility and rights, and provide residents access to state institutions, regardless of citizenship status (De Trinidad Young & Wallace, 2019; Perreira & Pedroza, 2019). For example, some states provide Medicaid-prenatal care to pregnant woman regardless of legal status. (De Trinidad Young & Wallace, 2019). Inclusive policies are found to be associated with better outcomes (e.g., reduced preterm birth in immigrant mothers; Sudhinaraset et al., 2021). However, other exclusionary and restrictive policies curtail immigrants' access to public services, education, employment, and healthcare by producing a fearful, unwelcoming, hostile, and stressful climate to live in (Nichols et al., 2018). For example, states such as Georgia and Alabama are actively exclusionary and take restrictive approaches to immigrants' eligibility for public social welfare programs such as Medicaid and food stamps (Wallace & Young, 2018). Although exclusionary policies primarily harm undocumented immigrants, they also have spillover effects on other non-citizens (those with temporary and

permanent legal status, as well as those with mixed family status) (Asad & Clair, 2018; Nichols et al., 2018; Young et al., 2020).

Additionally, despite having legal status in the U.S., immigrant policies influence the racialization of persons of color (Asad & Clair, 2018; Wallace et al., 2019; Young et al., 2020). Some laws, like Arizona's SB 1070, have been implemented to subtly target a particular immigrant group, such as Latinos (De Trinidad Young et al., 2018; Martin, 1995; Partida, 2020). Some restrictive policies are also *criminalizing* as they link local criminal justice systems with immigration enforcement (Wallace et al., 2019; Young et al., 2019). They also include policies that influence activities of noncitizens by increasing or decreasing their exposure to law enforcement (e.g., complying with Real ID, employment authorization, driver's license verification, sentencing laws for minor infraction) (Sudhinaraset et al., 2021; Young et al., 2020). These policies criminalize immigrants by denying them citizenship-based social protections and rights, restricting their ability to enter the country, and endangering their ability to stay in their communities (Wallace & Young, 2018; Young et al., 2022).

While state inclusive policies facilitate immigrant communities to utilize programs, state criminalizing policies raise the risk of exposure to law enforcement, incarceration, and deportation (Alberto et al., 2020). The core elements and measurement of inclusive and criminalizing policies are outlined in Tables 1 and 2. It is important to note that while state criminalizing and inclusive immigrant polices may co-exist, they represent two different constructs. Due to the extensive inflow of immigrants after 1965 and accompanying debates over immigrants' rights and legal status, inclusive and criminalizing immigrant policies are an important topic of public health research as they can influence the health and well-being of immigrants and people of marginalized conditions (De Trinidad Young & Wallace, 2019). The

goal of the present dissertation research is to examine the role of immigrant policies on diabetes and physical activity overall and by Latino and Asian American population groups.

**Table 1. List of Criminalizing Immigrant Policies**

| Sector | Policy | Indicator that policy exists (Yes = 1, No = 0) |
|---|---|---|
| **Identification and licensing** | State driver's license | Does the state require a social security number to obtain driver's license? |
| | Compliance with the federal ID act of 2005, which sets standards for state licenses and IDs | Does the state comply with RealID? |
| **Work authorization** | Use of employment authorization database, E-verify | Does the state mandate employers use E-verify? |
| **Immigration enforcement and criminal justice** | Law enforcement collaboration with federal enforcement | Does the state fully collaborate with federal immigration authorities? |
| | Law enforcement inquiry about the legal status | Does the state require or allow law enforcement to verify individuals' legal status at the time of a stop or arrest? |
| | Sentencing laws | Does the state sentence nonviolent criminal offenses for at least 365 days? |

**Table 2. List of Inclusive Policies**

| Sector | Policy | Indicator that policy exists (Yes = 1, No = 0) |
|---|---|---|
| **Health and social service benefits** | State Children's Health Insurance Program (SCHIP) | Does the state provide health insurance to children regardless of legal status? |
| | Medicaid—prenatal care | Does the state provide care to pregnant women regardless of legal status? |
| | Supplemental Nutrition Assistance Program | Does the state count a prorated share of ineligible noncitizen |

| Sector | Policy | Indicator that policy exists (Yes = 1, No = 0) |
|---|---|---|
| | | income to determine family eligibility for benefits? |
| **Education** | In-state college and university tuition | Does the state provide most students in-state tuition regardless of legal status? |
| | Financial aid for colleges and universities | Does the state provide students with scholarships or financial aid regardless of legal status? |
| **Labor and employment** | Citizenship requirements for peace officers | Does the state require peace officers be citizens? |
| | Citizenship requirements for teachers | Does the state require teachers be citizens? |
| | Worker's compensation | Does the state include undocumented immigrants in the definition of employee? |
| | Extension of protections for agricultural workers | Does the state extend wage and hour protections for agricultural workers? |
| | Extension of protections for domestic workers | Does the state extend wage and hour protections for domestic workers? |
| | Domestic Worker's Bill of Rights | Does the state have a Domestic Worker's Bill of Rights? |
| | Protection against immigration-related employer retaliation | Does the state have laws that protect noncitizen workers from employer retaliation related to their legal status? |
| | Professional licensing of undocumented and DACAmented professionals | Does the state allow licensing of undocumented or DACAmented professionals? |
| **Language access** | Payment of interpreters through Medicaid or SCHIP | Does the state pay for interpreters through Medicaid or SCHIP? |
| | English language–only legislation | Does the state have English as the official language? |

## Study Goal and Specific Aims

This study involves secondary data analysis of data from the Behavioral Risk Factor Surveillance System (BRFSS), existing state policy data compiled by Young (2019), and the American Community Survey data (ACS), with an overarching goal to assess if state-level immigration policy factors are associated with type 2 diabetes or T2DM and physical activity. The specific aims and research questions of this dissertation are as follows:

Aim 1. To examine if state-level immigrant policy is associated with prevalence of diabetes (T2DM).

1.1 What is the association between state-level criminalizing policies and the prevalence of diabetes (T2DM) while controlling for individual- and state-level characteristics?

1.2 What is the association between state-level inclusive policies and the prevalence of diabetes (T2DM) while controlling for individual- and other state-level characteristics?

1.3 Does the association between state-level immigrant policies (criminalizing and inclusive) and diabetes (T2DM) prevalence vary between Latin American and Asian American origin adults?

Aim 2. To examine if state-level immigrant policy is associated with meeting recommended levels of physical activity (PA).

2.1 What is the association between state-level criminalizing policies and the prevalence of recommended physical activity (PA) while controlling for individual- and state-level characteristics?

2.2 What is the association between state-level inclusive policies and the prevalence of recommended physical activity (PA) while controlling for individual- and state-level characteristics?

2.3 Does the association between state-level immigrant policies (criminalizing and inclusive) and recommended physical activity (PA) prevalence vary between Latino American and Asian American origin adults?

## Significance of the study

Health disparities research and interventions in the U.S. have focused primarily on proximal factors such as education (Borrell et al., 2006; Dray-Spira et al., 2010; Sacerdote et al., 2012; Whitaker et al., 2014), income (P. A. Braveman et al., 2010; Gaskin et al., 2014), diet (Ilunga Tshiswaka et al., 2017; Orr et al., 2019; Seligman et al., 2010), weight gain/obesity (Cameron et al., 2021; Commodore-Mensah et al., 2018; Kim et al., 2018), physical activity/sedentary behavior (Joseph et al., 2016) and to some extent community-level factors, such as neighborhood characteristics, (Christine et al., 2015; Grigsby-Toussaint et al., 2015; Lagisetty et al., 2016; Osypuk et al., 2009) to understand determinants of chronic health conditions. However, these studies have shown little progress in promoting and sustaining health (Chow et al., 2012), likely due to the lack of integration of structural conditions, such as policies that shape health (Dias et al., 2020). Moreover, few studies have specifically examined how policies shape diabetes and physical activity in racial/ethnic marginalized groups and immigrants (Alvidrez et al., 2019; Brown et al., 2019; Clark & Utz, 2014). Therefore, there is a critical need to identify factors that contribute to increased rates of diabetes and decreased rates of physical activity that could lead to a reassessment of current individual-level prevention and intervention efforts.

Racial/ethnic and immigrant groups face legal and social barriers to health that can depend on a state's policies, above and beyond any individual-level determinants of health (Young et al., 2020). Although restrictive/criminalizing policies are largely detrimental for

undocumented immigrants, their impact can have spillover effects to other non-citizens. For example, temporary, undocumented or  mixed status families can experience a stressful immigrant-related climate that discourages anyone in the family from participating in public benefit programs due to fears of deportation (Asad & Clair, 2018; Nichols et al., 2018; Young et al., 2020). Additionally, immigrant policy contexts influence the racialization of people of color even when they have legal status in the U.S. (Asad & Clair, 2018; Wallace et al., 2019; Young et al., 2020). Some policies, for example, are enacted to indirectly target a specific immigrant group, such as Arizona's SB 1070 law, which primarily affects Latinos (De Trinidad Young et al., 2018; Martin, 1995; Partida, 2020). Given that Latino and Asian adults suffer an increased burden of T2DM and not meeting recommneded physical activity relative to their non-Latino White counterparts (Commodore-Mensah et al., 2018; Engelman & Ye, 2019; Spanakis & Golden, 2013), restrictive/criminalzing and inclusive immigrant policies may explain some of the excess burden of T2DM and lower prevalence of meeting recommneded physical activity osberevd in these population groups. To our knowledge, no study has examined the association of the immigrant policy context with T2DM and PA in the Latin American and Asian American origin adults. These results will provide novel and timely data on the role of policies shaping chronic health conditions and spur state-level policymakers to advocate for more effective policies to mitigate harm and promote health for these two racially marginalized populations.

## Overview of Methodology

Contextual factors, such as the immigrant policy context, may independently or in combination with individual-level characteristics pattern chronic health conditions and health behaviors (Wallace et al., 2019). Multilevel models (MLM) that simultaneously account for individual-level and contextual level variation (Diez-Roux, 2000; Leyland & Groenewegen,

2020a) can provide a more comprehensive assessment of the determinants of diabetes and physical activity prevalence.

The present study used publicly available, complex probability surveys to create a data set with person-level measures of race/ethnicity, diabetes status and physical activity and state-level measures of criminalizing and inclusive immigrant policy. Given the complex survey design of the source data, my study uses weighted multilevel modeling (MLM) to answer the research questions. The study employs several multi-level models capturing immigrant policy at a state-level and adjusts for individual- and state-level characteristics to understand the association of state-level immigrant policies with two individual-level outcomes: diagnosis of diabetes and meeting physical activity recommendations. At the individual level, several distinct factors are important to understand the role of immigrant policies on diabetes and physical activity prevalence among racial/ethnic minorities and immigrants. Education level, employment, income, sex at birth, health insurance coverage and access to healthcare can influence health promoting behaviors like physical activity and chronic health conditions such as diabetes. For example, education level influences employment opportunities as well as income and health insurance coverage. At the contextual or group level, the percentage of foreign-born people in a state can capture economic, demographic, and political conditions.

## Organization of the Dissertation

Chapter II reviews prior research on the association between immigrant policy and T2DM and physical activity. Chapter III details the methodologies for the study. Chapters IV tests the association between state-level immigrant policies and prevalence of diabetes (T2DM) in Latin American and Asian American origin adults (Aim 1). Chapter V tests the association between state-level immigrant policies and prevalence of meeting recommended physical

activity (PA) in Latin American and Asian American origin adults (Aim 2). Chapter VI discusses the implications this study has for understanding how state-level immigrant policy influences T2DM and PA in Latin American and Asian American origin adults.

# CHAPTER II: LITERATURE REVIEW

## Immigrant Policy

From 1965, the start of the Immigration and Nationality Act (INA), to 2016, approximately 43.2 million immigrants moved to the United States (U.S.). The majority of immigrants were from Latin America and Asia (M. Lopez, 2015). This influx of immigrants has resulted in policies that maintain legal immigration and impact the well-being of immigrants. The legal immigration policy (who can enter and remain in the U.S.) is the federal government's responsibility. In contrast, immigrant policies enacted at the state level since Welfare Reform Act 1996 give enhanced discretion to states to provide or not provide a wide range of public services to immigrants based on their legal status (Motomura, 2014; Wallace et al., 2019; Wallace & Young, 2018).

In 1996, the federal Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA) and the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) transferred policy-making authority regarding immigrants' public program eligibility and immigration enforcement from the federal government to state government (Perreira & Pedroza, 2019; Wallace et al., 2019; Young et al., 2020). This change gave states discretion to shape immigrants' social and legal incorporation by creating two types of immigrant policies, restrictive and inclusive. *Restrictive policies* increase the gap between immigrants and U.S.-born Americans in access to public services, education, and employment (Wallace et al., 2019). These restrictive policies can legitimize discrimination, institutionalize racism, and increase fear and mistrust among immigrants. Restrictive policies began with the onset of the Welfare Reform Act in 1996 through the PRWORA act, which created two categories of immigrants for federally funded health insurance and public assistance (e.g., food and cash assistance): qualified (legal

permanent residents or LPRs, refugees, and asylees) and unqualified (undocumented, temporary protected status or TPS, student and work visa holders) (Fortuny & Chaudry, 2012; Perreira & Pedroza, 2019). Although the Affordable Care Act in 2010 and the Deferred Action for Childhood Arrivals (DACA) executive order in 2012 increased eligibility for immigrants to access federal health insurance, it prohibited undocumented individuals to purchase marketplace health insurance (C. Becerra, 2019; French et al., 2016; Lantz & Rosenbaum, 2020). Additionally, the companion law of PRWORA, the IIRIRA 1996 (section 287g) granted states and local police immigration enforcement that started to grow in 2002 and amplified with the launch of the secure communities (SComm) program in 2008 (American Immigration Council, 2021; Perreira & Pedroza, 2019; Waslin, 2011). This enforcement allowed local police to match the fingerprints of all arrested immigrants with the U.S. Immigration and Customs Enforcement (ICE) database to determine their legal status (Wallace et al., 2019; Young et al., 2020). Hence, these policies are also considered as criminalizing policies, as they link local police with immigration enforcement (Young et al., 2020). Criminalizing policies can also make a green card holder ineligible for naturalization or liable to deportation under the federal definition of "aggravated felony" if they get a sentence of a year or longer for minor offenses (such as misdemeanor theft) (García Hernández, 2015; Young et al., 2020). Criminalizing policies shape immigrants' day-to-day work and can increase exposure of non-citizens to law enforcement (e.g., via complying with Real ID, mandating employer use of E-Verify, and requiring or allowing law enforcement to verify an individual's legal status during an arrest or traffic stop) (Sudhinaraset et al., 2021; Young et al., 2020). These activities criminalize immigrants by denying them citizenship-based social protections and rights, restricting their ability to enter the country, and endangering their ability to stay in their communities (Wallace & Young, 2018). Moreover,

states can enact laws or administrative regulations that can affect access to education, employment, health-promoting behavior, health, and human services (e.g., California's proposition 187 in 1994 and Arizona's SB 1070 in 2010) (Hardy et al., 2012; Spetz et al., 2000; White et al., 2014). Some of the obvious effects of these laws include denying undocumented students access to in-state tuition or funding for education, requiring state ID or driver's license, and electronic verification (E-verify) that verifies work authorization of new employees (Perreira & Pedroza, 2019; Wallace et al., 2019).

In contrast to these restrictive and criminalizing policies, states can also adopt *inclusive immigrant policies* that extend rights or increase access for immigrants (Perreira & Pedroza, 2019; Young et al., 2019). Inclusive policies blur the lines between immigrants and native-born Americans, acknowledging immigrant residents of the United States as "Americans in Waiting" who have the potential to become productive and loyal citizens of the United States (Perreira & Pedroza, 2019). Research shows that inclusive policies have been adopted in some states to promote their adaptation to the United States (Perreira & Pedroza, 2019). To fill the gaps in ACA, for example, some states (e.g., California, to some extent in New York, Hawaii, Illinois, and Colorado) have started programs to provide healthcare access (through health insurance) to low-income, pregnant and infant, and elderly, regardless of their immigration status (National Immigration Law Center, 2015). Sanctuary policies have also been adopted in some states. For example, in New York, 300 precincts refused to cooperate with at least some ICE detainer requests (Hausman, 2020). Sixteen states and the District of Columbia have enacted laws to allow unauthorized immigrants to obtain driver's licenses if they can provide an acceptable form of identification (e.g., birth certificate or passport) (National Conference of State Legislatures, 2022). At least 17 states offer state financial assistance to undocumented immigrant college

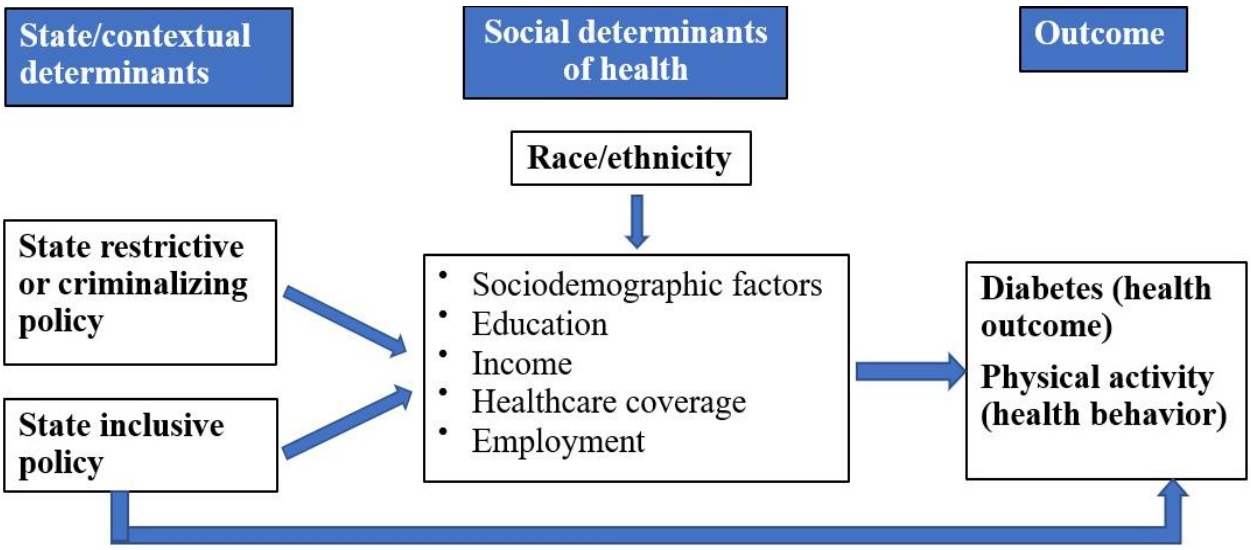
students (National Conference of State Legislatures, 2021). Growing literature shows that inclusive policy benefits immigrants and the U.S. community (Sherman et al., 2019).

State criminalizing and inclusive immigrant polices may coexist, but they represent two distinct constructs. For example, while inclusive policies may provide access to health promoting resources, criminalizing policies may produce an environment where immigrants are more likely to be deported because state-level agencies reinforce surveillance (Young et al., 2020). Importantly, the presence of inclusive policies does not curtail criminalizing policies (De Trinidad Young & Wallace, 2019). Thus, there is general consensus that public health research should include both criminalizing and inclusive policies as two independent contexts while examining their effect on health and health related behaviors (Alberto et al., 2020; De Trinidad Young & Wallace, 2019; Sudhinaraset et al., 2021).

## Theoretical Framework

Several theoretical frameworks have been proposed to explain health behaviors and health outcomes for racial/ethnic marginalized populations and immigrants. These frameworks identify some essential elements and lay the foundation of the theoretical framework most relevant to my research. Furthermore, these theoretical frameworks helped me to understand the strength and limitations of the existing models as it relates to my topic of interest and paved the way for proposing a modified framework to understand T2DM and physical activity in Latin American and Asian American adults.

**Figure 1. Proposed Conceptual Framework**




The link between public policy and health has been discussed previously (Navarro et al., 2006; Navarro & Shi, 2001). It may be both a direct or indirect relationship, and here in **Figure 1**, I show that immigrant policy context may independently lead to cardiovascular health behaviors (e.g., physical activity) and health outcomes (e.g., diabetes), while also shaping intermediate social determinants of health.

The first component of my conceptual framework -immigrant policy -is a structural or contextual level determinants. Context is broadly defined as a structural mechanism that creates social class division (or stratification) and assigns individuals to different social positions (Solar & Irwin, 2010). Contextual or policy level factors can directly impact health through health services, provision of healthcare coverage and prevention programs (e.g., screening facility) (Osypuk et al., 2014; Schoeni et al., 2008). Theoretical models, such as Andersen's behavioral model postulate that macrosocial environmental policies related to non-health and health are important inputs in use of health services and health status (Andersen, 1995). For example, immigration policies like the Illegal Immigration Reform and Immigrant Responsibility Act of

1996 (IIRIRA) restricted access to public health coverage for recent and undocumented immigrants (Fragomen, 1997). Lack of health coverage leads to increased symptoms and complications resulting from disease due to delay in treatment in marginalized population groups (E. Hall & Cuellar, 2016; Stone et al., 2007). In contrast, policy contexts indirectly impact health by virtue of their influence on social determinants of health (Berkman et al., 2014; Osypuk et al., 2014). One of the contextual factors that powerfully drives social class division is state's public policies, such as immigrant policies. In 1996, the Welfare Act transferred policy making authority regarding immigrants' public program eligibility and immigration enforcement from federal government to state government (Perreira & Pedroza, 2019; Wallace et al., 2019; Young et al., 2020). It gave states enhanced discretion to shape immigrants social and legal incorporation creating restrictive and inclusive immigrant policies.

*Restrictive and criminalizing policies* increase the gap between immigrant and US-born Americans' access to public services, education, and employment (Wallace et al., 2019). In contrast to restrictive or criminalizing policies, states can also adopt *inclusive immigrant policies* that blur the lines between immigrants and native-born Americans and extend rights or increase access for immigrants (Perreira & Pedroza, 2019; Young et al., 2019). Immigrant policies can play an important role in the cultural, social and economic well-being of racial or ethnic marginalized population and immigrants (Castañeda et al., 2015; Galeucia & Hirsch, 2016; Torres & Young, 2016).

Several scholars and agencies have integrated the social determinants of health (SDH) framework to understand immigrant health, including having been adopted by the World Health Organization (Solar & Irwin, 2010). This framework was central to my study. According to the SDOH framework, social, economic, and political mechanisms give rise to a set of

socioeconomic condition, where people are divided according to their age, sex, race/ethnicity, education, income, occupation, and other factors. This socioeconomic position in turn operates through a set of intermediary determinants (e.g., stress, food availability) to shape health. The SDH framework recognizes the fact that the political context or public policy is a social determinant of health that influences health behaviors and health, particularly for marginalized populations.

Wallace, Young, and colleagues (dates) and Philbin and colleagues (date) integrated the SDOH framework in theorizing about immigrant health. These authors explicitly identify state-level immigrant policies as the key structural factors that influence racial/ethnic marginalized group's health behaviors and health (M. M. Philbin et al., 2018; Wallace et al., 2019). These authors provide frameworks that center social determinants explicitly from the perspective of immigrants and people of color who live in a socially disadvantaged position. According to Wallace and Young (date), immigrant policies are public policies that affect many social structures where immigrants and people of color live and work. These structures can produce inequitable conditions based on individuals' immigration status as well as other categories such as race/ethnicity and sex at birth. Philbin argues that state-level immigration-related policies serve as the drivers of Latino health by exerting harmful effects beyond targeted individuals (e.g., undocumented immigrants) to affect authorized immigrants and racial/ethnic minoritized groups (M. M. Philbin et al., 2018). Philbin's theoretical framework also shows how immigrant policies impact individual level determinants (e.g., education, employment, income, race/ethnicity, age, sex), which is the second element of my proposed framework.

In general, education increases knowledge and provides formal qualifications that contribute to socioeconomic status through employment and income (Solar & Irwin, 2010). It

also improves health literacy and access to health related information and promotes adoption of healthy lifestyles (Solar & Irwin, 2010; Wallace et al., 2019). Inclusive immigrant policies have been shown to increase educational opportunities for young immigrants by reducing student absenteeism and providing an avenue for future employment opportunities (Heller, 1999; Wallace et al., 2019). In turn, inclusive policies facilitate racial or ethnic marginalized and immigrants' economic and social integration and increases access to resources that promote well-being (Baum & Flores, 2011; Heller, 1999; M. M. Philbin et al., 2018; Wallace et al., 2019). Restrictive immigrant policies, on the other hand, reduce educational attainment in immigrant and racial/ethnic minority children and adolescents and create a perception of intimidation and deprivation (Barajas-Gonzalez et al., 2021; Ee & Gándara, 2020; Kirksey & Sattin-Bajaj, 2021; M. M. Philbin et al., 2018). Immigrant students experience behavioral changes in eating and sleeping habits, and emotional changes such as increased anxiety, anger and difficulty in concentrating to do schoolwork if their parents are in threat of deportation (Rodriguez et al., 2022). Fuentes et al. emphasized that the acculturation-based framework to explain health disparity in racial/ethnic marginalized and immigrant in the U.S. needs a shift (Viruell-Fuentes et al., 2012). They argued that this shift should expand the examination of the impact of immigrant policies and neighborhood and residential segregation on immigrant well-being. They particularly noted that examining immigrant policies is imperative since policies not only limit access to healthcare but also impact individual-level education and employment opportunities, which are fundamental causes of limited health-promoting behavior and adverse health outcomes (Viruell-Fuentes, 2007). Furthermore, low healthcare access or higher uninsurance rate among Latino stems from their lower education, low-wage jobs (that do not offer health benefits), being foreign-born, language barriers, and living in Latino concentrated/isolated areas such as Arizona,

California, New Mexico, and Texas. Finally, as a result of not having health insurance, Latinos do not have a regular source of care and suffer from delayed care, lack of preventative care and screening (Dondero & Altman, 2020; Stone et al., 2007).

My proposed framework also supports minority stress theory to explain marginalized populations' health, including health behaviors (Meyer, 2003; Valentín-Cortés et al., 2020). The theory posits that individuals from underprivileged social groups are subjected to unique stress and coping mechanisms related to their minority identity, which determines the effect of this social status on health, particularly mental health. The model presents stress and coping through multilayered constructs such as circumstances in the environment, minority status and identity, general stressors, and social support, which impact mental health outcomes (Meyer, 2003). In the context of immigrants and Latino and Asians, research finds that these groups endure increased anxiety and harmful mental health outcomes as a result of distinct minority identity-related stressors likely produced by anti-immigrant climate in the United States. These stressors can lead to a lack of faith in community resources, uncertainty about health benefits, delays in medical treatment, and adverse mental health outcomes (Valentín-Cortés et al., 2020). Moreover, these frameworks suggest that as a result of restrictive environment, low education and lower income immigrants and racial/ethnic minorities do not engage in health promoting behavior (e.g., physical activity; Philbin et al., 2018; Solar & Irwin, 2010). The fear of criminalizing policies like being stopped and apprehended can affect Latinos' ability to access resources ranging from physical activity to employment (Hardy et al., 2012). In addition, restrictive policies force immigrants and racial/ethnic minorities to work in a strict environment where there are usually no exercise facilities and live in impoverished residential areas with a lack of park, walking and bicycle trails and transportation (M. M. Philbin et al., 2018; Rogerson & Emes, 2006; Solar &

Irwin, 2010). Exclusionary or restrictive policies can also deteriorate neighborhood conditions (e.g., housing, food) of racial/ethnic minority and immigrants through lower wages, financial instability, exclusion from housing subsidies, and reduced access to public nutrition assistance program (e.g., Supplemental Nutritional Assistance Program or SNAP) (M. M. Philbin et al., 2018; Wallace et al., 2019).

In summary, I have presented that the relationship between immigrant policy and health behavior or health has both direct and indirect mechanisms. As can be seen, I have retained the needed factors that specifically influence one key chronic health condition (e.g., T2DM) and one key health behavior (e.g., PA) in immigrants and racial/ethnic marginalized people. My framework incorporates the abovementioned theories and frameworks offers a fuller understanding of the determinants and a potential pathway through which immigrants develops or aggravate type 2 diabetes and underperform recommended physical activity. Although my study will not test the causal pathway, it provides a critical first step to understand associations that may exist between state-level immigrant policy contexts and diabetes and physical activity.

## Mechanisms Linking Immigrant Policies and Health Behavior and Health

Immigrant policies influence health behavior and health, more specifically chronic health conditions (e.g., diabetes), through several distinct mechanisms. This section describes the relationships between aspects of immigrant policies that shape health and health behavior, more specifically, T2DM and PA.

### Healthcare Access and Diabetes

The first important aspect is *health insurance coverage and healthcare access*. Health insurance is important for immigrants and racial/ethnic marginalized people to access preventive healthcare, screening, and chronic disease management (Chasens et al., 2020). However, the

Illegal Immigration Reform and Immigrant Responsibility Act 1996 restricted access of public insurance for recent lawful permanent residents (LPRs) and other lawful immigrants for the initial five years; meanwhile undocumented immigrants remain ineligible (Fragomen, 1997). Job-based insurance is also unavailable to many immigrants because many are involved in agriculture, food, and construction work. These types of jobs less commonly offer health insurance. Together, these problems have created low insurance coverage among immigrants, racial/ethnic marginalized people (KFF, 2005) and what some refer to as 'occupational segregation.' In addition, language barriers and lack of interpreter services at health centers and clinics make it complicated for immigrants and racial/ethnic marginalized people to access health services (KFF, 2005). Although the Patient Protection and Affordable Care Act (ACA) in 2014 reduced health insurance coverage disparities between U.S.-born citizens and naturalized citizens and LPRs, disparities still remain for undocumented immigrants (Chasens et al., 2020; Dondero & Altman, 2020).

Research finds that uninsured immigrants and racial/ethnic marginalized people are more likely to delay treatment, postpone care, and skip purchasing needed prescriptions, which leads to severe disease symptoms and increased complications (E. Hall & Cuellar, 2016). States that support restrictive policies create barriers for immigrants and racial/ethnic marginalized people to receive federal benefits based on the legal status. For example, nineteen states retained these restrictive policies and offer no medical coverage for low-income pregnant women who are undocumented or recently arrived LPRs (Wallace et al., 2019). On the other hand, some of the states proactively opt immigrants and racial/ethnic marginalized people in through their inclusive policies and increases their healthcare access for continuity of care (Perreira & Pedroza, 2019; Wallace et al., 2019). For example, fifteen states extended Medicaid to pregnant women who are

legal permanent resident in those 15 states (without a five years wait), in spite of not receiving federal Medicaid funds for their care (Wallace et al., 2019). Inclusive policy helps immigrants and racial/ethnic marginalized people in receiving preventive and primary care service, stalling chronic disease development (e.g., diabetes) and potentially reduces healthcare spending. In contrast, lack of health insurance and inadequate healthcare access prevents immigrants and racial/ethnic marginalized people from regular screening and delays diagnosis and treatment of chronic conditions (e.g., diabetes) (E. Hall & Cuellar, 2016).

**Healthcare Access and Physical Activity**

Healthcare access can also affect physical activity behavior. Health insurance is an important part of healthcare access as it provides an easier entrance to preventive health care (Institute of Medicine, 2002). Affording health insurance is dependent on income status of the individual gained through education and employment (Fletcher & Frisvold, 2009; Lazar & Davenport, 2018). Although only a few studies directly determined whether having health insurance increases physical activity among adults, having higher socioeconomic status and health insurance may have a positive influence on physical activity through higher facilities, decreased stress, increased social interaction and participation (Luo et al., 2022; O'Donoghue et al., 2018; Stalling et al., 2022; Stalsberg & Pedersen, 2018). Healthcare providers can also motivate and advise their patients on the benefits of PA and connect them to community-based programs of physical activity such as 'Rx for Exercise' (Albert et al., 2020; Lobelo & de Quevedo, 2016). However, due to a lack of health insurance and interpreter services at the health center this process often becomes difficult (KFF, 2005). Health insurance coverage varies substantially between racial and ethnic groups in the U.S. for example, compared to non-Hispanic whites, people of Latino origin and Asians have persistently lower insurance coverage

(Artiga et al., 2021; Sohn, 2017). Restrictive immigrant acts (e.g., IIRAIRA) also made it more difficult to get public health insurance for these socially disadvantaged and immigrant population (Fragomen, 1997).

Physical activity can benefit everyone, but lack of access to safe and convenient places to be physically active may contribute to racial and ethnic inequities in active living (Fulton, 2020). Socially disadvantaged groups, such as Latin and Asian American adults, in general, have less access to safe and affordable places to exercise, leisure time and energy, and exposure to networks that support physical activity, compared with White (Divney et al., 2019; Easier, 2021; Echeverria et al., 2014; S. E. Echeverría et al., 2019; Mendoza-Vasconez et al., 2016; Murillo et al., 2016). These factors provide significant barriers to physical activity, and result in systematic disparities in physical activity and its related health outcomes (Lee & Cubbin, 2009).

**Education, Employment, Income, and Diabetes**

As previously noted, *education, employment, and income* create a web of conditions that affect health-promoting behaviors and health (P. Braveman et al., 2011). Immigrants and racial/ethnic marginalized people face significant financial and legal challenges that hinder their educational attainment. States like Georgia, Alabama, Indiana, and Arizona do not allow unauthorized residents to attend some state universities. Those that do allow enrollment do not offer in-state tuition benefits (National Conference of State Legislature, 2021; Wallace & Young, 2018). Research shows that lack of education leads to immigrants and racial/ethnic marginalized individuals being less informed in health-related decision and management of diseases (e.g., diabetes) (P. Braveman et al., 2011; DeWalt et al., 2004). Furthermore, low education has been associated with lower perceived personal control, which has been linked with decreased well-being (P. Braveman et al., 2011; Mirowsky & Ross, 1998).

Moreover, education plays a vital role in health by shaping employment opportunities. Low-educated individuals experience higher rates of unemployment that leads to economic hardship and subsequent inability to buy health insurance and to afford the cost of medical care (Bartley & Plewis, 2002; P. Braveman et al., 2011; P. Braveman & Egerter, 2008; Woolf & Braveman, 2011). Research shows that unemployment is strongly associated with worse health and higher mortality (P. Braveman et al., 2011). A contradictory immigrant (criminalizing) policy related to employment was the adoption of the 1986 Immigration Reform and Control Act (IRCA), which instituted employer restrictions for hiring unauthorized immigrants (M. A. Rodríguez et al., 2015). The act required all employers to use the federal electronic verify (E-Verify) authorization system for all new hires. To date, 22 states require E-verify for immigrants (NCSL, 2015; Westat, 2009). This program has been shown to be erroneously identified authorized immigrants and racial/ethnic marginalized people as unauthorized (Westat, 2009).

Adopting criminalizing immigrant policies to limit employment opportunities increase poverty among an already marginalized population (Bohn & Lofstrom, 2012). It pushes immigrants into informal employment, the effects of which are fewer benefits, lower wages, and worse working and housing conditions (M. A. Rodríguez et al., 2015). Restrictive employment is also associated with increased poor physical and mental health outcomes due to difficulty in affording necessities, increasing stress, and increasing unhealthy coping behaviors (such as alcohol, smoking, or drug use) (Rudolph et al., 2013). Another important criminalizing policy concerning employment opportunities is the presence of a *driver's license*. A driver's license provides immigrants and racial/ethnic marginalized people access to economic resources, banking, school, and employment opportunities (M. A. Rodríguez et al., 2015; Wallace et al., 2019). Lack of a driver's license produces more stress among immigrants and racial/ethnic

marginalized people due to fewer resources to cope with daily challenges (P. Braveman et al., 2011; Marmot & Allen, 2014).

On the other hand, inclusive policies like extending in-state tuition benefits can motivate immigrant youth and racial/ethnic marginalized people to complete high school because they will see education as more attainable. States such as California, Colorado, and New York have adopted inclusive policies and passed laws allowing states to pay in-state tuition for public universities (Wallace & Young, 2018). Adopting these policies reduces high school dropout and increased graduation rates among youth immigrants and racial/ethnic marginalized people in these states (Filindra et al., 2011). In addition, educated immigrants and racial/ethnic marginalized people may have improved work compensation, resulting in better food habits, living conditions and better health (P. Braveman et al., 2011; Crissey, 2009).

**Education, Employment and Income, and Physical Activity**

Studies have demonstrated that education, employment, and income are generally positively associated with physical activity (Saffer et al., 2013; Scholes & Bann, 2018). Education is highly associated with health-promoting behavior, such as physical activity (Davies et al., 2019; Kantomaa et al., 2016; Kari et al., 2020; C. Park & Kang, 2008). This can be explained by the fact that individuals who attain more education invest more in health by adopting a healthy lifestyle (C. Park & Kang, 2008). Limited physical activity among racial/ethnic minorities and immigrants has been partly explained by socioeconomic status (Anderson et al., 2006; Crespo et al., 2000). For example, the lack of education and information about appropriate types of exercise is one of the important reasons of reduced physically activity in Latinos (Ramirez et al., 2007). Income and employment are also intimately associated here. Educated people have better employment opportunities and higher income. Individuals with

higher income more likely to participate in any physical activity than individuals with lower income (Humphreys & Ruseski, 2006; Meltzer & Jena, 2010). Results also show that individuals with low income due to lack of exercise facilities, parks, and open space as well as strict work environment cannot meet recommended physical activity guidelines (Larsen et al., 2013; Shuval et al., 2013). Latinos in the U.S. have a lower median family income of approximately than non-Latino Whites and approximately 25% of Latinos lives in poverty compared with 12.3% of non-Latino Whites (Brodsky et al., 2010).

Moreover, it has been suggested that racial/ethnic marginalized people and immigrants who arrive in the United States as a result of economic hardship and relocation are relatively impoverished and are thus compelled to live in deteriorating residential areas and abandoned homes (Amesty, 2003; Caperchione et al., 2009). They also face sociocultural (e.g., gender issues, husband support, language barrier) and environmental barriers (e.g., inability to drive, unleashed dogs) (Evenson et al., 2002). As a result, education levels are low among these immigrants and their children, and there is a lack of general resources (e.g., parks, walking and bicycle trails, transportation), all of which affect participation in physical activity (Rogerson & Emes, 2006; Sundquist et al., 1995).

**Immigration Enforcement and Diabetes**

Another mechanism linking policies to diabetes is *immigration enforcement*. These criminalizing policies set state-sanctioned surveillance linking local criminal justice systems with immigration enforcement (Perreira & Pedroza, 2019; Wallace et al., 2019; Young et al., 2020). For example, currently there are two state-sanctioned practices: the 287 (g)-a section of Illegal Immigration Reform and Immigrant Responsibility Act 1996 (IIRIRA) and Secure Communities (SComm) enforcement program of 2008. The 287 (g) section authorizes Immigration and

Customs Enforcement (ICE) to share information between state and local law enforcement agencies to enforce federal immigration law during daily law enforcement activities (American Immigration Council, 2021; U.S. Immigration and Customs Enforcement, 2021). SComm is a technology-based management program complementary to 287 (g). It flags those immigrants whose fingerprints are already in immigration databases. When an individual is arrested by local police, under the SComm technology, local police scan the arrestee's fingerprints in the ICE and the FBI database. If the check reveals an unlawful presence or criminal activity, ICE takes enforcement action against the immigrant (Rhodes et al., 2015). From 2008 to 2013, the SComm program grew to all 3,181 jurisdictions within the 50 states, the District of Columbia, and five U.S. territories sharing law enforcement information with federal immigration enforcement authorities (Kohli et al., 2011; Kubrin, 2014; U.S. Immigration and Customs Enforcement, 2018). In 2018, the SComm program carried out the removal of 337,287 immigrants (removals of nationals from Mexico made up 65%), a 17% increase from the previous year (Gramlich, 2020; Guo & Baugh, 2019). Policies like Secure Communities produce a chilling effect among immigrants, discouraging them from using public services due to immigration-related consequences (Wallace et al., 2019). In addition to increasing fear and stress, being in public places can negatively impact health (Arbona et al., 2010; Watson, 2014). Although criminalizing and restrictive policies focus on undocumented people and LPRs with less than 5 years in the U.S., it has created spillover effects among general noncitizens and racial/ethnic marginalized people with legal status (Wallace et al., 2019). For example, undocumented parents are fearful of seeking public services for their citizen children owing to concerns of enforcement (O. Martinez et al., 2015; Rhodes et al., 2015).

### Immigration Enforcement and Physical Activity

Immigrant policies can also impact engagement in a physically active lifestyle for Latin American and Asian American population groups. Although undocumented immigrants may worry that any interaction with law enforcement may lead to their arrest, legal immigrants and people of racial/ethnic minorities may also fear harassment by law enforcement because of racial profiling (Morey, 2018). The concern of being arrested or harassed due to criminalizing and restrictive policies can hinder immigrants and racial/ethnic minorities from accessing resources like physical activity (Hardy et al., 2012). As an example, the enactment of the Support Our Law Enforcement and Safe Neighborhoods Act (SB 1070) in 2010 in Arizona (a repeat of the aftermath of Proposition 187 in the 1990s) increased the overall level of fear among people of Latin American origin (Hardy et al., 2012). As a result of the law, Latino residents who already had difficulty accessing healthy food also became reluctant to go outside for physical activity for fear of arrest by police. Lack of access to a healthy lifestyle (e.g., physical activity, healthy food) is also a risk factor for diabetes and other chronic health conditions (Booth et al., 2012; Hardy et al., 2012).

### Physiological Links Between Immigrant Policies and Diabetes

Both inclusive and restrictive or criminalizing policies can have physiologic and psychologic effects. Briefly, inclusive environments help maintain positive emotionality which increases the level of serotonin production in the body and thereby decreases depression, increases the feeling of belongingness, social participation, and general wellbeing (P. A. Hall & Lamont, 2009; Peyrot et al., 1999). Immigrants and racial/ethnic marginalized people live in social and economic disadvantages due to restrictive and criminalizing policy environments that restrain their access to education, employment, income and also keep them under continuous

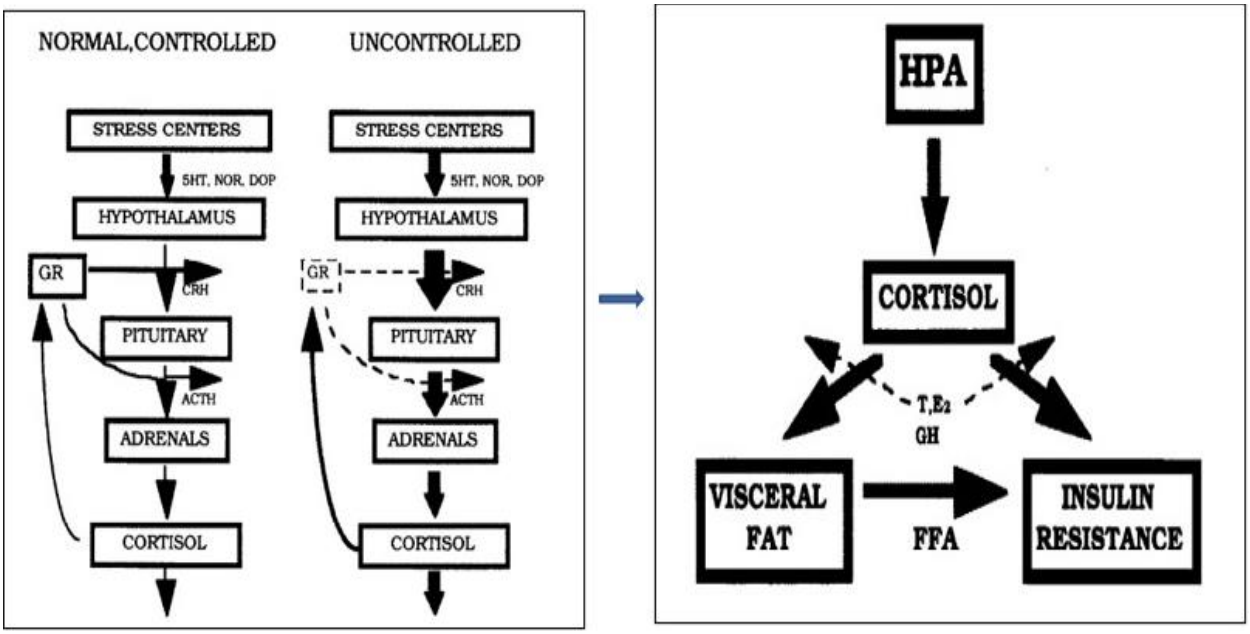
surveillance (Perreira & Pedroza, 2019; Young et al., 2020). Coping with these disadvantages daily can be stressful (Björntorp, 1997). Stressful conditions make them psychologically vulnerable, for example, as they may experience feelings of hopelessness or anxiety, particularly in the context of social isolation or poverty (Lloyd et al., 2005). Over the long term, living under *stress/stressful conditions* impacts the physiology of the body through the activation of the stress response. The stress response in turn activates the autonomic nervous system, neuroendocrine system, and the immune system which can lead to poor health outcomes (P. Braveman et al., 2011; Lloyd et al., 2005; Woolf & Braveman, 2011).

The autonomic nervous system is involved with the regulation of smooth muscle, cardiac muscle, and glands. In addition, it regulates the functions over which we have no conscious control, such as cardiovascular function and digestion. The autonomic nervous system includes two main branches: the parasympathetic and the sympathetic nervous system. The sympathetic part is most dominant in stress, and the sympathetic system prepares the body for action. For example, it increases oxygen and nutrient supplies to the muscles by increasing the blood flow to the skeletal muscles and freeing glucose from the hepatic system (liver) and lipids from body fat stores and, at the same time, prepare the immune system for possible injury (Surwit et al., 1990).

The neuroendocrine system activates the hypothalamic-pituitary-adrenal axis or HPA axis (the main neurohormonal pathway to maintain body homeostasis). This activation causes the HPA axis to release corticotropin-releasing hormone from the hypothalamus, which in turn releases adrenocorticotropin hormone from the pituitary gland (Björntorp, 1997; Lloyd et al., 2005). The adrenocorticotropin hormone travels to the adrenal gland via blood and causes glucocorticoid secretion, particularly cortisol. A point of note here is that cortisol is also produced and secreted in normal humans, which functions to regulate metabolism, immune

function, and stress. However, stressful events cause additional cortisol secretion to reduce stress (Lloyd et al., 2005; Thau et al., 2022). In addition, periodic elevated cortisol secretion causes fat breakdown and direct storage of body fat to deposit in the viscera (internal body organs such as the intestines) and increases abdominal obesity (Björntorp, 1997; Galicia-Garcia et al., 2020). These hormonal abnormalities contribute to the development of insulin resistance—the main feature of type 2 diabetes (Björntorp, 1997) (**Figure 2**). Insulin resistance is also amplified by excess circulatory free fatty acids (FFA) due to abdominal obesity that impairs insulin receptors (cell protein that binds with insulin and helps in the absorption of glucose from the blood to cells) or the insulin signaling process (Björntorp, 1997).

**Figure 2. Pathway of Stress Leading to T2DM**




Stress also influences the immune system by increasing the number of circulating white blood cells (immune cells that protect our body). One possible mechanism of enhanced immune response and dysfunction or death of pancreatic beta cells (cells that produce insulin) is the production of cytokine and inflammatory mediators in the body, especially tumor necrosis factor

(TNF) and interleukin-6 (IL-6) (Martínez et al., 2018). Beta cell dysfunction can also occur due to excess deposition of fat in the pancreas resulting from abdominal obesity (Skyler et al., 2017). When both beta cell dysfunction and insulin resistance are present, hyperglycemia is amplified leading to the progression of T2DM (Galicia-Garcia et al., 2020; Skyler et al., 2017).

# CHAPTER III: METHODS

## Methods

This study involves secondary data analysis of data from the Behavioral Risk Factor Surveillance System (BRFSS), existing state policy data compiled by Young (DATE), and the American Community Survey data (ACS), with an overarching goal to assess if state-level immigration policy factors are associated with type 2 diabetes (T2DM) and physical activity. The specific aims and research questions of this dissertation are as follows:

Aim 1. To examine if state-level immigrant policy is associated with prevalence of diabetes (T2DM).

1.1 What is the association between state-level criminalizing policies and the prevalence of diabetes (T2DM) while controlling for individual- and state-level characteristics?

1.2 What is the association between state-level inclusive policies and the prevalence of diabetes (T2DM) while controlling for individual- and other state-level characteristics?

1.3 Does the association between state-level immigrant policies (criminalizing and inclusive) and diabetes (T2DM) prevalence vary between Latin American and Asian American origin adults?

My hypotheses for Aim 1 are that people residing in states with higher criminalizing policies will have higher prevalence of diabetes (T2DM) and people residing in states with lower inclusive policies will have a higher prevalence of diabetes (T2DM). For the cross-level interactions, I hypothesize that the association between criminalizing policy and T2DM results will vary between Latin American and Asian American adults. In addition, the association of inclusive policy and T2DM results will also vary between Latin American and Asian American adults.

Aim 2. To examine if state-level immigrant policy is associated with meeting recommended levels of physical activity (PA).

2.1 What is the association between state-level criminalizing policies and the prevalence of recommended physical activity (PA) while controlling for individual- and state-level characteristics?

2.2 What is the association between state-level inclusive policies and the prevalence of recommended physical activity (PA) while controlling for individual- and state-level characteristics?

2.3 Does the association between state-level immigrant policies (criminalizing and inclusive) and recommended physical activity (PA) prevalence vary between Latino American and Asian American origin adults?

My hypotheses for aims two are that people residing in states with higher criminalizing policies will have a lower prevalence of meeting recommended physical activity (PA), and people residing in states with lower state-level inclusive policies will have a lower prevalence of meeting recommended physical activity (PA). For the cross-level interactions, my hypothesis is that the association of criminalizing policy and PA results will vary between Latin American and Asian American adults. In addition, the association of inclusive policy and PA results will vary between Latin American and Asian American adults.

## Study Design and Measures

### Study Design

This dissertation research involves a cross-sectional study design utilizing a large-scale complex survey with state-level identifiers: the Behavioral Risk Factor Surveillance System (BRFSS). BRFSS provides the state-specific prevalence of health outcomes and health behaviors

of the noninstitutionalized U.S. adult population. BRFSS is a collaborative project between all the U.S. states, participating U.S. territories, and the Centers for Disease Control and Prevention (CDC). Established in 1984, BRFSS now collects data in all 50 states, the District of Columbia, and three U.S. territories. BRFSS completes more than 400,000 adult interviews each year, making it the world's largest continuously conducted health survey system. For this study, the sample will be restricted to adults aged 18 years and older who were not pregnant, did not have gestational diabetes, and self-identified as Latino/Hispanic or Asian. Nationally, in the U.S., "Latino" is defined as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin (Office of Management and Budget, 1997). Nationally, in the U.S., "Asians" are defined as people with origin in East Asia, Southeast Asia, or the Indian subcontinent, including Cambodia, China, India, Bangladesh, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, or Vietnam (Office of Management and Budget, 1997). Based on the eligibility criteria mentioned above, the study created a final dataset pooling data from 2014-2018 BRFSS, yielding a total of 201824 respondents with diabetes data, and 2015 and 2017 BRFSS, yielding a total of 80516 respondents with physical activity data. All 50 U.S. states were included in the analysis, including the District of Columbia. Latinos and Asian Americans of all ethnic backgrounds (i.e., subgroups) were included, although Puerto Rico is not a U.S. state and thus not represented in state-level analyses.

**Data Merging**

I created a dataset with individual-level measures of race/ethnicity and health outcome (diabetes) and health behavior (physical activity) and state-level measures of immigrant policy. For the health outcome (diabetes), I combined BRFSS 2014 to 2018 of adults 18 years and older and merged it with the existing policy dataset that came from Young's systematic review and

2014 to 2018 American Community Survey (ACS) data. For the health behavior outcome (physical activity), I combined BRFSS 2015 and 2017 of adults ≥ 18 years and merged it with the existing policy dataset and 2015 and 2017 ACS data.

**Individual-Level Data**

Data on individual-level demographic characteristics and diabetes were obtained from the pooled 2014 to 2018 waves of BRFSS. In addition, data on physical activity were obtained for 2015 and 2017 waves of BRFSS because the 2014, 2016, and 2018 survey years did not have total physical activity variables. Details of the BRFSS are described elsewhere (CDC/BRFSS, 2021).

**State-Level Data**

*Immigrant Policy Data*

For data on state immigrant policy, I used an existing policy dataset that categorized states and the District of Columbia based on the presence of criminalizing and integration policies developed by De Trinidad Young et al. (De Trinidad Young et al., 2018). For each policy, a state was coded as 1 - Yes, having the policy, or 0 - No, not having the policy. Information on each state's policy was identified through a systematic review of secondary data sources on state legislation, administrative regulations, or court rulings (Young et al., 2020). States were coded as having a policy if it was enacted any time before December 31, 2013, a date aligning with the end point of a period of extensive new state-level policy activity.

*American Community Survey Data*

The U.S. Census Bureau has long been a reliable source of socioeconomic and demographic data for ethnic and immigrant populations in the United States (U.S. Census Bureau, 2012). The ACS, conducted by the U.S. Census Bureau, is an annual survey that is

intended to give communities timely and accurate demographic, social, economic, and housing data of various population groups, including ethnic and immigrant populations, at the national, state, county, and local levels (U.S. Census Bureau, 2009). All ACS data are self-reported and collected using mail-back questionnaires, phone calls, and in-person interviews (U.S. Census Bureau, 2009). Details of the ACS are explained elsewhere (U.S. Census Bureau, 2009). For this study, the variable percent of the state that is foreign-born was obtained from the ACS 2014 to 2018 annual data to be merged with the BRFSS and existing policy data.

## Measures

### Criminalizing Policy

As previously noted, data on state criminalizing policy was based on an existing dataset classifying states and the District of Columbia based on six criminalizing policies (**Table 3**) (De Trinidad Young & Wallace, 2019). For each policy, a state was coded as 1 - Yes, having the policy, or 0 - No, not having the policy. The state criminalizing policy score is composed of the number of criminalizing policies present in each state (possible range = 0–6, observed range = 1–6). A higher score indicated higher levels of criminalizing policies. From this continuous variable, tertiles of criminalizing policies were derived and classified as low, medium, and high criminalizing policies. Prior studies have used varying approaches to create cut-offs for this criminalizing policy score. Some researchers have used an extreme score while others used a median cut-off (Alberto et al., 2020; Young et al., 2022). In the present study, we examined the distribution of the score empirically and also made a decision on cut-offs given our knowledge of policy context for some states. So, we categorize 1 to 3 for low criminalizing policy, 4 for moderate criminalizing policy, and 5 to 6 for higher criminalizing policy.

**Table 3. List of Criminalizing Policies**

| Sector | Policy | Indicator that policy exists (Yes = 1, No = 0) |
|---|---|---|
| **Identification and licensing** | State driver's license | Does the state require a social security number to obtain driver's license? |
| | Compliance with the federal ID act of 2005, which sets standards for state licenses and IDs | Does the state comply with real ID? |
| **Work authorization** | Use of employment authorization database, E-verify | Does the state mandate employers use E-verify? |
| **Immigration enforcement and criminal justice** | Law enforcement collaboration with federal enforcement | Does the state fully collaborate with federal immigration authorities? |
| | Law enforcement inquiry about the legal status | Does the state require or allow law enforcement to verify individuals' legal status at the time of a stop or arrest? |
| | Sentencing laws | Does the state sentence nonviolent criminal offenses for at least 365 days? |

**Table 4. List of Inclusive Policies**

| Sector | Policy | Indicator that policy exists (Yes = 1, No = 0) |
|---|---|---|
| **Health and social service benefits** | State Children's Health Insurance Program (SCHIP) | Does the state provide health insurance to children regardless of legal status? |
| | Medicaid—prenatal care | Does the state provide care to pregnant women regardless of legal status? |
| | Supplemental Nutrition Assistance Program | Does the state count a prorated share of ineligible noncitizen income to determine family eligibility for benefits? |

| Sector | Policy | Indicator that policy exists (Yes = 1, No = 0) |
|---|---|---|
| **Education** | In-state college and university tuition | Does the state provide most students in-state tuition regardless of legal status? |
| | Financial aid for colleges and universities | Does the state provide students with scholarships or financial aid regardless of legal status? |
| **Labor and employment** | Citizenship requirements for peace officers | Does the state require peace officers be citizens? |
| | Citizenship requirements for teachers | Does the state require teachers be citizens? |
| | Worker's compensation | Does the state include undocumented immigrants in the definition of employee? |
| | Extension of protections for agricultural workers | Does the state extend wage and hour protections for agricultural workers? |
| | Extension of protections for domestic workers | Does the state extend wage and hour protections for domestic workers? |
| | Domestic Worker's Bill of Rights | Does the state have a Domestic Worker's Bill of Rights? |
| | Protection against immigration-related employer retaliation | Does the state have laws that protect noncitizen workers from employer retaliation related to their legal status? |
| | Professional licensing of undocumented and DACAmented professionals | Does the state allow licensing of undocumented or DACAmented professionals? |
| **Language access** | Payment of interpreters through Medicaid or SCHIP | Does the state pay for interpreters through Medicaid or SCHIP? |
| | English language–only legislation | Does the state have English as the official language? |

**Inclusive Policy**

For data on state-inclusive policy, the existing policy dataset was used that categorizes states and the District of Columbia based on 14 policies (**Table 4**) (De Trinidad Young & Wallace, 2019). For each policy, a state was coded as 1 (Yes) or 0 (No), not having the policy. The state inclusive policy score is the number of inclusive policies present in each state (possible range = 0–14, observed range = 1–14). A higher score indicated a higher level of inclusive policies. From this continuous variable, tertiles of inclusive policies were derived and classified as low, medium, and high inclusive policies. We examined the distribution of the score and also made a decision on cut-offs given our knowledge of policy context for some states. So, we categorize 1 to 4 for low inclusive policy, 5 and 6 for medium inclusive policy, and 7 or more for high inclusive policy.

**Diabetes (Dependent Variable)**

Diabetes status in BRFSS is ascertained by asking participants, "Have you ever been told by a doctor that you have diabetes?" Responses were coded as "yes," "yes, but female told only during pregnancy," or "no." For this study, people with gestational diabetes were excluded. Self-reports rely on the accurate recall of a person diagnosed with the chronic health condition under study. Although the unknown status of diabetes can reach as high as 30% of the U.S. adult population, some research suggests that respondents can accurately report whether they have ever been diagnosed with health conditions (Garmon Bibb et al., 2014). For example, comparing BRFSS with two other national benchmark surveys (NHANES and NHIS) data suggests that overall prevalence (or means) from BRFSS, NHANES, and NHIS are mostly similar (Hsia et al., 2020). Evidence also shows that the estimation of the prevalence of diabetes through self-

reported health surveys is a good instrument for evaluating social inequalities in health (Espelt et al., 2012).

**Physical Activity (Dependent Variable)**

The physical activity outcome of this study was measured in the BRFSS by asking participants a series of questions about their weekly physical activities and how much time they spent engaging in each activity. Physical activity in BRFSS is available as a calculated variable classifying participants as meeting the recommended amount of engaging in 150 minutes of physical activity per week. Specifically, it was based on the amount of time participants spent engaging in "active" (≥150 min of moderate-intensity activities per week or ≥75 min of vigorous-intensity activities per week, or an equivalent combination of both), "insufficiently active" (1–149 min of moderate-intensity activities per week or 1–74 min of vigorous-intensity activities per week), and "inactive (0 minutes of physical activity/week) physical activity per week. For this study, we dichotomized PA into "active" and "insufficiently active." The "active" physical activity group was classified as people who "met recommended PA." The "insufficiently active" and "inactive" groups were combined and classified as "did not meet recommended PA."

**Race/Ethnicity**

For the race/ethnicity, participants in BRFSS were asked to self-report their identity as "White only non-Hispanic, Black only non-Hispanic, American Indian or Alaskan Native only non-Hispanic, Asian only non-Hispanic, Native Hawaiian or other Pacific Islander only, Non-Hispanic, Other race only, non-Hispanic, multiracial non-Hispanic, Hispanic, and Don't know/Not sure/Refused." For the purpose of this study, all racial/ethnic groups except Latino American or Hispanic and Asian American only non-Hispanic were excluded.

## Individual-Level Covariates

### Sex at Birth

The sex at birth of BRFSS participants is self-reported and classified as male or female.

### Age

The age (in years) variable was available in BRFSS as a categorical variable and in my study was classified into three categories: 18–44, 45–64, and 65 or over.

### Educational Attainment

Educational attainment was classified as having less than a high school diploma, high school diploma, some college, and college degree or more.

### Employment Status

Employment status in BRFSS is classified as employed for wages, self-employed, out of work one year or more, out of work less than one year, homemaker, student, retired, or unable to work. For this study, employed for wages and self-employed was grouped into “employed” while out of work one year or more, out of work less than one year, those unable to work, students, retired people, and homemakers was grouped into “unemployed.”

### Healthcare coverage

Healthcare coverage was categorized as yes (have healthcare coverage) and no (do not have healthcare coverage).

### Household Income

The annual household income variable in BRFSS was available as a categorical variable. In this study it was classified as earning less than $25,000, $25,000–$49,999, $50,000–$74,999, and $75,000 or more.

## State-Level Covariates

### Percent of State Foreign-Born

BRFSS data do not include individual-level nativity status, and obviously, not all Latinos and Asians are immigrants. Approximately 33% Latino and 73% Asians in the U.S. are foreign-born (Monte & Shin, 2022; Noe-Bustamante, 2019). However, evidence suggests that restrictive and criminalizing policies' harmful effects can extend beyond their stated target to affect authorized immigrants and both native-born and naturalized U.S. citizens (Almeida et al., 2016; Moya & Shedlin, 2008; Sabo & Lee, 2015). Restrictive or criminalizing policies harm immigrant and non-immigrant Latin Americans and Asian Americans, given that approximately nine million Americans live in mixed-status families and nearly 10% of babies born each year have one undocumented parent (Aranda & Vaquera, 2015; Taylor et al., 2011). In addition, for Latinos, race/ethnicity and immigration status are often conflated, and in the popular imagination, Latino immigrants are frequently perceived to be undocumented (Viruell-Fuentes et al., 2012). This means that anti-immigrant sentiments can facilitate racism and xenophobic attitudes toward all Latinos and Asians, irrespective of their immigration status or generation.

Nonetheless, the percent of the state population that is foreign-born was calculated from ACS data and included as a contextual covariate in the complete dataset. For the ease of interpretation, from the continuous version of the percent foreign-born, tertiles were derived to classify states as having a low, medium, or high percent of foreign-born individuals.

## Analytic Plan

### Power Analysis

The ability to correctly detect a difference of a given magnitude in the mean outcome for the two groups (affected group and non-affected group) is characterized by the power of the

study. If a study is underpowered, a practically significant true difference might go undetected. For this study, the "power determination approach" was taken that begins with an assumption about the effect size a study produces. The aim was to compute the power the study needed to detect that effect with a given sample size. The study used the publicly available and free 'Optimal Design' software for multilevel modeling and longitudinal research developed by Raudenbush (Raudenbush, S.W. et al., 2011). However, as a secondary data analysis, it is important to note that many researchers do not consider power calculations appropriate because the dataset is already observed and recorded. There is nothing a secondary data analyst can do to get a larger dataset to avoid type-II errors if it is determined that the current dataset is inadequate (Dziak et al., 2020). Nonetheless, I discussed the possible role of sample size issues in my study design using outcome and exposure prevalence tests of significance.

**Diabetes**

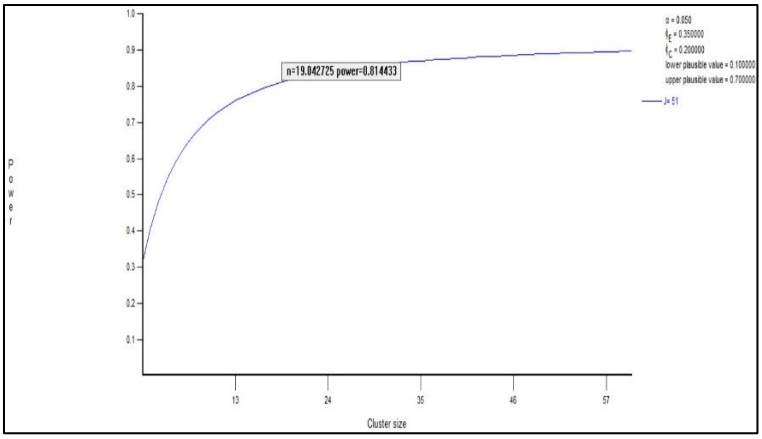
The study investigates effects of criminalizing and inclusive policy on the prevalence of diabetes. The hypothesis is that racial or ethnic marginalized populations and immigrants residing in states with higher criminalizing policies will have higher prevalence of diabetes (T2DM), and people residing in states with lower inclusive policies will have a higher prevalence of diabetes (T2DM). The study implemented at the state level, so I had a nested data structure of racial or ethnic marginalized population and immigrants within states.

Past data show that in most states in the U.S., the prevalence of diabetes ranges between 10% and 20% (American Diabetes Association, 2022). Based on the assumption that due to criminalizing policy exposure people of racial or ethnic marginalized populations and immigrants had a diabetes prevalence of 35%, I calculated the number of racial or ethnic

marginalized populations and immigrants in each of the 50 states and District of Columbia if the study required a power of 0.80. The following parameters were used:

- Significance level (α): 0.05
- Number of clusters/states (J): 51
- Percentage of diabetes in the exposed group ($\varphi_E$): 35% (0.35)
- Percentage of diabetes in the unexposed/control group ($\varphi_C$): 20% (0.20)
- Plausible Interval for the prevalence of diabetes in the unexposed group (PI): 10% to 70% (0.10 to 0.70)

**Figure 3. Power Curve for the Association Between Immigrant policy (Criminalizing and Inclusive policy) and Diabetes Prevalence in Racial or Ethnic Marginalized Population and Immigrants**




Based on the parameters, the resulting power curve in **Figure 3** shows that to detect exposure effects in 50 states and District of Columbia if I had approximately 20 racial or ethnic marginalized population and immigrant participants from each state, a power of 0.80 will be achieved. Thus, the total sample size required for a power of 0.80 is (approximately) = number

of states (51)* participants from each state (20) = 1020. Generally, I meet all of these requirements.

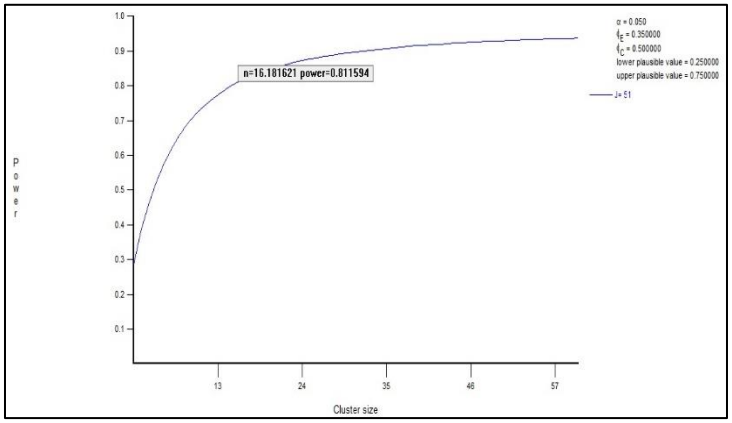
**Physical Activity**

The study also investigates effects of criminalizing and inclusive policy on the prevalence of meeting recommended physical activity. The hypothesis is that people of racial or ethnic marginalized population and immigrants residing in states with higher criminalizing policies will have a lower prevalence of meeting recommended physical activity (PA), and people residing in states with lower state-level inclusive policies will have a lower prevalence of meeting recommended physical activity (PA). The study will be implemented at the state level, so I will have a nested data structure of racial or ethnic marginalized population and immigrants within states.

National data shows that most of the states in the US the prevalence of meeting recommended PA ranges from 40% to 55% (CDC, 2023). Based on the assumption that due to higher criminalizing and low inclusive policy exposure people of racial or ethnic marginalized population and immigrants had a PA prevalence of 35%, I calculated the number of racial or ethnic marginalized population and immigrants in each of the 50 states and district of Columbia if the study required a power of 0.80. The following parameters were used:

- Significance level ($\alpha$): 0.05
- Number of clusters/states (J): 51
- Percentage of meeting recommended PA in the exposed group ($\varphi_E$ ): 35% (0.35)
- Percentage of meeting recommended PA in the unexposed group ($\varphi_C$ ): 50% (0.50)
- Plausible Interval for prevalence of meeting recommended PA in the unexposed group (PI): 25% to 75% (0.25 to 0.75)

**Figure 4. Power Curve for the Association Between Immigrant Policy (Criminalizing and Inclusive Policy) and Recommended PA Prevalence in Racial or Ethnic Marginalized Population and Immigrants**




Based on the parameters, the resulting power curve in **Figure 4** shows that to detect exposure effect in 50 states and the District of Columbia, if I have approximately 17 racial or ethnic marginalized populations and immigrant participants from each state, a power of 0.80 will be achieved. Thus, the total sample size required for a power of 0.80 is (approximately) = the number of states (51)* participants from each state (17) = 867. Generally, I meet all of these requirements.

## Statistical Analysis

### *Outcome: Diabetes or Physical Activity*

**Criminalizing Policy.** The combined and merged dataset with individual-level measures of race/ethnicity and diabetes/physical activity status (BRFSS), state-level measures of immigrant policy (the Young policy dataset), and percent of foreign-born (ACS dataset) was used for the criminalizing policy and diabetes/physical activity outcome. The statistical analysis for both diabetes and physical activity was the same since they both dichotomized. Hence, the analytic description applied for both diabetes and physical activity.

The first research question of the Aim 1 and two was to understand the relationships between state-level criminalizing policies and the prevalence of T2DM or physical activity and if that relationship varies between Latin Americans and Asian Americans. PROC GLIMMIX (for weighted survey data) was used to fit a weighted multilevel model to this data (Ene et al., 2014). Sampling probabilities and individual-level weights was incorporated into the model to draw valid inferences in the population of interest. The point of note here is that BRFSS and other publicly available data do not include weights for each level of analysis. Rather, they include a single overall level-1 weighting variable that incorporates level-2 design issues. The weights in BRFSS start from design weights—also known as sampling weights (reciprocal of the probabilities of selection) to reflect disproportional stratified sampling for fielding efficiency. Additionally, the current BRFSS state-level weighting methodology includes a raking process, an iterative form of post-stratification that ensures that weights sum to known population totals for key demographics in each state. With the additional layer for the raking that adds the state as a margin ensures that using the national weights at the state level will reproduce the usual state estimate, for every state and every estimate (Iachan et al., 2016). Hence, level-2 weight (state-level weight) in our analysis left unweighted. Moreover, in order to subsample or stratify the data by Latin American and Asian American group, we created revised weight variable for our group of interest because we cannot just remove other individuals from the BRFSS data as it is complex survey in nature (removing others would provide inaccurate standard errors and parameter estimates). We did this by maintaining weights where race was Latin Americans and Asian Americans and pregnancy status was non-pregnant, and set others to virtually zero (Lewis, 2013). Missing data on the outcome T2DM was assumed to be missing at random.

Multicollinearity was assessed through correlation matrix to ensure that none of the independent variables are strongly associated with each other.

Analytic sample descriptive statistics were generated for the variables of interest and tested for differences by race/ethnicity using chi-square ($\chi^2$) tests. Then, data on variables were expressed as percentages (based on weighted frequency) and frequency for categorical variables. The model-building process was begun with the empty, unconditional model (random intercept model) with the outcome (T2DM or PA) but no predictors. This model provided information about how much variation in the prevalence of the outcome (T2DM or PA) exists between states (through the calculation of intraclass correlation coefficient or ICC). The equations necessary for estimating the unconditional model are presented below.

Hierarchical

Level 1: $T2DM/PA_{ij} = \beta_{0j}$ ..... (eq. 1)

Level 2: $\beta_{0j} = \gamma_{00} + \mu_{0j}$ ..... (eq. 2)

Combined

$T2DM/PA_{ij} = \beta_{0j} + \gamma_{00} + \mu_{0j}$ ..... (eq. 3)

Equation 1 represents a level-1 model with no individual-level predictor, where $T2DM/PA_{ij}$ represents the log odds of the outcome (having T2DM or meeting recommended PA) for participant *i* in state *j*, $\beta_{0j}$ is the intercept or the mean log odds of the outcome (having T2DM or meeting recommended PA) at state *j*. It is important to notice that, unlike hierarchical linear models, this model has no error variance at level 1. This is not separately estimated when dealing with multilevel models with binary outcomes because, in this case, the variance is a function of the population mean and is directly determined by this mean (Ene et al., 2014; Luke, 2004). Equation 2 represents a level 2 model with no state-level covariates. Here, where $\gamma_{00}$ provides the

log odds of the outcome (having T2DM or meeting recommended PA) at a state and $\mu_{0j}$ is the level 2 error term representing a unique effect associated with state *j*. The final unconditional model is the combined level 1 and level 2 model (equation 3) is created by substituting the values of $\beta_{0j}$ as shown in equation 2 into the level 1 equation represented in equation 1.

Using the estimates presented in the equations 1, 2 and 3, I computed the intraclass correlation coefficient (ICC) that indicates how much of the total variation in the prevalence of diabetes is accounted for by the states. In multilevel model with dichotomous outcome, there is assumed to be no error at level 1, therefore, a slight modification is needed to calculate the ICC. This modification assumes the dichotomous outcome comes from an unknown latent continuous variable with a level-1 residual that follows a logistic distribution with a mean of 0 and a variance of 3.29 (O'Connell & McCoach, 2008; Snijders & Bosker, 2011). Therefore, 3.29 is used as the level 1 error variance in calculating the ICC. The formula for calculating ICC is following:

$$ICC = \tau_{00} / (\tau_{00} + 3.29)$$

Here, $\tau_{00}$ is the level-2 error variance.

Next, to examine the effect of criminalizing policies on the prevalence of T2DM/PA, the model-building process was continued by including state-level criminalizing policies as the main predictor in an unadjusted or crude model (Model 1) followed by models that adjusted for individual level covariates (age, sex at birth, race/ethnicity, education, employment, health insurance and income) in Model 2 and state level covariate (percent of state foreign-born) in Model 3. The slopes associated with the variables showed the relationship between state- and individual-level variables and the log odds of the outcome (having T2DM or meeting recommended PA). Here, to account for the clustering of data by state, U.S. states was included

as a random intercept; that included all 50 states and District of Columbia. As the effect of the predictors was modeled as fixed or constant across states, this represented a random intercept-only model.

Finally, to examine the extent to which the effect of criminalizing policies on the prevalence of the outcome (T2DM or meeting recommended PA) varies between Latin Americans and Asian Americans, the model-building process was continued by constituting a two-way interaction term (cross-level interaction) between criminalizing policy and race/ethnicity (Latin American and Asian American). The Chi-square test was used to estimate the significance of the interaction. The interaction determined whether the relationship between criminalizing policy and the prevalence of T2DM/PA varies by race/ethnicity (Latino American and Asian American) across states. Followed by the interaction, we tested for effect measure modification by race/ethnicity (Latin American and Asian American origin adults) on the association between criminalizing policy and T2DM/PA. Here also, as the effect of the predictors is modeled as fixed or constant across states, this represents a random intercept-only model. This effect measure modification approach provided answer to the third research question for criminalizing policy of both Aim 1 and Aim 2.

I also performed sensitivity analyses where I replaced the state-level covariate 'percent of foreign-born' in a state with the percent foreign-born of Latino and Asian in stratified analyses. While fitting these models, I lost nine states from the sample because data were not available.

SAS version 9.4 (Cary, NC) was used to analyze the data, and a $p$-value $< 0.05$ was used to determine the significance of all analyses.

**Inclusive Policy.** The combined and merged dataset with individual-level measures of race/ethnicity and outcome (diabetes and physical activity status) (BRFSS), state-level measures

immigrant policy (existing policy dataset), and percent of foreign-born (ACS dataset) was used for the inclusive policy and outcome (diabetes and meeting recommended physical activity).

The second research question of Aim 1 and Aim 2 of this study was to understand the relationships between state-level inclusive policies and prevalence of the outcome (T2DM or meeting recommended PA), and if that relationship varies between Latin Americans and Asian Americans. PROC GLIMMIX (for weighted survey data) was used to fit a weighted multilevel model to this data (Ene et al., 2014). Sampling probabilities and individual-level weights was incorporated into the model to draw valid inferences in the population of interest. Level-2 weight left unweighted as BRFSS include a single overall level-1 weighting variable that incorporates level-2 design issues. Moreover, in order to subsample or stratify the data by Latin American and Asian American group, we created revised weight variable for our group of interest (Latino and Asian adults who are non-pregnant). Missing data on the outcome T2DM were missing at random. Multicollinearity was assessed to ensure that none of the independent variables are strongly associated with each other.

First, analytic sample descriptive statistics was generated for the variables of interest and tested for difference by race/ethnicity status using chi-square ($\chi^2$) tests (described in the method for criminalizing policy and outcome association).

Next, model building process was begun with the empty, unconditional model (random intercept model) with the outcome (T2DM or meeting recommended PA) but no predictors (described in the method for criminalizing policy and outcome association).

After that, to examine the effect of inclusive policies on the prevalence of T2DM/PA, the model-building process was continued by including state-level inclusive policies as the main predictor in an unadjusted or crude model (Model 1) followed by models that adjusted for

individual level covariates (age, sex at birth, race/ethnicity, education, employment, health insurance and income) in Model 2 and state level covariate (percent of state foreign-born) in Model 3. The slopes associated with the variables showed the relationship between state- and individual-level variables and the log odds of the outcome (having T2DM or meeting recommended PA). Here, to account for the clustering of data by state, U.S. states was included as a random intercept; that included all 50 states and District of Columbia. As the effect of the predictors was modeled as fixed or constant across states, this represented a random intercept-only model.

To examine the extent to which the effect of inclusive policies on the prevalence of the outcome (T2DM or meeting recommended PA) varies between Latino Americans and Asian Americans, the model-building process was continued by constituting a two-way interaction term (cross-level interaction) between inclusive policy and race/ethnicity (Latin American and Asian American). The Chi-square test was used to estimate the significance of the interaction. The interaction determined whether the relationship between inclusive policy and the prevalence of T2DM/PA varies by race/ethnicity (Latin American and Asian American) across states. Followed by the interaction, we tested for effect measure modification by race/ethnicity (Latin American and Asian American) on the association between inclusive policy and T2DM/PA. Here also, as the effect of the predictors is modeled as fixed or constant across states, this represents a random intercept-only model. This effect measure modification approach provided answers to the third research question on the role of inclusive policy of both Aim 1 and Aim 2.

Moreover, here I also performed sensitivity analyses where I replaced state-level covariate percent of foreign-born with foreign-born percent for Latino and Asian Americans,

losing 9 states. SAS version 9.4 (Cary, NC) was used to analyze the data, and a $p$-value < 0.05 was used to determine the significance of all analyses.

Finally, an important aspect of multilevel modelling is the selection of predictor variables in the model. Changes in goodness-of-fit statistics are often used to evaluate the contribution of predictor variables to a particular model. Deviance or Pearson goodness-of-fit is often used as a measure of goodness of fit. My strategy for variable selection was to fit a sequence of models, beginning with a simple model with only intercept term and then to include predictor variables in the successive models. Goodness of fit statistics were assessed to ensure that predicting prevalence of T2DM/PA with the fully adjusted model was a better fit to the data than predicting prevalence of T2DM/PA with the unconditional model.

## Limitations

As this is a cross sectional study, the study is affected by antecedent-consequent or temporal bias, (i.e., "which came first?"). This bias occurs when we cannot determine that exposure preceded outcome, since both are ascertained at the same time (Setia, 2016). Consequently, the temporal relationship between the exposure and the outcome is unclear. While temporal bias is a valid concern in cross-sectional studies, it is also the case that in my study none of my outcomes (i.e., diabetes or physical activity) are unlikely to influence state-level policies, thereby reducing temporality as a large source of bias.

In addition, the prevalence of disease is influenced both by incidence and duration of disease (or survival with disease). Persons who survive longer with a disease will have a higher probability of being counted in the numerator of a prevalence proportion. Short-term survivors will be less likely to be counted as a case. We know that incidence is influenced only by exposure, whereas prevalence is influenced both by exposure and duration of disease. If

exposure influences survival time, then the odds ratio may not provide a valid estimate of the risk ratio or rate ratio. Thus, the interpretation of the odds ratio is subject to survival bias (Setia, 2016; Szklo & Nieto, 2019).

Even though this study will explore state-level differences, this analysis will be unable to consider migration patterns between states and length of state residency in a state; migration patterns among immigrants are not random and could influence the policy exposure of interest and other social determinants of health and subsequently T2DM/PA prevalence. My data are cross-sectional in nature and I do not have mobility variable in my data.

# CHAPTER IV: THE ASSOCIATION BETWEEN STATE-LEVEL IMMIGRANT POLICIES AND PREVALENCE OF DIABETES (T2DM) IN PEOPLE OF LATIN AMERICAN AND ASIAN AMERICAN ORIGIN: A WEIGHTED MULTILEVEL ANALYSIS

## Introduction

Cardiovascular disease (CVD) and associated comorbid conditions, such as type 2 diabetes (T2DM) are the leading cause of death in the United States (U.S.) (Ahmad & Anderson, 2021; Case & Deaton, 2015; Global Burden of Cardiovascular Diseases Collaboration, 2018; Tsao et al., 2022). T2DM has become an epidemic in the United States. In 2019, an estimated 37.3 million (11.3%) people in the U.S. were living with diabetes (American Diabetes Association [ADA], 2022; Centers for Disease Control and Prevention [CDC], 2022). Of these prevalent cases, 28.7 million were diagnosed, and an estimated 8.5 million were undiagnosed (ADA, 2022). The incidence of diabetes is also climbing, with 1.4 million new cases of diabetes (5.9 per 1000 persons) diagnosed in 2019 (ADA, 2022; CDC, 2022). There are enormous health complications and mortality associated with diabetes (Papatheodorou et al., 2018). Diabetes is the seventh leading cause of death in the U.S. (ADA, 2022; Murphy, 2021). It is also the most expensive chronic condition in the US and costs approximately $327 billion in healthcare expenditures annually (Yang, 2018).

There is a disproportionate burden of diabetes in racial/ethnic marginalized groups such as Asian Americans and people of Latin American origin (herein Latino) (Cheng et al., 2019; Golden et al., 2019). For example, national data (National Diabetes Statistics Report) shows that from 2018 to 2019, the prevalence of diagnosed diabetes was higher in Latin American (11.8%) and Asian American adults (9.5%) than non-Latino White adults (7.4%) (CDC, 2022).

Over the years, a growing literature has shown that contextual factors can have a significant impact on social inequalities in health, chronic disease prevalence and outcomes (Diez-Roux, 1998; Havranek et al., 2015). Contextual-level characteristics are distinct from individual-level characteristics that may affect individual-level outcomes independently of individual characteristics or modify how individual characteristics are related to outcomes (Subramanian et al., 2003). For example, place-based measures of socioeconomic factors (e.g., poverty) are linked with health outcomes after adjusting for individual-level factors (Diez-Roux, 1998).

When explaining immigrant and racial marginalized group health, there has been an emphasis on behavioral and cultural factors where the importance of structural or contextual factors is more limited (Castañeda et al., 2015). Cultural factors like acculturation (J. Choi et al., 2009; Liu et al., 2009) and behaviors like smoking, diet (Castañeda et al., 2015; Hunt et al., 2004; Poureslami et al., 2007; Viruell-Fuentes, 2007) has been emphasized previously leaving behind broader contextual factor like the immigrant policy that limits or enhance immigrants' rights, resources, and sense of security in everyday life (Perreira & Pedroza, 2019; Wallace et al., 2019).

Immigrant policies can be defined as laws, regulations, and court rulings developed at the federal, state, and local levels within a variety of areas of public policy that generate different rights and opportunities based on an immigrant's legal status (De Trinidad Young et al., 2018; Wallace et al., 2019; Wallace & Young, 2018). From 1965, the start of the Immigration and Nationality Act (INA), to 2016, approximately 43.2 million immigrants moved to the United States (U.S.), mainly from Latin America and Asia (M. Lopez, 2015). This influx of immigrants has resulted in policies to maintain legal immigration and provide services that impact the well-

being of immigrants. Most states possess a mixture of immigrant policies. Some of these policies are *inclusive* and potentially protect immigrants by expanding their eligibility and rights (Perreira & Pedroza, 2019). Inclusive policies are found to be associated with better outcomes (e.g., reduced preterm birth in immigrant mothers) (Sudhinaraset et al., 2021). Others are exclusionary and restrictive policies that curtail immigrants' access to public services, education, employment, and healthcare by producing a fearful, unwelcoming, hostile, and stressful climate to live in (Nichols et al., 2018). For example, states such as Georgia and Alabama are actively exclusionary and take restrictive approaches to immigrants' eligibility for public social welfare programs such as Medicaid and food stamps (Wallace & Young, 2018). Although restrictive policies primarily harm undocumented immigrants, they also have spillover effects on other non-citizens (those with temporary and permanent legal status and those with mixed family status; Asad & Clair, 2018; Nichols et al., 2018; Young et al., 2020). For example, given that over 10% of infants born each year have one undocumented parent and that 9 million Americans live in mixed status, arguably, it can be said that restrictive policies affect Latino and Asian immigrants and non-immigrants (Aranda & Vaquera, 2015; Taylor et al., 2011). In addition, for Latinos, race or ethnicity and immigration status are often conflated, and in the popular imagination, Latino immigrants are frequently perceived to be undocumented (Viruell-Fuentes et al., 2012). This means that, regardless of immigration status, anti-immigrant sentiments encourage racism and xenophobic attitudes toward all Latinos and Asians (Wallace et al., 2019). Some restrictive policies are also criminalizing as they link local criminal justice systems with immigration enforcement (Wallace et al., 2019; Young et al., 2019). Sentencing laws are another aspect of criminalizing policies that may cause deportation under federal immigration law (Stumpf, 2006). Furthermore, criminalizing policies dictate who is eligible for identification documents or

driver's licenses and the requirement for law enforcement to confirm the legal status and job authorization (E-Verify; LeBrón et al., 2018). Immigrants and other racial and ethnic marginalized groups face bureaucratic hurdles due to these policies. Due to the extensive inflow of immigrants after 1965 and accompanying debates over immigrant legal status, both inclusive or exclusionary and criminalizing immigrant policies are an important topic of public health research as they influences the health and well-being of immigrants, Latinos, and Asians (De Trinidad Young & Wallace, 2019).

Although criminalizing and inclusive policies may coincide, they capture distinct contexts (De Trinidad Young & Wallace, 2019). For example, while criminalizing policy creates a distinct mechanism of deportability through the regulation of legality, inclusive policy function to integrate immigrants and racial/ethnic marginalized through expanded rights and eligibility for healthcare, social services, and other resources. Majority of the previous studies used global index of immigrant policy context that provided an overall climate of policy effect on immigrant well-being (Almeida et al., 2016; De Trinidad Young et al., 2018; Hatzenbuehler et al., 2017; Vargas et al., 2017; Young et al., 2019). However, the independent effect of criminalizing and integration policy may elucidate particular process through which they operate. Recent studies also tested the sperate effect of criminalizing and inclusive policy as there was non-significant interaction between the two policy contexts (Alberto et al., 2020; Sudhinaraset et al., 2021). Overall, while criminalizing and inclusive immigrant policies may intersect in certain ways, they represent distinct approaches to immigrant policy and have different implications for immigrant and people of marginalized communities.

Moreover, research on health and health-promoting behavior focused on majority-minority health differences (e.g., natives versus immigrants, Whites versus Blacks, or non-Latino

versus Latino) (Carlisle, 2012; Divney et al., 2019; Hernandez & Kimbro, 2013; Huh et al., 2008; Leclere et al., 1994; Murillo et al., 2016; Wallace et al., 2008; Ye et al., 2012). Thinking that both Latino American and Asian origin are similar in socioeconomic profiles, some researchers have combined them into one socially disadvantaged group and compared them with a White or non-immigrant population (Hasanali et al., 2016). However, these two racial/ethnic marginalized and immigrant groups exhibit differences in several ways (Alegria et al., 2004; Kiang et al., 2017), most notably in education and income (Gonzalez-Barrera, 2015; Hasanali et al., 2016). ACS 2010 figures indicated that only 53% of Latino immigrants (only 40 % of Mexican immigrants) had completed a high school degree or higher compared to nearly 84 % of Asian immigrants (Grieco et al., 2012). Similarly, immigrants from Latin America had a median family income of $38,238 ($35,254 for Mexican immigrants), approximately $25,000 less than Asian immigrants, whose median family income was $63,777 (Grieco et al., 2012). Higher educational attainment is associated with better income and linked to a greater likelihood of having health insurance coverage. Consequently, it increases access to preventive healthcare, screening, and chronic disease management (Bartley & Plewis, 2002; P. Braveman et al., 2011; Chasens et al., 2020).

The National Latino and Asian American Study provides national information on mental illness and service use of Latinos and Asian Americans (Alegria et al., 2004). However, there is no research available at the national level that documents similarities or differences between Latino and Asian Americans when associating immigrant policy with T2DM. Therefore, it is important to recognize the differences between these two groups and avoid generalizing their experiences. Combining them into a single group may erase their unique experiences and perpetuate the marginalization they face. Given that exclusionary policies on educational

opportunity negatively affect education, employment, and income, there may be a distinct difference in T2DM prevalence between Latino and Asian Americans with unequal educational attainment and economic capital levels. While this remains under-researched, it calls for greater clarity to reveal the differences in T2DM between these two immigrant groups (Latino and Asian Americans).

Finally, previous studies on risk factors associated with the prevalence of T2DM have largely been individual-level analyses focused on diet, weight gain, sedentary lifestyles, and aging (Chasens et al., 2020; Chatterjee et al., 2017; Galicia-Garcia et al., 2020; F. B. Hu et al., 2009; R. Hu et al., 2014; Joo & Lee, 2016; NCD Risk Factor Collaboration, 2016; Schellenberg et al., 2013; Stoddard et al., 2010; Wieland et al., 2012). However, we know that contextual factors, such as the immigrant policy context, may independently or in combination with individual-level characteristics pattern diabetes risk. Specifically, multilevel models that simultaneously account for context and individual-level variation (Diez-Roux, 1998; Leyland & Groenewegen, 2020a) could provide important answers on the role of policies as levers for reducing T2DM prevalence.

The current study investigated the association between immigrant policy context and the prevalence of diabetes mellitus among people of Latin American and Asian American origin. It also examined the extent to which these associations vary between Latin Americans and Asians using multilevel modeling. The study tested three specific research questions:

1. What is the association between state-level criminalizing policies and the prevalence of diabetes (T2DM) while controlling for individual- and state-level characteristics?

2. What is the association between state-level inclusive policies and the prevalence of diabetes (T2DM) while controlling for individual- and other state-level characteristics?
3. Does the association between state-level policies (criminalizing and inclusive) and diabetes (T2DM) prevalence vary between Latin American and Asian American adults?

## Method

This study involves a cross-sectional study design utilizing a combined datasets of individual-level measures of race/ethnicity and T2DM and state-level measures of criminalizing and inclusive immigrant policies. The study conducted a multilevel analysis examining the association between state-level immigrant policy (criminalizing and inclusive) and T2DM and whether the associations varied between adults of Latino-American and Asian-American origin, the two largest immigrant groups in the U.S.

### Data Source

#### *Behavioral Risk Factor Surveillance System*

Data on individual-level demographic characteristics and T2DM was obtained from the pooled 2014 to 2018 Behavioral Risk Factor Surveillance System (BRFSS) data, a large-scale complex survey with state-level identifiers. BRFSS is a telephone-based survey (landline and cellular) that provides data on health outcomes and behaviors for the noninstitutionalized U.S. adult population. The sampling design allows for state-specific estimates to be generated. A full description of the BRFSS survey design, sampling methods, data collection, and statistical weighting can be found elsewhere (CDC/BRFSS, 2021). For purposes of this study, the sample was restricted to adults aged 18 years and older who were not pregnant, did not have gestational

diabetes, and self-identified as Latino or Asian American. Nationally, in the U.S., "Latino" is defined as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin (Office of Management and Budget, 1997). Nationally, in the U.S., "Asians" are defined as people with origin in East Asia, Southeast Asia, or the Indian subcontinent, including Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, or Vietnam (Office of Management and Budget, 1997). Based on the eligibility criteria mentioned above, the study included a total of 201824 individuals with demographic and diabetes data. BRFSS is a publicly available dataset, so these analyses did not require Institutional Review Board approval.

## State-Level Data Sources

### *Immigrant Policy Data*

For data on state immigrant policy, we used an existing policy dataset that categorized states and the District of Columbia based on the presence of criminalizing and integration policies (De Trinidad Young et al., 2018). Information on each state's policy was identified through a systematic review of secondary data sources on state legislation, administrative regulations, or court rulings (Young et al., 2020). States were coded as having a policy if enacted before December 31, 2013, a date aligning with the end point of a period of extensive new state-level policy activity. For this study, we merged state immigrant policy data with the pooled 2014-2018 BRFSS data.

### *American Community Survey Data*

The U.S. Census Bureau has long been a reliable source of socioeconomic and demographic data for ethnic and immigrant populations in the United States (U.S. Census Bureau, 2012). The ACS, conducted by the U.S. Census Bureau, is an annual survey that is

intended to give communities timely and accurate demographic, social, economic, and housing data of various population groups, including ethnic and immigrant populations, at the national, state, county, and local levels (U.S. Census Bureau, 2009). Details of the ACS are explained elsewhere (U.S. Census Bureau, 2009). In order to capture state-level demographic characteristics, the variable "percent of the state that is foreign-born" was obtained from the ACS 2014 to 2018 annual data and merged with BRFSS and immigrant policy data.

## Measures

### *State Criminalizing Policy*

Data on state criminalizing policy was based on six criminalizing policies (see **Table 5**; De Trinidad Young & Wallace, 2019). For each policy, a state was coded as 1 - Yes, having the policy, or 0 - No, not having the policy. The policy score was a continuous variable with a possible range of 0–6 and an observed range of 1–6. Higher score indicated higher levels of criminalizing policies. From this continuous variable, tertiles of criminalizing policies were derived and classified as low, medium, and high criminalizing policies. Prior studies have used varying approaches to create cut-offs for this criminalizing policy score. Some researchers have used an extreme score while others used a median cut-off (Alberto et al., 2020; Young et al., 2022). In the present study, we examined the distribution of the score empirically and also made a decision on cut-offs given our knowledge of policy context for some states. The study opted to use the cut-off 1 to 3 for low criminalizing policy, 4 for moderate criminalizing policy, and 5 to 6 for higher criminalizing policy.

**Table 5. List of Criminalizing Policies**

| Sector | Policy | Indicator That Policy Exists (Yes = 1; No = 0) |
|---|---|---|
| Identification and licensing | State driver's licenses | Does the state require a social security number to obtain a driver's license? |
| | Compliance with the federal Real ID Act of 2005, which sets standards for state licenses and IDs | Does the state comply with Real ID? |
| Work authorization | Use of employment authorization database, E-Verify | Does the state mandate employers use E-Verify? |
| Immigration enforcement and criminal justice | Law enforcement collaboration with federal enforcement | Does the state fully collaborate with federal immigration authorities? |
| | Law enforcement inquiry about legal status | Does the state require or allow that law enforcement verify individuals' legal status at the time of a stop or arrest? |
| | Sentencing laws | Does the state sentence nonviolent criminal offenses at least 365 d? |

### *State Inclusive Policy*

Data on state-inclusive policy was based on 14 policies (see **Table 6**; De Trinidad Young & Wallace, 2019). For each policy, a state was coded as 1 - Yes, having the policy, or 0 - No, not having the policy. The policy score was a continuous variable with a possible range of 0–14 and an observed range of 1–14. A higher score indicates a higher level of inclusive policies. The study examined the distribution of the inclusive policy score empirically and also made a decision on cut-offs given knowledge of the policy context for some states. Therefore, from the continuous inclusive policy score, tertiles were derived and classified as low inclusive policy (1 to 4), medium inclusive policy (5 and 6), or high inclusive policy (7 or higher).

## Table 6. List of Inclusive Policies

| Sector | Policy | Indicator That Policy Exists (Yes = 1; No = 0) |
|---|---|---|
| Health and social services benefits | State Children's Health Insurance Program (SCHIP) | Does the state provide health insurance to children regardless of legal status? |
| | Medicaid-prenatal care | Does the state provide care to pregnant women regardless of legal status? |
| | Supplemental Nutrition Assistance Program | Does the state count a prorated share of ineligible noncitizen income to determine family eligibility for benefits? |
| Education | In-state college and university tuition | Does the state provide most students in-state tuition regardless of legal status? |
| | Financial aid for colleges and universities | Does the state provide students scholarships or financial aid regardless of legal status? |
| Labor and Employment | Citizenship requirements for peace officers | Does the state require peace officers be citizens? |
| | Citizenship requirements for teachers | Does the state require teachers be citizens? |
| | Worker's compensation | Does the state include undocumented immigrants in the definition of employee? |
| | Extension of protections for agricultural workers | Does the state extend wage and hour protections for agricultural workers? |
| | Extension of protections for domestic workers | Does the state extend wage and hour protections for domestic workers? |
| | Domestic Worker's Bill of Rights | Does the state have a Domestic Worker's Bill of Rights? |
| | Protection against immigration-related employer retaliation | Does the state have laws that protect noncitizen workers from employer retaliation related to their legal status? |
| | Professional licensing of undocumented and DACAmented professionals | Does the state allow licensing of undocumented or DACAmented professionals? |
| Language Access | Payment of interpreters through Medicaid or SCHIP | Does the state pay for interpreters through Medicaid or SCHIP? |
| | English language-only legislation | Does the state have English as the official language? |

### *Diabetes (Dependent Variable)*

Diabetes status in BRFSS is ascertained by asking participants, “Have you ever been told by a doctor that you have diabetes?” Responses were coded as “yes,” “yes, but female told only during pregnancy,” or “no.” For this study, people with gestational diabetes were excluded. Self-reports rely on a person having been diagnosed with the chronic health condition under study. Although the unknown status of diabetes can reach as high as 30% of the U.S. adult population, research suggests that respondents can accurately report whether they have ever been diagnosed with health conditions (Garmon Bibb et al., 2014). For example, comparing BRFSS with two other national benchmark survey (NHANES and NHIS) data suggests that overall prevalence (or means) from BRFSS, NHANES, and NHIS are mostly similar (Hsia et al., 2020). Evidence also shows that the estimation of the prevalence of diabetes through self-reported health surveys is a good instrument for evaluating social inequalities in health (Espelt et al., 2012).

### *Race/Ethnicity*

For the race/ethnicity, participants were asked to self-report their identity as “White only non-Hispanic, Black only non-Hispanic, American Indian or Alaskan Native only non-Hispanic, Asian only non-Hispanic, Native Hawaiian or other Pacific Islander only, Non-Hispanic, Other race only, non-Hispanic, multiracial non-Hispanic, Hispanic, and Don’t know/Not sure/ Refused.” For this study, all racial/ethnic groups except Latino or Hispanic and Asian only non-Hispanic was excluded.

We included the following individual level covariates associated with the outcome.

### *Sex at Birth*

The sex at birth of BRFSS participants is self-reported and was classified as male or female.

### *Age*

Age in years was provided as a categorical variable in BRFFS and was classified as 18–44 years, 45–64 years, and 65 years or over in this study.

### *Educational Attainment*

Educational attainment was classified as having less than a high school diploma, high school diploma, some college, and college degree or more.

### *Employment Status*

Employment status in BRFSS is classified as employed for wages, self-employed, out of work one year or more, out of work less than one year, homemaker, student, retired, or unable to work. For this study, employed for wages and self-employed were grouped into "employed" while out of work one year or more, out of work less than one year, those unable to work, students, retired people, and homemakers were grouped into "unemployed."

### *Healthcare coverage*

Healthcare coverage was categorized as yes (have healthcare coverage) and no (do not have healthcare coverage).

### *Household Income*

The annual household income was categorical in BRFSS and in this study was classified as earning less than $25,000, $25,000–$49,999, $50,000–$74,999, and $75,000 or more.

## State-Level Covariates

### *Percent of State Foreign-Born*

BRFSS data do not include individual-level nativity status, and it is obvious that all Latinos and Asians are not immigrants. However, evidence suggests that exclusionary and criminalizing policies' harmful effect can extend beyond their stated target to affect U.S.

citizens, authorized and mixed-family status immigrants (Almeida et al., 2016; Aranda & Vaquera, 2015; Moya & Shedlin, 2008; Sabo & Lee, 2015; Taylor et al., 2011; Viruell-Fuentes et al., 2012). Hence, exclusionary, and criminalizing policies can negatively affect all Latinos and Asians, irrespective of their immigration status. Nonetheless, the percent of the foreign-born state population was calculated from ACS data and included as a contextual covariate in the complete dataset, to adjust for immigration status. From the continuous version of the percent foreign-born, tertiles were derived to classify states as having a low, medium, or high percentage of foreign-born individuals.

**Statistical Analysis**

The combined and merged dataset with individual-level measures of race/ethnicity and T2DM (BRFSS), state-level measures of immigrant policy (immigrant policy dataset), and percent of foreign-born (ACS dataset) was used to examine associations between criminalizing and inclusive policy and T2DM. The statistical analysis for immigrant policy and T2DM association for both criminalizing and inclusive policy was the same. Hence, the analytic description applies for both criminalizing and inclusive policy associations with T2DM.

The first research question was to understand the relationships between state-level criminalizing policies and the prevalence of T2DM among adults f Latin American and Asian American origin. PROC GLIMMIX was used to fit a weighted multilevel model to this data (Ene et al., 2015). Sampling probabilities and individual-level weights were incorporated into the model to draw valid inferences in the population of interest. The point of note here is that BRFSS and other publicly available data do not include weights for each level of analysis. Rather, they include a single overall individual (level-1) weighting variable that incorporates state (level-2) design issues. Therefore, level-2 weight in our analysis was not necessary.

Additionally, in order to subsample or stratify the data by Latino American and Asian American groups, we created a revised weight variable for our group of interest because we cannot just remove other individuals from the BRFSS data as it is a complex survey (removing others would provide inaccurate standard errors and parameter estimates). Following simulation studies developed by Lewis et al., we did this by maintaining weights where race was Latino and Asian Americans, and pregnancy status was non-pregnant, and set others to virtually zero (Lewis, 2013). Missing data on the outcome of T2DM is assumed to be missing at random. Multicollinearity assessment ensured that none of the independent variables were strongly associated with each other.

Sample descriptive statistics were generated for the variables of interest and tested for differences by race/ethnicity using chi-square ($\chi^2$) tests. Categorical data were expressed as percentages (based on weighted frequency). We also reported criminalizing policy and inclusive policy percentage by race/ethnicity using chi-square ($\chi^2$) test based on unweighted frequency and estimates were lower than weighted frequency.

We also calculated and plotted predicted probabilities of T2DM by criminalizing and inclusive policy tertiles using SAS-callable SUDAAN. We tested differences in the predicted probability of T2DM by criminalizing policy tertile in states with high criminalizing compared to low criminalizing policies for the full population and for Latinos and Asians, separately. We also tested differences in the predicted probability of T2DM by inclusive policy tertile in states with low inclusive compared to high inclusive policies for the full population and for Latinos and Asians, separately.

The model-building process began with the empty, unconditional (random intercept) model with the outcome (T2DM) but no predictors. This model provided information about how

much of the total variation in the prevalence of diabetes is accounted for by the states (through the calculation of the intraclass correlation coefficient or ICC). Next, to examine the effect of state-level criminalizing and inclusive policies on the prevalence of T2DM, the model-building process was continued by including state-level criminalizing (or inclusive) policies as the main predictor in an unadjusted or crude model (Model 1) followed by models that adjusted for individual-level covariates (age, sex at birth, race/ethnicity, education, employment, health insurance, and income) in Model 2 and state-level covariate in Model 3. Here, to account for the clustering of data by state, U.S. states was included as a random intercept; that included all 50 states and the District of Columbia (Washington, DC). As the effect of the predictors was modeled as fixed or constant across states, this represented a random intercept-only model.

Finally, to examine the extent to which the effect of criminalizing or inclusive policies on the prevalence of the outcome (T2DM) varies between Latino Americans and Asian Americans, the model-building process was continued by constituting a two-way interaction term (cross-level interaction) between criminalizing or inclusive policy and race/ethnicity (Latino and Asian American). The Chi-square test was used to estimate the significance of the interaction. The interaction term determined whether the statistical significance between criminalizing or inclusive policy and the prevalence of T2DM varies by race/ethnicity (Latino American and Asian American) across states. Results were subsequently stratified by race/ethnicity. Here also, as the effect of the individual-level predictors is modeled as fixed or constant across states, this represents a random intercept-only model. Goodness of fit statistics were assessed to ensure that predicting prevalence of T2DM with the fully adjusted model was a better fit to the data than predicting prevalence of T2DM with the unconditional model.

We also performed sensitivity analysis where we replaced state-level percent of foreign-born with percent foreign-born for each race/ ethnic group (Latino and Asian). While fitting these models, we lost 9 clusters/states from the sample because data were not available in ACS.

SAS version 9.4 (Cary, NC) was used to analyze the data, and a $p$-value < 0.05 was used to determine the significance of all analyses.

## Results

**Table 7** displays the descriptive characteristics of the sample by race/ethnicity ($n$ = 201824). Latino adults were relatively less educated and had low annual household income than Asian American adults (11.9% vs. 53.6%, $p$-value <0.0001; 15.7% vs. 47.6%, $p$-value <0.0001, respectively). Also, Latino adults are more likely to have no health coverage than Asian American adults (30.8% vs. 8.9%, $p$-value <0.0001). In addition, Latino adults reported more diabetes than Asian American adults (11.2% vs. 8.7%, $p$-value <0.0001). Adults of Latin American origin were more likely to live in a high criminalizing policy state than Asian American adults (35.2% vs. 14.1%, $p$-value <0.0001). Likewise, the unweighted bivariate analysis showed that 25.8% of Latino adults live in a high criminalizing policy state compared to 10.0% of Asian Americans (data not shown). Asian American adults were also more likely to live in a high inclusive policy state than Latino adults (68.9% vs. 63.1%, $p$-value <0.0001). Likewise, the unweighted bivariate analysis showed that 61.1% of Asians live in a high inclusive policy state compared to 45.2% of Latinos (data not shown). Asians were more likely to live in a high foreign-born state than Latinos (58.0% vs. 48.7%, $p$-value <0.0001).

**Table 7. Characteristics of the Study Population (weighted) by Race/Ethnicity, BRFSS 2014-2018 (*n* = 201824)**

| Characteristics | Latin American (*n* = 155721) | Asian American (*n* = 46103) | *p*-value |
|---|---|---|---|
| | % (weighted frequency), *n* | | |
| **Individual-level** | | | |
| **Age (years)** | | | <0.0001 |
| 18 to 44 | 62.6 (80780) | 61.9 (23472) | |
| 45 to 64 | 28.1 (51155) | 27.1 (13626) | |
| 65+ | 9.4 (22573) | 10.1 (8125) | |
| **Sex at birth** | | | 0.32 |
| Male | 50.7 (70506) | 50.2 (24061) | |
| Female | 49.3 (85102) | 49.8 (22001) | |
| **Educational level** | | | <0.0001 |
| <High school | 20.4 (24844) | 1.7 (538) | |
| High school | 44.4 (63369) | 20.4 (8132) | |
| Some college | 23.3 (34940) | 24.4 (8971) | |
| College+ | 11.9 (31452) | 53.6 (28083) | |
| **Annual household income** | | | <0.0001 |
| <$25000 | 47.7 (58823) | 20.3 (7584) | |
| $25000 to $4999 | 26.5 (33630) | 19.2 (8082) | |
| $50000 to 74999 | 10.1 (13690) | 13.9 (5637) | |
| $75000+ | 15.7 (22069) | 46.7 (16533) | |
| **Employment status** | | | 0.06 |
| Employed | 60.8 (89499) | 61.8 (28003) | |
| Unemployed | 39.2 (63713) | 38.2 (17331) | |
| **Healthcare coverage** | | | <0.0001 |
| Present | 70.2 (114357) | 91.1 (42258) | |
| Absent | 30.8 (40417) | 8.9 (3556) | |
| **Diabetes** | | | <0.0001 |
| Yes | 11.2 (20589) | 8.7 (4544) | |
| No | 88.8 (132318) | 91.3 (40884) | |
| **State-level** | | | |
| **State criminalizing policy** | | | <0.0001 |
| Low criminalizing | 42.4 (69226) | 53.8 (26790) | |
| Medium criminalizing | 22.3 (46314) | 32.0 (14693) | |
| Higher criminalizing | 35.2 (40181) | 14.1 (4620) | |
| **State Inclusionary policy** | | | <0.0001 |

| Characteristics | Latin American (*n* = 155721) | Asian American (*n* = 46103) | *p*-value |
|---|---|---|---|
| | % (weighted frequency), *n* | | |
| High inclusion | 63.1 (70257) | 68.9 (28179) | |
| Medium inclusion | 23.5 (48761) | 16.8 (8554) | |
| Low inclusion | 13.4 (36703) | 14.3 (9370) | |
| **State foreign-born** | | | <0.0001 |
| Low foreign-born | 16.7 (56985) | 14.9 (12169) | |
| Moderate foreign-born | 34.6 (50672) | 27.1 (11950) | |
| Higher foreign-born | 48.7 (48014) | 58.0 (21968) | |

*Note*. Percentage for state criminalizing and inclusive policy category is based on weighted frequency. See result section for percentage based on unweighted frequency.

**Figure 5** presents the age-adjusted predicted probabilities of T2DM by criminalizing policy for the overall full sample consisting of both Latin American and Asian American. Overall, among Latino and Asian Americans in states with high criminalizing policies, predicted T2DM was 11% compared to 10% in states with low criminalizing policies. **Figure 6** presents the age-adjusted predicted probabilities of T2DM by criminalizing policy for Latino and Asian American separately. Among Latin American origin adults, the predicted probability of T2DM was the same (11%) in high criminalizing policy states vs. low criminalizing policy states. Among Asian American adults, the predicted probability of T2DM was 8% in high criminalizing states vs 9% in low criminalizing policy states.

**Figure 5. Age-Adjusted Predicted Probabilities of T2DM by Criminalizing Policy Level, Among Latin and Asian Americans, BRFSS 2014-2018**

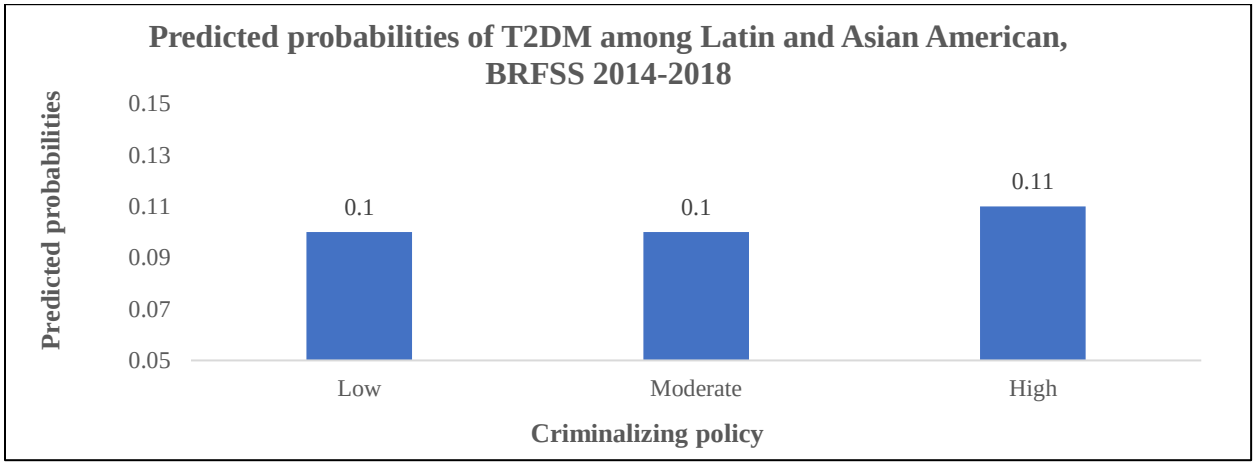
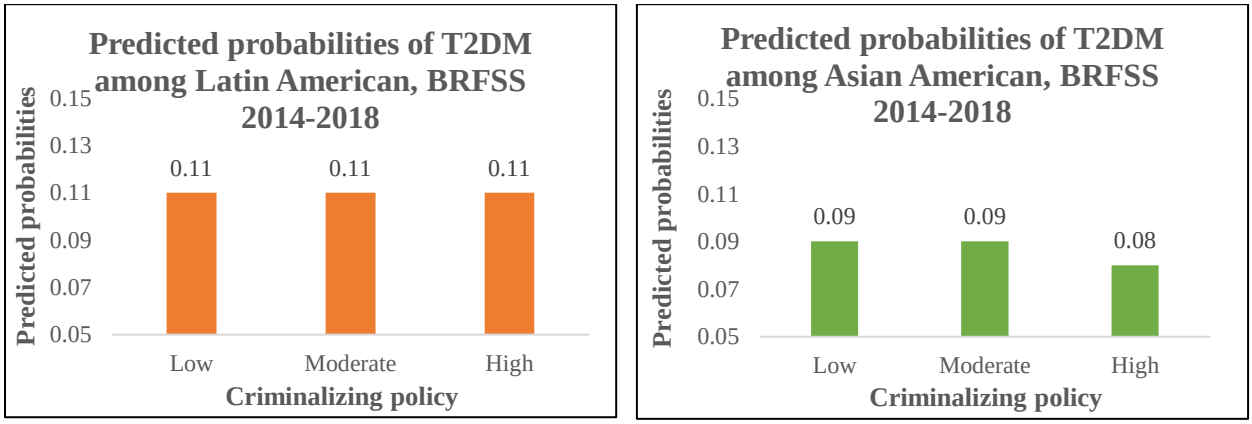



**Figure 6. Age-Adjusted Predicted Probabilities of T2DM by Criminalizing Policy in Latin Americans (Left) and Asian Americans (Right), BRFSS 2014-2018**




We computed the intraclass correlation coefficient (ICC) to indicate how much of the total variation in the prevalence of T2DM is accounted for state-level predictors. In multilevel modeling with dichotomous outcomes, there is assumed to be no error at level 1, therefore, a slight modification is needed to calculate the ICC. This modification assumes the dichotomous outcome comes from an unknown latent continuous variable with a level-1 residual that follows a logistic distribution with a mean of 0 and a variance of 3.29 (Ene et al., 2015; O'Connell &

McCoach, 2008; Snijders & Bosker, 1999). Therefore, 3.29 was used as our level-1 error variance in calculating the ICC. Following is the calculation of the ICC.

$ICC = \tau_{00} / (\tau_{00} + 3.29)$

Here,

$\tau_{00}$ = level-2 error variance = 0. 09681

3.29 = level-1 error variance

So, ICC = 0. 09681/(0. 09681+3.29)

= 0. 09681/3.38681

= 2.9%

This indicates that approximately 2.9% of the variability in the prevalence of T2DM is accounted for by the states in our study, leaving 97.1% of the variability to be accounted for by the participants or other unknown factors. We also computed intraclass correlation coefficient (ICC) in the fully adjusted model for inclusive policy in Latinos. Results show that the same (2.9% ) variability in the prevalence of T2DM is accounted for by the states.

**Table 8** displays the association between state-level criminalizing immigration policy and the prevalence of T2DM in the overall sample and Latino and Asian American adults separately (stratified analysis). Overall, results indicated that in the unadjusted model (Model 1), the odds of T2DM among Latino and Asian Americans living in high criminalizing states was equal the odds of T2DM among Latin and Asian Americans living in low criminalizing states (odds ratio [OR]: 1.00, 95% confidence interval [CI]: 0.77–1.31). The association was not statistically significant (*p*-value >0.05). This association was strengthened when model adjusted for individual and state level covariates (Model 3) but the results did not reach statistical significance (OR = 1.20, 95% CI: 0.97-1.48, *p*-value >0.05).

**Table 8** also shows stratified analysis of state-level criminalizing policy and T2DM by race/ethnicity (*p*-value for interaction = 0.01). In the unadjusted model (Model 1), among Latinos, those who live in high criminalizing policy states had equal odds of T2DM compared to Latinos lived in the low criminalizing policy states (OR = 1.00, 95% CI: 0.77-1.31). This association was not statistically significant (*p*-value >0.05). In fully adjusted models (Model 3), the results did not reach statistical significance (OR = 1.21, 95% CI: 0.79-1.83, *p*-value >0.05). Asian Americans showed a similar pattern of higher T2DM for those living in the high criminalizing policy states vs. low criminalizing policy states. However, the strength of the association was less pronounced for Asian Americans. For example, although unadjusted models showed lower odds of T2DM for the high vs. low criminalizing policy (Model 1: OR = 0.87, 95% CI: 0.68-1.12), the direction of association was reversed in the fully adjusted model (Model 3: OR = 1.16, 95% CI: 0.75-1.79) but of lower intensity than adults of Latin American origin. Results also did not reach statistical significance (*p*-value >0.05).

**Table 8. Association of State-Level Criminalizing Immigrant Policy and Prevalence of T2DM in the Overall Sample, Latin American, and Asian American Adults, BRFSS 2014-2018 (*n* = 201824)**

| State Criminalizing Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Overall | | | |
| High criminalizing | 1.00 (0.77, 1.31) | 1.20 (0.88, 1.65) | 1.20 (0.97, 1.48) |
| Medium criminalizing | 1.06 (0.88, 1.27) | 1.08 (0.89, 1.31) | 1.09 (0.94, 1.26) |
| Low criminalizing | Ref. | Ref. | Ref. |
| Latin Americans | | | |
| High criminalizing | 1.00 (0.77, 1.30) | 1.20 (0.62, 2.32) | 1.21 (0.79, 1.83) |
| Medium criminalizing | 1.10 (0.90, 1.34) | 1.08 (0.88, 1.33) | 1.09 (0.92, 1.29) |
| Low criminalizing | Ref. | Ref. | Ref. |

| State Criminalizing Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Asian Americans | | | |
| High criminalizing | 0.87 (0.68, 1.12) | 1.10 (0.83, 1.46) | 1.16 (0.75, 1.79) |
| Medium criminalizing | 0.90 (0.70, 1.17) | 0.94 (0.73, 1.22) | 1.03 (0.76, 1.39) |
| Low criminalizing | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (T2DM) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus percent of foreign-born in a state; OR=Odds Ratio; CI=Confidence interval.

**Figure 7** presents the age-adjusted predicted probabilities of T2DM for the overall full sample consisting of both Latin American and Asian American origin adults by inclusive policy. Overall, among Latinos and Asian American in states with low inclusive policy, 10% were predicted to report T2DM, compared to 11% in states with high inclusive policy. **Figure 8** presents the age-adjusted predicted probabilities of T2DM by inclusive policy for the Latinos and Asian American separately. Among Latinos in states with low inclusive policy, 11% were predicted to report T2DM, compared to 12% in states with high inclusive policies. Among Asian American, in states with low inclusive policy, 8% were predicted to report T2DM, compared to 9% in states with high inclusive policies.

**Figure 7. Age-Adjusted Predicted Probabilities of T2DM by Inclusive Policy Level, Among Latin and Asian Americans, BRFSS 2014-2018**

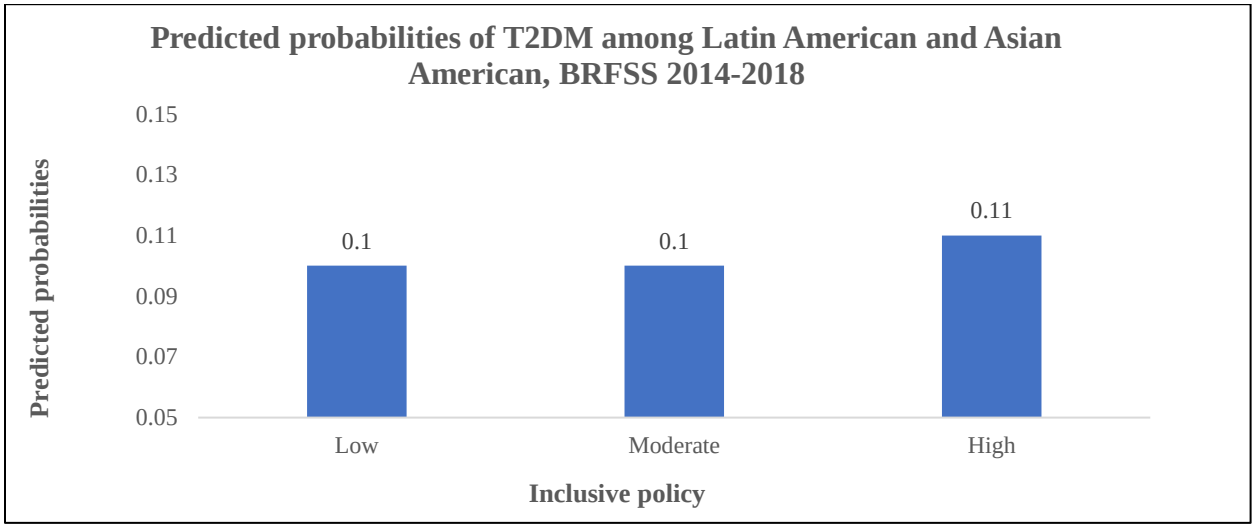
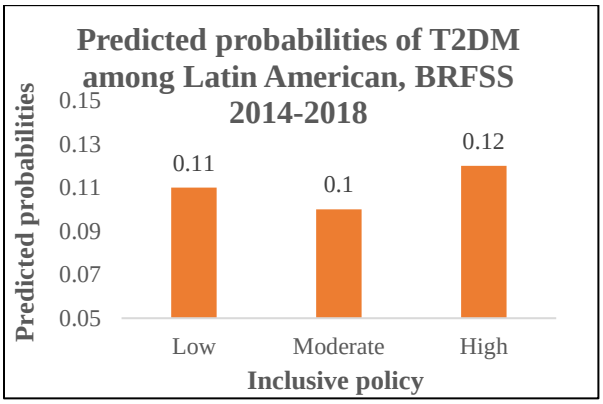



**Figure 8. Age-Adjusted Predicted Probabilities of T2DM by Inclusive Policy in Latin Americans (Left) and Asian Americans (Right), BRFSS 2014-2018**



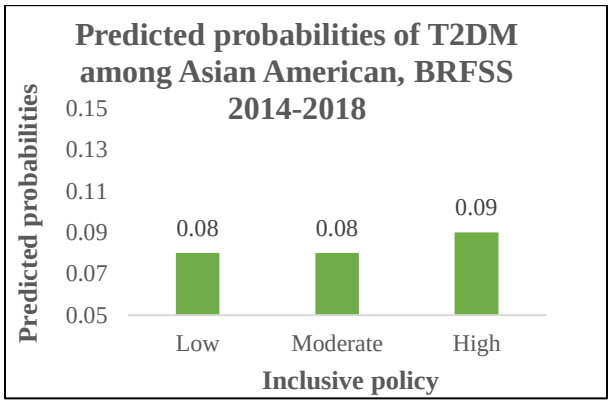




**Table 9** displays the association of state-level inclusive immigrant policy and prevalence of T2DM in overall sample, and Latin American and Asian American origin adults separately (stratified analysis). Overall, results indicated that in the unadjusted model (Model 1), the odds of T2DM among Latinos and Asian Americans living in low inclusive states was 0.88 times the odds of T2DM among Latinos and Asian Americans living in high inclusive states (odds ratio

(OR): 0.88, 95% confidence interval (CI): 0.71–1.09). The association was statistically non-significant (*p*-value >0.05). This association was reversed when model adjusted for individual and state level covariates (Model 3) and became statistically significant. More specifically, in the fully adjusted models, the odds of T2DM among Latinos and Asian Americans living in low inclusive states was 1.22 times the odds of T2DM Latinos and Asian Americans living in high inclusive states (OR = 1.22, 95% CI: 1.05-1.43, *p*-value <0.05).

**Table 9** also shows stratified analysis of state-level inclusive policy and T2DM by race/ethnicity (*p*-value for interaction = 0.98). In the unadjusted model (Model 1), among Latinos, those lived in the low inclusive policy states had lower odds of T2DM compared to Latinos lived in the high inclusive policy states (OR = 0.78, 95% CI: 0.63-0.97, *p*-value <0.05). This association was reversed in the fully adjusted model (Model 3) and the results became statistically significant. More specifically, in the fully adjusted model, among Latinos, those lived in the low inclusive policy states had 1.21 times the odds of T2DM compared to Latinos living in high inclusive states (OR = 1.21, 95% CI: 1.03-1.43, *p*-value <0.05). Asian Americans showed a similar pattern of higher T2DM for those lived in the low inclusive policy states vs. high inclusive policy states in the fully adjusted model (Model 3) (OR = 1.14, 95% CI: 0.85-1.51). However, strength of the association were less pronounced for Asian Americans and results also did not reach statistical significance (*p*-value >0.05).

**Table 9. Association of State-Level Inclusive Immigrant Policy and Prevalence of T2DM in the Overall Sample, and Latin American and Asian American Adults, BRFSS 2014-2018 (*n* = 201824)**

| State inclusive Policy | Model 1<br>OR (95% CI) | Model 2<br>OR (95% CI) | Model 3<br>OR (95% CI) |
|---|---|---|---|
| | Overall | | |
| Low inclusion | 0.88 (0.71, 1.09) | 1.13 (0.99, 1.28) | 1.22 (1.05, 1.43)* |
| Medium inclusion | 0.97 (0.72, 1.31) | 1.01 (0.81, 1.25) | 1.01 (0.84, 1.22) |
| High inclusion | Ref. | Ref | Ref. |
| | Latin Americans | | |
| Low inclusion | 0.78 (0.63, 0.97) | 1.12 (0.98, 1.28) | 1.21 (1.03, 1.43)* |
| Medium inclusion | 0.84 (0.63, 1.13) | 1.00 (0.82, 1.23) | 1.01 (0.83, 1.22) |
| High inclusion | Ref. | Ref. | Ref. |
| | Asian Americans | | |
| Low inclusion | 0.76 (0.59, 0.97) | 0.95 (0.78, 1.14) | 1.14 (0.85, 1.51) |
| Medium inclusion | 0.75 (0.53, 1.05) | 0.89 (0.68, 1.17) | 0.95 (0.72, 1.25) |
| High inclusion | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (T2DM) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus percent of foreign-born in a state; OR=Odds Ratio; CI=Confidence interval; *= *p*-value <0.05.

Our goodness of fit statistics results show that the value of the Pearson Chi-Square divided by its degrees of freedom was changed from 1.67 in the unconditional model (with no predictor) to less than 1 (0.98) in the fully adjusted model for inclusive policy context and T2DM association. A *p*-value was not computed for the Pearson Chi-Square statistics; however, a

Pearson Chi-Square divided by its degrees of freedom that is approximately equal to 1 was an indication of a good model fit. Other model fit statistics such as, -2 log likelihood (deviance), AIC, and BIC, all were reduced in the fully adjusted model compared to the unconditional model. This suggests that predicting prevalence of T2DM with the fully adjusted model was a better fit to the data than predicting prevalence of T2DM with the unconditional model.

We also performed sensitivity analysis where we replaced our state-level covariate percent of foreign-born in a state with a percent of Latino and Asian foreign-born in the stratified analysis. Results of sensitivity analysis can be found in *Appendix A*. We found the same pattern and associations for state-level criminalizing policy context and T2DM with no associations being significant in the overall and stratified analysis. We also found same pattern and significant associations for state-level inclusive policy and T2DM for the overall sample. Stratified analysis for race/ethnicity showed similar but less pronounced associations for Latino low vs. high inclusive policy states and the associations became non-significant in the fully adjusted model. The was no associations for Asian living in low vs. high inclusive policy states and T2DM.

To reiterate, while fitting model with percent of Latino and Asian foreign-born in a state we lost 9 clusters/states from our sample because of unavailability of the percent of Latino and Asian foreign-born estimates in those states in the ACS data. Previous research on multilevel methods suggest at least 50 groups to produce valid estimates for multi-level logistic regression models (Moineddin et al., 2007; Paccagnella, 2011). General estimates may produce biased results and standard errors in two level multilevel logistic regression models if the number of clusters is not at least 50 (Ali et al., 2019; Hox & McNeish, 2020; Leyland & Groenewegen, 2020b; Maas & Hox, 2005). Additionally, research questions impact the number of contextual

level units needed. Contextual level units or cluster size is specially a concern if research question examines the association of contextual level predictors and individual level outcome. In this study, the research question was about the association of immigrant policy context in states and prevalence of T2DM. As a result, we need a sufficient number of states to estimate associations between state characteristics and health, which we did not have in sensitivity analyses (Leyland & Groenewegen, 2020b).

## Discussion

In this study, we sought to understand the associations between state-level immigrant inclusive and criminalizing policies and T2DM, and whether these associations varied between Latin American and Asian American origin adults. The study showed that approximately 2.9% of the variability in the prevalence of T2DM is accounted for by the states. Age-adjusted predicted probability showed that among Latinos and Asian American in low inclusive policy states had lower predicted probability of T2DM compared to states with high inclusive policy. However, in the multilevel model, in the full sample, the study observed that Latino and Asian Americans living in low inclusive policy states had significantly higher odds of T2DM in the fully adjusted model. When models stratified by race/ethnicity, this pattern of significant higher odds of T2DM remained for Latinos in the fully adjusted model. Results were less pronounced and statistically non-significant for Asian Americans in the fully adjusted models.

Age-adjusted predicted probability also showed that among Latino and Asian Americans in living states with high criminalizing policies had higher predicted probability of T2DM compared to living in states with low criminalizing policies. In the multilevel model, in the full sample, Latino and Asian Americans living in high criminalizing policy states had higher odds of T2DM in the fully adjusted model. However, the results were not statistically significant. When

models stratified by race/ethnicity, this pattern of higher odds of T2DM remained for Latinos. Results were less pronounced for Asian Americans. Also, models for the stratified analysis were statistically non-significant for both groups.

Our work on state-level anti-immigrant policy among Latinos and Asian American differs in critical ways from existing studies. We used a composite index comprised of state-level immigration policies (Almeida et al., 2016; De Trinidad Young et al., 2018; Dondero & Altman, 2020; Young et al., 2019), rather than individual-level measures. While these studies used both inclusionary and criminalizing policies as a global measure, they did not examine the impact of the inclusive and criminalizing policy context separately. This is important given that although state criminalizing and inclusive immigrant policies coincide, the two capture are different contexts (De Trinidad Young & Wallace, 2019). Moreover, none of these studies have examined the effect of inclusive and criminalizing policy context on any particular health outcome.

Our results are consistent with previous studies on immigrant policies in self-rated health (W. D. Lopez et al., 2017; Young et al., 2022), mental health outcomes (Hatzenbuehler et al., 2017; Nichols et al., 2018; Vargas et al., 2017; Wang & Kaushal, 2019), obesity (Torres et al., 2018), food security (Potochnick et al., 2017), preterm birth (Sudhinaraset et al., 2021), and HIV vulnerability (Galeucia & Hirsch, 2016) that included individuals from marginalized groups. These studies similarly documented the negative health consequences of exposure to immigrant policies that constrain opportunities. However, none of these studies examined the impact of state-level inclusive and criminalizing policy context on T2DM among Latin American and Asian American origin populations, reflecting an important gap in this area of public health research.

Low-inclusive or exclusionary immigration policies may have various, intricate effects on chronic health outcomes, including an increase in stress. For example, states such as Georgia and Alabama take exclusionary approaches to immigrants' eligibility to public programs such as Medicaid (health insurance program for low income individuals) and food stamps (Wallace & Young, 2018). Exclusionary policy climates may also impact utilization of health services in immigrants and marginalized population (D. Becerra et al., 2015). For example, exclusionary policy coupled with poverty, low English proficiency, uninsurance may cause underutilization of health services among Latinos to varying degrees (Alegría et al., 2007; D. Becerra et al., 2015). As a result of underutilization of health services, immigrants and Latinos suffer from delayed care, lack of preventative care and screening (Dondero & Altman, 2020; Stone et al., 2007). Furthermore, exclusionary immigrant policy found to decline educational attainment in immigrant adolescent and create a perception of persistent threat and deprivation (Barajas-Gonzalez et al., 2021; Ee & Gándara, 2020; Kirksey & Sattin-Bajaj, 2021). Especially, students experience negative behavioral changes (anxiety and difficulty in concentrating on schoolwork) if their parents are in threat of deportation which in turn produces stress among their parents (Rodriguez et al., 2022).

Although it is yet unknown which specific subgroups of people are more prone to physiological reactions brought on by stress, a significant amount of evidence indicates links between the role of context, stress, and T2DM (Björntorp, 1997; Galicia-Garcia et al., 2020; Mezuk, 2009; Skyler et al., 2017). Immigrants and racial/ethnic marginalized people live in social and economic disadvantages due to low inclusive environments that restrain their access to education, employment, income and health coverage (Perreira & Pedroza, 2019; Young et al., 2020). Coping with these disadvantages can be stressful and make them psychologically

vulnerable (Björntorp, 1997). For example, they may experience feelings of hopelessness or anxiety, particularly in the context of social isolation or poverty (Lloyd et al., 2005). Over the long term, living under stressful conditions impacts the physiology of the body through the activation of the stress response. This stress response leads to activation of hypothalamic-pituitary-adrenal axis or HPA axis to release of additional cortisol that induces insulin resistance-the main feature of type 2 diabetes (Galicia-Garcia et al., 2020; Thau et al., 2022).

We found significantly higher odds of T2DM for Latino adults living in low inclusive policy states but results were less pronounced and non-significant for Asian American adults in the fully adjusted models. This finding indicates that Latinos appear to be at greater disadvantage than Asian Americans when it comes to exclusionary policy environment and T2DM. Although both Latinos and Asian Americans share many similar experiences, such as distinct languages across subgroups and experience varying levels of acculturation, they differ considerably in respect to socioeconomic status particularly education, income, health insurance coverage. Asian Americans surpass Latin American origin adults in these aspects and attain higher average levels of formal education that drive them towards a similarly higher degree of occupational status and income earnings (Zhou & Gatewood, 2007). Moreover, Asian Americans are more likely to work in jobs that offer private insurance (e.g., computer, engineering, or technical occupations) in contrast to Latino employees who are highly concentrated in the construction, lodging services, and retail trade industries that leaves them at greater risk of uninsurance (Alegría et al., 2006). Furthermore, the legislative acts of 1996 (PRWORA) eliminated safety nets for new immigrants and appears to have affected Asian immigrants differentially by easing the process of immigration for skilled and educated migrants who are more likely to have access to private insurance (E. Park & Park, 2005). Overall, this study found that immigrant policies that fostered

a less inclusive climate that includes reduced access to quality education, health care access, and housing, civic participation and equitable employment opportunities most likely affect Latin American origin adults (Hwang & Goto, 2008; Kandula et al., 2007). However, limitations apply to Asian Americans finding. Aggregated data may mask differences among Asian subgroups. Further investigation is needed to focus on the role of the policy context on meeting recommended PA in Asians among subgroups and over time. Other reasons such as being a newer immigrant group, much more varied in social profiles, sample size issues may also play a role in findings.

We also observed that overall Latino and Asian Americans living in high criminalizing policy states had higher odds of T2DM than Latin and Asian Americans living in low criminalizing policy states. However, this association was not significant. When the model was stratified by race/ethnicity, we observed higher odds of T2DM for Latin Americans living in high criminalizing policy states but this finding was less pronounced for Asian American group. Also, all of these associations were statistically non-significant. This conclusion may be explained, in part, by the fact that, over time, Latinos have been the primary target of criminalizing laws, with occasional anti-Asian rhetoric (Ybarra et al., 2016). Because of this, there may have been widespread exposure to xenophobia that did not significantly differ between states. Therefore, it is probable that the overall national context of criminalizing in relation to T2DM outweighs state-level action, diminishing the significance of state variation. Other elements, such as the legal status of the immigrants and Latinos and Asians and the duration of their stay in the US, may also be at play.

## Strengths and Limitations

Our findings contribute to the growing body of research on state-level immigrant policy and T2DM, examining the relationship between state-level policies and health in a multi-race/ethnic sample. This study also had a number of methodological strengths. In particular, we used population-based data from all states in the US and objective indicator of separate policy climate surrounding Latinos and Asians. Because these contexts did not rely on self-report perceptions of Latinos and Asians about the policy climate in their state, we minimized confounding with T2DM status (e.g., individuals with T2DM could be more likely to perceive a negative social climate). This approach overcomes the limitations associated with in same-source bias, which can create spurious associations when the exposure and outcome are both measured via the same method (i.e., self-report). Additionally, in linking the existing policy dataset at the state level to individual-level T2DM outcomes, our study employed multilevel modeling to avoid ecologic fallacy and to capture the contribution of immigrant policy contexts on the prevalence of T2DM while controlling for individual and state level factors (Haneuse & Bartell, 2011).

The results for this study should be considered in light of several limitations. First of all, the study is cross-sectional and does not test a causal association between immigrant policy and T2DM. Although we controlled for potential confounders at the individual and state level, it is possible that an unmeasured common factor may be responsible for the observed relationship between policy contexts and T2DM among Latinos and Asians. Secondly, the BRFSS dataset does not provide information on immigration status, so we were unable to examine relationships between state policies and T2DM of Latino and Asian immigrant or undocumented residents. Most US national surveys does not measure the documentation statuses of immigrants. In addition, we argue that anti-immigrant policies create harmful climates for all Latinos and

Asians, irrespective of their immigration status. Moreover, to capture nativity status, we calculated percent of the state population that is foreign-born from ACS data and included it as a contextual covariate in our study. Thirdly, our study did not examine variation in T2DM prevalence by ethnic groups among Latin and Asian Americans. Evidence suggests that ethnic differences in T2DM are present among Asian and Latin Americans (J. E. Rodríguez & Campbell, 2017; Shah et al., 2022). Future studies should examine relationship between immigrant policy and within-group variations in chronic health condition or T2DM. Fourthly, this analysis was unable to consider migration patterns between states and length of state residency in a state; migration patterns among immigrants are not random and could influence the policy exposure of interest and subsequently T2DM prevalence. This study was cross-sectional in nature and did not have mobility variable. Future studies should consider this factor. Finally, this study makes use of an important data source BRFSS, however, it is a complex probability sample and the estimates using this dataset have been produced may be slightly biased because it applies weight to our policy score which was unweighted.

## Conclusion

This study demonstrates unequal distribution of diabetes across states as a result of low-inclusive or exclusionary immigrant policies. Such policies may be advanced at the discretion of state policymakers and inaction itself is a form of exclusion. As the federal government pursues ever-more exclusive policies, inclusive immigrant policies can promote welcoming social environments that improve health outcomes for immigrants in general and for Latinos more specifically.

# CHAPTER V: THE ASSOCIATION BETWEEN STATE-LEVEL IMMIGRANT POLICIES AND PREVALENCE OF MEETING RECOMMENDED PHYSICAL ACTIVITY (PA) IN PEOPLE OF LATIN AMERICAN AND ASIAN AMERICAN ORIGIN: A WEIGHTED MULTILEVEL ANALYSIS

## Introduction

Physical activity has been characterized as a wonder pill because of the substantial benefits it has on both physical and mental health (McNally, 2020; Piercy et al., 2018; van der Ploeg & Bull, 2020; Vuori et al., 2013). The 2018 Physical Activity (PA) Guidelines Advisory Committee Scientific Report recommends that adults should perform at least 150 minutes of moderate intensity physical activity throughout the week or do at least 75 minutes of vigorous intensity aerobic physical activity throughout the week or an equivalent combination of both (Piercy et al., 2018). Regular physical activity improves overall health, and also helps to reduce chances of developing depression, obesity, hypertension, diabetes, and heart disease, cancer, bone and joint disease (Blair, 2009; Lobelo et al., 2018; Piercy et al., 2018; Vuori et al., 2013; Warburton et al., 2006a). According to the CDC, about 110,000 deaths could be prevented if US adults increased moderate-to-vigorous physical activity by even just 10 minutes per day (CDC, 2022; Piercy et al., 2018). The economic toll of inadequate physical activity is not low and linked to approximately $117 billion in annual health care costs (Piercy et al., 2018).

Across the United States, racial and ethnic minorities are less likely to meet the federal recommendations for physical activity (Fulton, 2020; Piercy et al., 2018). People of Latino origin have the highest prevalence of not meeting recommended physical activity (31.7%) putting them in danger of health issues ranging from cardiovascular health risks to cancer (Centers for Disease Control and Prevention/Division of Nutrition, 2022; Fulton, 2020). Additionally, Asian

Americans have lower physical activity levels compared to other racial and ethnic groups but data are sparse (Chen et al., 2017; Yi et al., 2015). Latin American and Asian American origin adults are the two fastest growing racial/ethnic groups in the United States. By 2060, the number of U.S. Latinos and Asians is projected to rise to around 111.0 and 35.8 million, respectively, more than double what it is today (Budiman & Ruiz, 2021b; Colby & Jennifer, 2015; US Census Bureau, 2018). Despite the growing national-level prominence of Latinos and Asian Americans, research on physical activity among them is still limited.

Individual characteristics like low socioeconomic standing (e.g., low education and income), cultural barriers, psychosocial factors such as low self-efficacy, limited English language proficiency, lack of time, and safety concerns have been identified as important correlates of PA in immigrants and people with marginalized status (Castañeda et al., 2015; Crespo, 2000; Eyler et al., 2002; Keller & Fleury, 2006; Seefeldt et al., 2002). Despite their considerable contributions, individual characteristics have not fully explained the gap in PA that exists among immigrants and racial and ethnic marginalized groups (J. Y. Choi, 2009; Marshall et al., 2007). Focusing solely on individual level factors may overlook the impact of broader contextual factors which might explain why PA is lower among them.

Over the years, a growing literature has highlighted the importance of contextual effects in understanding social inequalities in health (Diez-Roux, 1998; Kawachi, 2002). To capture contextual correlates of PA, a growing body of literature has concentrated on the role of neighborhood cohesion (Douglas et al., 2018; S. Echeverría et al., 2008; Fisher et al., 2004; S. M. Martinez, 2009; Murillo et al., 2016; Pickett & Pearl, 2001; Vasquez et al., 2018) and residential segregation (Corral et al., 2014; Mellerson et al., 2010; Osypuk et al., 2009; Wen & Maloney, 2011) on PA. Findings support that higher neighborhood cohesion may be an

important factor for PA promotion and residential segregation may have deleterious effect on levels of physical activity among Latinos. However, neighborhood cohesion and residential segregation are downstream products of larger contextual factor such as immigrant policies that limits or enhance immigrant and racial/ethnic marginalized population's rights, resources, and sense of security in everyday life (Perreira & Pedroza, 2019; Wallace et al., 2019).

Contextual determinants such as immigrant policies include laws, regulations, and court rulings that generate rights and opportunities for labor and employment, education, healthcare, housing, and social welfare based on an immigrant's legal status (De Trinidad Young et al., 2018; Wallace et al., 2019; Wallace & Young, 2018). State-level immigrant policies can extend rights to categories of immigrants excluded by federal policies and provide them access to resources (Young et al., 2020). For example, in some states undocumented immigrants have the ability to attain higher education as a result of inclusive state policy environments. In contrast, some states can reinforce federal policies that exclude or restrict immigrant rights and marginalize low-income immigrants (Perreira & Pedroza, 2019). Some of these restrictive policies are criminalizing because they reinforce restriction on immigrants and racial/ethnic minority through active surveillance by law enforcement, sentence laws for minor infraction, regulate driver's license qualification and mandate employment authorization (Young et al., 2020, 2022). However, inclusive and criminalizing policies capture distinct context and both should be tested separately in public health research (Alberto et al., 2020; De Trinidad Young & Wallace, 2019; Sudhinaraset et al., 2021).

While restrictive and criminalizing policies primarily harm undocumented immigrants, they also have chilling effects on non-citizens (those with temporary and permanent legal status and those with mixed family status; (Aranda & Vaquera, 2015; Asad & Clair, 2018; Batalova,

2020; Nichols et al., 2018; Pedraza & Zhu, 2015; Taylor et al., 2011; Young et al., 2020). Furthermore, among Latinos, race or ethnicity and immigration status are commonly confused, and in the public's perception, immigrants from this group are frequently thought to be undocumented (Viruell-Fuentes et al., 2012). This means that, anti-immigrant attitudes foster racism and xenophobia toward all Hispanics and Asians, regardless of immigration status. (Wallace et al., 2019).

While much of the recent research on immigrant policy and health has focused on single policies, it is a state's combination of policies that shape the context of settlement and reinforce attitudes towards immigrants (Hatzenbuehler et al., 2017; Wallace et al., 2019). Understanding the overall climate of state immigrant policies is critical to understanding the factors that shape health among immigrants and the potential variation in health across U.S. states. Moreover, most of the research on immigrant policy contexts have focused on select health outcomes (Hatzenbuehler et al., 2017; Vargas et al., 2017; Young et al., 2022), poverty (Young et al., 2019), healthcare inequities and utilization (Heyman et al., 2009; Young et al., 2020), food security (Potochnick et al., 2017), birth outcome (Sudhinaraset et al., 2021) and infectious diseases (Galeucia & Hirsch, 2016). Little is known about the influence of immigrant policy context on physical activity, a prime health-promoting behavior associated with reduced risk of chronic diseases.

Immigrants represent groups with distinct political histories, levels of integration (acceptance), cultural norms and socioeconomic background. (Hasanali et al., 2016; Oh et al., 2022). Although Latinos and Asians make up more than 80 % of the U.S. immigrant population, are racialized groups, and share varying immigration status (i.e. foreign-born vs. US-born), and acculturation processes (Alegría et al., 2006; Greenstone & Looney, 2010; Kiang et al., 2017;

Schwartz et al., 2010), they exhibit differences in several ways (Alegria et al., 2004; Kiang et al., 2017). For example, data shows that prevalence of educational attainment of high school or more is greater in Asian American than Latin American origin population (84% vs. 53%) (Gonzalez-Barrera, 2015; Grieco et al., 2012; Hasanali et al., 2016). Similarly, Latin Americans lag behind Asians in terms of median family income ($38,238 vs. $63,777) (Grieco et al., 2012; Hasanali et al., 2016). Consequently, they differ in terms of health care access. Census data shows that uninsurance rate among Latinos (17.7%) is nearly three times higher than Asian American population (5.8%) (Branch & Conway, 2021).

Latinos and Asian Americans also differ socio-culturally. For instance, data showed that 43% of all Latinos lived in Census tracts with a Latino majority compared to 11 % of all Asians who lived in Asian-majority Census tracts (Pew Research Center, 2012). Furthermore, the percentage of undocumented and deported Latinos are higher than Asian Americans. For example, among the undocumented population who are highly racialized as non-White, approximately 72% self-identify themselves as “Hispanic or Latino ” and 16% identify as “Asian” (Center for Migration Studies of New York [CMSNY], 2022). Hence, studying these two racial/ethnic group as one may mask their distinct socioeconomic profiles and health and health behaviors.

There is limited research using population-based data examining the role of immigrant policies on physical activity levels among Latino and Asian Americans. Given that immigrant policy contexts impact education, employment, income, and healthcare access, there may be a significant difference in meeting recommended PA between Latinos and Asian Americans.

The current study investigated the association between immigrant policy context and the prevalence of meeting recommended physical activity among people of Latin American and

Asian American origin and examined the extent to which these associations vary between Latin American and Asian Americans origin adults using multilevel modeling (MLM).

## Method

The study involves a cross-sectional study design utilizing a combined and merged dataset of individual-level measures of race/ethnicity and PA and state-level measures of criminalizing and inclusive immigrant policy. The study conducted a multilevel analysis examining the association between state-level immigrant policy (criminalizing and inclusive) and PA and whether the associations varied between people of Latin American and Asian American origin adults, the two largest immigrant groups in the U.S.

### Data Source

#### *Behavioral Risk Factor Surveillance System*

Data on individual-level demographic characteristics and PA was obtained from the pooled 2015 and 2017 Behavioral Risk Factor Surveillance System (BRFSS) data, a large-scale complex survey with state-level identifiers. The BRFSS is a telephone-based survey (landline and cellular) that provides the state-specific prevalence of health outcomes and health behaviors of the noninstitutionalized U.S. adult population. A full description of the BRFSS survey design, sampling methods, data collection, and statistical weighting can be found elsewhere (CDC/BRFSS, 2021). For purposes of this study, the sample was restricted to adults aged 18 years and older who were not pregnant and self-identified as Latino or Asian American. Nationally, in the U.S., "Latino" is defined as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin (Office of Management and Budget, 1997). Nationally, in the U.S., "Asians" are defined as people with origin in East Asia, Southeast Asia, or the Indian subcontinent, including Cambodia, China, India, Japan, Korea, Malaysia,

Pakistan, the Philippine Islands, Thailand, or Vietnam (Office of Management and Budget, 1997). Based on the eligibility criteria mentioned above, the study included a total of 80516 individuals with demographic and physical activity data. Given that BRFSS is a publicly available dataset, these analyses did not require Institutional Review Board approval.

## State-Level Data Sources

### *Immigrant Policy Data*

For data on state immigrant policy, the study used Young's existing policy dataset that categorized states and the District of Columbia based on the presence of criminalizing and integration policies (De Trinidad Young et al., 2018). Information on each state's policy was identified through a systematic review of secondary data sources on state legislation, administrative regulations, or court rulings (Young et al., 2020). States were coded as having a policy if it was enacted any time before December 31, 2013, a date aligning with the end point of a period of extensive new state-level policy activity. For the purpose of the study, we merged state immigrant policy data with the pooled 2015 and 2017 BRFSS data.

### *American Community Survey Data*

The U.S. Census Bureau has long been a reliable source of socioeconomic and demographic data for ethnic and immigrant populations in the United States (U.S. Census Bureau, 2012). The ACS, conducted by the U.S. Census Bureau, is an annual survey that is intended to give communities timely and accurate demographic, social, economic, and housing data of various population groups, including ethnic and immigrant populations, at the national, state, county, and local levels (U.S. Census Bureau, 2009). Details of the ACS are explained elsewhere (U.S. Census Bureau, 2009). In order to capture the state demographic condition, the

variable ‘percent of the state that is foreign-born’ was obtained from the ACS 2015 and 2017 annual data to be merged with the BRFSS and the immigrant policy data.

## Measures

### State Criminalizing Policy

Data on state criminalizing policy was based on six criminalizing policies (see **Table 10**) (De Trinidad Young & Wallace, 2019). For each policy, a state was coded as 1 – Yes, having the policy, or 0 – No, not having the policy. The policy score was a continuous variable with possible range 0–6 and observed range 1–6. Higher score indicated higher levels of criminalizing policies. From this continuous variable, tertiles of criminalizing policies were derived and classified as low, medium, and high criminalizing policies. Prior studies have used varying approaches to create cut-offs for this criminalizing policy score. Some researchers have used an extreme score while others used a median cut-off (Alberto et al., 2020; Young et al., 2022). In the present study, we examined the distribution of the score empirically and also made a decision on cut-offs given our knowledge of policy context for some states. The study opted to use the cut-off 1 to 3 for low criminalizing policy, 4 for moderate criminalizing policy, and 5 to 6 for higher criminalizing policy.

**Table 10. List of Criminalizing Policies**

| Sector | Policy | Indicator That Policy Exists (Yes = 1; No = 0) |
|---|---|---|
| Identification and licensing | State driver’s licenses | Does the state require a social security number to obtain a driver’s license? |
| | Compliance with the federal Real ID Act of 2005, which sets standards for state licenses and IDs | Does the state comply with Real ID? |

| Sector | Policy | Indicator That Policy Exists (Yes = 1; No = 0) |
|---|---|---|
| Work authorization | Use of employment authorization database, E-Verify | Does the state mandate employers use E-Verify? |
| Immigration enforcement and criminal justice | Law enforcement collaboration with federal enforcement | Does the state fully collaborate with federal immigration authorities? |
| | Law enforcement inquiry about legal status | Does the state require or allow that law enforcement verify individuals' legal status at the time of a stop or arrest? |
| | Sentencing laws | Does the state sentence nonviolent criminal offenses at least 365 d? |

**State Inclusive Policy**

Data on state-inclusive policy was based on 14 policies (see **Table 11**; De Trinidad Young & Wallace, 2019). For each policy, a state was coded as 1 – Yes, having the policy, or 0 – No, not having the policy. The policy score was a continuous variable with possible range 0–14 and observed range 1–14. A higher score indicates a higher level of inclusive policies. From this continuous variable, tertiles of inclusive policies were derived and classified as low, medium, and high inclusive policies. We examined the distribution of the score empirically and also made a decision on cut-offs given our knowledge of policy context for some states. So, we use the cut-off 1 to 4 for low inclusive policy, 5 and 6 for medium inclusive policy, and 7 or more for high inclusive policy.

## Table 11. List of Inclusive Policies

| Sector | Policy | Indicator That Policy Exists (Yes = 1; No = 0) |
|---|---|---|
| Health and social services benefits | State Children's Health Insurance Program (SCHIP) | Does the state provide health insurance to children regardless of legal status? |
| | Medicaid-prenatal care | Does the state provide care to pregnant women regardless of legal status? |
| | Supplemental Nutrition Assistance Program | Does the state count a prorated share of ineligible noncitizen income to determine family eligibility for benefits? |
| Education | In-state college and university tuition | Does the state provide most students in-state tuition regardless of legal status? |
| | Financial aid for colleges and universities | Does the state provide students scholarships or financial aid regardless of legal status? |
| Labor and Employment | Citizenship requirements for peace officers | Does the state require peace officers be citizens? |
| | Citizenship requirements for teachers | Does the state require teachers be citizens? |
| | Worker's compensation | Does the state include undocumented immigrants in the definition of employee? |
| | Extension of protections for agricultural workers | Does the state extend wage and hour protections for agricultural workers? |
| | Extension of protections for domestic workers | Does the state extend wage and hour protections for domestic workers? |
| | Domestic Worker's Bill of Rights | Does the state have a Domestic Worker's Bill of Rights? |
| | Protection against immigration-related employer retaliation | Does the state have laws that protect noncitizen workers from employer retaliation related to their legal status? |
| | Professional licensing of undocumented and DACAmented professionals | Does the state allow licensing of undocumented or DACAmented professionals? |
| Language Access | Payment of interpreters through Medicaid or SCHIP | Does the state pay for interpreters through Medicaid or SCHIP? |
| | English language-only legislation | Does the state have English as the official language? |

**Physical Activity (Dependent Variable)**

The physical activity outcome of this study was measured in the BRFSS by asking participants a series of questions about their weekly physical activities and how much time they spent engaging in each activity. Physical activity in BRFSS is available as a calculated variable classifying participants as meeting the recommended amount of engaging in 150 minutes of physical activity per week. Specifically, it was based on the amount of time participants spent engaging in "active" (≥ 150 min of moderate-intensity activities per week or ≥ 75 min of vigorous-intensity activities per week, or an equivalent combination of both), "insufficiently active" (1–149 min of moderate-intensity activities per week or 1–74 min of vigorous-intensity activities per week), and "inactive (0 minutes of physical activity/week) physical activity per week. For this study, "active" physical activity group was classified as people who "met recommended PA." The "insufficiently active" and "inactive" groups were combined and classified as "did not meet recommended PA."

***Race/Ethnicity***

For the race/ethnicity, BRFSS participants were asked to self-report their identity as "White only non-Hispanic, Black only non-Hispanic, American Indian or Alaskan Native only non-Hispanic, Asian only non-Hispanic, Native Hawaiian or other Pacific Islander only, Non-Hispanic, Other race only, non-Hispanic, multiracial non-Hispanic, Hispanic, and Don't know/Not sure/Refused." For the purpose of this study, all racial/ethnic groups except Latino or Hispanic and Asian only non-Hispanic was excluded.

We included the following individual-level covariates associated with the outcome.

### *Sex at Birth*

The sex at birth of BRFSS participants is self-reported and was classified as male or female.

### *Age*

Age in years was classified as 18–44 years, 45–64 years, and 65 years or over.

### *Educational Attainment*

Educational attainment was classified as having less than a high school diploma, high school diploma, some college, and college degree or more.

### *Employment Status*

Employment status in BRFSS is classified as employed for wages, self-employed, out of work one year or more, out of work less than one year, homemaker, student, retired, or unable to work. For this study, employed for wages and self-employed were grouped into "employed" while out of work one year or more, out of work less than one year, those unable to work, students, retired people, and homemakers were grouped into "unemployed."

### *Healthcare Coverage*

Healthcare coverage was categorized as yes (have healthcare coverage) and no (do not have healthcare coverage).

### *Household Income*

The annual household income level used in this study was classified as earning less than $25,000, $25,000–$49,999, $50,000–$74,999, and $75,000 or more.

## State-Level Covariates

### Percent of State Foreign-Born

The BRFSS data does not include individual-level nativity status, and it is an obvious fact that all Latinos and Asians are not immigrants. However, evidence suggests that criminalizing policies' harmful effects can extend beyond their stated target to affect U.S. citizens, authorized and mixed-family status immigrants (Almeida et al., 2016; Aranda & Vaquera, 2015; Moya & Shedlin, 2008; Sabo & Lee, 2015; Taylor et al., 2011; Viruell-Fuentes et al., 2012). Hence, these policies negatively affect all Latinos and Asians, irrespective of their immigration status. Nonetheless, the percent of the state population that is foreign-born was calculated from ACS data and included as a contextual covariate in the complete dataset. For ease of interpretation, from the continuous version of the percent foreign-born, tertiles were derived to classify states as having a low, medium, or high percentage of foreign-born individuals.

### Statistical Analysis

The combined and merged dataset with individual-level measures of race/ethnicity and PA (BRFSS), state-level measures of immigrant policy (existing policy dataset), and percent of foreign-born (ACS dataset) was used for the criminalizing and inclusive policy and PA outcome. The statistical analysis for immigrant policy and recommended PA association for criminalizing and inclusive policy was the same since PA was dichotomized. Hence, the analytic description applies to criminalizing and PA association and inclusive policy and PA association.

The first research question was to understand the relationships between state-level criminalizing policies and the prevalence of recommended PA among people of Latin American and Asian American origin adults. PROC GLIMMIX was used to fit a weighted multilevel model to this data (Ene et al., 2015). Sampling probabilities and individual-level weights were

incorporated into the model to draw valid inferences in the population of interest. The point of note here is that BRFSS and other publicly available data do not include weights for each level of analysis. Rather, they include a single overall individual (level-1) weighting variable that incorporates state (level-2) design issues. Therefore, level-2 weight in our analysis was not necessary.

Additionally, to subsample or stratify the data by Latin American and Asian American group, we created a revised weight variable for our group of interest because we cannot just remove other individuals from the BRFSS data as it is a complex survey (removing others would provide inaccurate standard errors and parameter estimates). We did this by maintaining weights where race was Latin American and Asian American, and pregnancy status was non-pregnant, and set others to virtually zero (Lewis, 2013). Missing data on the outcome PA assumed to be missing at random. Multicollinearity assessment ensured that none of the independent variables were strongly associated with each other.

Analytic sample descriptive statistics was generated for the variables of interest and tested for differences by race/ethnicity using chi-square ($\chi^2$) tests. Data on variables were expressed as percentages (based on weighted frequency) and frequency for the categorical variables. We also reported criminalizing policy and inclusive policy percentage by race/ethnicity using chi-square ($\chi^2$) test based on unweighted frequency and estimates were lower than weighted frequency.

We also calculated and plotted predicted probabilities of meeting recommended PA by criminalizing and inclusive policy using SAS-callable SUDAAN. We tested differences in the predicted probability of meeting recommended PA by criminalizing policy in states with high criminalizing compared to low criminalizing policies for the full population and for Latinos and

Asians, separately. We also tested differences in the predicted probability of meeting recommended PA by inclusive policy in states with low inclusive compared to high inclusive policies for the full population and for Latinos and Asians, separately.

The model-building process began with the empty, unconditional model (random intercept model) with the outcome (PA) but no predictors. This model provided information about how much of the total variation in the prevalence of recommended PA is accounted for by the states (through the calculation of intraclass correlation coefficient or ICC). Next, to examine the effect of state-level criminalizing and inclusive policies on the prevalence of PA, the model-building process was continued by including state-level criminalizing (or inclusive) policies as the main predictor in an unadjusted or crude model (Model 1) followed by models that adjusted for individual-level covariates (age, sex at birth, race/ethnicity, education, employment, health insurance, and income) in Model 2 and state level covariate in Model 3. Here, to account for the clustering of data by state, U.S. states was included as a random intercept; that included all 50 states and the District of Columbia. As the effect of the predictors was modeled as fixed or constant across states, this represented a random intercept-only model.

Finally, to examine the extent to which the effect of criminalizing or inclusive policies on the prevalence of the outcome (PA) varies between Latinos and Asian Americans, the model-building process was continued by constituting a two-way interaction term (cross-level interaction) between criminalizing (or inclusive) policy and race/ethnicity (Latino and Asian American). The Chi-square test was used to estimate the significance of the interaction. The interaction determined whether the relationship between criminalizing or inclusive policy and the prevalence of PA varies by race/ethnicity (Latino and Asian American) across states. Followed by the interaction, we tested for effect measure modification by race/ethnicity (Latino and Asian

American) on the association between immigrant policy (criminalizing policy and inclusive policy, separately) and PA. Here also, as the effect of the individual-level predictors is modeled as fixed or constant across states, this represents a random intercept-only model. Goodness of fit statistics were assessed to ensure that predicting prevalence of meeting recommended PA with the fully adjusted model was a better fit to the data than predicting prevalence of meeting recommended PA with the unconditional model.

We also performed sensitivity analysis where we replaced state-level percent of foreign-born with percent foreign-born for each race/ ethnic group (Latino and Asian). While fitting these models, we lost 9 clusters/states from the sample because data were not available in ACS.

SAS version 9.4 (Cary, NC) was used to analyze the data, and a $p$-value < 0.05 was used to determine the significance of all analyses.

## Results

**Table 12** displays the descriptive characteristics of the sample by race/ethnicity ($n$ = 80516). Latino adults were relatively less educated and had lower annual household income than Asian American adults (12.0% vs. 53.5%, $p$-value <0.0001; 15.8% vs. 47.1%, $p$-value <0.0001, respectively). Also, Latin American adults were more likely to have no health coverage than Asian American adults (30.4% vs. 8.7%, $p$-value <0.0001). The Latin American adults reported a lower percentage of meeting recommended PA than the Asian American adults (44.4% vs. 50.5%, $p$-value <0.0001) and were more likely to live in a high criminalizing policy state than Asian American adults (35.1% vs. 14.5%, $p$-value <0.0001). Additionally, Asian American adults were more likely to live in a high inclusive policy state than Latin American adults (69.0% vs. 63.3%, $p$-value <0.0001). Asian Americans were more likely to live in a high foreign-born state than Latinos (57.8% vs. 48.8%, $p$-value <0.0001).

**Table 12. Characteristics of the Study Population (Weighted) by Race/Ethnicity, BRFSS 2015 and 2017 (*n* = 80516)**

| Characteristics | Latino (*n* = 62004) | Asian (*n* = 18512) | *p*-value |
|---|---|---|---|
| | % (weighted frequency), *n* | | |
| **Individual-level** | | | |
| **Age (years)** | | | 0.08 |
| 18 to 44 | 62.7 (32196) | 61.6 (9467) | |
| 45 to 64 | 28.0 (20396) | 27.0 (5512) | |
| 65+ | 9.3 (8959) | 10.4 (3222) | |
| **Sex at birth** | | | 0.57 |
| Male | 50.6 (27867) | 50.2 (9669) | |
| Female | 49.4 (34118) | 49.8 (8837) | |
| **Educational level** | | | <0.0001 |
| <High school | 20.7 (9896) | 1.4 (192) | |
| High school | 44.1 (25292) | 19.8 (3191) | |
| Some college | 23.2 (13999) | 24.4 (3664) | |
| College+ | 12.0 (12516) | 53.5 (11358) | |
| **Annual household income** | | | <0.0001 |
| <$25000 | 47.5 (23306) | 20.5 (3015) | |
| $25000 to $4999 | 26.5 (13448) | 18.6 (3201) | |
| $50000 to 74999 | 10.2 (5540) | 13.9 (2302) | |
| $75000+ | 15.8 (8766) | 47.1 (6769) | |
| **Employment status** | | | 0.09 |
| Employed | 60.6 (35397) | 62.0 (11319) | |
| Unemployed | 39.4 (25759) | 38.0 (6946) | |
| **Healthcare coverage** | | | <0.0001 |
| Present | 69.6 (45729) | 91.3 (17005) | |
| Absent | 30.4 (15880) | 8.7 (1389) | |
| **Physical activity** | | | <0.0001 |
| Met recommendation | 44.4 (23915) | 50.5 (8181) | |
| Did not meet recommendation | 55.6 (28799) | 49.5 (7548) | |
| **State-level** | | | |
| **State criminalizing policy** | | | <0.0001 |
| Low criminalizing | 42.5 (27045) | 53.6 (10827) | |
| Medium criminalizing | 22.4 (18516) | 31.9 (5797) | |
| Higher criminalizing | 35. 1 (16443) | 14.5 (1888) | |
| **State Inclusionary policy** | | | <0.0001 |

| Characteristics | Latino (*n* = 62004) | Asian (*n* = 18512) | *p*-value |
|---|---|---|---|
| | % (weighted frequency), *n* | | |
| High inclusion | 63.2 (28318) | 69.0 (11282) | |
| Medium inclusion | 23.5 (18827) | 16.9 (3434) | |
| Low inclusion | 13.3 (14859) | 14.1 (3796) | |
| **State foreign-born** | | | <0.0001 |
| Low foreign-born | 14.1 (19596) | 13.2 (4414) | |
| Moderate foreign-born | 37. 1 (24082) | 29.0 (5406) | |
| Higher foreign-born | 48.8 (18326) | 57.8 (8692) | |

*Note*. Percentage for state criminalizing and inclusive policy category is based on weighted frequency. See result section for percentage based on unweighted frequency.

**Figure 9** presents the age-adjusted predicted probabilities of meeting recommended PA by criminalizing policy for Latin American and Asian Americans origin adults. Overall, among Latino and Asian Americans in states with high criminalizing policies, predicted probabilities showed that 42% met recommendations for PA compared to 50% in states with low criminalizing policies.

**Figure 9. Age-Adjusted Predicted Probabilities of Meeting Recommended PA by Criminalizing Policy Level, Among Latino and Asian Americans, BRFSS 2015 and 2017**

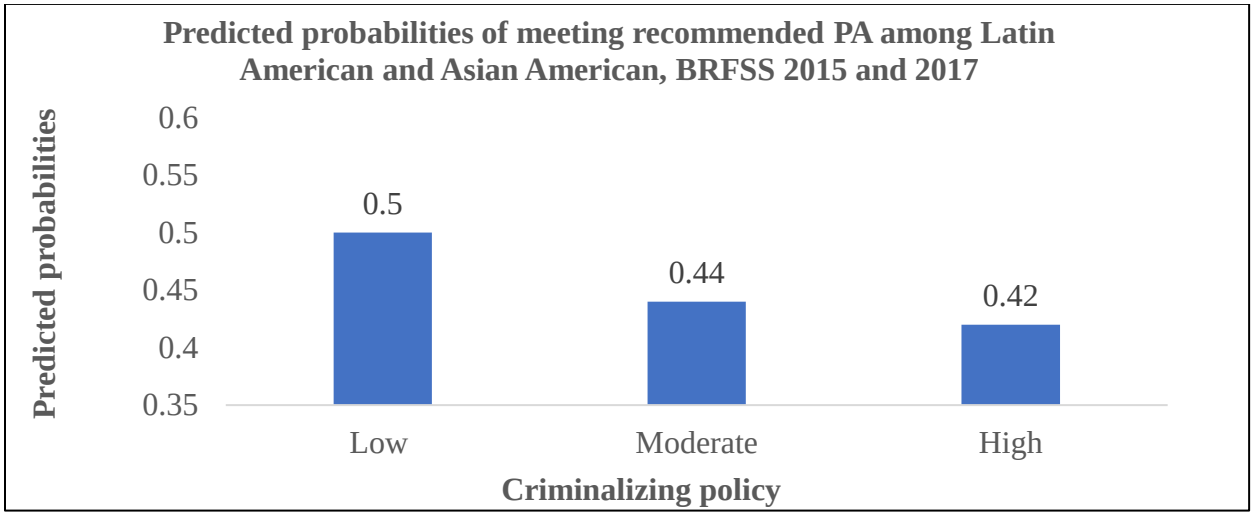
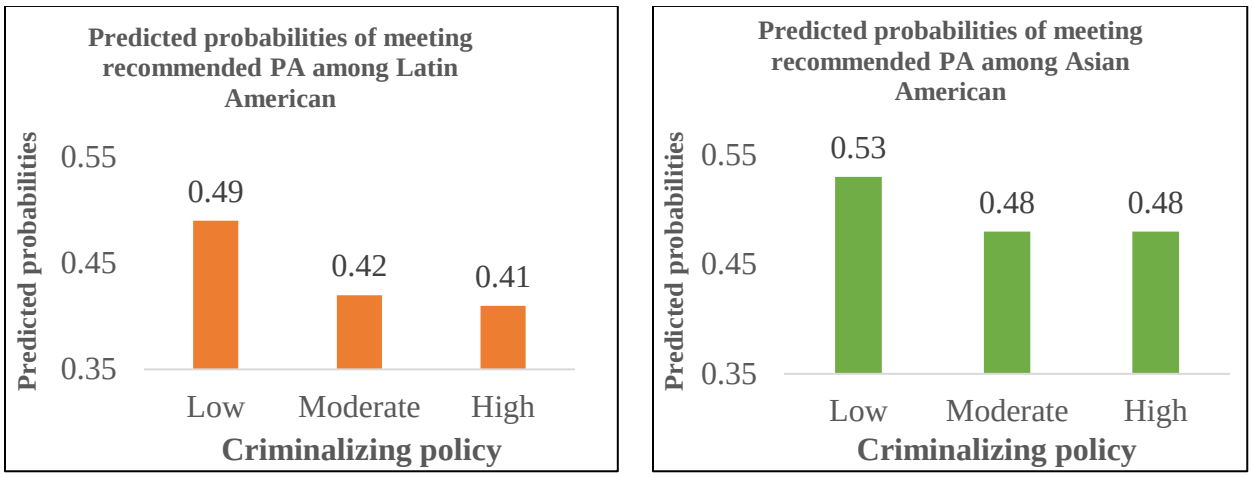


**Figure 10** presents the age-adjusted predicted probabilities of meeting recommended PA by criminalizing policy for Latin Americans and Asian Americans separately. There was a relatively steeper gradient in meeting PA for Latinos than Asian Americans. Among Latinos living in states with high criminalizing policies, there was an 8% difference in meeting recommended PA for high vs. low criminalizing policies. Among Asian Americans this difference was 5%, with 48% of those living in states with high criminalizing policies predicted to meet recommended PA, compared to 53% in states with low criminalizing policies.

**Figure 10. Age-Adjusted Predicted Probabilities of Meeting Recommended PA by Criminalizing Policy Level, Among Latin Americans (Left) and Asian Americans (Right), BRFSS 2015 and 2017**




We computed the intraclass correlation coefficient (ICC) that indicates how much of the total variation in the prevalence of meeting recommended PA is accounted for by the states. In multilevel modeling with dichotomous outcomes, there is assumed to be no error at level 1, therefore, a slight modification is needed to calculate the ICC. This modification assumes the dichotomous outcome comes from an unknown latent continuous variable with a level-1 residual that follows a logistic distribution with a mean of 0 and a variance of 3.29 (Ene et al., 2015;

O'Connell & McCoach, 2008; Snijders & Bosker, 1999). Therefore, 3.29 was used as our level-1 error variance in calculating the ICC. Following is the calculation of the ICC.

$ICC = \tau_{00} / (\tau_{00} + 3.29)$

Here,

$\tau_{00}$ = level-2 error variance = 0.04077

3.29 = level-1 error variance

So, ICC = 0.04077/(0. 04077+3.29)

= 0. 04077/3.32394

= 1.2%

This indicates that approximately 1.2% of the variability in the prevalence of meeting recommended PA is accounted for by the states in our study, leaving 98.8% of the variability to be accounted for by the participants or other unknown factors. We also computed intraclass correlation coefficient (ICC) in the fully adjusted model for criminalizing policy in Latinos. Results show that variability increased in the fully adjusted model and 3.6% of the variability in the prevalence of meeting recommended PA was accounted for by the states.

**Table 13** displays the association of state-level criminalizing immigrant policy and the prevalence of meeting recommended PA in the overall sample and Latin American and Asian American adults separately (stratified analysis). Overall, results indicate that in the unadjusted model (Model 1), the odds of meeting recommended PA among Latin American and Asian Americans living in high criminalizing states was 16% lower than the odds of meeting recommended PA among Latin American and Asian American living in low criminalizing states (odds ratio (OR): 0.84, 95% confidence interval (CI): 0.71-0.99). The association was statistically significant (*p*-value <0.05). This association was remained statistically significant in

the fully adjusted model (Model 3). Specifically, the odds of meeting recommended PA among Latin Americans and Asian Americans living in high-criminalizing states was 17% lower than the odds of meeting recommended PA among Latin Americans and Asian Americans living in low-criminalizing states (OR = 0.83, 95% CI: 0.69-0.99, *p*-value <0.05).

**Table 13. Association of State-Level Criminalizing Policy and Meeting Recommended PA: Overall and Separately in Latin American and Asian American, BRFSS 2015 and 2017 (*n* = 80516)**

| State Criminalizing Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Overall | | | |
| High criminalizing | 0.84 (0.71, 0.99)* | 0.81 (0.62, 1.05) | 0.83 (0.69, 0.99)* |
| Medium criminalizing | 0.90 (0.81, 1.01) | 0.82 (0.59, 1.14) | 0.82 (0.71, 0.94)* |
| Low criminalizing | Ref. | Ref | Ref. |
| Latin Americans | | | |
| High criminalizing | 0.78 (0.63, 0.96)* | 0.79 (0.62, 1.01) | 0.79 (0.62, 1.01)* |
| Medium criminalizing | 0.87 (0.75, 1.01) | 0.83 (0.69, 1.01) | 0.84 (0.69, 1.01) |
| Low criminalizing | Ref. | Ref. | Ref. |
| Asian Americans | | | |
| High criminalizing | 0.96 (0.77, 1.20) | 0.82 (0.51, 1.30) | 0.82 (0.53, 1.27) |
| Medium criminalizing | 0.90 (0.75, 1.08) | 0.88 (0.65, 1.18) | 0.90 (0.69, 1.17) |
| Low criminalizing | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (PA) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus percent of foreign-born in a state; OR=Odds Ratio; CI=Confidence interval; *= *p*-value <0.05

**Table 13** also shows the stratified analysis of state-level criminalizing policy and meeting recommended PA by race/ethnicity (*p*-value for interaction = 0.45). In the unadjusted model (Model 1), among Latin Americans, those who lived in the high criminalizing policy states had 22% lower odds of meeting recommended PA compared to Latin Americans who lived in the low criminalizing policy states (OR = 0.78, 95% CI: 0.63-0.96). The association was statistically significant (*p*-value < 0.05). This association remained marginally significant in the fully adjusted model (Model 3). Specifically, among Latin Americans, those who lived in high criminalizing policy states had 21% lower odds of meeting recommended PA than Latin Americans who lived in low criminalizing policy states (OR = 0.79, 95% CI: 0.62-1.01, *p*-value = 0.05). Asian Americans showed a similar pattern of meeting recommended PA for those who lived in the high criminalizing policy states vs. low criminalizing policy states. However, the strength of the associations was less pronounced for Asian Americans. For example, fully adjusted models showed 18% lower odds of meeting recommended PA for the high vs. low criminalizing policy (Model 1: OR = 0.82, 95% CI: 0.53-1.27). Results also did not reach statistical significance (*p*-value >0.05).

**Figure 11** presents the age-adjusted predicted probabilities of meeting recommended PA by inclusive policy for the overall full sample consisting of both Latin American and Asian American. Overall, among Latin American and Asian American, in states with low inclusive policy 44% were predicted to report meeting recommended PA compared to 46% in states with high inclusive policy. **Figure 12** presents the age-adjusted predicted probabilities of meeting recommended PA by inclusive policy for the Latin American and Asian American separately. Among Latin American, in states with low inclusive policy, 43% were predicted to report meeting recommended PA, compared to 45% in states with high inclusive policies. Among

Asian American in states with low inclusive policy, 48% were predicted to report meeting recommended PA, compared to 51% in states with high inclusive policy.

**Figure 11. Age-Adjusted Predicted Probabilities of Meeting Recommended PA by Inclusive Policy Level, Among Latin and Asian Americans, BRFSS 2015 and 2017**

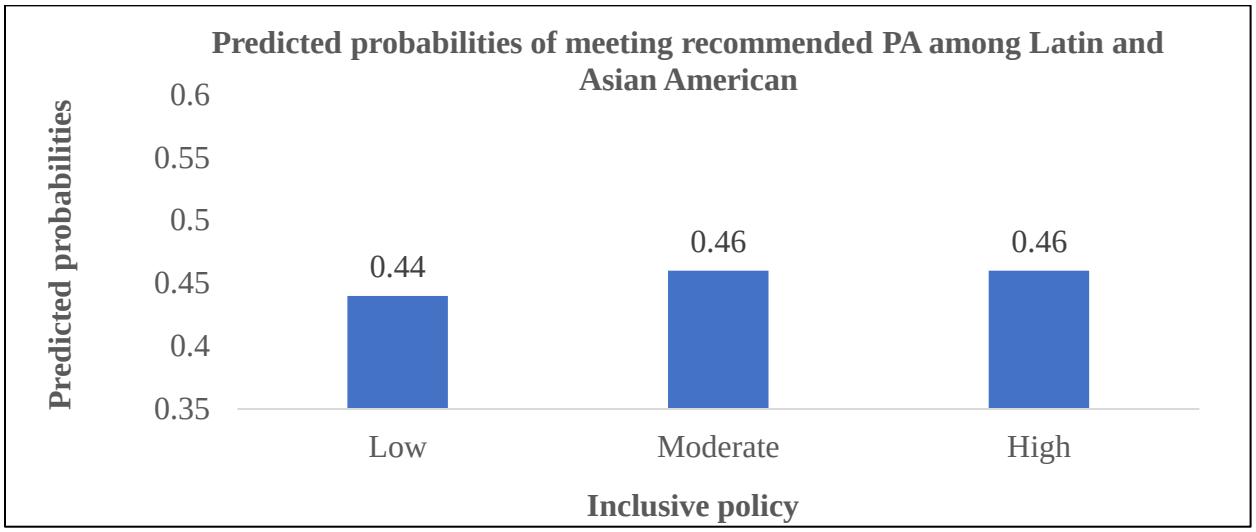



**Figure 12. Age-Adjusted Predicted Probabilities of Meeting Recommended PA by Inclusive Policy Level, Among Latin and (Left) and Asian Americans (Right), BRFSS 2015 and 2017**

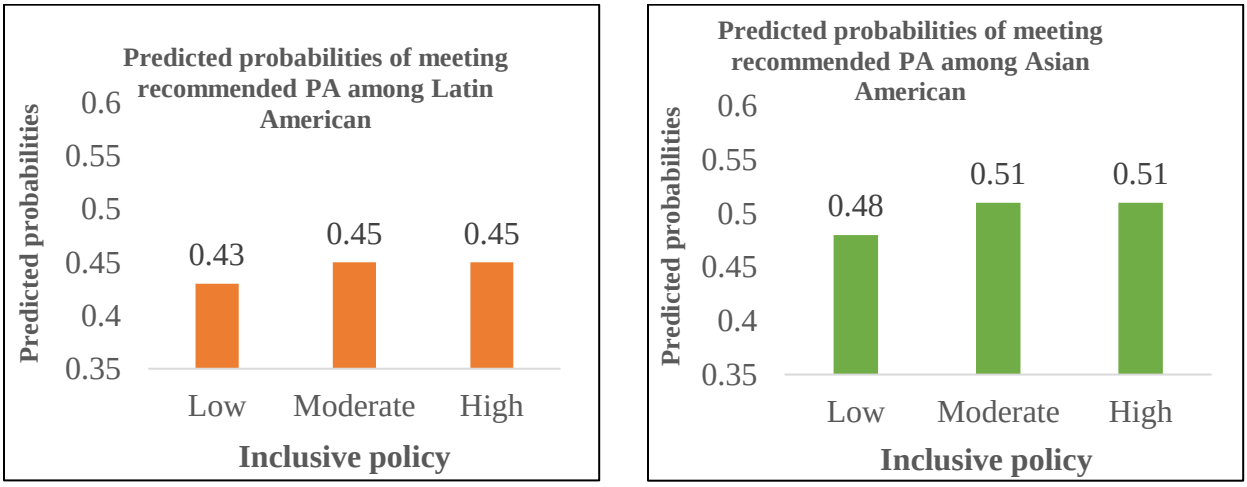



**Table 14** displays the association of state-level inclusive immigrant policy and prevalence of meeting recommended PA in overall sample, and Latin American and Asian

American adults separately (stratified analysis). Overall, results indicated that in the unadjusted model (Model 1), the odds of meeting recommended PA among Latin Americans and Asian Americans living in low inclusive states was 6% lower than the odds of meeting recommended PA among Latin Americans and Asian Americans living in high inclusive states (OR: 0.94, 95% CI: 0.83–1.07). However, the association was not statistically significant (*p*-value >0.05). This association was strengthened in the fully adjusted model (Model 3) but did not reach statistical significance (OR: 0.90, 95% CI: 0.78-1.04, *p*-value >0.05).

**Table 14** also shows stratified analysis of state-level inclusive policy and meeting recommended PA by race/ethnicity (*p*-value for interaction = 0.15). In the unadjusted model (Model 1), among Latin American adults, state-level inclusive policy was not significantly associated meeting recommended PA (OR: 1.04, 95% CI: 0.87, 1.23, *p*-value >0.05). However, fully adjusted model (Model 3) showed that among Latin American, those lived in the low inclusive policy states had 16% lower odds of meeting recommended PA compared to Latin American lived in the high inclusive policy states (OR: 0.84, 95% CI: 0.69, 1.02). The result became marginally significant (*p*-value = 0.07). Asian Americans showed a similar pattern of lower odds of meeting recommended PA for those lived in the low inclusive policy states vs. high inclusive policy states in the fully adjusted model (Model 3). However, strength of the association were less pronounced for Asian Americans and results was statistically non-significant (OR = 0.91, 95% CI: 0.69-1.21, *p*-value >0.05).

**Table 14. Association of State-Level Inclusive Policy and Meeting Recommended PA: Overall and Separately in Latin American and Asian American, BRFSS 2015 and 2017 (*n* = 80516)**

| State Inclusive Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Overall | | | |
| Low inclusion | 0.94 (0.83, 1.07) | 0.95 (0.81, 1.10) | 0.90 (0.78, 1.04) |
| Medium inclusion | 1.03 (0.87, 1.21) | 0.96 (0.80, 1.16) | 0.95 (0.79, 1.14) |
| High inclusion | Ref. | Ref | Ref. |
| Latin Americans | | | |
| Low inclusion | 1.04 (0.87, 1.23) | 0.86 (0.70, 1.05) | 0.84 (0.69, 1.02) |
| Medium inclusion | 1.12 (0.90, 1.40) | 0.96 (0.76, 1.22) | 0.96 (0.76, 1.21) |
| High inclusion | Ref. | Ref. | Ref. |
| Asian Americans | | | |
| Low inclusion | 0.85 (0.71, 1.02) | 0.93 (0.67, 1.31) | 0.91 (0.69, 1.21) |
| Medium inclusion | 0.94 (0.74, 1.18) | 0.99 (0.68, 1.46) | 0.99 (0.72, 1.35) |
| High inclusion | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (PA) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus percent of foreign-born in a state; OR=Odds Ratio; CI=Confidence interval.

Our goodness of fit statistics results show that the value of the Pearson Chi-Square divided by its degrees of freedom was changed from 1.03 in the unconditional model (with no predictor) to less than 1 (0.99) in the fully adjusted model for criminalizing policy context and meeting recommended PA association. A *p*-value was not computed for the Pearson Chi-Square

statistics; however, a Pearson Chi-Square divided by its degrees of freedom that is approximately equal to 1 was an indication of a good model fit. Other model fit statistics such as, -2 log likelihood (deviance), AIC, and BIC, were all reduced in the fully adjusted model compared to the unconditional model. This suggests that that predicting prevalence of meeting recommended PA with the fully adjusted model was a better fit to the data than predicting prevalence of meeting recommended PA with the unconditional model.

We also performed sensitivity analysis where we replaced our state-level covariate percent of foreign-born in a state with a percent of Latino and Asian foreign-born in stratified analyses. Results of the sensitivity analysis can be found in *Appendix B*. We found same pattern and significant associations for state-level criminalizing policy context and meeting recommended PA in the overall sample for high vs. low criminalizing policy states. In the stratified analysis, we found same pattern and significant associations for state-level criminalizing policy context and meeting recommended PA in Latino for high vs. low criminalizing policy states. Pattern and associations for state-level criminalizing policy and meeting recommended PA in Asian for high vs. low criminalizing policy states results were similar as before. We also found same pattern and associations for state-level inclusive policy and meeting recommended PA with no associations being significant.

To reiterate, while fitting model with percent of Latino and Asian foreign-born in a state we lost 9 clusters/states from our sample because of unavailability of the percent of Latino and Asian foreign-born estimates in those states in the ACS data. Previous research on multilevel methods suggests at least 50 groups to produce valid estimates for multi-level logistic regression models (Moineddin et al., 2007; Paccagnella, 2011). General estimates may produce biased results and standard errors in two level multilevel logistic regression models if the number of

clusters is not at least 50 (Ali et al., 2019; Hox & McNeish, 2020; Leyland & Groenewegen, 2020b; Maas & Hox, 2005). Contextual level units or cluster size is specially a concern if research question examines the association of contextual level predictors and individual level outcome. In this study research question was about the association of immigrant policy context in a state and prevalence of meeting recommended PA. As a result enough states were needed to estimate the effect of the state characteristics or test the hypothesis, which we did not have during sensitivity analysis (Leyland & Groenewegen, 2020b).

## Discussion

In this study, we sought to understand the associations between state-level immigrant criminalizing and inclusive policies and prevalence of meeting recommended PA, and whether these associations varied between Latin American and Asian American origin adults. The study showed that approximately 1.2% of the variability in the prevalence of meeting recommended PA is accounted for by the states. Age-adjusted predicted probability showed that Latino and Asian Americans living in high criminalizing policy states had lower predicted probability of meeting recommended PA compared to living in states with low criminalizing policies. In the multilevel model, in the full sample, Latino and Asian Americans living in high criminalizing policy states had significantly lower odds of meeting recommended PA in the fully adjusted model. When models stratified by race/ethnicity, this pattern of significant lower odds of meeting recommended PA remained for Latinos. Results were less pronounced and non-significant for Asian Americans.

Age-adjusted predicted probability also showed that Latinos and Asian American living in states with low inclusive policy states had lower predicted probability of meeting recommended PA compared to states with high inclusive policy. In the multilevel model, in the

full sample, the study observed that Latino and Asian Americans living in low inclusive policy states had lower odds of meeting recommended PA in the fully adjusted model. However, results were statistically non-significant. When models stratified by race/ethnicity, this pattern of lower odds of meeting recommended PA remained for Latinos in the fully adjusted model. Results were less pronounced and statistically non-significant for Asian Americans.

This study results are consistent with previous studies on immigrant policies and health (A. N. Martinez et al., 2007; Rhodes et al., 2009), alcohol risk behaviors (Rhodes et al., 2009; Worby & Organista, 2007) that included individuals from marginalized groups. These studies similarly documented the negative health behavioral consequences of exposure to immigrant-related factors and policies that constrain opportunities. However, none of these studies examined the impact of state-level criminalizing and inclusive policy context on meeting recommended PA among Latin American and Asian American populations, reflecting an important gap in this area of public health research.

Our work on state-level anti-immigrant policy and Latino and Asians health differs in critical ways from existing studies that used a composite index comprised of state-level immigration policies (Almeida et al., 2016; De Trinidad Young et al., 2018; Dondero & Altman, 2020; Young et al., 2019). These studies used both inclusionary and criminalizing policies as a global measure and did not examine the impact of the criminalizing and inclusive policy context separately. Moreover, our study is one of the first to examine the effect of criminalizing and inclusive policy context on a health behavior.

The adoption of a physically active lifestyle by the Latino and Asian American populations can be impacted by criminalizing policies. Although undocumented immigrants fear being in contact with law enforcement could result in arrest, legal immigrants and members of

racial/ethnic minorities also fear harassment by law enforcement due to racial profiling (Morey, 2018). Therefore, immigrants and racial/ethnic minorities may be prevented from accessing resources like physical activity because of the fear of being arrested or harassed due to criminalizing policy (Hardy et al., 2012). For instance, the passage of Arizona's Support Our Law Enforcement and Safe Neighborhoods Act (SB 1070) in 2010 raised the general degree of anxiety among Latin American (Hardy et al., 2012). Due to the law, Latinos already having trouble accessing healthy food also started to avoid going outside for exercise because of the concern that the police may stop them. Lack of access to a healthy lifestyle (such as exercise and nutritious food) increases the chance of developing diabetes and other chronic health issues (Booth et al., 2012; Hardy et al., 2012).

In stratified analyses, we observed significant lower odds of meeting recommended PA for Latin American adults in high criminalizing policy states but results were less pronounced and non-significant for Asian American adults in the fully adjusted models. This finding indicated that Latin Americans appear to be at a greater disadvantage than Asian American when it comes to high criminalizing policy environment and adequate PA. Previous research has shown that Latinos are less likely than Whites to report being physically active, exercising in the park, and exercising outside the park, whereas Asians were more likely than whites to report visiting the park and using the parks for social interactions (Derose et al., 2015). Criminalizing policies, including pathways to legalization and access to resources invoked in racialization processes, such as state-issued driver's licenses, may hinder health-promoting resources such as physical activity for Latin Americans (LeBrón et al., 2022). In 2012–2013, 97% of persons deported from the United States were of Latin American origin (70% were Mexican nationals) compared to  0.5% from Asian American origin (LeBrón et al., 2022; TRAC Immigration,

2014). It is assumable that the fear of deportation is higher among Latin Americans and consequently, they may refrain themselves from going outdoors and engaging in physical activity. This deportation worry became widespread among citizen and noncitizen Latinos after 2016 presidential election due to higher immigration enforcement (Asad, 2020). Our study suggests the potential consequences of fear and anxiety associated with deportation and harassment that targets a particular racial group disproportionately. However, limitations apply to Asian Americans finding. Aggregated data may mask differences among Asian subgroups. Further investigation is needed to focus on the role of the policy context on meeting recommended PA in Asians among subgroups and over time. Other reasons such as being a newer immigrant group, much more varied in social profiles, sample size issues may also play role.

We also observed that overall, Latin and Asian Americans living in low inclusive policy states had lower odds of meeting recommended PA than Latin Americans and Asian Americans living in high inclusive policy states in the fully adjusted model. However, the association was not significant. When stratified by race/ethnicity, we observed marginally significant lower odds of meeting recommended PA for Latin American adults living in low inclusive policy states but results were less pronounced and non-significant for Asian American adults in the fully adjusted models.

These findings suggest that low inclusive policy may affect Latin Americans negatively in meeting recommended PA than Asian Americans. Our findings also follow a national report of physical activity which showed that Latinos have a higher prevalence of not meeting recommended physical activity (32.1%) compared to Asian Americans (20.1%) (Centers for Disease Control and Prevention/Division of Nutrition, 2022). In addition, while Latinos and

Asians have many similar experiences, such as linguistic barriers and acculturation processes, Latinos are socioeconomically disadvantaged when compared to Asians, particularly in education, income, and access to health care (Artiga & Hill, 2022; Kochhar, 2018; Noël, 2018).

Having a lower socioeconomic status leaves Latinos at a higher risk of being uninsured which may have a negative influence on physical activity through a lack of access to workplace initiatives that support active living and can cover use of health promotion services (Luo et al., 2022; O'Donoghue et al., 2018; Stalling et al., 2022; Stalsberg & Pedersen, 2018). Exclusionary immigrant acts (e.g., IIRAIRA) also made it more difficult to get public health insurance for these socially disadvantaged immigrant populations (Fragomen, 1997). While healthcare providers can motivate Latino patients on the benefits of PA, the lack of health insurance and interpreter services at the health center makes this process difficult (Albert et al., 2020; Lobelo & de Quevedo, 2016). Additionally, Latinos report higher levels of physician distrust, making it difficult to promote PA among these populations through this channel (Bantham et al., 2021).

Lastly, Latino American immigrants who arrive in the United States as a result of economic hardship usually relocate to impoverished areas and live in Latino enclaves that have a lack of general resources (e.g., park, walking and bicycle trails, transportation), all of which negatively impact participation in physical activity (Rogerson & Emes, 2006; Sundquist et al., 1995). Previous research has also shown that among Latino individuals, living in a neighborhood with higher proportions of Latin American immigrants was associated with lower levels of physical activity (Osypuk et al., 2009). Future research should examine the role of neighborhood contexts as buffers (or barriers) to state-level immigrant policies.

## Strengths and Limitations

Our study contributes to the growing body of literature on state-level immigrant policy and health behavior, examining the relationship between state-level policies and meeting recommended PA among a multi racial and socially marginalized groups. We used population-based data from all states in the US and objective indicators of the policy climate surrounding Latinos and Asians. Because these contexts did not rely on self-report perceptions of Latinos and Asians about the policy climate in their state, we minimized confounding with meeting recommended PA status (e.g., individuals with not meeting recommended PA could be more likely to perceive a negative social climate). Additionally, in linking the existing policy dataset at the state level to individual-level PA outcomes, our study employed multilevel modeling to avoid the ecologic fallacy and captured the contribution of immigrant policy contexts on the prevalence of meeting recommended PA while controlling for individual and state level factors (Haneuse & Bartell, 2011).

Our study has some limitations that warrant attention. First, the study is cross-sectional and does not test a causal association between immigrant policy and PA. Secondly, the BRFSS dataset does not provide information on immigration status, so we could not examine relationships between state policies and meeting recommended PA of Latino and Asian immigrant or undocumented residents. Most U.S. national surveys do not measure the documentation status of immigrants. In addition, we argue that anti-immigrant policies create harmful climates for all Latinos and Asians, irrespective of their immigration status. Nevertheless, we adjusted for percentage of the state population that is foreign-born from ACS data and included it as a contextual covariate in our study. Thirdly, our study did not examine variation in meeting recommended PA prevalence by ethnic groups among Latin and Asian

Americans. Evidence suggests that ethnic differences in meeting recommended PA are present among Asian and Latin Americans (Arredondo et al., 2016; Bhattacharya Becerra et al., 2015; Bungum et al., 2012). Future studies should examine the relationship between immigrant policy and within-group variations in meeting recommended PA. Fourthly, this analysis was unable to consider migration patterns between states and length of state residency in a state; migration patterns among immigrants are not random and could influence the policy exposure of interest and subsequently P prevalence. This study was cross-sectional in nature and did not have mobility variable. Future studies should consider this factor. Finally, this study made use of an important data source BRFSS; however, it is a complex probability sample and the estimates using this dataset may be slightly biased because it applies weight to our policy score which was unweighted.

## Conclusion

In the U.S., low PA in Latin Americans reflects their broader social marginalization. This study suggests that criminalizing and exclusionary immigrant policies have distinct mechanisms to reinforce that marginalization. Therefore, to support Latinos' healthy behavior, laws that decriminalize them or protect them from federal enforcement and exclusionary practices are essential.

# CHAPTER VI: DISCUSSION AND IMPLICATIONS

## Study Purpose

The goal of this study was to assess associations between state-level immigration policy contexts and two individual-level outcomes: type 2 diabetes or T2DM and physical activity or PA among U.S. adults of Latin American and Asian American origin.

The following research questions guide the first aim of the study:

1. Is there an association between state-level immigrant policies and the prevalence of diabetes (T2DM)?
    - 1.1 What is the association between state-level criminalizing policies and the prevalence of diabetes (T2DM) while controlling for individual- and state-level characteristics?
    - 1.2 What is the association between state-level inclusive policies and the prevalence of diabetes (T2DM) while controlling for individual- and other state-level characteristics?
    - 1.3 Does the association between state-level immigrant policies (criminalizing and inclusive) and diabetes (T2DM) prevalence vary between Latin American and Asian American origin adults?

The following research questions guide the second aim of this study:

2. Is there an association between state-level immigrant policies and the prevalence of meeting recommended physical activity (PA)?
    - 2.1 What is the association between state-level criminalizing policies and recommended physical activity (PA) prevalence while controlling for individual- and state-level characteristics?

2.2 What is the association between state-level inclusive policies and the prevalence of recommended physical activity (PA) while controlling for individual- and state-level characteristics?

2.3 Does the association between state-level immigrant policies (criminalizing and inclusive) and recommended physical activity (PA) prevalence vary between Latino American and Asian American origin adults?

## Key Findings

Overall, the present dissertation research showed that Latin Americans and Asian Americans living in low-inclusive exclusionary policy states had significantly higher odds of T2DM than Latin and Asian Americans living in high-inclusive policy states in the full model. In analyses stratified by race/ethnicity (Latin and Asian American), there were significantly higher odds of T2DM for Latin American adults in living low inclusive policy states than Latin Americans living high inclusive policy states, but results were less pronounced and non-significant for Asian American adults. This finding indicates that Latin Americans appear to be at a greater disadvantage than Asian Americans concerning the low-inclusive policy environment and T2DM. Adopting exclusionary immigrant policies can limit employment opportunities and increase poverty among an already marginalized population (Bohn & Lofstrom, 2012). It pushes immigrants into informal employment, the effects of which are fewer benefits, lower wages, and worse working and housing conditions (M. A. Rodríguez et al., 2015). Coping with these disadvantages can be stressful and make them psychologically vulnerable (Björntorp, 1997). For example, they may experience hopelessness or anxiety (Lloyd et al., 2005). Over the long term, this stress response leads to the release of additional cortisol that induces insulin resistance-the main feature of type 2 diabetes (Galicia-Garcia et al., 2020; Thau et al., 2022).

Previous studies find that low socioeconomic status (SES) is a risk factor for T2DM. Although the explanation for this effect is not clear, it likely relates to earlier and increased exposure to lifestyle and environmental risk factors for type 2 diabetes among people experiencing low socioeconomic status both at an individual-level and based on where they live (Connolly, 2000). Research also suggests that states of prolonged stress, anxiety and anticipation among people of low SES can result in allostatic dysregulation and promote maladaptive wear-and-tear on the body and brain which can ultimately lead to T2DM (McEwen & Gianaros, 2010; McEwen & Stellar, 1993). Other researchers suggest the life course influences trajectories of T2DM. This area of research indicates that the cumulative impact of exposure to poverty, lack of education, job insecurity, impoverished neighborhoods, undernutrition, and reduced healthcare access in immigrant and Latino groups may be exacerbated by low inclusive exclusionary policies to increase risk of metabolic disorders like T2DM (Barker, 2006; Dias et al., 2020; Grigsby-Toussaint et al., 2015; Juster et al., 2010; LeBrón et al., 2019; W. D. Lopez et al., 2017; National Conference of State Legislature, 2017; Pollitt et al., 2005; Romieu et al., 2017).

The immigrant climate can also lead to the adoption of poor health behaviors. We observed that overall Latino and Asian Americans living in high criminalizing policy states had significantly lower odds of meeting recommended PA than those living in low criminalizing policy states in the full model. Prior research has shown that being exposed to immigration policies that restrict opportunities have a negative impact on health and health behaviors. Our study fills a significant gap in public health since no study has examined how state-level criminalizing and inclusive policy contexts are associated with meeting levels of physical activity in Latino and Asian American populations. Immigrants and racial/ethnic minorities may be prevented from accessing health promotion resources like physical activity because of the fear

of being arrested or harassed as a result of criminalizing policy (Hardy et al., 2012). For example, the Safe Neighborhoods Act (SB 1070) in 2010, raised the general degree of anxiety among Latinos and they started to avoid going outside for exercise because of the concern that they may be arrested by the police (Hardy et al., 2012). In analyses stratified by race/ethnicity, Latinos living in high criminalizing policy states showed significant lower odds of meeting recommended PA while results were less pronounced and non-significant for Asian American adults. This finding suggests that criminalizing policies had a more pronounced effect on Latinos.

Study findings also point to possible short-term effects resulting from fear of violence to engage in health-promoting strategies. Previous studies have found that fear of racism prevents people from recreational facilities or walking, cycling, or running in public spaces (Hayes et al., 2002). Additionally, as a result of low wage jobs, Latinos report working additional hours than they are supposed to, leaving them little space to participate in exercise and healthy eating (Abraído-Lanza et al., 2016; de Oca et al., 2011; Luque et al., 2018). Qualitative interviews suggest that fear associated with deportation prevents Latinos from spending time outside or in parks where they might exercise (Hardy et al., 2012; S. M. Martinez, 2009). This may be the case in our study as well resulting from the fear associated with living in states with high criminalizing policies. (M. Philbin et al., 2016). Other studies also suggest that overall low socioeconomic status, lack of recreational facilities, park and open spaces, inflexible work schedule, transportation difficulties, uninsurance and fear and anxiety to anti-immigrant climate lead to health behaviors those are not conducive to health (Day, 2006).

## Implications and Future Research

This study has several implications for public health researchers looking to prevent chronic diseases and promote social equity for people of marginalized social conditions, such as Latin American and Asian origin adults, through the examination of state-level immigrant policy contexts.

Racial/ethnic disparities in diabetes are a pervasive public health problem in the United States. There is a disproportionate burden of diabetes in racial/ ethnic marginalized groups such as Latinos and Asian Americans (Cheng et al., 2019; Golden et al., 2019). A combination of policy, systems, or structural level approaches, in addition to individual lifestyle modifications, is required to curb the increasing burden of T2DM and prevention of T2DM in high-risk racial/ethnic groups.

In the U.S., higher T2DM in Latinos reflect their broader social marginalization. This study suggests that low inclusive or exclusionary policies are a distinct mechanism to reinforce that marginalization. The study also points to the role of low inclusive immigrant policies in producing T2DM inequity between states. Latinos currently live across distinct environments and face varying exclusionary policies and enforcement levels that shape their socioeconomic position and access to health-enhancing resources. Public health scholars must acknowledge and interrogate the harm created by exclusionary and punitive immigrant policies and recognize how such policies exacerbate existing racial/ethnic disparities in chronic health conditions. Advancing policies that would bring a more inclusive environment and de-criminalize immigrants is critical to foster socio-economic well-being, access to healthcare, and reduce the growing burden of T2DM.

Future research should apply more multilevel models to understand the effect of contextual level factors on individual-level outcomes for the complete understanding of health outcomes and their correlates. Furthermore, future research is needed that examines subgroup differences for Latino and Asian American populations. Previous research shows that T2DM varies substantially in Latin Americans and Asian Americans. However, due to the unavailability of these subgroups in our publicly available BRFSS dataset we could not perform ethnic differences in T2DM.

In the coming years, tensions will likely continue regarding the inclusion and criminalizing of immigrants in the United States. State governments will continue to play a vital role in determining the extent to which immigrants are restricted as they pursue their lives, seek work, and access health care. There is still much research needed to comprehend the long-term impact of policies on chronic and cardiovascular health, particularly as some states engage in efforts to bring more inclusive environments while others engage in expanding exclusionary environments. It will be critical to understand and address how these intentional policy contexts are related to the overall chronic and cardiovascular health of vulnerable population groups over time.

The role of the criminalizing policy context associated with lower levels of physical activity among Latinos was novel and an important contribution of this study. Changes in immigrant policies and heightened immigration enforcement over the last several years have caused fear and insecurity for racial/ethnic marginalized and immigrant populations across the country. The production of fear directly shapes Latinos and other vulnerable immigrants' health behaviors, such as engaging in preventive exercise in public spaces, and determines what spaces may be safe from law enforcement. These findings imply that future interventions to promote

physical activity among Latin Americans and other vulnerable immigrants should not focus only on individual and interpersonal level factors. Instead, strategies should combine mitigating policy or contextual-level barriers while strengthening socioeconomic position and community or neighborhood-level facilities for physical activities. Moreover, adequate physical activity is crucial for health promotion since it helps keep individuals from acquiring type 2 diabetes, excess weight, and heart disease. Qualitative research also suggests that climates of fear of deportation, detention, and separation (from family) rooted in criminalizing policy lead to reduced mobility and access to healthy food and exercise (Hardy et al., 2012).

These barriers to PA need to be addressed at the policy level. Policymakers must recognize the potentially disproportionate effects these criminalizing policies have on certain group(s), for whom physical activity serves as an important resource for promoting and maintaining health. Therefore, policy changes are needed, and effective strategies should be established at the state level to motivate an increase in active living among Latin Americans and high-risk immigrant groups.

In the future, research on other health behaviors is needed to determine the far reaching effect of immigrant policies on marginalized populations. Finally, public health professionals, immigrants, advocates, and policymakers must work together to improve health behaviors and overall health of vulnerable but resilient populations that represent this country's future.

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APPENDIX A: SENSITIVITY ANALYSIS FOR STATE-LEVEL IMMIGRANT POLICY CONTEXT AND T2DM

**Table A1. Association of State-Level Criminalizing Immigrant Policy and Prevalence of T2DM in the Overall Sample, Latin American, and Asian American Adults, BRFSS 2014-2018 (*n* = 196316)**

| State Criminalizing Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Overall | | | |
| High criminalizing | 1.00 (0.77, 1.31) | 1.20 (0.88, 1.65) | 1.20 (0.97, 1.48) |
| Medium criminalizing | 1.06 (0.88, 1.27) | 1.08 (0.89, 1.31) | 1.09 (0.94, 1.26) |
| Low criminalizing | Ref. | Ref. | Ref. |
| Latin Americans | | | |
| High criminalizing | 1.00 (0.77, 1.30) | 1.20 (0.62, 2.32) | 1.16 (0.87, 1.54) |
| Medium criminalizing | 1.10 (0.90, 1.34) | 1.08 (0.88, 1.33) | 1.04 (0.90, 1.20) |
| Low criminalizing | Ref. | Ref. | Ref. |
| Asian Americans | | | |
| High criminalizing | 0.87 (0.68, 1.12) | 1.10 (0.83, 1.46) | 1.03 (0.77, 1.36) |
| Medium criminalizing | 0.90 (0.70, 1.17) | 0.94 (0.73, 1.22) | 0.88 (0.71, 1.08) |
| Low criminalizing | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (T2DM) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus state percent of foreign-born (overall sample), state percent of foreign-born Latino (Latino Americans sample), state percent of foreign-born Asian (Asian Americans sample); OR=Odds Ratio; CI=Confidence interval.

**Table A2. Association of State-Level Inclusive Immigrant Policy and Prevalence of T2DM in the Overall Sample, and Latin American and Asian American Adults, BRFSS 2014-2018 (*n* = 196316)**

| State Inclusive Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| | | Overall | |
| Low inclusion | 0.88 (0.71, 1.09) | 1.13 (0.99, 1.28) | 1.22 (1.05, 1.43)* |
| Medium inclusion | 0.97 (0.72, 1.31) | 1.01 (0.81, 1.25) | 1.01 (0.84, 1.22) |
| High inclusion | Ref. | Ref | Ref. |
| | | Latin Americans | |
| Low inclusion | 0.78 (0.63, 0.97) | 1.12 (0.98, 1.28) | 1.06 (0.91, 1.22) |
| Medium inclusion | 0.84 (0.63, 1.13) | 1.00 (0.82, 1.23) | 1.01 (0.89, 1.15) |
| High inclusion | Ref. | Ref. | Ref. |
| | | Asian Americans | |
| Low inclusion | 0.76 (0.59, 0.97) | 0.95 (0.78, 1.14) | 1.00 (0.79, 1.26) |
| Medium inclusion | 0.75 (0.53, 1.05) | 0.89 (0.68, 1.17) | 0.99 (0.74, 1.33) |
| High inclusion | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (T2DM) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus state percent of foreign-born (overall sample), state percent of foreign-born Latino (Latino Americans sample), state percent of foreign-born Asian (Asian Americans sample); OR=Odds Ratio; CI=Confidence interval; * = *p*-value <0.05.

APPENDIX B: SENSITIVITY ANALYSIS FOR STATE-LEVEL IMMIGRANT POLICY CONTEXT AND MEETING RECOMMENDED PA

**Table B1. Association of State-Level Criminalizing Policy and Meeting Recommended PA: Overall and Separately in Latin American and Asian American, BRFSS 2015 and 2017 (*n* = 78302)**

| State Criminalizing Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Overall | | | |
| High criminalizing | 0.84 (0.71, 0.99)* | 0.81 (0.62, 1.05) | 0.83 (0.69, 0.99)* |
| Medium criminalizing | 0.90 (0.81, 1.01) | 0.82 (0.59, 1.14) | 0.82 (0.71, 0.94)* |
| Low criminalizing | Ref. | Ref | Ref. |
| Latin Americans | | | |
| High criminalizing | 0.78 (0.63, 0.96)* | 0.79 (0.62, 1.01) | 0.76 (0.58, 0.99)* |
| Medium criminalizing | 0.87 (0.75, 1.01) | 0.83 (0.69, 1.01) | 0.83 (0.66, 1.04) |
| Low criminalizing | Ref. | Ref. | Ref. |
| Asian Americans | | | |
| High criminalizing | 0.96 (0.77, 1.20) | 0.82 (0.51, 1.30) | 0.80 (0.55, 1.16) |
| Medium criminalizing | 0.90 (0.75, 1.08) | 0.88 (0.65, 1.18) | 0.83 (0.59, 1.16) |
| Low criminalizing | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (PA) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus state percent of foreign-born (overall sample), state percent of foreign-born Latino (Latino Americans sample), state percent of foreign-born Asian (Asian Americans sample); OR=Odds Ratio; CI=Confidence interval; *= *p*-value <0.05.

**Table B2. Association of State-Level Inclusive Policy and Meeting Recommended PA: Overall and Separately in Latin American and Asian American, BRFSS 2015 and 2017 (*n* = 78302)**

| State Inclusive Policy | Model 1 OR (95% CI) | Model 2 OR (95% CI) | Model 3 OR (95% CI) |
|---|---|---|---|
| Overall | | | |
| Low inclusion | 0.94 (0.83, 1.07) | 0.95 (0.81, 1.10) | 0.90 (0.78, 1.04) |
| Medium inclusion | 1.03 (0.87, 1.21) | 0.96 (0.80, 1.16) | 0.95 (0.79, 1.14) |
| High inclusion | Ref. | Ref | Ref. |
| Latin Americans | | | |
| Low inclusion | 1.04 (0.87, 1.23) | 0.86 (0.70, 1.05) | 0.84 (0.63, 1.10) |
| Medium inclusion | 1.12 (0.90, 1.40) | 0.96 (0.76, 1.22) | 0.95 (0.72, 1.26) |
| High inclusion | Ref. | Ref. | Ref. |
| Asian Americans | | | |
| Low inclusion | 0.85 (0.71, 1.02) | 0.93 (0.67, 1.31) | 0.84 (0.58, 1.22) |
| Medium inclusion | 0.94 (0.74, 1.18) | 0.99 (0.68, 1.46) | 0.96 (0.63, 1.48) |
| High inclusion | Ref. | Ref. | Ref. |

*Note*. Models are estimated using multilevel models with a binary outcome (PA) with a random intercept to account for the clustering of individuals in states. All other variables were treated as fixed effects; Model 1- crude or unadjusted; Model 2- adjusted for age, sex, race/ethnicity (except stratified analysis), educational attainment, employment, household income, and health coverage; Model 3- Model 1 and 2 plus state percent of foreign-born (overall sample), state percent of foreign-born Latino (Latino Americans sample), state percent of foreign-born Asian (Asian Americans sample); OR=Odds Ratio; CI=Confidence interval.