THREE HEALTHCARE TOPICS: ADULT CHILDREN'S INFORMAL CARE TO AGING PARENTS, WORKING AGE POPULATION'S MARIJUANA USE, AND INDIGENOUS ADOLESCENTS' SUICIDAL BEHAVIORS

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THREE HEALTHCARE TOPICS: ADULT CHILDREN'S INFORMAL CARE TO AGING PARENTS, WORKING AGE POPULATION'S MARIJUANA USE, AND INDIGENOUS ADOLESCENTS' SUICIDAL BEHAVIORS

This dissertation examines three vulnerable groups' health and healthcare access.

The first research uses the 2002–2011 Health and Retirement Study data to estimate the effects of adult children's employment on their caregiving to aging parents. State monthly unemployment rates are used as an instrument for employment. Results show that being employed affects neither male nor female adult children's caregiving to aging parents significantly. The findings imply that the total amount of informal care provided by adult children might not be affected by changes in labor market participation trends of the two genders.

The second research studies the labor impact of Colorado and Washington's passage of recreational marijuana laws in December 2012. The difference-in-differences method is applied on the 2010–2013 National Survey on Drug Use and Health state estimates and the 2008–2013 Survey of Income and Program Participation data to estimate legalization's effects on employment. The results show that legalizing recreational marijuana increases marijuana use and reduces the number of weeks employed in a given month by 0.090 among those aged 21 to 25. The laws' labor effects are not significant on those aged 26 and above. To reduce legalization's negative effects on employment, states may consider raising the minimum legal age for recreational marijuana use.

The third research examines disparities in suicidal behaviors between indigenous and non-indigenous adolescents. The study analyzes the 2001–2013 Youth Risk Behavior Survey data. Oaxaca decomposition is applied to detect sources of disparities in suicide consideration, planning, and attempts. The study finds that the disparities in suicidal behaviors can be explained by differences in suicidal factors' prevalence and effect sizes between the two groups. Suicidal behavior disparities might be reduced by protecting male indigenous adolescents from sexual abuse and depression, reducing female indigenous adolescents' substance use, as well as involving male indigenous adolescents in sports teams.

Anne Royalty, PhD, Chair

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Chapter One

Introduction

This dissertation focuses on three vulnerable populations' healthcare access and health.

The first vulnerable population is elderly people. Five million elderly Americans are in need of long-term care (LTC) because of aging or disability in activities of daily living (ADL) or instrumental activities of daily living (IADL) (Kaye, Harrington, & LaPlante, 2010). Approximately 90% of them rely on informal care to meet LTC needs (Kaye et al., 2010). Examining whether employment affects the care they receive from their adult children, i.e., their main caregiving sources, would help us to understand whether changes in male and female labor force participation trends would affect the total informal care provided to the aging population.

The second vulnerable group is employed drug users. In 2012, Washington and Colorado passed laws to legalize recreational marijuana use among people aged 21 and over (Office of National Drug Control Policy, 2012). The laws' passage reduces the penalties of using recreational marijuana in the two states and may increase the number of employed drug users. Chapter Two answers the question of whether the laws' passage affects this population's employment.

The third vulnerable group is indigenous adolescents. Indigenous adolescents have the highest suicide and suicidal behavior rates among American adolescents (Centers for Disease Control and Prevention, 2015b; Qiao & Bell, 2016). It is important to study factors that contribute to their high suicidal behavior rates as well as factors that

are associated with disparities in suicidal behaviors between indigenous adolescents and their non-indigenous peers.

The research reported in the dissertation answers questions regarding factors that affect the healthcare access and health of vulnerable populations. The findings can provide implications for government interventions.

Chapter Two

Does Employment Affect Adult Children's Informal Caregiving to Aging Parents?

Background

Adult children are the major informal caregivers in the United States, providing half of the total informal care hours (Spillman, Wolff, Freedman, & Kasper, 2014). Significant gender differences can be seen among caregivers. Women are the primary caregivers and comprise 66% of the total caregiver population (National Alliance for Caregiving & AARP, 2009). Women provide more care hours and perform more complex caring tasks, while men are more likely to take on arrangement and decision-making roles (National Alliance for Caregiving & AARP, 2009; Navaie-Waliser, Spriggs, & Feldman, 2002; Pinquart & Sorensen, 2006). Almost half of female caregivers feel that caregiving is an obligation, in comparison to 38% of male caregivers (National Alliance for Caregiving & AARP, 2009). Around 70% of female caregivers are employed, in comparison to 82% of male caregivers. A larger proportion of female caregivers report difficulties in balancing employment and caregiving, and some even cut their working hours, change positions, or quit their jobs to meet care recipients' needs (National Alliance for Caregiving & AARP, 2009). Female caregivers also experience more stress and emotional problems than male caregivers (National Alliance for Caregiving & AARP, 2009; Navaie-Waliser et al., 2002).

With the aging of the baby boomers, the elderly population in the United States will grow from the current 46 million to more than 98 million in 2060 (Population Reference Bureau, 2016). The rapidly increasing aging population's demand for informal care can hardly be met by formal LTC resources. On the one hand, formal LTC is too

costly for most elderly people. In 2013/14, the median annual costs for nursing homes, home care, and adult day care were $87,600, $45,760, and $16,900 respectively (Reaves & Musumeci, 2015), while the median American household income in the same time period was $51,939 (DeNavas-Walt & Proctor, 2014), meaning nursing home care or home care are hardly affordable for many American families when paying out-of-pocket. On the other hand, long-term care insurance (LTCI) is under-developed in the United States. Private LTCI has strict screening criteria and charges high premiums (Hendren, 2013; Ujvari, 2012), and it only comprises less than 10% of total LTC expenditures (Reaves & Musumeci, 2015; Sloan & Norton, 1997). The public health programs, Medicare and Medicaid, account for 21% and 51% of national LTC expenditures, respectively (Reaves & Musumeci, 2015). However, Medicare only covers post-hospitalization LTC (Medicare.gov), and Medicaid has been promoting the use of less costly home- and community-based care (HCBS) instead of expensive nursing home care (Eiken et al., 2014). HCBS often has a long waiting period, does not provide 24/7 services, and does not always cover ADL care (Hoffman, 2014), making it hardly a substitute for nursing homes for elderly people with high LTC needs.

As the formal LTC market lacks the capacity to meet aging baby boomers' care needs, informal care provided by adult children will remain the main LTC source. The old-age dependency ratio will increase from the current 21 elders per 100 working-age adults to 35 elders per 100 working-age adults by 2030 (Ortman, Velkoff, & Hogan, 2014). Therefore, adult children's caregiving burden will increase rapidly. Meanwhile, fundamental changes have taken place in the labor market in that women's labor force participation has been continuously increasing, and men's labor force participation has

been gradually decreasing (Federal Reserve Bank of St. Louis, 2016). Women, the primary caregivers, may face greater challenges in balancing work and caregiving.

A large discrepancy in informal care has been observed in adult children with different employment statuses: In a given month, an unemployed adult child provides 93 informal care hours on average, in comparison to 53 hours provided by an employed adult child; a part-time employed adult child provides 70 hours of care on average, compared to 45 hours provided by a full-time employed adult child (Spillman et al., 2014). The inverse relationship between employment and caregiving may reflect employment's effects on caregiving, caregiving's effects on employment, or a third factor's effects on both (He & McHenry, 2015). Simultaneous employment and caregiving can be understood as substitution between the two. An example of a third factor that affects both could be work ability, i.e., adult children with low work ability might tend to stay at home and provide care to their aging parents. Other examples could be adult children's preferences, family tradition, culture, etc.

To detect whether changes in the labor market would constitute challenges to caregiving, it is important to test whether employment has causal effects on informal caregiving. The estimation methods should be able to eliminate bias caused by the simultaneity and omitted variables. One approach is to examine the effects of previous employment on present caregiving, under the assumption that present decisions cannot affect past events (Carmichael, Charles, & Hulme, 2010; Michaud, Heitmueller, & Nazarov, 2010; Stern, 1995). This approach can eliminate bias caused by simultaneity but not bias caused by omitted variables that correlate to both previous employment and present caregiving. The other approach is the instrumental variable (IV) method, which

uses exogenous shocks such as implementation of labor market policy or economic cycles as instruments for employment. For example, Golberstein (2008) used the Earned Income Tax Credit expansions in the 1990s as an instrument for income. Nizalova (2012) used state unemployment rates, industry structure, and education as instruments for wages. He and McHenry (2015) used state unemployment rates as instruments for employment and work hours.

Previous studies that controlled for employment's endogeneity often detected its negative effects on caregiving. Golberstein (2008) found the Earned Income Tax Credit expansions reduce single women's co-residing with disabled parents. Michaud et al. (2010) found that previous years of unemployment increased British women's probability of becoming caregivers. Carmichael et al. (2010) found that previous years of employment reduced the odds of becoming an informal caregiver in the following years among British men and women alike. Nizalova (2012) found that higher wage rates led to lower informal care supply, and the effects were greater among those who were female, with siblings, and not co-residing with parents. He and McHenry (2015) found that every 10% increase in working hours reduced the probability of being a caregiver by 2.06 percentage points among both employed and unemployed women and by 1.83 percentage points among employed women. They also found that being employed reduced the probability of providing care by 25.5 percentage points. None of these estimates were statistically significant.

Although these studies applied different methodologies to control for endogeneity, their results may not be used to assist today's policymaking in the United States. The studies done by Michaud et al. (2010) and Carmichael et al. (2010) were

based on the United Kingdom, where LTC is financed and delivered differently and paid family leave is common (Chen, 2014; Comas-Herrera, Pickard, Wittenberg, Malley, & King, 2010). Informal caregiving in the United Kingdom might be less elastic to employment than in the United States. Most U.S. studies have used data from the 1980s and the 1990s, but the LTC compositions have since changed (Golberstein, 2008; Nizalova, 2012; Stern, 1995). In addition, previous studies' selection of study populations and outcomes also limits their generalizability. Regarding study population, Golberstein (2008), Nizalova (2012), and He and McHenry (2015) studied single low-income women, aging adults, and women aged 40–64 years, respectively. Their results may not be applicable to the general population. Regarding outcomes, Stern (1995) used being a primary caregiver as the outcome, neglecting the fact that an individual can reduce the amount of care provided while remaining the primary caregiver or increase the amount of care provided while becoming a secondary caregiver. Golberstein (2008) used co-residing with disabled parents as a measure of single women's informal caregiving. The negative effects of employment on co-residing may instead suggest that single women are more likely to be able to afford independent living when being employed.

This study uses the 2002–2011 Health and Retirement Study (HRS) data to examine the effects of male and female adult children's employment on their caregiving to aging parents. To control for endogeneity of employment, the paper uses the same instrumental variable (IV) as He and McHenry (2015), i.e., state unemployment rates.

Although it applies a similar data analysis approach, this paper makes contributions in addition to He and McHenry (2015): First, it expands the study population from middle-aged women in He and McHenry (2015) to working-age men

and women and hence has higher external validity. Second, this study uses the HRS 2002–2011, which is not only more recent than the Survey of Income and Program Participation (SIPP) 1996–2004 panels used by He and McHenry (2015) but also provides a rich set of variables on aging parents' wealth, income, and health. Controlling for these variables can increase estimation's precision. In addition, their effects on adult children's caregiving might be of policymaking interest.

Methods

Data.

The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. The analysis uses RAND HRS Family Respondent-Kid File waves 6–10 (Health and Retirement Study, 2014a; RAND HRS Family Data, Version C, 2014). The file provides longitudinal information about children whose parents were HRS respondents during interview years 2002–2011, including their demographics, family structure, employment, income, wealth, living distance from parents, and caregiving to parents (Campbell et al., 2014). The Respondent-Kid file was merged with the RAND HRS data on the unique longitudinal respondent identifications to obtain aging parents' demographics, family structure, income, wealth, health, and health insurance coverage information (Health and Retirement Study, 2014b; RAND HRS Data, Version N, 2014). Then, restricted HRS respondent residency state information was merged with the longitudinal respondent identifications. Finally, state non-seasonally and seasonally adjusted monthly unemployment rates obtained from the Bureau of Labor Statistics were merged into the month and year of the interview.

Study population and sample.

The study population comprised adult children who were in the labor force and were potential caregivers. The sample consisted of observations of HRS adult children aged between 18 and 64. Adult children who were not alive, not of working age, without recorded interview dates, institutionalized, losing contact, lost to follow-up, or not working across all the HRS waves were excluded. The HRS Family Respondent-Kid File contains duplicate records of a child if more than one of the parents in his or her household are HRS respondents. These duplicate records were removed using an indicator variable generated by the HRS, yielding unique household-kid level observations across years (Campbell et al., 2014). The final sample consisted of 184,508 observations, including 93,586 male observations and 90,920 female observations.

Study variables.

Informal care supply was constructed as a binary variable measuring whether an adult child was a helper to parents or had helped with parents' ADL/IADL in the past month.

The main explanatory variable was whether an adult child was employed. To control for the endogeneity of employment and caregiving, state unemployment rates during the month of the interview were used as an instrument. From 2002 to 2010, under the influence of two successive economic recessions occurring between March 2001 and November 2001 and between December 2007 and June 2009 (National Bureau of Economic Research, 2014), unemployment rates in most states experienced a slow decline and then a rapid rise (Bureau of Labor Statistics, 2015), making them a potential instrument for employment.

To reduce omitted variable bias and increase estimation precision, adult children's age, gender, marital status, number of children/grandchildren, and living distance from parents, as well as aging parents' age, gender, race, ethnicity, marital status, non-housing wealth, first residency net value, household income, self-rated physical/mental health, ADL, IADL, Medicare, Medicaid, and private LTCI coverage, were controlled for in regressions. Adult children's income was not surveyed for the re-interviewed households in waves 4, 6, 8, and 10, and their homeownership was not surveyed in wave 8 for the re-interviewed households (Campbell et al., 2014). To maximize sample size, these two variables were not included in the analysis. As adult children's income is closely correlated with their employment status, and their home ownership is partly reflected by whether they co-reside with their parents, not including these variables may also avoid collinearity. All these variables and their corresponding HRS survey contents are summarized in Appendix A.

Table 1.1 reports the weighted descriptive statistics of all the variables discussed above. From the table, 3.7% of female adult children had provided care to their aging parents in the past month, in comparison to 1.8% of male adult children. Among female adult children caregivers, 18.6% had provided more than 100 hours of care, and 43.5% had provided ADL care in the past month, in comparison to 12.6% and 35.1% of male adult children. Female adult children were also more likely to have provided financial transfers to their parents compared to male children (2.3% vs. 2.2%). The average state unemployment rate was around 6.27% during the study period. The average age of adult children was about 40 years, over half of them were married, and over 40% of them lived within 10 miles from their parents. Parents were 66 years old on average, over 70% of

them were female, and around half of them were married. Parents' average non-housing wealth was about $120,000 (in 2011 dollars), the average net value of their first residency was over $140,000 (in 2011 dollars), and their average household income (the sum of a respondent's and his or her spouse's income) was between $65,000 and $71,000 (in 2011 dollars). Parents' average self-rated health on a 5-point Likert scale (ranging from 1 = Excellent to 5 = Poor) was around 3, and their average mental health, measured by the Center for Epidemiologic Studies depression scale (CESD) (ranging from 1 to 8; higher scores indicate more depressive symptoms), was around 1.60. Parents' ADL and IADL were around 0.30 on average. Half of parents reported having Medicare coverage, reflecting that 37.44% of the parents were less than 65 years old. Parents' Medicaid coverage rates and LTCI coverage rates were both around 10%.

Table 1.1. Descriptive statistics, HRS waves 6–10

	Female		Male		F-statistic
	Mean	S.E.	Mean	S.E.	
Dependent variables					
Any care in the past month	0.037	0.001	0.018	0.001	484.72***
Intensive care in the past month[a]	0.186	0.007	0.126	0.009	26.45***
ADL care in the past month[a]	0.435	0.009	0.351	0.014	26.19***
Financial transfer in the past two years	0.023	0.001	0.022	0.001	4.41**
Independent variable					
Adult children employed	0.792	0.002	0.875	0.001	1432.57***
Instrument variable					
State monthly unemployment rates	6.274	0.009	6.255	0.009	2.36
Covariates					
Adult children					
Age	39.638	0.044	39.587	0.043	0.69
Married	0.567	0.002	0.539	0.002	95.62***
Number of kids	1.700	0.006	1.529	0.006	395.17***
Number of grandkids	0.069	0.001	0.025	0.001	626.33***
Living within 10 miles of parents	0.412	0.002	0.405	0.002	5.97**
Aging parents					
Age	65.822	0.043	65.828	0.042	0.01
Male	0.234	0.002	0.226	0.002	9.86**

Nonwhite	0.184	0.001	0.169	0.001	59.71***
Hispanic	0.092	0.001	0.087	0.001	10.76**
Married	0.532	0.002	0.543	0.002	16.86***
Number of children in household	4.311	0.009	4.283	0.009	4.73**
Non-housing wealth ($1,000s)	117.411	1.921	121.143	2.154	1.67
First residency net value ($1,000s)	141.192	1.239	142.285	1.205	0.40
Annual household income ($1,000s)	65.494	0.951	70.951	1.604	8.57**
Self-rated health	2.884	0.005	2.841	0.005	43.89***
CESD	1.647	0.009	1.628	0.009	2.51
ADL	0.339	0.003	0.319	0.003	16.69***
IADL	0.292	0.003	0.275	0.003	14.02***
Medicare coverage	0.535	0.002	0.534	0.002	0.08
Medicaid coverage	0.094	0.001	0.089	0.001	12.33***
LTCI coverage	0.104	0.001	0.111	0.001	17.80***

Notes: Weighted means are reported. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$. [a] Conditional on having provided care in the past month.
Abbreviations: HRS = Health and Retirement Study; S.E. = Standard Error; ADL = Activities of Daily Living; CESD = the Center for Epidemiologic Studies Depression Scale; IADL = Instrumental Activities of Daily Living; LTCI = Long-Term Care Insurance.

Statistical analysis.

To control for bias caused by simultaneity or confounders, the study employed state monthly unemployment rates during the month of interview as an instrument for adult children's employment. State unemployment rates were assumed to affect adult children's caregiving only through their employment status. Table 1.2 demonstrates the correlation between changes in state unemployment rates and adult children's employment. In the sample that includes all adult children, i.e., caregivers and non-caregivers, a one percentage point increase in state unemployment rates reduced male children's probability of being employed by 1.0 percentage points ($p < 0.001$) and female children's by 0.9 percentage points ($p < 0.001$). The F statistics are very high, at 264.58 for male children and 137.58 for female children. In the sample that includes only adult children caregivers, a one percentage point increase in state unemployment rates reduced male caregivers' probability of employment by 1.9 percentage points ($p = 0.005$) and

female children's by 2.1 percentage points ($p < 0.001$). The F statistics are 14.97 and 8.61 for male and female adult children caregivers, respectively. According to Stock, Wright, and Yogo (2002), for a number of covariates greater than 15, first-stage F statistics should be greater than 26.80 to avoid weak instrument problems in two-stage least-square regressions. Based on this rule of thumb, estimation based on samples of adult children caregivers should be interpreted with caution.

Table 1.2. Coefficient estimates of state unemployment rates on adult children's employment, HRS waves 6–10

	Male		Female	
	All	Caregivers	All	Caregivers
State unemployment rate	-0.010***	-0.019**	-0.009***	-0.021***
	(0.001)	(0.006)	(0.001)	(0.004)
Adult children				
Age	-0.006*	0.009	0.014**	-0.021
	(0.003)	(0.024)	(0.005)	(0.022)
Married	0.107***	0.138***	-0.014**	0.004
	(0.004)	(0.036)	(0.005)	(0.023)
Number of kids	0.001	-0.011	-0.027***	-0.023**
	(0.001)	(0.012)	(0.002)	(0.007)
Number of grandkids	-0.011	0.033	-0.018**	-0.006
	(0.008)	(0.032)	(0.005)	(0.012)
Living within 10 miles of parents	-0.036***	-0.121***	-0.004	-0.069**
	(0.004)	(0.032)	(0.005)	(0.028)
Parents				
Age	-0.012**	-0.040	-0.003	0.021
	(0.004)	(0.024)	(0.005)	(0.019)
Male	-0.015**	0.097**	-0.019**	0.034
	(0.006)	(0.038)	(0.006)	(0.035)
Nonwhite	-0.052***	-0.006	0.003	0.044*
	(0.007)	(0.044)	(0.009)	(0.024)
Hispanic	-0.001	0.083**	-0.049***	0.036
	(0.006)	(0.036)	(0.008)	(0.024)
Married	0.016***	0.019	0.018**	-0.015
	(0.004)	(0.041)	(0.006)	(0.027)
Number of household children	-0.002	-0.008	-0.002	-0.001
	(0.001)	(0.007)	(0.001)	(0.007)
First residency value	-0.0001	0.005	-0.001	-0.003
	(0.0004)	(0.005)	(0.0004)	(0.007)

Housing value	0.0003	0.010	-0.002**	0.011**
	(0.001)	(0.009)	(0.001)	(0.005)
Total income	0.00002*	0.002	-0.00004	0.001
	(0.00001)	(0.001)	(0.0002)	(0.003)
Self-reported health	-0.009***	0.007	-0.011***	-0.011
	(0.002)	(0.021)	(0.002)	(0.013)
CESD	-0.006***	-0.015**	-0.005***	0.004
	(0.001)	(0.006)	(0.001)	(0.004)
ADL	-0.003	-0.0002	-0.008**	-0.006
	(0.003)	(0.010)	(0.003)	(0.008)
IADL	-0.016***	-0.003	-0.017**	-0.004
	(0.004)	(0.015)	(0.005)	(0.009)
Medicare	0.020**	0.019	0.027**	0.069
	(0.008)	(0.058)	(0.008)	(0.051)
Medicaid	-0.024**	0.051	-0.026**	-0.026
	(0.009)	(0.042)	(0.012)	(0.029)
LTCI	0.007	-0.060	0.024**	0.050
	(0.004)	(0.070)	(0.007)	(0.048)
N	69,836	1,281	68,609	2,648
IV strength F-statistics test	264.58***	14.97***	137.58***	8.61***

Notes: Average marginal effects are reported. Standard errors are in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.001. [a] Estimated by probit regression with robust standard errors.
Abbreviations: HRS = Health and Retirement Study; N = number; IV = instrumental variable.

As both the outcome variable and the endogenous explanatory variable are binary, bivariate probit was applied to estimate the causal effects, as suggested by Nichols (2011). The bivariate probit model can be written as follows (Cameron & Trivedi, 2010):

$$employed_i^* = unemployrate_i\pi_1 + X_i\pi_2 + \varepsilon_i \quad (1)$$

$$care_i^* = employed_i\beta_1 + X_i\beta_2 + u_i \quad (2)$$

where $employed_i^*$ and $care_i^*$ are latent variables for the adult child i's employment status and informal care supply, $unemployrate_i$ is state unemployment rates, and X_i is the covariate vector. The two error forms ε_i and u_i follow a joint normal distribution $(\varepsilon_i, u_i) \sim N(0,1)$ and the correlations between ε_i and u_i, $\rho \neq 0$.

HRS household weights were applied to reduce estimation bias and match the HRS observations with the nationally representative non-institutionalized American population sample collected in the Current Population Survey (Campbell et al., 2014). The HRS Family Respondent-Kid File consists of longitudinal data, and regression standard errors for a given adult child across time were correlated. Besides, the regression standard errors were assumed to be correlated within states but not across states. Based on Cameron and Miller (2015), cluster-robust standard errors at the state level were estimated to get valid statistical inference. Finally, employment's average treatment effects (ATEs) were post-estimated and reported.

Results

Table 1.3 displays employment's estimated effects on female and male adult children's caregiving by using both OLS and bivariate probit, with the purpose of exhibiting the bias caused by the endogeneity of employment. The OLS estimation results are presented in columns 1–2, which show that being employed reduced both male and female adult children's caregiving by 0.7 percentage points. By comparing the OLS results to the bivariate probit results displayed in columns 3–4, we can see that not controlling for endogeneity changes not only the magnitudes of the effects' estimates but also their directions and significances. Therefore, applying bivariate probit to control for endogeneity of employment was necessary.

The bivariate probit results show that being employed reduced neither male children's nor female children's informal caregiving significantly. Being married did not affect female children's caregiving but reduced male children's caregiving by 0.9 percentage points, which might reflect that daughters-in-law take over sons' caregiving

roles after marriage. Having more kids reduced adult children's informal caregiving, but having more grandkids increased adult children's caregiving. This might be because adult children's children can be substitute caregivers but could reduce their help when starting to care for their own children. Living within 10 miles of parents increased adult children's caregiving, which might reflect lower transportation time and costs to provide care to parents when living nearer to them. Parents' age was positively correlated with adult children's caregiving. Adult children were less likely to be caregivers to their fathers than to their mothers, which might be because aging fathers can also get care from their wives but aging mothers tend to outlive their husbands. Daughters of non-white parents were more likely to be caregivers than daughters of white parents. Sons of Hispanic parents were less likely to be caregivers than sons of non-Hispanic parents. Adult children with married parents or more siblings were less likely to be caregivers. Parents' wealth was negatively associated with children's informal caregiving. Parents' poorer physical and mental health increased adult children's caregiving. Parents' Medicare coverage increased their children's caregiving, which may suggest that children's informal care is a supplement to post-acute formal care. Parents' Medicaid coverage was not significantly associated with their children's caregiving, which might suggest that Medicaid-covered formal care is not a substitute for children-provided care. Parents' LTCI coverage reduced sons' caregiving but did not significantly affect daughters' caregiving.

Table 1.3. Average treatment effects of adult children's employment on their caregiving, HRS waves 6–10

	OLS[a]		Bivariate Probit[b]	
	Male	Female	Male	Female
Adult children employed	-0.007**	-0.007***	0.004	0.001
	(0.002)	(0.002)	(0.007)	(0.004)

Adult children				
Age (10 years)	-0.001	-0.001	-0.002**	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Married	-0.009***	0.002	-0.009***	0.001
	(0.002)	(0.002)	(0.003)	(0.002)
Number of kids	-0.002***	-0.003***	-0.002***	-0.001**
	(0.0004)	(0.001)	(0.0004)	(0.001)
Number of grandkids	0.021***	0.033***	0.006***	0.010***
	(0.005)	(0.003)	(0.001)	(0.001)
Living ≤ 10 miles from parents	0.022***	0.036***	0.021***	0.033***
	(0.002)	(0.003)	(0.002)	(0.002)
Parents				
Age (10 years)	0.006***	0.012***	0.006***	0.009***
	(0.001)	(0.002)	(0.001)	(0.001)
Male	-0.007**	-0.014***	-0.007**	-0.013***
	(0.002)	(0.002)	(0.002)	(0.003)
Nonwhite	-0.001	0.007**	0.001	0.007**
	(0.003)	(0.003)	(0.002)	(0.002)
Hispanic	-0.009***	0.0002	-0.007***	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Married	-0.008***	-0.016***	-0.010***	-0.017***
	(0.002)	(0.002)	(0.002)	(0.002)
Number of household children	-0.003***	-0.003***	-0.002***	-0.003***
	(0.0003)	(0.0005)	(0.0003)	(0.0004)
Non-housing wealth ($100,000s)	-0.00003	-0.0002**	-0.0002	-0.001**
	(0.00004)	(0.0001)	(0.0002)	(0.0004)
First residency net value ($100,000s)	-0.0002*	0.0002	-0.0005	-0.001
	(0.0001)	(0.0002)	(0.0003)	(0.0004)
Annual household income ($10,000s)	2.30e-06	0.0002**	-3.43e-06	-0.00004
	(4.21e-06)	(0.00005)	(8.10e-06)	(0.0002)
Self-rated health	0.001	0.0004	0.004***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
CESD	0.001	0.0001	0.001**	0.001**
	(0.0004)	(0.001)	(0.0003)	(0.0004)
ADL	0.011**	0.021***	0.003**	0.006***
	(0.004)	(0.002)	(0.001)	(0.001)
IADL	0.054***	0.094***	0.011***	0.022***
	(0.004)	(0.004)	(0.001)	(0.001)
Medicare	0.0004	-0.0001	0.004**	0.011***
	(0.003)	(0.004)	(0.002)	(0.003)
Medicaid	0.005	0.005	0.001	0.0003
	(0.004)	(0.005)	(0.002)	(0.002)
LTCI	-0.002	-0.002	-0.004**	-0.003

	(0.001)	(0.003)	(0.002)	(0.003)
N	69,832	68,603	69,832	68,603

Notes: Average treatment effects are reported. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$. [a] Estimated by OLS; [b] Estimated by bivariate probit.
Abbreviations: HRS = Health and Retirement Study; OLS = Ordinary Least Squares; CESD = the Center for Epidemiologic Studies Depression Scale; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living; LTCI = Long-Term Care Insurance; N = number.

Heterogeneity checks.

The effects of adult children's employment on their informal caregiving could be heterogeneous in population subgroups or for different types of caregiving. Adult children who provide intense or complex care may react differently to employment changes than other adult children caregivers. To test this heterogeneity, the effects of employment on intensive or complex caregiving were estimated. Intensive caregiving was measured by whether an adult child had provided more than 100 hours of care in the previous month, and complex care was measured by whether an adult child had helped with parents' ADL in the past month. Table 1.4 demonstrates whether employment can affect adult children caregivers' provision of intensive or complex care. The results show that being employed significantly reduced female children's intensive caregiving by 31.6 percentage points but did not affect male adult children's intensive caregiving, and being employed affected neither male nor female children's complex caregiving significantly. However, the effect magnitudes for outcomes such as female adult children's intensive caregiving and male and female children's complex caregiving are blown up, which might have been caused by weak instrument problems (first stage F = 14.97 for male children caregivers and = 8.61 for female children caregivers); hence, the estimation is not valid.

Table 1.4. Heterogeneity check results, HRS waves 6–10[a]

	Intensive Care[b]		ADL Care[b]	
	Male	**Female**	**Male**	**Female**
Adult children employed	0.069	-0.316***	0.253	-0.188
	(0.155)	(0.063)	(0.878)	(0.116)
Adult children				
Age (10 years)	-0.017	-0.018	0.022	-0.044**
	(0.018)	(0.012)	(0.023)	(0.018)
Married	-0.101**	-0.058***	-0.078	-0.032
	(0.041)	(0.016)	(0.138)	(0.026)
Number of kids	-0.002	-0.010**	-0.004	-0.008
	(0.006)	(0.004)	(0.017)	(0.007)
Number of grandkids	0.015	0.037***	0.013	0.023*
	(0.013)	(0.008)	(0.061)	(0.014)
Living ≤ 10 miles from parents	0.088	0.036**	0.063	0.073**
	(0.057)	(0.018)	(0.130)	(0.022)
Parents				
Age (10 years)	0.040**	0.034**	-0.031	0.035*
	(0.019)	(0.011)	(0.057)	(0.020)
Male	-0.009	-0.039	0.020	-0.139***
	(0.023)	(0.023)	(0.131)	(0.024)
Nonwhite	-0.009	-0.006	0.025	-0.036*
	(0.023)	(0.017)	(0.034)	(0.020)
Hispanic	-0.017	0.015	-0.075	0.059**
	(0.031)	(0.018)	(0.108)	(0.019)
Married	-0.014	-0.015	0.042	-0.010
	(0.032)	(0.020)	(0.066)	(0.025)
Number of household children	-0.004	-0.002	-0.010	-0.011*
	(0.005)	(0.003)	(0.017)	(0.005)
Non-housing wealth ($100,000s)	-0.005	-0.027**	-0.001	0.004
	(0.010)	(0.010)	(0.010)	(0.010)
First residency net value ($100,000s)	-0.003	0.013**	-0.008	-0.008
	(0.008)	(0.005)	(0.017)	(0.008)
Annual household income ($10,000s)	-0.011*	0.002	-0.001	0.0004
	(0.006)	(0.002)	(0.002)	(0.003)
Self-rated health	0.004	0.001	-0.007	0.005
	(0.010)	(0.009)	(0.017)	(0.010)
CESD	-0.003	0.002	0.003	-0.011**
	(0.005)	(0.003)	(0.021)	(0.004)
ADL	0.020**	0.016**	0.131	0.150***
	(0.007)	(0.006)	(0.079)	(0.010)
IADL	0.012	0.027***	-0.052	-0.058***

	(0.009)	(0.008)	(0.038)	(0.011)
Medicare	0.013	0.072**	0.046	0.064*
	(0.032)	(0.029)	(0.075)	(0.036)
Medicaid	0.019	0.042**	0.038	0.018
	(0.025)	(0.020)	(0.110)	(0.025)
LTCI	0.012	0.064**	0.071	0.103**
	(0.043)	(0.031)	(0.063)	(0.049)
N	1,135	2,340	1,256	2,625

Notes: Average treatment effects are reported. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$. [a] Estimated by bivariate probit. [b] Conditional on having provided care in the past month.
Abbreviations: HRS = Health and Retirement Study; ADL = Activities of Daily Living; CESD = the Center for Epidemiologic Studies Depression Scale; IADL = Instrumental Activities of Daily Living; LTCI = Long-Term Care Insurance; N = number.

This study selected the 100 hours per month arbitrarily to define intensive care. He and McHenry (2015) used 20 hours or 40 hours of caregiving per week to measure intensive caregiving, which approximately equals 80 hours or 160 hours of caregiving per month. The study also tested employment's effects using these two thresholds to define the intensive care outcome. Average marginal effect estimates for the percentage points reduction in intensive caregiving are 0.078 ($p = 0.630$) and –0.190 ($p = 0.158$) for male children and –0.352 ($p = 0.000$) and –0.231 ($p = 0.006$) for female children for the 80 hours and 160 hours of intensive care thresholds. Although the effect estimates for female adult children are statistically significantly, the reduction magnitudes are larger than the percentage of female adult children givers who had provided more than 80 hours and 160 hours of care in the past month, which are 23.6% and 12.7%, respectively. Two-stage least-squares regressions on the actual number of informal care hours provided by male and female caregivers were also conducted. Being employed did not affect male adult children caregivers' caregiving hours significantly (coefficient estimate = 3.061 hours; $p = 0.964$). Being employed reduced female adult children caregivers' caregiving hours by

163.136 hours ($p = 0.013$) in the past month, which is greater than this subgroup's average care hours of 76 hours in the past month.

Sensitivity analyses.

Sensitivity analyses were conducted by removing significant covariates from the model and checking whether excluding them would substantially change employment's estimated effects. The results are shown in Table 1.5 (p. 24).

Excluding adult children's marriage status (Columns 1–2), number of kids/grandkids (Columns 3–4), or living distance from parents (Columns 5–6), or parents' marriage status (Columns 7–8), resulted in minimal changes in estimated effects, suggesting that these factors have limited confounding effects.

People may argue that adult children's employment is not the only way unemployment rates could affect their informal caregiving. Rising unemployment rates may also affect adult children's caregiving through their and their aging parents' income and wealth (McInerney, Mellor, & Nicholas, 2013; McLaughlin et al., 2012). When unemployed, adult children may decide to move into their parents' house to reduce housing spending. In the meantime, living together with parents may also increase adult children's caregiving. When aging parents lose income and wealth during recessions, children may have less motivation to provide informal care if their caregiving motivation is to exchange care for parents' financial support. However, from Table 6, columns 5–6 and 9–10, dropping children's living distance from parents and parents' income and wealth from regressions produced similar results to the estimated caregiving effects of employment, indicating that these two potential pathways between recessions and adult children's caregiving are negligible. From columns 11–12, excluding parents' health

variables not only inflated the magnitudes of estimated effects but also changed their direction to negative. This might indicate that parents' health is another important pathway between recessions and adult children's caregiving and should be controlled for.

People may also argue that the effects of unemployment rates on informal caregiving could work through reduced access to formal LTC; for example, many states implemented large funding cuts in Medicaid and community-based LTC programs during the Great Recession (Johnson, Oliff, & Williams, 2011; Modrek, Stuckler, McKee, Cullen, & Basu, 2013). However, parents' Medicaid coverage is controlled for in the regressions and shows no significant effects on adult children's caregiving.

The study used seasonally unadjusted state monthly unemployment rates as the instrument because they reflect the actual unemployment in a state. Robustness checks were conducted by switching the instrument to seasonally adjusted state monthly unemployment rates. The results show that being employed affected neither male nor female adult children's informal caregiving. The directions of the effect estimates are the same as, and the magnitudes are also very similar to, the base case results (male adult children: average marginal effect estimate = 0.005, p = 0.521; female adult children: average marginal effect estimate = 0.002, p = 0.617).

Further exploration.

Being employed not only reduces adult children's available time in which to provide care but also increases their income. Table 1.6 (p. 26) demonstrates the effects of employment on adult children's financial transfers to aging parents. From the table, being employed increased the probability of providing financial support to aging parents among male and female adult children by 5.2 and 11.4 percentage points, respectively.

The study also made comparisons to He and McHenry (2015) by conducting analyses on middle-aged women in scenarios in which (a) a similar set of variables were used and (b) elderly parents' health variables were added in. Due to the weak instrument problem, estimates in both cases were blown up. The results are shown in Appendix B.

Table 1.5. Sensitivity analysis results, HRS waves 6–10[a]

	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Adult children employed	0.001	0.002	0.006	0.002	0.003	0.002	0.004	0.002	0.004	0.002	-0,007	-0.016
	(0.005)	(0.004)	(0.008)	(0.004)	(0.006)	(0.003)	(0.009)	(0.004)	(0.007)	(0.004)	(0.013)	(0.017)
Adult children												
Age (10 years)	-0.003**	-0.002	-0.003**	-0.003**	-0.003***	-0.003**	-0.002**	-0.002	-0.002**	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Married			-0.011***	0.0001	-0.011***	-0.001	-0.010**	0.001	-0.010***	0.001	-0.010**	0.0005
			(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Number of kids	-0.003***	-0.001**			-0.002***	-0.001**	-0.002***	-0.001**	-0.002***	-0.001**	-0.002***	-0.001*
	(0.0004)	(0.001)			(0.0004)	(0.0004)	(0.0004)	(0.001)	(0.0004)	(0.001)	(0.001)	(0.001)
Number of grandkids	0.007***	0.010***			0.009***	0.014***	0.007***	0.010***	0.007***	0.010***	0.011***	0.017***
	(0.001)	(0.001)			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Living ≤ 10 miles from parents	0.021***	0.033***	0.022***	0.034***			0.021***	0.033***	0.021***	0.033***	0.026***	0.046***
	(0.002)	(0.002)	(0.002)	(0.002)			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Parents												
Age (10 years)	0.006***	0.009***	0.006***	0.009***	0.006***	0.009***	0.007***	0.010***	0.006***	0.008***	0.011***	0.017***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Male	-0.007***	-0.013***	-0.007**	-0.013***	-0.008***	-0.014***	-0.006**	-0.012***	-0.007**	-0.013***	-0.006***	-0.015***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Nonwhite	0.002	0.006**	0.001	0.007**	0.001	0.008**	0.002	0.009***	0.001	0.007**	0.005**	0.015***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Hispanic	-0.008***	0.002	-0.008***	0.003	-0.008***	0.001	-0.007**	0.0005	-0.007***	0.002	-0.004**	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Married	-0.010***	-0.017***	-0.010***	-0.018***	-0.009***	-0.017***			-0.010***	-0.018***	-0.013***	-0.023***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)			(0.002)	(0.002)	(0.002)	(0.003)
Number of household children	-0.002***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.002***	-0.002***	-0.003***	-0.003***
	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0005)	(0.001)

Non-housing wealth ($100,000s)	-0.0002	-0.001**	-0.0002	-0.001**	-0.0002	-0.002**	-0.0002	-0.001**			-0.0005	-0.001**
	(0.0002)	(0.0004)	(0.0002)	(0.0005)	(0.0002)	(0.0005)	(0.0002)	(0.0004)			(0.0003)	(0.0004)
First residency net value ($100,000s)	-0.0005	-0.001*	-0.0005	-0.001*	-0.0003	-0.001*	-0.001**	-0.001**			-0.003***	-0.003**
	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.001)			(0.001)	(0.001)
Annual household income ($10,000s)	-3.58e-06	-0.00004	-3.33e-06	-0.00005	-2.30e-06	-0.0001	-0.0001	-0.0004			-0.0002	-0.001**
	(6.36e-06)	(0.0002)	(7.67e-06)	(0.0002)	(0.00001)	(0.0002)	(0.0001)	(0.0003)			(0.0002)	(0.001)
Self-rated health	0.004***	0.006***	0.004***	0.006***	0.004***	0.006***	0.004***	0.006***	0.004***	0.006***		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)		
CESD	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001***	0.002***	0.001**	0.001**		
	(0.0003)	(0.0004)	(0.0003)	(0.0004)	(0.0002)	(0.0004)	(0.0003)	(0.0004)	(0.0003)	(0.0004)		
ADL	0.003**	0.006***	0.003**	0.006***	0.003**	0.006***	0.003**	0.006***	0.003**	0.006***		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)		
IADL	0.011***	0.022***	0.012***	0.022***	0.011***	0.021***	0.011***	0.021***	0.011***	0.022***		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)		
Medicare	0.004**	0.011***	0.004**	0.011**	0.005**	0.010**	0.005**	0.011***	0.004**	0.011***	0.012***	0.024***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.005)
Medicaid	0.002	0.0002	0.001	0.0002	0.002	0.0002	0.003*	0.003	0.002	0.001	0.017***	0.028***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
LTCI	-0.004**	-0.003	-0.004**	-0.003	-0.005**	-0.005	-0.004**	-0.003	-0.004**	-0.004	-0.007**	-0.011**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.002)	(0.003)	(0.003)	(0.005)
N	69,837	68,611	70,238	68,909	77,252	75,175	69,886	68,640	69,832	68,603	72,986	71,925

Notes: Average treatment effects are reported. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$. [a] Estimated by bivariate probit.
Abbreviations: HRS = Health and Retirement Study; CESD = the Center for Epidemiologic Studies Depression Scale; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living; LTCI = Long-Term Care Insurance; N = number.

Table 1.6. Average treatment effects of adult children's employment on their financial transfer, HRS waves 6–10[a]

	Male	Female
Adult children employed	0.052***	0.114
	(0.013)	(0.114)
Adult children		
Age (10 years)	0.001	-0.0002
	(0.001)	(0.002)
Married	-0.010**	0.008**
	(0.003)	(0.004)
Number of kids	-0.002***	-0.002
	(0.001)	(0.003)
Number of grandkids	0.010**	0.015*
	(0.004)	(0.009)
Living ≤ 10 miles from parents	0.005**	0.005
	(0.002)	(0.004)
Parents		
Age (10 years)	0.004*	0.004
	(0.002)	(0.004)
Male	-0.019***	-0.027***
	(0.004)	(0.007)
Nonwhite	0.013**	0.026**
	(0.004)	(0.009)
Hispanic	0.017***	0.016
	(0.003)	(0.012)
Married	-0.015***	-0.016
	(0.003)	(0.011)
Number of household children	-0.003***	-0.003**
	(0.001)	(0.001)
Non-housing wealth ($100,000s)	-0.004**	-0.011**
	(0.001)	(0.005)
First residency net value ($100,000s)	-0.001	-0.001
	(0.001)	(0.001)
Annual household income ($10,000s)	-0.001***	-0.002**
	(0.0002)	(0.001)
Self-rated health	0.0002	0.003
	(0.001)	(0.002)
CESD	0.002***	0.002
	(0.001)	(0.001)
ADL	0.0003	-0.0004
	(0.001)	(0.002)
IADL	0.001	0.007
	(0.002)	(0.004)

Medicare	-0.0002	-0.003
	(0.004)	(0.006)
Medicaid	-0.002	-0.002
	(0.004)	(0.004)
LTCI	-0.006**	-0.021*
	(0.003)	(0.012)
N	68,844	67,679

Notes: Average treatment effects are reported. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$. [a] Estimated by bivariate probit.
Abbreviations: HRS = Health and Retirement Study; CESD = the Center for Epidemiologic Studies Depression Scale; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living; LTCI = Long-Term Care Insurance; N = number.

Discussion

This study used recent years' data to examine employment's effects on adult children's caregiving to aging parents. The results show that being employed affects neither male adult children's nor female adult children's informal caregiving.

Women's labor force participation has been steadily increasing in the United States. Based on this study's findings, the trend does not affect women's caregiving to parents, which might reflect that females consider caring for aging parents as an obligation (National Alliance for Caregiving & AARP, 2009). Taking care of aging parents while working might increase female adult children caregivers' stress, harm their health, and affect their work performance as well as the quality and quantity of their care provision. On the contrary, men's labor force participation has been gradually decreasing. However, even after their retreat from the labor market, male adult children have not taken over their female counterparts' role in caring for aging parents, which might be because they view caregiving as a choice instead of an obligation (National Alliance for Caregiving & AARP, 2009).

To protect female adult children caregivers from burnout due to working while providing care to aging parents, the government can consider using work-life balance

policies to alleviate conflicts between employment and informal caregiving. Currently, several federal and state policies allow employees to take leave when aging parents need care. The Family and Medical Leave Act (FMLA) allows employees to take 12 weeks of leave per year to care for seriously ill parents without losing group health insurance coverage (Department of Labor, 2013). States including California, Connecticut, and Rhode Island have enacted paid family leave laws that mandate that employers pay employees a certain percentage of their income when they take leave to care for seriously ill parents (National Conference of State Legislatures, 2014). Some other states have passed laws to allow public and/or private employees to take sick leave to care for their parents (Pandya, Wolkwitz, & Feinberg, 2006). However, most policies exclude employees who are most likely to be informal caregivers, such as part-time employees (Chen, 2014). Eligibility for these policies should be expanded.

The government may also consider motivating male adult children to share the caregiving burden with their female counterparts. Even though women are positioned to be primary caregivers by traditional gender roles, the declining gender gap in labor force participation requires men to contribute more in caregiving. The reality is that the proportion of male caregivers has increased very slowly in the United States, from 27% in 1997 to 34% in 2009 (National Alliance for Caregiving & AARP, 2009); in contrast, in the United Kingdom, men even comprise a higher proportion of caregivers to elderly people aged 70 and above than women (Dahlberg, Demack, & Bambra, 2007). Reasons for the difference in male caregiving between the two countries need to be further explored, but one possibility is that men in the United Kingdom are given incentives to provide more informal care. In Britain, the government sets up a caregiver allowance for

those who are unemployed and provide at least 35 hours of care per week (Courtin, Jemiai, & Mossialos, 2014). To make men in the United States take on primary caregiving roles, policymakers may consider implementing similar policies.

Limitations.

This study has several limitations. First, informal caregiving was measured with binary variables, and the results only reflect employment's effects on the extensive margin of caregiving. To test whether employment also affects caregiving's intensive margin, binary outcomes measuring whether adult children caregivers provided more than 80, 100, and 160 hours of care and the continuous outcome measuring the number of caregiving hours provided by adult children caregivers in the past month were examined in heterogeneity checks. Possibly due to the weak instrument problem, bivariate probit regressions on the variable produced blown-up estimates. Therefore, the findings cannot indicate whether being employed affects the quantity of care supplied by caregivers. Second, people may argue that unemployment rates' effects on adult children's informal caregiving could also be through pathways such as changes in adult children's income and wealth and formal caregivers' availability. As discussed in the methods section, the study assumed that adult children's income mainly depends on their employment and that their wealth can be largely reflected by whether they live together with their aging parents or not. When excluding the variable measuring adult children's living distance from parents in the sensitivity analyses, the estimated effect of being employed on adult children's caregiving remained similar (Table 1.5, Columns 5–6). When state unemployment rates increase, the number of formal caregivers decreases. Without controlling formal caregivers' availability leads to overestimation of employment's

effects on caregiving, meaning the effect magnitudes would be smaller if controlling for formal caregivers' availability. Third, the study addressed gender differences in caregiving but did not test other types of heterogeneity that may exist within each gender, such as racial or ethnic. Due to the small number of informal caregivers surveyed by the HRS, more detailed subgroup analyses cannot be conducted.

Chapter Three

The Short-Term Effect of Legalizing Recreational Marijuana on Employment

Background

Recreational marijuana legalization.

Marijuana was first brought into the United States as a recreational drug by Mexican laborers in the 1900s and gained popularity in the 1960s (Abadinsky, 2001). Marijuana use has long been criminalized at both the federal and the state level. While it remains an offense at the federal level, as of now, 22 states and the District of Columbia have decriminalized marijuana (National Conference of State Legislatures, 2018a), and 33 states and the District of Columbia have legalized medical marijuana (National Conference of State Legislatures, 2018b). In November 2012, Washington and Colorado, two states that had already legalized medical marijuana in 1998 and 2001, started the trend of legalizing recreational marijuana with Washington Initiative 502 and Colorado Amendment 64 (Office of National Drug Control Policy, 2012). Under the new laws, adults aged 21 and over in the two states have been allowed to possess and consume marijuana for recreational purposes since December 2012, and to produce, distribute, and sell recreational marijuana for commercial purposes since 2014 (Garvey & Yeh, 2014).

The passage of these laws in these two states is no accident. Advocates and lawmakers suggest that legalizing recreational marijuana would reduce law enforcement costs, improve racial equity, and generate new tax revenues. For example, the leading drug policy advocate, Drug Policy Alliance, stated on its website that

> The prohibition of marijuana is an utter failure. The United States wastes billions of dollars enforcing marijuana laws even for low-level offenses, incarcerating and penalizing marijuana users, and denying seriously ill patients access to beneficial treatment. . . . The criminalization of

> marijuana use disproportionately harms young people and people of color, sponsors massive levels of violence and corruption, and fails to curb youth access. (Drug Policy Alliance, 2014)

Washington Initiative 502 stated that the intent of the law includes the following:

> (1) Allows law enforcement resources to be focused on violent and property crimes; (2) Generates new state and local tax revenue for education, health care, research, and substance abuse prevention; and (3) Takes marijuana out of the hands of illegal drug organizations and brings it under a tightly regulated, state-licensed system similar to that for controlling hard alcohol. (INIT. 502, 63rd Leg., Reg. Sess. §19 (Wash. 2013))

Although savings on law enforcement and improvement of racial equity have not been estimated, financing data have shown that the two earliest legalization states greatly benefit from tax revenues generated by recreational marijuana's legalization: In 2014, Colorado earned $63 million in tax revenues and $13 million for licenses and fees, and Washington earned $70 million in marijuana-related tax revenues (Imam, 2015; Ingraham, 2015).

Following recreational marijuana legalization in Washington and Colorado, Alaska, Oregon, and the District of Columbia also passed laws to legalize marijuana's recreational use in fall of 2014, California, Maine, Massachusetts, and Nevada passed their recreational marijuana laws in November 2016; Michigan and Vermont passed laws to allow recreational marijuana use in 2018 (National Conference of State Legislatures, 2018a). Due to data availability, this paper only focuses on the first two states that passed recreational marijuana laws, i.e., Washington and Colorado.

Recreational marijuana legalization and employment.

Since the laws' implementation, people in the two legalization states are no longer subject to penalties and punishment when using marijuana for recreational purposes. Those who had previously never used recreational marijuana or used it occasionally due

to fear of punishment or desire to be law-abiding might have initiated or increased recreational marijuana use after the passage of these laws. A report from the National Survey on Drug Use and Health (NSDUH) shows that from 2011 to 2013, the percentage of people aged 18 and over who used marijuana in a given month increased from 10.40% to 12.86% in Colorado and from 10.29% to 12.53% in Washington (Substance Abuse and Mental Health Services Administration, 2014a). No studies have been conducted to examine whether increases in the percentage of people who used marijuana in a given month in these two states are caused by recreational marijuana legalization. Findings from studies examining the effect of legalizing medical marijuana support that legalization can significantly increase marijuana use or lead to earlier initiation (Cerdá, Wall, Keyes, Galea, & Hasin, 2012; Chu, 2014).

Marijuana use can affect employment in several ways. First, marijuana use can affect people's health in both directions: On the one hand, marijuana's harmful effects on the nervous system and cognition have long been recognized. In the short run, marijuana impairs memory, motor coordination, and judgment, and taking high doses can lead to paranoia and psychosis; in the long-run, it generates addiction, impairs brain development and cognition, and increases risks of chronic psychosis disorders (Volkow, Baler, Compton, & Weiss, 2014). On the other hand, clinical research has discovered in recent years that marijuana can relieve sclerosis, pain, nausea, and loss of appetite (Kramer, 2015; McGeeney, 2013; Robson, 2014). Empirical research has also found that medical marijuana can reduce headache frequency in the adult population and relieve chronic pain in the aging population (Nicholas & Maclean, 2016; Rhyne, Anderson, Gedde, & Borgelt, 2016). As health's positive relationship with labor supply has been

affirmed in many economic studies (Currie & Madrian, 1999), the labor effects of recreational marijuana legalization in the two states depend on which health effect direction dominates.

The health pathway can also work through other substances that are closely related to marijuana use. Although currently disputed, marijuana is argued to be the "gateway" drug, leading to initiation or increased use of other substances (Morral, McCaffrey, & Paddock, 2002; National Institute on Drug Abuse, 2016). In contrast, research has found that legalizing medical marijuana reduces alcohol consumption (Anderson, Hansen, & Rees, 2013). Given the potential gateway and substitution effects of recreational marijuana, its legalization can also indirectly affect people's health and labor supply through changing use of other substances.

Second, although the laws' passage legalized recreational marijuana use, the majority of employers in the two legalization states were concerned about poor work performance related to substance use and chose to continue their zero-tolerance drug policies (Briggs, 2014). A survey shows that after Colorado legalized recreational marijuana use, 77% of employers in the state maintained their pre-law drug testing policies, and one in five employers implemented more stringent drug testing policies. Moreover, 53% of employers with drug testing policies stated that they would fire an employee for his or her first-time positive test result (Raabe, 2014). In 2015, the Colorado Supreme Court ruled that employers can fire employees for off-duty marijuana use given marijuana's illegal status at the federal level (Wallace & Steffen, 2015), which expands employers' power to discipline employees for their off-duty marijuana use. Therefore, recreational marijuana users in the two legalization states may lose their jobs

involuntarily for using marijuana. In addition, marijuana users may also quit their jobs or take leave to avoid drug testing.

Finally, the two legalization states began issuing licenses to recreational marijuana producers, distributors, and retailers in 2014 to allow them to produce, distribute, and sell marijuana for commercial purposes. The newly established recreational marijuana industries may have generated a large increase in demand for labor and consequently stimulated labor supply. However, as the Survey of Income and Program Participation (SIPP) 2008 panel ranged from 2008 to 2013, the potential labor supply stimulating effects of new marijuana industries cannot be tested.

Previous literature on marijuana use and labor supply.

The trend of recreational marijuana legalization just started in 2012. Due to the lack of data, no studies have been done to examine the labor effects of legalization. In this section, literature studying the labor effects of marijuana use and medical marijuana legalization is summarized.

A few studies have investigated the effect of marijuana use on labor supply. Kaestner (1994) used the 1984 and 1988 National Longitudinal Survey of Youth (NLSY) to estimate the effects of marijuana use on the labor supply of youths aged 14 to 21. Both a cross-sectional analysis and an individual fixed effects analysis were conducted, and significant effects were only discovered from the former. The author concluded that marijuana use does not affect the youth labor supply. French, Roebuck, and Alexandre (2001) used the 1997 National Household Survey on Drug Abuse to study the effects of chronic drug use (i.e., using illicit drugs weekly or more often in the past year) on employment among adults aged 25 to 59. Strong religiosity was used as an instrument for

illicit drug use, as “many organized religions advocate a whole- some lifestyle that is free of unhealthy substance” and significantly negative relationship between religiosity and drug use has been identified in published empirical studies. The study found that chronic illicit drug use reduces labor participation significantly in both males and females. DeSimone (2002) used the 1984 and 1988 NLSY data to study the impact of marijuana and cocaine use on the labor supply of young males aged 14 to 22. Living with parents at the age of 14, having an alcoholic parent, regional cocaine prices, and state decriminalization of marijuana were used as instruments for drug use. Marijuana use was found to lead to a significant 15.0% drop in employment in 1984 and a 16.5% drop in employment in 1988. van Ours (2006) employed drug use survey data collected in Amsterdam in 1990 and 1994 to estimate the effects of marijuana use on employment. The effects of marijuana use became insignificant in both males and females after controlling for unobserved individual characteristics. The mixed findings from these studies might be partly due to different study populations. For example, the 1984 and 1988 NLSYs surveyed youths aged 14 to 22, a population with a highly elastic labor supply. Studies based on this young group may yield different effect estimates than studies based on an older age group. In addition, most studies used data collected 10 years ago, when no recreational marijuana laws existed. Therefore, they may not be able to assist today’s recreational marijuana lawmaking.

In recent years, studies have been conducted to test medical marijuana legalization’s labor market influence. Sabia and Nguyen (2016) used the Current Population Survey (CPS) to study medical marijuana legalization’s effects on employment, work hours, and wage rates. They found that medical marijuana legalization

affects neither employment nor work hours but leads to a 2.5% hourly wage reduction among males aged 20–29. Nicholas and Maclean (2016) used the Health and Retirement Study data to examine medical marijuana legalization's impact on older adults' health and labor supply. They found that medical marijuana legalization was associated with 3% increases in their self-reported very good and excellent health, 3% increases in their full-time employment, and 3% increases in their weekly working hours. Ullman (2017) also used the CPS and found that medical marijuana legalization was associated with an 8% reduction in work absence related to illnesses or medical issues. Medical marijuana legalization's main targeted population includes patients suffering from sclerosis, pain, nausea, and loss of appetite caused by chronic diseases, although some studies have shown its spillover effects on the healthy population (Anderson et al., 2013). However, precautions should be taken when generalizing findings from the medical marijuana legalization literature to recreational marijuana users, who are healthier and more likely to participate in the labor market.

This study focuses on examining recreational marijuana's effects on the American working-age population's employment. The analysis takes two steps. The first step tests the laws' effects on marijuana use, and the second step tests the laws' employment effects.

Methods

Data.

The NSDUH state estimates were used to test legalization's effects on the use of marijuana and other substances, as well as on health. The NSDUH is a nationally representative survey conducted on a random sample of 70,000 noninstitutionalized

participants aged 12 and older. It provides the most accurate drug use information in the United States (National Survey on Drug Use and Health, 2016). Because the publicly accessible individual-level data do not include respondents' geographic information, the state estimates generated by the NSDUH via Monte Carlo techniques based on two adjacent years' individual-level data were used to estimate it. The state estimates are available for years 2010–11, 2011–12, 2012–13, and 2013–14. Each estimate measures the proportion of state residents with self-reported substance use and mental conditions in the last year/month prior to their interview dates. State estimates for the years 2013–14 were collected after marijuana industries' establishment in the two legalization states and were not included in the analyses.

The SIPP 2008 panel was used to estimate the employment effects of legalizing recreational marijuana. The SIPP is a household survey that investigates labor supply and welfare program participation among non-institutionalized individuals (United States Census Bureau, 2013). The 2008 panel had 16 waves, ranging from September 2008 to December 2013 (United States Census Bureau, 2014), covering the time when recreational marijuana laws were passed in the two states.

Study Population.

Because the two states set 21 as the minimum legal age for recreational marijuana use, the study's population is the working age population aged 21 and above. The NSDUH state estimates do not include estimates for an over-21 age group. Therefore, for the substance use estimation, the study population is those aged 18 and above. For the employment estimation, the study population is those aged 21 and above. The NSDUH

also provides state estimates for the 18–25 age group and the 26+ age group. The SIPP sample was divided into 21–25 and 26+ age groups correspondingly.

Study variables.

Substance use and health outcomes extracted from the NSDUH state estimates include past month marijuana use, past year marijuana use initiation, past month use of illicit drugs other than marijuana, past year cocaine use, past month alcohol use, past month tobacco use, past year alcohol dependence, past year illicit drug dependence, having serious mental illness in the past year, having any mental illness in the past year, and having at least one major depressive episode in the past year.

Descriptive statistics of the baseline NSDUH state estimates by treatment and control are displayed in Table 2.1. In the two treatment states, 17.08% of residents had used marijuana in the last month, 4.86% of residents had first started to use marijuana in the past year, 4.47% of residents had used cocaine in the past year, 65.10% of residents had drunk alcohol in the past month, 5.44% of residents had developed alcohol dependence in the past year, 20.07% of residents had had any mental problems in the past year, and 8.18% of residents had had depression in the past year. No significant differences were found between treatment and control states across different outcomes.

Table 2.1. Descriptive statistics, NSDUH 2010–2011 state estimates [a, b]

	Control	Treatment	t
Past month marijuana use	15.571	17.083	-0.292
Past year marijuana initiation	4.781	4.868	-0.033
Past month other illicit drug use	5.615	6.413	-0.464
Past year cocaine use	3.606	4.468	-0.591
Past month alcohol use	60.650	65.100	-1.277
Past month tobacco use	34.595	35.233	-0.130
Past year alcohol dependence	5.015	5.435	-0.362
Past year illicit drug dependence	3.497	3.530	-0.024
Serious mental problems	4.135	4.458	-1.115

Any mental problems	18.848	20.068	-1.372
Depression	7.528	8.183	-0.924

Notes: *, < 0.10; **, < 0.05; ***: < 0.001. [a] Includes two age groups, age 18–25 and age ≥ 26. [b] All means are in percentages.
Abbreviation: NSDUH = National Survey on Drug Use and Health.

Labor outcomes extracted from the SIPP include having at least one paid job in the past month and the number of weeks with a job in the past month. Covariates include respondents' gender, age, race, ethnicity, marital status, number of children, education, non-earned family income per member, disability, and living in metropolitan areas. As the data cover the Great Recession period, state monthly unemployment rates retrieved from the U.S. Bureau of Labor Statistics were included to control for the employment variation caused by the economic cycle. State, survey wave, and calendar month fixed effects were also included to control for unobserved time-invariant state characteristics and seasonal labor supply variations.

Table 2.2 presents a comparison of all the retrieved variables between treatment and control groups in the SIPP baseline wave. The treatment group had a higher proportion of individuals with at least one job in the past month. The treatment group also had a higher proportion of observations who were white, married, and college graduates, while the control group had a higher proportion of observations who were Hispanic, had non-adult children, and resided in metropolitan areas. Additionally, the control group had higher unearned income per family member than the treatment group. Average monthly unemployment rates were higher in the control group than in the treatment group.

Table 2.2. Descriptive statistics, SIPP 2008-2013 wave 1

	Control	Treatment	t
Employed	0.649	0.698	-11.328***
Work weeks per month	4.250	4.250	0.081
Age	45.800	46.050	-1.582

Male	0.478	0.484	-1.150
Nonwhite	0.230	0.137	25.122***
Hispanic	0.212	0.089	35.256***
Married	0.545	0.568	-5.003***
Number of children aged < 18	0.752	0.642	10.463***
College graduate	0.619	0.689	-15.902***
Average unearned income	0.493	0.475	2.080**
Disabled	0.126	0.130	-1.070
Live in metro area	0.867	0.823	13.655***
State unemployment rate	7.277	5.193	234.333***

Note: *, < 0.10; **, < 0.05; ***: < 0.001.
Abbreviation: SIPP = Survey of Income and Program Participation

Statistical analysis.

The DID approach was applied to estimate marijuana legalization's effects on both substance use and employment. The intervention was the recreational marijuana laws implemented in December 2012. Therefore, for the estimation of substance use effects based on the NSDUH state estimates, the pre-intervention period was 2010–2011 and 2011–2012, and the post-intervention period was 2012–2013, and for the estimation of labor effects based on the SIPP, the pre-intervention period was from September 2008 to August 2012 (waves 1–12), and the post-intervention period was from January 2013 to December 2013 (waves 14–16). The treatment group comprises Colorado and Washington. The control group includes states that legalized **medical** marijuana before 2010 but had not yet legalized **recreational** marijuana by 2013, namely, Alaska, California, Hawaii, Maine, Michigan, Montana, Nevada, New Mexico, Oregon, Rhode Island, and Vermont.

The DID model for the estimation of substance use effects can be expressed as follows:

$$Y_{st} = \alpha + state_s\beta_1 + year_t\beta_2 + treatment_s * post_t\beta_3 + u_{st} \quad (1)$$

where s and t represent each state and year, Y is the proportion of people who use substances or suffer from related health problems in each state, $state$ represents state fixed effects, $year$ represents year fixed effects, $treatment$ comprises Colorado and Washington, and $post$ represents the post-intervention period. Because the NSDUH state estimates do not provide variables other than substance use and related health outcomes and are limited in sample size, no other covariates were added into the DID estimation. Omitted variables were assumed to be fully controlled for by state and year fixed effects.

The DID model for the labor effects estimation can be expressed as follows:

$$Work_{ist} = \alpha + state_s\beta_1 + wave_t\beta_2 + month_t\beta_3 + treatment_s * post_t\beta_4 + X_{ist}\beta_5 + u_{ist} \quad (2)$$

where i, s, and t represent each individual, state and month; $work$ represents the individual labor supply measures, including whether an individual had a job and the number of weeks he or she was employed in the past month; $state$ is state fixed effects; $wave$ is survey wave fixed effects; $month$ is calendar month fixed effects, $treatment$ identifies Colorado and Washington; $post$ identifies the post-intervention period; and X is a matrix of covariates, including respondents' gender, age, race, ethnicity, marital status, number of children, education, non-earned family income per family member, disability, living in metropolitan areas, and state monthly unemployment rates.

The model uses robust standard errors clustered at the individual level to control for correlations among one respondent's different records across time.

DID validity checks.

The "parallel trends" assumption must hold to use the DID approach, i.e., outcomes between treatment and control groups should follow the same trends if laws

had not been passed. This assumption is examined by comparing average outcome values pre-intervention and depicting outcome trends between treatment and control groups across time.

Substance use effects were estimated based on three waves of NSDUH data. Figure 2.1 displays NSDUH state outcome trends between treatment and control groups. Pre-intervention trends for most substance use and health outcomes are parallel, except for past month marijuana use, past month tobacco use, any mental problems, and depression. For past month marijuana use and past month tobacco use, as the pre-intervention trends of treatment and control for these outcomes converge, the DID regressions should produce conservative estimates that do not affect the conclusion of whether the laws affect these two outcomes. Outcomes such as any mental problems and depression clearly do not follow the same trends in the pre-intervention period and the pre-intervention trends continue after the laws' passage. Therefore, they were not analyzed using the DID regressions.

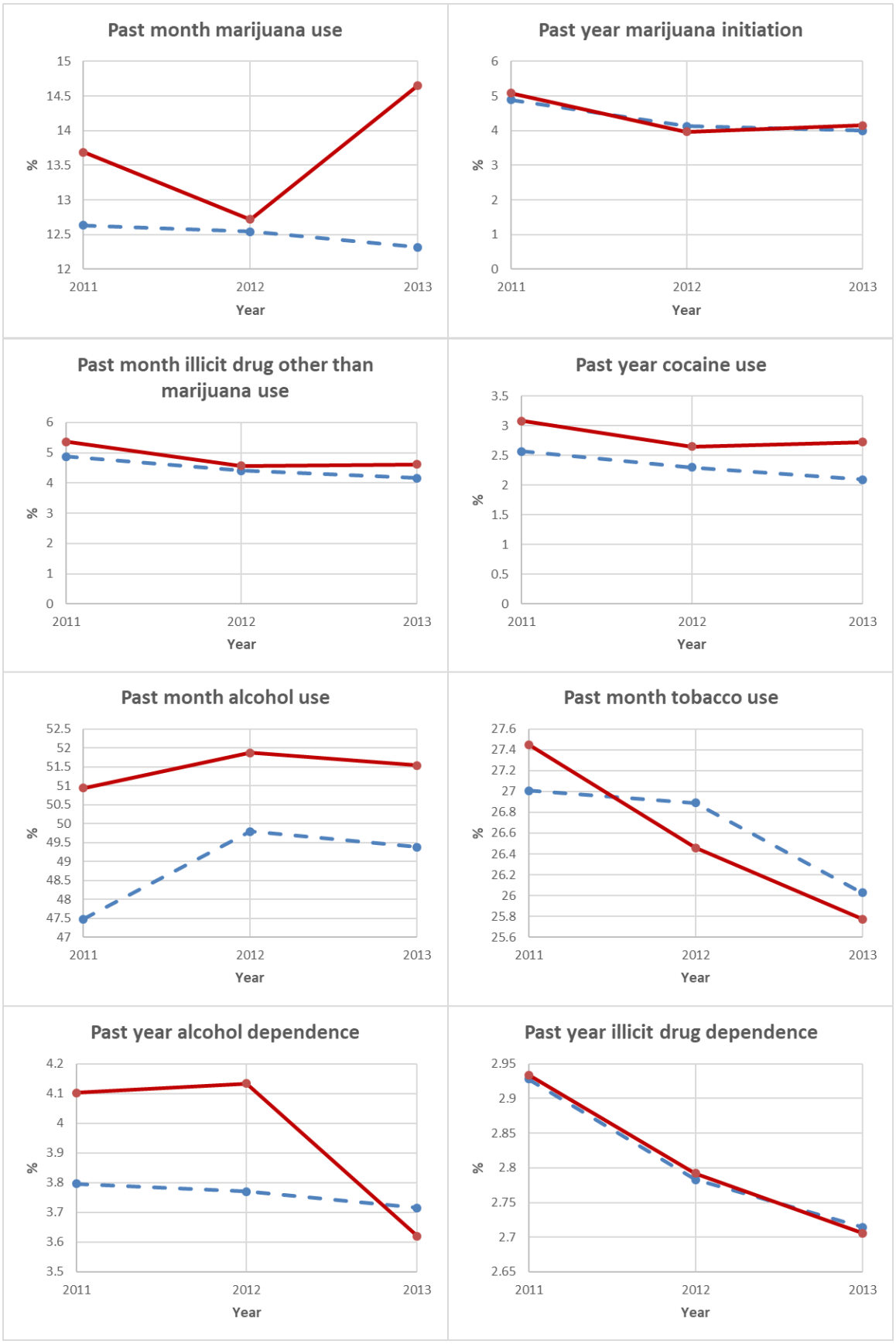
Past month marijuana use
15
14.5
14
13.5
13
12.5
12
%
2011
2012
2013
Year
Past year marijuana initiation
6
5
4
3
2
1
0
%
2011
2012
2013
Year
Past month illicit drug other than marijuana use
6
5
4
3
2
1
0
%
2011
2012
2013
Year
Past year cocaine use
3.5
3
2.5
2
1.5
1
0.5
0
%
2011
2012
2013
Year
Past month alcohol use
52.5
52
51.5
51
50.5
50
49.5
49
48.5
48
47.5
47
%
2011
2012
2013
Year
Past month tobacco use
27.6
27.4
27.2
27
26.8
26.6
26.4
26.2
26
25.8
25.6
%
2011
2012
2013
Year
Past year alcohol dependence
4.2
4.1
4
3.9
3.8
3.7
3.6
3.5
%
2011
2012
2013
Year
Past year illicit drug dependence
2.95
2.9
2.85
2.8
2.75
2.7
2.65
%
2011
2012
2013
Year

Figure 2.1. Substance abuse and health outcomes parallel trends tests, NSDUH 2010–13

Abbreviation: NSDUH = National Survey on Drug Use and Health.

The SIPP 2008 panel was used to estimate laws' employment effects. The panel includes 16 waves of data.

Treatment and control groups' labor supply trends are depicted across different age groups (Figure 2.2). The graphs in the top and bottom rows show that employment and the number of weeks employed in the past month are parallel before intervention for those aged 21 and above and 26 and above. This pre-intervention parallel trend can be observed for the employment outcome among those aged between 21 and 25, but not for

the weeks employed in the past month outcome for this age group (Figure 2, row 2), which might be due to the smaller sample size.

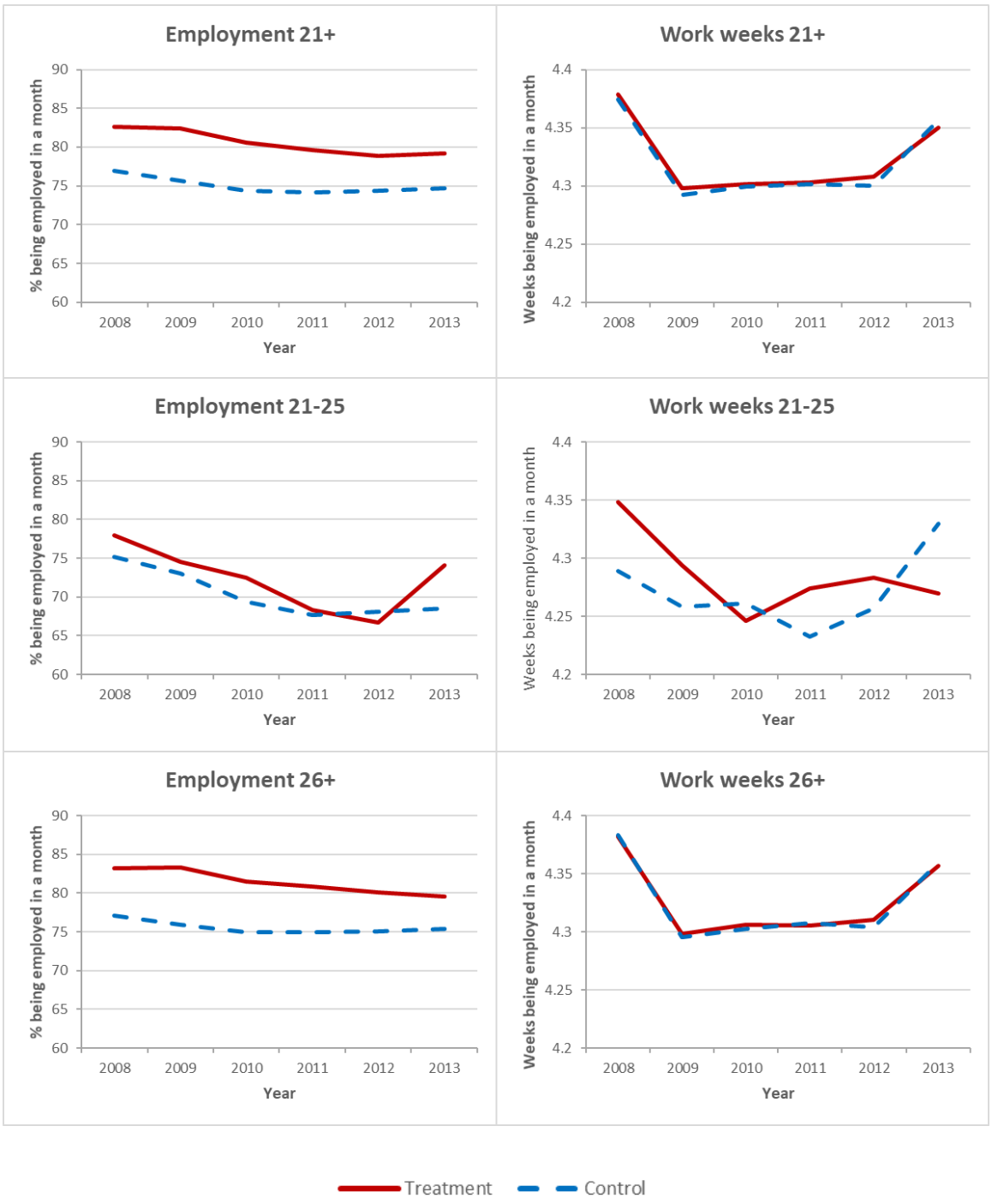

Figure 2.2. Pre-intervention labor outcome parallel trends tests, SIPP 2008 panel

Notes: Row 1 depicts parallel trends tests for individuals aged 21+ in treatment and control states; Row 2 depicts parallel trends tests for individuals aged 21–25; and Row 3 depicts parallel trends tests for individuals aged 26+.
Abbreviation: SIPP = Survey of Income and Program Participation

To further examine whether the "parallel trends" assumption holds for the 21–25 age group, regressions of pre-intervention labor outcomes on interactions of treatment and wave dummies were conducted (Table 2.3). The results show that the treatment and control groups' trends of employment and employment weeks per month pre-intervention were not significantly different from each other in this age group.

Table 2.3. Pre-intervention parallel trends test, SIPP 2008–2013[a,b]

	Employed	Weeks employed per month
treatment*wave1	-	-
	-	-
treatment*wave2	-0.080	0.000
	(0.041)	(0.058)
treatment*wave3	-0.077	-0.076
	(0.052)	(0.056)
treatment*wave4	-0.001	-0.017
	(0.065)	(0.052)
treatment*wave5	0.015	-0.040
	(0.062)	(0.058)
treatment*wave6	0.039	-0.012
	(0.067)	(0.054)
treatment*wave7	0.007	-0.087
	(0.068)	(0.074)
treatment*wave8	-0.027	-0.029
	(0.080)	(0.062)
treatment*wave9	-0.012	-0.073
	(0.079)	(0.082)
treatment*wave10	0.012	-0.021
	(0.073)	(0.067)
treatment*wave11	-0.051	0.044
	(0.076)	(0.055)
treatment*wave12	-0.070	0.052
	(0.074)	(0.060)

Notes: *, < 0.05; **, < 0.01; ***: < 0.001. [a] Estimated with ordinary least squares. [b] All regressions also control for covariates, including respondents' age, gender, race, ethnicity, marital status, number of children, education, unearned income, disability, living in metropolitan areas, state unemployment status, month fixed effects, and state fixed effects. Weight and clustered standard errors were applied. Abbreviation: SIPP = Survey of Income and Program Participation.

Results

Recreational marijuana legalization's effects on substance use.

Table 2.4 presents the estimated effects of recreational marijuana legalization on substance use and health, i.e., estimates for β_3 in equation (1), in individuals aged 18 to 25, 18 and above, and 26 and above. The findings include the following: First, legalization increased the proportion of people who reported using marijuana in the past month in all three age groups. The largest increase appeared in the 18–25 age group, with a magnitude of 2.81 percentage points. No significant effects of the laws were found on the proportion of individuals who had initiated marijuana use in the past year, which might be because the majority of individuals initiate their marijuana use before the age of 18 (Substance Abuse and Mental Health Services Administration, 2014b). Second, marijuana might be a gateway drug to cocaine use. Legalizing recreational marijuana did not affect the proportion of people who used other illicit drugs, alcohol, and tobacco products, except for a marginal increase in the proportion of people in the 18+ and 26+ age groups who used cocaine. Third, marijuana might be a substitute for alcohol among heavy drinkers. Legalization marginally reduced the proportion of people aged 18–25 and 18+ who developed alcohol dependence. Fourth, marijuana legalization reduced the proportion of individuals aged 18+ and 26+ who reported having serious mental problems. This might reflect marijuana's placebo effects on mentally ill patients, as marijuana is believed to help relieve stress and benefit mental health (Hyman & Sinha, 2009). However, this placebo effect may only hold in the short term. Previous studies have reported that marijuana use predicts later-life depression and anxiety and is

associated with mental illnesses' relapse and aggravated mental symptoms (JOHNS, 2001; Patton et al., 2002).

Table 2.4. Recreational marijuana legalization's effects on substance use and health, NSDUH state estimates 2011–2013[a, b, c]

	18–25				18+				26+			
	Coef.	S.E.	N	R^2	Coef.	S.E.	N	R^2	Coef.	S.E.	N	R^2
Marijuana use												
Past month marijuana use	2.810**	1.113	39	0.917	2.166**	0.665	26	0.902	1.601**	0.537	39	0.888
Past year marijuana initiation	0.180	0.729	39	0.690	0.086	0.094	26	0.935	0.029	0.026	39	0.899
Other illicit drug use												
Past month other illicit drug use	-0.044	0.582	39	0.834	0.347	0.268	26	0.869	0.251	0.255	39	0.783
Past year cocaine use	0.251	0.512	39	0.915	0.305*	0.151	26	0.951	0.262*	0.126	39	0.852
Alcohol use												
Past month alcohol use	-0.372	1.288	39	0.960	-0.04	1.671	26	0.946	-1.326	1.771	39	0.915
Tobacco use												
Past month tobacco use	0.712	1.304	39	0.954	-0.091	0.769	26	0.985	-0.425	0.959	39	0.951
Substance dependence/abuse												
Past year alcohol dependence	-0.881*	0.509	39	0.758	-0.493*	0.237	26	0.795	-0.342	0.223	39	0.651
Past year illicit drug dependence	-0.028	0.407	39	0.842	-0.041	0.096	26	0.942	0.005	0.113	39	0.814
Mental impairment												
Serious mental problems	-0.22	0.185	39	0.876	-0.535**	0.226	26	0.933	-0.605**	0.249	39	0.883

Notes: *, < 0.10; **, < 0.05; ***: < 0.001. [a] Estimated with difference-in-differences; [b] Controlled for state and year fixed effects; [c] All coefficient estimates are in percentage points.
Abbreviation: NSDUH = National Survey on Drug Use and Health.

Recreational marijuana legalization's labor effects.

Estimated labor market effects of recreational marijuana legalization are presented in Table 2.5. No significant effects were discovered in the full sample. However, after stratifying the sample into different age ranges, legalizing recreational marijuana reduced weeks with a job in the past month by 0.090 (i.e., 0.63 days in the past month) among those aged 21 to 25 but did not affect the 26+ age group. One possible explanation is that the 26+ age group has better self-control and is more likely to have stable jobs, which makes their employment less elastic to the laws' passage. In the 21–25 age group, significant effects were only detected on the number of weeks with a job in the past month, but not on employment in the past month. The reduction in the number of weeks with a job in the past month might be caused by losing jobs temporarily or switching to a new job.

Table 2.5. Labor supply effects of legalizing recreational marijuana, SIPP 2008–2013[a]

	21+		21–25		26+	
	Employed[b]	Work weeks per month	Employed	Work weeks per month	Employed[c]	Work weeks per month
Tx*Post	-0.006	-0.004	0.033	-0.090**	-0.012	0.004
	(0.011)	(0.005)	(0.054)	(0.033)	(0.011)	(0.005)
Age	0.001**	0.001***	0.036***	0.007*	-0.001	0.001***
	(0.000)	(0.000)	(0.008)	(0.004)	(0.000)	(0.000)
Male	0.125***	0.009**	0.057*	-0.001	0.130***	0.010***
	(0.010)	(0.003)	(0.030)	(0.012)	(0.010)	(0.002)
Nonwhite	-0.056***	-0.011**	-0.136**	-0.031	-0.051***	-0.010**
	(0.014)	(0.004)	(0.042)	(0.021)	(0.014)	(0.004)
Hispanic	-0.047**	0.002	-0.013	0.047**	-0.051**	-0.004
	(0.015)	(0.004)	(0.039)	(0.014)	(0.016)	(0.004)
Married	0.009	0.009**	-0.036	0.010	-0.001	0.007**
	(0.010)	(0.003)	(0.041)	(0.016)	(0.010)	(0.003)
Number of children aged <18	-0.029***	-0.001	-0.027*	0.006	-0.035***	-0.003**
	(0.005)	(0.001)	(0.016)	(0.006)	(0.005)	(0.001)
College graduate	0.105***	0.017***	0.069**	0.045**	0.103***	0.012***
	(0.012)	(0.003)	(0.034)	(0.017)	(0.013)	(0.003)

Unearned income per person	-0.132***	-0.020***	-0.122**	-0.034	-0.129***	-0.018***
	(0.008)	(0.003)	(0.036)	(0.022)	(0.008)	(0.003)
Disabled	-0.437***	-0.037***	-0.349***	-0.010	-0.443***	-0.039***
	(0.017)	(0.007)	(0.058)	(0.034)	(0.017)	(0.007)
Living in metro area	0.006	0.011**	-0.055	0.054**	0.006	0.005
	(0.014)	(0.005)	(0.043)	(0.027)	(0.015)	(0.004)
State unemployment rate	-0.002	-0.007***	-0.002	-0.001	-0.002	-0.008***
	(0.002)	(0.001)	(0.011)	(0.007)	(0.002)	(0.001)
Wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	248,965	188,112	19,396	12,748	229,569	175,364
R squared	0.238	0.063	0.106	0.057	0.265	0.064

Notes: *, < 0.10; **, < 0.05; ***: < 0.001. [a] Estimated with difference-in-differences; [b] Aged between 21 and 64; [c] Aged between 26 and 64.
Abbreviation: SIPP = Survey of Income and Program Participation; N = number.

Heterogeneity checks and sensitivity analyses.

Previous studies have reported that marijuana use affects men's and women's labor supply heterogeneously (French, 2001; van Ours, 2006). To check whether the 21+ and 26+ age groups' insignificant estimation was due to ignoring gender heterogeneity, gender subgroup analyses were conducted (Table 2.6). The results show that recreational marijuana legalization affected neither employment nor work weeks in both genders.

Table 2.6. Heterogeneity checks of population aged 21+ and 26+ by gender, SIPP 2008–2013[a]

	21+				26+			
	Male		Female		Male		Female	
	Employed	Work weeks per month	Employed	Work weeks per month	Employed	Work weeks per month	Employed	Work weeks per month
Tx*Post	-0.006	0.001	-0.006	-0.010	-0.017	0.006	-0.006	0.001
	(0.014)	(0.006)	(0.017)	(0.009)	(0.012)	(0.006)	(0.018)	(0.009)
Age	0.001	0.001***	0.001**	0.001***	-0.001**	0.001**	-0.001	0.001***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Nonwhite	-0.060**	-0.016**	-0.053**	-0.005	-0.057**	-0.015**	-0.048**	-0.005
	(0.020)	(0.006)	(0.020)	(0.005)	(0.021)	(0.006)	(0.020)	(0.005)
Hispanic	0.009	0.005	-0.105***	-0.003	0.002	-0.002	-0.108***	-0.008
	(0.017)	(0.004)	(0.023)	(0.007)	(0.019)	(0.004)	(0.024)	(0.007)
Married	0.058***	0.009**	-0.044**	0.009**	0.042**	0.008**	-0.053***	0.006
	(0.013)	(0.004)	(0.014)	(0.004)	(0.014)	(0.004)	(0.014)	(0.004)
Number of children aged <18	0.002	0.000	-0.060***	-0.003	-0.003	-0.003*	-0.066***	-0.004*
	(0.005)	(0.002)	(0.007)	(0.002)	(0.006)	(0.002)	(0.007)	(0.002)
College graduate	0.083***	0.019***	0.129***	0.016**	0.075***	0.012**	0.136***	0.015**
	(0.016)	(0.005)	(0.018)	(0.005)	(0.017)	(0.004)	(0.019)	(0.005)
Unearned income per person	-0.129***	-0.026***	-0.133***	-0.020***	-0.126***	-0.024***	-0.129***	-0.019***
	(0.013)	(0.005)	(0.010)	(0.004)	(0.013)	(0.005)	(0.010)	(0.004)
Disabled	-0.450***	-0.029**	-0.417***	-0.044***	-0.463***	-0.032**	-0.418***	-0.045***
	(0.024)	(0.010)	(0.023)	(0.011)	(0.025)	(0.010)	(0.022)	(0.011)
Living in metro area	0.004	0.009	0.009	0.011	0.005	0.005	0.009	0.004
	(0.018)	(0.007)	(0.021)	(0.008)	(0.019)	(0.006)	(0.022)	(0.007)
State unemployment rate	-0.001	-0.008***	-0.003	-0.007***	0.001	-0.009***	-0.004	-0.008***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	119,020	94,795	129,945	85,344	109,314	88,186	120,255	79,205
R squared	0.302	0.065	0.210	0.062	0.341	0.066	0.229	0.064

Notes: *, < 0.10; **, < 0.05; ***: < 0.001. [a] Estimated with difference-in-differences.
Abbreviation: SIPP = Survey of Income and Program Participation; N = number.

Gender subgroup analyses were also conducted to check whether recreational marijuana legalization affected men and women aged 21–25 differently. In addition, racial/ethnic disparities in marijuana use penalties are an important argument for marijuana legalization. Therefore, race/ethnicity subgroup analyses were also conducted. The results are shown in Table 2.7. From the table, legalizing recreational marijuana reduced males' number of weeks with a job in the past month by 0.069 and females' by 0.143. Young (2010) found that women are more likely to have precarious jobs, such as part-time jobs or poorly paid jobs, than men, which might cause their employment to be more elastic to the laws' passage. Legalizing recreational marijuana reduced white youth's number of weeks with a job in the past month by 10.4 percentage points but had insignificant effects on nonwhites. Wu, Woody, Yang, Pan, and Blazer (2011) found that white adolescents aged 12–17 are more likely to have substance-related disorders compared to black adolescents. The race-related heterogeneous labor supply effects might indicate that marijuana is more likely to affect white youth's health than that of black youth.

Table 2.7. Heterogeneity checks across genders and races among people aged 21–25, SIPP 2008–2013[a]

	Male		Female		White		Nonwhite	
	Employed	Work weeks per month	Employed	Work weeks per month	Employed	Work weeks per month	Employed	Work weeks per month
Tx*Post	0.082	-0.069*	-0.030	-0.143**	0.062	-0.104**	-0.148	-0.010
	(0.077)	(0.039)	(0.067)	(0.055)	(0.060)	(0.035)	(0.124)	(0.083)
Age	0.035**	0.016**	0.037**	0.001	0.035***	0.004	0.044**	0.029*
	(0.011)	(0.007)	(0.011)	(0.005)	(0.008)	(0.004)	(0.018)	(0.015)
Male	-	-	-	-	0.072**	0.004	0.006	-0.031
	-	-	-	-	0.033	0.013	0.069	0.042
Nonwhite	-0.134**	-0.053	-0.126**	-0.011	-	-	-	-
	(0.056)	(0.034)	(0.058)	(0.026)	-	-	-	-
Hispanic	0.052	0.049**	-0.076	0.044**	-0.033	0.038**	0.083	0.052*
	(0.048)	(0.020)	(0.057)	(0.020)	(0.042)	(0.015)	(0.086)	(0.030)
Married	0.085**	-0.016	-0.110**	0.030	-0.047	0.012	0.051	0.001
	(0.042)	(0.027)	(0.055)	(0.019)	(0.043)	(0.017)	(0.106)	(0.056)
Number of children aged <18	0.005	0.020**	-0.065**	-0.009	-0.028	0.003	-0.024	0.022
	(0.017)	(0.008)	(0.021)	(0.009)	(0.017)	(0.006)	(0.032)	(0.015)
College graduate	0.097**	0.072**	0.034	0.017	0.086**	0.044**	-0.013	0.044
	(0.046)	(0.025)	(0.049)	(0.019)	(0.039)	(0.018)	(0.063)	(0.044)
Unearned income per person	-0.117**	-0.052	-0.131**	-0.029*	-0.152***	-0.047*	-0.039	0.006
	(0.046)	(0.041)	(0.050)	(0.017)	(0.043)	(0.027)	(0.066)	(0.034)
Disabled	-0.281***	0.023	-0.444***	-0.039	-0.284***	-0.004	-0.499***	-0.012
	(0.070)	(0.041)	(0.092)	(0.081)	(0.070)	(0.038)	(0.074)	(0.090)
Living in metro area	-0.072	0.042	-0.045	0.057*	-0.062	0.051*	-0.078	0.060
	(0.053)	(0.040)	(0.063)	(0.034)	(0.048)	(0.031)	(0.085)	(0.047)
State unemployment rate	-0.021	-0.002	0.010	-0.002	-0.014	-0.001	0.067**	0.003
	(0.016)	(0.011)	(0.015)	(0.011)	(0.012)	(0.008)	(0.027)	(0.019)
Wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9,706	6,609	9,690	6,139	15,452	10,452	3,944	2,296
R squared	0.135	0.066	0.140	0.055	0.093	0.057	0.198	0.074

Notes: *, < 0.10; **, < 0.05; ***: < 0.001. [a] Estimated with difference-in-differences.
Abbreviation: SIPP = Survey of Income and Program Participation; N = number.

Further exploration.

To explore potential different impacts of recreational and medical marijuana legalization on the labor market, medical marijuana legalization's effects on employment were estimated.

Between September 2008 and December 2013, eight states passed laws to legalize medical marijuana, namely, Michigan (effective date: December 4, 2008), the District of Columbia (July 27, 2010), New Jersey (October 1, 2010), Delaware (July 1, 2011), Connecticut (October 1, 2012), Massachusetts (January 1, 2013), Arizona (May 7, 2013), and New Hampshire (June 26, 2013) (ProCon.ORG, 2017). These states were set as the treatment group in the DID analyses. The states that did not change the legality of medical marijuana were set as the control group. The pre-treatment period is the period before medical marijuana was legalized in each state, and the post-treatment period is the period after medical marijuana was legalized in each state. To be comparable with recreational marijuana legalization's estimated labor effects, analyses in this section were also conducted in the 21+, 21–25, and 26+ age groups.

Table 2.8 presents the DID estimation results. Medical marijuana legalization did not affect people's probability of being employed in different age groups but increased work weeks in the past month by 0.01 for the 21+ age group and by 0.013 for the 26+ age group. The results indicate that, unlike recreational marijuana legalization, medical marijuana legalization benefits employment, possibly by reducing pain caused by chronic diseases and increasing self-rated health.

Table 2.8. Labor supply effects of legalizing medical marijuana, SIPP 2008–2013[a]

	21+		21–25		26+	
	Employed[b]	Work weeks per month	Employed	Work weeks per month	Employed[c]	Work weeks per month
Tx*Post	0.000	0.010**	-0.028	-0.015	0.003	0.013**
	(0.007)	(0.004)	(0.033)	(0.018)	(0.007)	(0.004)
Age	0.001***	0.001***	0.035***	0.013***	-0.001**	0.001***
	(0.000)	(0.000)	(0.004)	(0.002)	(0.000)	(0.000)
Male	0.108***	0.005***	0.051***	-0.001	0.113***	0.005***
	(0.004)	(0.001)	(0.014)	(0.005)	(0.004)	(0.001)
Nonwhite	-0.045***	-0.004**	-0.083***	0.001	-0.042***	-0.005**
	(0.006)	(0.002)	(0.019)	(0.007)	(0.006)	(0.002)
Hispanic	-0.039***	0.001	-0.014	0.034***	-0.043***	-0.003*
	(0.008)	(0.002)	(0.021)	(0.008)	(0.008)	(0.002)
Married	-0.003	0.011***	-0.010	0.015**	-0.015**	0.008***
	(0.004)	(0.001)	(0.018)	(0.007)	(0.005)	(0.001)
Number of children aged <18	-0.022***	0.000	-0.035***	-0.004	-0.027***	-0.001**
	(0.002)	(0.001)	(0.008)	(0.003)	(0.002)	(0.001)
College graduate	0.096***	0.010***	0.054**	0.005	0.096***	0.009***
	(0.005)	(0.001)	(0.015)	(0.006)	(0.005)	(0.001)
Unearned income per person	-0.124***	-0.017***	-0.070***	-0.026**	-0.122***	-0.015***
	(0.006)	(0.001)	(0.020)	(0.009)	(0.007)	(0.001)
Disabled	-0.453***	-0.039***	-0.340***	-0.048**	-0.463***	-0.040***
	(0.008)	(0.003)	(0.028)	(0.019)	(0.008)	(0.003)
Living in metro area	0.012**	0.003*	0.007	0.016*	0.009	0.001
	(0.006)	(0.002)	(0.019)	(0.010)	(0.006)	(0.001)
State unemployment rate	-0.001	-0.009***	0.000	-0.002	-0.001	-0.010***
	(0.001)	(0.001)	(0.006)	(0.003)	(0.001)	(0.001)
Wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	1,350,769	1,033,750	101,456	68,924	1,249,313	964,826
R squared	0.248	0.053	0.098	0.043	0.279	0.054

Notes: *, < 0.10; **, < 0.05; ***: < 0.001. [a] Estimated with difference-in-differences; [b] Aged between 21 and 64; [c] Aged between 26 and 64.
Abbreviation: SIPP = Survey of Income and Program Participation; N = number.

Discussion

In this study, the effects of legalizing recreational marijuana on employment were examined using nationally representative data collected in recent years. The findings show that recreational marijuana legalization significantly reduced the number of weeks of employment in a given month among those aged 21 to 25. The effect was greater among females than among males and was more significant among whites than among other races. This labor supply reduction might have been caused by legalization's positive effects on marijuana use in this age group. Although legalization also increased marijuana use among those aged 26 and above, no significant labor supply reduction effects were detected in this age group. This might be because the older age group had better control of their marijuana intake and did not let marijuana consumption affect their employment.

Different explanations can be given for recreational marijuana legalization's negative effects on the number of weeks employed in the past month among those aged 21 to 25. The health pathway hypothesis is not supported by findings from the first-stage analysis, which show that legalization reduced alcohol dependence and had no significant effects on serious mental problems, among people aged 18–25 in the past year. However, as the NSDUH state estimates do not provide detailed health information, the health pathway cannot be ruled out. It is also possible that the employment reduction effects were caused by zero-tolerance workplace policies.

In contrast, analyses of medical marijuana legalization using the same data show that medical marijuana legalization increased people's number of work weeks in the past month, especially for those aged 26+. The results are consistent with previous medical

marijuana legalization studies (Nicholas & Maclean, 2016; Ullman, 2017). The positive labor effects of medical marijuana legalization might work through medical marijuana's health benefits for working-age people with chronic diseases.

The SIPP 2008 panel only allows us to examine the short-term employment effects of recreational marijuana legalization. The findings largely reflect the effects of increased recreational marijuana use in the two legalization states on their residents' employment. In the long term, newly established marijuana industries may stimulate labor supply in the two states and change the direction of legalization's employment effects. Research should be done to estimate the long-term labor supply effect of legalizing recreational marijuana.

The findings from this study indicate that legalizing recreational marijuana increased marijuana use in the legalization states. The magnitudes were not very large, i.e., increases of 2.81% in the proportion of those aged 18–25 who used marijuana in the past month and of 1.60% for those aged 26 and above. Meanwhile, legalizing recreational marijuana reduced the young workforce's employment by half a day per month. In states that have passed recreational marijuana laws, lawmakers may consider raising the minimum legal age of recreational marijuana use to prevent reductions in the young workforce's labor supply. In states that haven't legalized recreational marijuana use, lawmakers may want to carefully evaluate the existing laws' costs and benefits before reaching their final decisions.

Chapter Four

Disparities in Suicidal Behaviors between Indigenous and Non-indigenous Adolescents

Background

Suicide is a leading cause of death for American adolescents (Centers for Disease Control and Prevention, 2015c). Within the adolescent population, American indigenous adolescents (American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders) have the highest suicide rates. Between 1999 and 2015, the suicide rate for American Indian/Alaska Native adolescents aged 12–18 years was 15.66 per 100,000, while the suicide rate among the overall adolescent population was only 4.88 (Centers for Disease Control and Prevention, 2015b). Corresponding to indigenous adolescents' high rates of suicide, the prevalence of their suicidal behaviors is also much higher than that of non-indigenous adolescents. Between 1991 and 2013, the prevalence of suicide consideration, planning, and attempts among US indigenous adolescents was 24.6%, 20.7%, and 16.2%, in comparison to non-indigenous adolescents' 18.3%, 14.3%, and 7.7% (Qiao & Bell, 2016).

It is important to understand the causes of such large disparities in suicide and suicidal behaviors between indigenous and non-indigenous adolescents from both public health and social justice perspectives.

Many previous studies have explored risk factors associated with indigenous adolescents' suicide or suicidal behaviors. Clarke, Frankish, and Green (1997) reviewed the literature and summarized multiple behavioral, cultural, familial, and socioeconomic factors that might contribute to indigenous adolescents' high suicide rates. These factors

include alcohol and drug use, chronic diseases, mental illnesses, unexpected pregnancy, previous suicide attempts, severe interpersonal conflicts, acculturation, television presentation of violence, family suicide history, childhood trauma, poverty, forced relocation, and isolation. Many of these suicide risk factors are also shared by the non-indigenous population, although cultural factors such as acculturation and socioeconomic factors such as forced relocation and isolation are unique risk factors among the indigenous population (Turecki & Brent, 2016). Correspondingly, Clarke et al. (1997) hypothesized that the disparities in suicide between the two groups of adolescents are caused by the higher prevalence of social risk factors for suicide in indigenous communities.

Borowsky, Resnick, Ireland, and Blum (1999) used the 1990 National American Indian Adolescent Health Survey to study factors that are associated with reservation-dwelling American Indian and Alaska Native adolescents' suicide attempts. The study identified significant differences in the prevalence of suicide attempts and suicide risk factors between male and female American Indian and Alaska Native adolescents. Suicide attempt rates were 11.8% among male adolescents and 21.8% among female adolescents. For male adolescents, factors associated with higher odds of suicide attempts include a history of suicide among friends and family, somatic symptoms, sexual abuse, physical abuse, health concerns, alcohol and marijuana use, gang involvement, and mental health issues; factors that are associated with lower odds of suicide attempts include support from family and friends, better emotional health, and family connectedness. Female adolescents share most suicide attempt risk and protective factors with their male counterparts, but in different magnitudes. In addition, gun availability and

special education are risk factors, and the presence of healthcare providers on campus is a protective factor for female adolescents. Borowsky et al. (1999) did not compare differences in suicide attempts between indigenous and non-indigenous adolescents.

Qiao and Bell (2016) used the Centers for Disease Control and Prevention (CDC) Youth Risk Behavior Survey (YRBS) to compare the prevalence of risk factors and suicidal behaviors between the two adolescent groups and found that suicide risk factors such as being threatened, being in a fight, being raped, feeling sad, smoking tobacco, using marijuana, and having multiple sex partners were more prevalent among indigenous adolescents. They also found that playing on sports teams, a suicide protective factor, was less prevalent among indigenous adolescents. When controlling for all the behavioral risk factors, Qiao and Bell (2016) found that being indigenous was no longer positively associated with suicide consideration and planning; the odds ratio of being indigenous on suicide attempts was reduced by one-third but not eliminated. This and all previous studies assumed that disparities in suicide/suicidal behaviors are caused by differences in suicide risk factors between the two groups. It is also possible that the same suicide risk factors may affect the two groups in different directions or magnitudes. There has been no investigation of this.

The objective of the current study was to examine different risk factors' correlation with disparities in suicidal behaviors between indigenous and non-indigenous adolescents. Specifically, the objective contained two parts:

1. To quantify different risk factors' effects on disparities in suicidal behaviors;
2. To identify the source of the detected effects, i.e., whether they are caused by different prevalence of risk factors or different effects of the same risk factors on the two adolescent groups.

This study used the same data and studied the same list of suicide risk factors as Qiao and Bell (2016). Relative to that paper, this study makes the following contributions: First, since Borowsky et al. (1999) showed the heterogeneity in suicide attempts and risk factors between male and female indigenous adolescents, this study investigated the differences in suicidal behaviors between genders. Stratified analyses were conducted in male and female adolescents, respectively, in both indigenous and non-indigenous groups. Second, this study applied Oaxaca decomposition to explore factors associated with the disparities in suicidal behaviors between the two groups. This enabled the determination of whether the same risk factors have different effects among indigenous and non-indigenous adolescents.

Methods

Data.

The study used pooled cross-sectional data from the 2001–2013 YRBS (Centers for Disease Control and Prevention, 2015a). The sample comprised 2,215 indigenous high school students and 98,245 non-indigenous high school students.

Suicide consideration, planning, and attempts were the studied suicidal behaviors. All three are binary indicators of whether the behavior occurred during the past 12 months. Indigenous adolescents are those who have self-reported as "American Indian/Alaska Native" or "Native Hawaiian/Other Pacific Islander." Suicide risk factors

include age (18 years or older), gender, obesity, being threatened at school, being in a fight, being raped, feeling sad, smoking, drinking alcohol, using marijuana, having multiple sex partners, watching television, and participating in team sports (a protective factor). All these factors were constructed as binary indicators. Students' grade levels and survey years were also controlled for in the model.

Detailed data description and variable selection can be found in Appendix C.

Statistical analysis.

To control for the special weighting, clustering, and stratification design in the YRBS, the Stata "*svy*" command was applied to descriptive statistics and data analyses (StataCorp, 2013). Ordinary least squares (OLS) regressions were conducted to estimate risk factors' association with suicidal behaviors among both indigenous and non-indigenous adolescents.

Let Y represent suicidal behavior. Its relationship with suicidal behavior risk factors X can be expressed as $Y_{indig} = X_{indig}\beta_{indig} + \varepsilon_{indig}$ for indigenous adolescents, where X_{indig} is the vector of different risk/protective factors for indigenous adolescents' suicidal behaivors. β_{indig} is the coefficient of interest, i.e.. different risk/protective factors' association with indigenous adolescents' suicidal behaviors.

In order to test how being indigenous affects different risk/protective factors' association with suicidal behaviors, interaction terms between these factors and being indigenous were added to the regression of model on overall adolescents' suicidal behaviors.

$$y_i = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + ... + \beta_{12} x_{i,12} + \gamma I_i + \sigma_1 x_{i,1} I_i + \sigma_2 x_{i,2} I_i + ... + \sigma_{12} x_{i,12} I_i + \varepsilon_i$$

where I_i is an indicator varaible indicating whether observation i is indigenous or not. σ s are coefficients of interest, indicating how being indigenous would change different factors' association with suicidal behaviors.

Following the expression of risk factors' relationship with suicidal behaviors among indigenous adolescents, $Y_{indig} = X_{indig}\beta_{indig} + \varepsilon_{indig}$, risk factors' relationship with suicidal behaivors can be expressed as $Y_{nonindig} = X_{nonindig}\beta_{nonindig} + \varepsilon_{nonindig}$ for non-indigenous adolescents. Risk factors' association with suicidal behaviors are β. The Oaxaca decomposition (Jann, 2008; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008) was applied to these two equations to decompose the differences in suicidal behaviors following Jann (2008):

$$E(Y_{indig}) - E(Y_{nonindig}) = (E(X_{indig}) - E(X_{nonindig}))\beta_{nonindig} + E(X_{nonindig})(\beta_{indig} - \beta_{nonindig})$$
$$+(E(X_{indig}) - E(X_{nonindig}))(\beta_{indig} - \beta_{nonindig}) = E + C + I$$

where E is the differences in suicidal behaviors associated with the different prevalence of risk factors, holding constant how indigenous adolescents' suicidal behaviors respond to those risk factors (the "endowments effect"); C is the differences in suicidal behaviors associated with different responses of that behavior to risk factors, holding constant the prevalence of risk factors among indigenous adolescents (the "coefficients effects"); and I is the differences in the interaction of the "endowments effects" and the "coefficients effects" (the "interactions effects").

To control for gender heterogeneity, all analyses were stratified by gender.

Results

Table 3.1 presents descriptive statistics of suicidal behaviors and suicide risk factors in indigenous and non-indigenous adolescents. The first three columns show that 21.0%, 16.3%, and 12.3% of indigenous adolescents had considered, planned, and attempted suicide in the past 12 months, respectively. The three suicidal behaviors were more prevalent among indigenous adolescents than among non-indigenous adolescents. Among indigenous adolescents, the prevalence of the three suicidal behaviors differed by gender: 15.4%, 13.8%, and 8.9% among male indigenous adolescents, compared to 26.1%, 18.7%, and 15.4% among their female counterparts (column 4 vs. column 7). Female indigenous adolescents considered, planned, and attempted more suicides than male indigenous adolescents.

For suicide risk factors, columns 4–5 show that, compared to male non-indigenous adolescents, male indigenous adolescents had higher prevalence of being threatened ($p = 0.006$), being in a fight ($p = 0.005$), feeling sad ($p = 0.003$), smoking tobacco ($p = 0.036$), using marijuana ($p = 0.075$), and having multiple sex partners ($p = 0.008$), while having significantly lower prevalence of playing on a sports team ($p = 0.008$). Columns 7–8 show that female indigenous adolescents had higher prevalence of being raped ($p = 0.017$), feeling sad ($p = 0.054$), smoking tobacco ($p = 0.028$), and using marijuana ($p = 0.040$) than female non-indigenous adolescents.

Table 3.1. Descriptive statistics, 2001–2013 combined YRBS

	Overall (N = 68,060)			Male (N = 32,626)			Female (N= 35,434)		
	Indigenous (%)	Non-indigenous (%)	F	Indigenous (%)	Non-indigenous (%)	F	Indigenous (%)	Non-indigenous (%)	F
Suicide consideration	21.0	15.3	13.94***	15.4	10.9	5.35**	26.1	19.6	8.51**
Suicide planning	16.3	11.9	10.17**	13.8	9.1	7.29**	18.7	14.7	3.43*
Suicide attempts	12.3	6.6	19.89***	8.9	4.0	9.41**	15.4	9.2	8.86**
Age ≥ 18	14.3	13.7	0.31	13.8	14.8	0.35	14.8	12.6	1.80
Male	48.4	49.3	0.28	-	-	-	-	-	-
Obese	13.4	11.8	1.32	17.2	15.1	1.05	9.9	8.5	0.81
Being threatened	9.0	6.4	5.65**	12.7	7.9	7.80**	5.5	5.0	0.23
In a fight	36.0	30.1	8.07**	46.5	37.9	7.97**	26.2	22.5	2.25
Being raped	9.7	6.6	8.92**	4.5	2.9	2.56	14.7	10.2	5.80**
Feeling sad	32.5	26.9	11.06**	25.8	19.3	8.87**	38.8	34.3	3.74*
Smoking	25.6	20.5	9.48**	26.2	21.0	4.44**	25.0	20.1	4.86**
Drinking	43.5	42.2	0.50	45.3	42.0	1.73	41.8	42.3	0.04
Using marijuana	25.2	20.5	6.55**	27.8	23.0	3.20*	22.8	18.1	4.26**
Multiple sex partners	11.2	8.0	6.19**	15.3	9.8	7.24**	7.4	6.3	0.69
Watching TV	89.9	91.0	0.98	91.3	92.1	0.32	88.5	89.8	0.66
Playing on a sports team	52.7	57.3	4.59**	54.6	63.0	7.18**	50.9	51.8	0.13

Notes: *: < 0.10; **: <0.05; ***: < 0.001; estimation was conducted with Stata svy.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

Table 3.2 displays estimates of different risk factors' effects on the three suicidal behaviors among male and female indigenous adolescents.

Being raped and feeling sad were strong predictors of all three behaviors for both male and female indigenous adolescents. Being raped was associated with increases of 28.4% ($p = 0.001$) in male indigenous adolescents' suicide consideration, 39.2% ($p < 0.001$) in their suicide planning, and 36.5% ($p < 0.001$) in their suicide attempts. It was also associated with 9.9% ($p = 0.085$), 12.9% ($p = 0.018$), and 14.8% ($p = 0.006$) increases in female indigenous adolescents' suicide consideration, planning, and attempts. Feeling sad was associated with 32.8% ($p < 0.001$), 26.7% ($p < 0.001$), and 21.9% ($p < 0.001$) increases in male indigenous adolescents' suicide consideration, planning, and attempts and was associated with 31.1% ($p < 0.001$), 19.3% ($p < 0.001$), and 15.4% ($p < 0.001$) increases in female indigenous adolescents' three suicidal behaviors.

Being threatened, using marijuana, and obesity were important suicidal behavior predictors for female indigenous adolescents. Being threatened at school was associated with a 16.3% ($p = 0.089$) increase in female adolescents' suicide consideration and a 20.4% ($p = 0.028$) increase in female adolescents' suicide planning. Being threatened was also associated with an 11.1% ($p = 0.042$) increase in male indigenous adolescents' suicide planning. Using marijuana was associated with a 12.9% ($p = 0.009$) increase in female indigenous adolescents' suicide planning and a 13.7% ($p = 0.005$) increase in their suicide attempts. Obesity was modestly associated with a 9.7% ($p = 0.089$) increase in female indigenous adolescents' suicide attempts.

Playing on a sports team was a protective factor against all three suicidal behaviors among male indigenous adolescents. It was associated with 6.6% (p = 0.002), 8.1% (p = 0.002), and 7.5% (p = 0.005) decreases in male indigenous adolescents' suicide consideration, planning, and attempts.

In addition, male indigenous adolescents' suicide consideration and female indigenous adolescents' suicide consideration and planning were less prevalent for those over the age of 18. Having multiple sex partners was associated with an 8.79% (p = 0.097) increase in male indigenous adolescents' suicide attempts.

Being in a fight, smoking, drinking alcohol, and watching television were not significantly associated with the three suicidal behaviors in either gender.

Table 3.2. Risk factors' association with indigenous adolescents' suicidal behaviors, 2001–2013 combined YRBS

	Male			Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Age ≥ 18	-0.080**	-0.021	0.026	-0.174**	-0.145*	-0.111
	(0.040)	(0.046)	(0.034)	(0.082)	(0.084)	(0.082)
Obese	0.006	-0.006	-0.003	0.066	0.070	0.097*
	(0.040)	(0.042)	(0.041)	(0.058)	(0.051)	(0.057)
Being threatened	0.094	0.111**	0.054	0.163*	0.204**	0.063
	(0.063)	(0.054)	(0.057)	(0.096)	(0.093)	(0.079)
In a fight	0.036	0.003	0.030	-0.051	-0.039	0.036
	(0.029)	(0.029)	(0.029)	(0.044)	(0.037)	(0.042)
Being raped	0.284***	0.392***	0.365***	0.099*	0.129**	0.148**
	(0.084)	(0.085)	(0.091)	(0.057)	(0.054)	(0.054)
Feeling sad	0.328***	0.267***	0.219***	0.311***	0.193***	0.154***
	(0.045)	(0.045)	(0.041)	(0.047)	(0.041)	(0.043)
Smoking	0.033	0.006	0.005	-0.007	0.053	0.069
	(0.046)	(0.044)	(0.043)	(0.054)	(0.051)	(0.047)
Drinking	0.012	0.029	0.023	0.070	0.031	-0.028
	(0.032)	(0.041)	(0.035)	(0.043)	(0.040)	(0.039)
Using marijuana	-0.016	-0.021	-0.022	0.072	0.129**	0.137**
	(0.041)	(0.039)	(0.034)	(0.054)	(0.049)	(0.049)

Multiple sex partners	0.048	0.029	0.088*	0.024	0.057	0.021
	(0.051)	(0.049)	(0.053)	(0.077)	(0.091)	(0.086)
Watching TV	-0.040	-0.021	-0.024	-0.027	-0.058	-0.045
	(0.046)	(0.047)	(0.036)	(0.054)	(0.052)	(0.050)
Playing on a sports team	-0.066**	-0.081**	-0.075**	0.009	0.022	0.042
	(0.027)	(0.027)	(0.027)	(0.042)	(0.039)	(0.036)
N	704	702	633	701	700	624
R-squared	0.310	0.286	0.342	0.199	0.195	0.188

Notes: *: < 0.10; **: <0.05; ***: < 0.001; estimation was conducted with Stata svy: regress command; linearized standard errors in parentheses; school grade and year variables were controlled for.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

Table 3.3 displays the estimated effects of the interactions between being indigenous and suicide risk factors, thereby comparing indigenous adolescents to the overall adolescent population. Being indigenous changed multiple factors' effects on adolescents' suicidal behaviors. Several factors had stronger associations with suicidal behaviors among indigenous adolescents.

Being indigenous was associated with 15.7% (p = 0.066), 26.9% (p = 0.002), and 22.1% (p = 0.019) increases in the effects of being raped on male adolescents' suicide consideration, planning, and attempts. Being indigenous was associated with a 12.7% (p = 0.005) decrease in the effects of being in a fight on female adolescents' suicide consideration and a 9.9% (p = 0.008) decrease in the factor's effects on female adolescents' suicide planning. Being indigenous was also associated with 10.7% (p = 0.042) and 10.0% (p = 0.056) increases in the effects of marijuana use on female adolescents' suicide planning and attempts.

Being indigenous was associated with 5.1% (p = 0.061) and 5.7% (p = 0.034) increases in the protective effects of playing on sports teams on male adolescents' suicide planning and attempts.

Table 3.3. Interactions effects between being indigenous and suicide risk factors, 2001–2013 combined YRBS

	Male			Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Indigenous	0.023	0.020	0.025	0.020	-0.003	0.006
	(0.047)	(0.050)	(0.042)	(0.060)	(0.055)	(0.057)
Age ≥ 18	-0.004	-0.008	-0.001	-0.011	-0.003	-0.001
	(0.008)	(0.008)	(0.005)	(0.008)	(0.008)	(0.006)
Indigenous#Age ≥ 18	-0.070**	-0.008	-0.012	-0.037	-0.047	-0.021
	(0.033)	(0.039)	(0.033)	(0.050)	(0.046)	(0.047)
Obese	0.018**	0.014**	0.001	0.041***	0.032***	0.029***
	(0.006)	(0.006)	(0.003)	(0.010)	(0.009)	(0.008)
Indigenous#Obese	-0.009	-0.018	-0.004	0.028	0.027	0.051
	(0.041)	(0.043)	(0.043)	(0.059)	(0.053)	(0.061)
Being threatened	0.089***	0.092***	0.071***	0.094***	0.119***	0.098***
	(0.011)	(0.011)	(0.009)	(0.013)	(0.013)	(0.013)
Indigenous#Being threatened	0.013	0.025	-0.005	0.061	0.092	-0.015
	(0.066)	(0.056)	(0.061)	(0.088)	(0.086)	(0.073)
In a fight	0.012**	0.014**	0.010***	0.070***	0.057***	0.068***
	(0.005)	(0.005)	(0.003)	(0.007)	(0.007)	(0.006)
Indigenous#In a fight	0.026	-0.012	0.027	-0.127**	-0.099**	-0.036
	(0.029)	(0.028)	(0.029)	(0.044)	(0.037)	(0.040)
Being raped	0.133***	0.129***	0.153***	0.126***	0.110***	0.116***
	(0.017)	(0.018)	(0.016)	(0.009)	(0.010)	(0.009)
Indigenous#Being raped	0.157*	0.269**	0.221**	-0.045	0.002	0.016
	(0.085)	(0.086)	(0.094)	(0.059)	(0.056)	(0.057)
Feeling sad	0.290***	0.217***	0.123***	0.300***	0.213***	0.150***
	(0.009)	(0.008)	(0.006)	(0.006)	(0.006)	(0.005)
Indigenous# Feeling sad	0.030	0.043	0.092**	0.007	-0.024	0.001
	(0.046)	(0.046)	(0.042)	(0.048)	(0.043)	(0.044)
Smoking	0.034***	0.032***	0.025***	0.060***	0.046***	0.044***
	(0.008)	(0.007)	(0.005)	(0.008)	(0.008)	(0.007)
Indigenous# Smoking	0.000	-0.029	-0.021	-0.058	0.013	0.037
	(0.045)	(0.040)	(0.041)	(0.053)	(0.051)	(0.049)
Drinking	0.009	0.015**	0.002	0.029***	0.018**	0.012**
	(0.005)	(0.005)	(0.004)	(0.006)	(0.006)	(0.005)
Indigenous# Drinking	0.015	0.019	0.017	0.052	0.014	-0.031
	(0.032)	(0.041)	(0.035)	(0.044)	(0.043)	(0.041)
Using marijuana	0.034***	0.016**	0.018***	0.019**	0.015*	0.019**
	(0.007)	(0.006)	(0.005)	(0.009)	(0.008)	(0.008)
Indigenous#Using marijuana	-0.060	-0.040	-0.040	0.037	0.107**	0.100*
	(0.041)	(0.040)	(0.034)	(0.058)	(0.052)	(0.052)
	-0.003	0.004	0.026***	0.024**	0.008	0.022**

Multiple sex partners	(0.009)	(0.008)	(0.007)	(0.011)	(0.011)	(0.010)
Indigenous# Multiple sex partners	0.047	0.024	0.056	0.009	0.061	0.011
	(0.051)	(0.049)	(0.053)	(0.073)	(0.090)	(0.085)
Watching TV	-0.017**	-0.031***	-0.007	-0.022**	-0.028***	-0.010
	(0.008)	(0.008)	(0.005)	(0.007)	(0.007)	(0.006)
Indigenous# Watching TV	-0.005	0.018	-0.009	0.021	-0.011	-0.003
	(0.047)	(0.049)	(0.037)	(0.057)	(0.055)	(0.055)
Playing on a sports team	-0.023***	-0.028***	-0.013***	-0.007	-0.010**	-0.007*
	(0.005)	(0.005)	(0.003)	(0.005)	(0.004)	(0.004)
Indigenous# Playing on a sports team	-0.041	-0.051*	-0.057**	0.018	0.034	0.055
	(0.028)	(0.027)	(0.027)	(0.044)	(0.041)	(0.041)
N	35,800	35,780	32,626	38,452	38,416	35,474
R-squared	0.194	0.151	0.147	0.222	0.162	0.171

Notes: *: < 0.10; **: < 0.05; ***: < 0.001; estimation was conducted with Stata *svy: regress* command; linearized standard errors in parentheses; school grade and year variables were controlled for.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

Table 3.4 displays the overall effects estimated by Oaxaca decomposition.

Suicide consideration rates for non-indigenous and indigenous male adolescents and their disparities are presented in the first column. Non-indigenous male adolescents' suicide consideration rates were 11.0%, and indigenous male adolescents' suicide consideration rates were 14.9%, yielding a difference of 3.9 percentage points. The disparity in suicide consideration between the two groups can be attributed to the following effects: If indigenous male adolescents experienced the same level of different suicide risk factors as non-indigenous male adolescents, their suicide consideration rates would be reduced by 0.041 ("endowments effects"); if different risk factors affected indigenous male adolescents the same as non-indigenous male adolescents, their suicide consideration rates would be reduced by 0.009 ("coefficients effects"); and the sum of the two is offset by 0.001 ("interactions effects"). Decomposition results look similar for male adolescents' suicide planning (Column 2) and attempts (Column 3), i.e., the

"endowments effects" dominated the "coefficients effects," but the "coefficients effects" had larger magnitudes in male adolescents' suicide consideration (Column 1).

The "coefficients effects" contributed a larger proportion of disparities between indigenous and non-indigenous female adolescents' suicide consideration (Column 4) and attempts (Column 6), while most disparities in their suicide planning (Column 5) were due to the "endowments effects."

Table 3.4. Oaxaca decomposition overall effects estimation, 2001–2013 combined YRBS

	Male			Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Non-indigenous	0.110***	0.091***	0.040***	0.202***	0.149***	0.092***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
Indigenous	0.149***	0.136***	0.089***	0.258***	0.181***	0.154***
	(0.018)	(0.016)	(0.014)	(0.022)	(0.020)	(0.022)
Difference	-0.039**	-0.045**	-0.049**	-0.057**	-0.032	-0.063**
	(0.018)	(0.016)	(0.014)	(0.022)	(0.020)	(0.022)
Endowments	-0.041***	-0.037***	-0.037***	-0.023**	-0.027**	-0.024**
	(0.010)	(0.010)	(0.009)	(0.011)	(0.010)	(0.009)
Coefficients	-0.009	-0.019	-0.029**	-0.025	-0.008	-0.044**
	(0.016)	(0.014)	(0.013)	(0.020)	(0.019)	(0.021)
Interaction	0.011*	0.011*	0.017**	-0.009	0.003	0.006
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.005)

Notes: *: < 0.10; **: < 0.05; ***: < 0.001; linearized standard errors in parentheses.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

Table 3.5 displays the "endowments effects" estimated by Oaxaca decomposition.

Differences in prevalence of being raped and feeling sad contributed to disparities in suicidal behaviors between the two male adolescent groups and the two female adolescent groups. If being raped among male indigenous adolescents were reduced to the same level as male non-indigenous adolescents, their suicide considerate rates would decrease by 0.6 percentage points and their suicide planning rates by 0.9 percentage

points. If being raped among female indigenous adolescents were reduced to the same level as their non-indigenous counterparts, their suicide attempts rates would decrease by 0.6 percentage points. If male indigenous adolescents' rates of feeling sad were reduced to the same as their non-indigenous counterparts, their rates of suicide consideration, planning, and attempts would decrease by 1.8, 1.5, and 1.4 percentage points, respectively. If female indigenous adolescents' rates of feeling sad were reduced to the same as their non-indigenous counterparts, their rates of the three suicidal behaviors would decrease by 1.6, 1.0, and 0.7 percentage points, respectively.

If male indigenous adolescents' rates of being threatened decreased to the same level as those of male non-indigenous adolescents, their suicide planning rates would decrease by 0.6 percentage points. If female indigenous adolescents' rates of marijuana use decreased to the same level as that of their non-indigenous counterparts, their suicide planning rates would decrease by 0.8 percentage points.

If male indigenous adolescents' rates of participating in sports teams increased to the same level as those of male non-indigenous adolescents, the rates of their three suicidal behaviors would decrease by 0.5, 0.6, and 0.6 percentage points, respectively.

Table 3.5. Oaxaca decomposition "endowments effects" estimation, 2001–2013 combined YRBS

	Male			Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Age ≥ 18	-0.001	-0.0002	-0.0003	0.001	0.001	0.001
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Obese	-0.0001	0.0001	0.0001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Being threatened	-0.006	-0.006*	-0.003	-0.001	-0.002	-0.001
	(0.004)	(0.004)	(0.003)	(0.002)	(0.003)	(0.001)
In a fight	-0.003	-0.0002	-0.003	0.002	0.002	-0.001
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Being raped	-0.006*	-0.009*	-0.006	-0.003	-0.005	-0.006*
	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)

Feeling sad	-0.018**	-0.015**	-0.014**	-0.016**	-0.010**	-0.007*
	(0.007)	(0.006)	(0.005)	(0.007)	(0.005)	(0.004)
Smoking	-0.002	-0.0001	-0.0003	-0.0004	-0.004	-0.004
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)
Drinking	-0.001	-0.001	-0.001	-0.001	-0.0004	-0.0001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Using marijuana	0.001	0.001	0.001	-0.003	-0.008*	-0.005
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
Multiple sex partners	-0.002	-0.001	-0.004	-0.0002	-0.001	-0.0003
	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)
Watching TV	-0.0001	-0.00004	-0.0001	-0.00003	-0.001	-0.0002
	(0.0003)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Playing on a sports team	-0.005*	-0.006*	-0.006*	0.0002	0.001	0.0004
	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)

Notes: *: < 0.10; **: < 0.05; ***: < 0.001; linearized standard errors in parentheses.
Abbreviation: YRBS = Youth Risk and Behavior Survey

Table 3.6 displays the "coefficients effects" estimated by Oaxaca decomposition. Differences in the effects of suicide risk factors, such as being raped and feeling sad, and in the effects of suicide protective factors, such as participating in sports teams, contributed to disparities in suicidal behaviors between indigenous and non-indigenous male adolescents. If the effects on indigenous male adolescents of being raped were reduced to the same as on non-indigenous male adolescents, indigenous adolescents' suicide consideration, planning, and attempts rates would decrease by 0.8, 1.4, and 1.0 percentage points. If the effects on indigenous male adolescents of feeling sad were reduced to the same level as on non-indigenous male adolescents, indigenous male adolescents' suicide attempts would decrease by 2.3 percentage points. If the protective effects on indigenous male adolescents of participating in sports teams were reduced to the same level as on non-indigenous male adolescents, indigenous male adolescents' rates of suicide planning and attempts would increase by 2.8 and 3.0 percentage points.

Differences in the effects of being in a fight and marijuana usage contributed to disparities in suicidal behaviors between indigenous and non-indigenous female adolescents. If the risk effects on indigenous female adolescents of being in a fight increased to the same level as on non-indigenous female adolescents, their rates of suicide consideration and planning would increase by 3.5 and 2.7 percentage points. If the risk effects on indigenous female adolescents of using marijuana were reduced to the same level as on non-indigenous female adolescents, indigenous female adolescents' rates of suicide planning and attempts would decrease by 2.6 and 2.2 percentage points.

Table 3.6. Oaxaca decomposition "coefficients effects" estimation, 2001–2013 combined YRBS

	Male			Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Age ≥ 18	0.010**	0.001	0.002	0.005	0.007	0.003
	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)
Obese	0.002	0.003	0.001	-0.003	-0.003	-0.005
	(0.007)	(0.007)	(0.007)	(0.006)	(0.005)	(0.006)
Being threatened	-0.002	-0.004	0.0005	-0.004	-0.006	0.001
	(0.009)	(0.008)	(0.008)	(0.005)	(0.005)	(0.004)
In a fight	-0.012	0.005	-0.013	0.035**	0.027**	0.009
	(0.013)	(0.013)	(0.014)	(0.013)	(0.011)	(0.011)
Being raped	-0.008**	-0.014**	-0.010**	0.006	-0.001	-0.003
	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)
Feeling sad	-0.007	-0.011	-0.023**	-0.002	0.010	-0.001
	(0.011)	(0.012)	(0.011)	(0.019)	(0.017)	(0.017)
Smoking	0.0001	0.008	0.005	0.015	-0.003	-0.009
	(0.012)	(0.011)	(0.011)	(0.014)	(0.014)	(0.012)
Drinking	-0.006	-0.008	-0.008	-0.026	-0.009	0.012
	(0.015)	(0.018)	(0.016)	(0.019)	(0.018)	(0.017)
Using marijuana	0.017	0.011	0.011	-0.007	-0.026*	-0.022*
	(0.012)	(0.011)	(0.010)	(0.014)	(0.013)	(0.012)
Multiple sex partners	-0.007	-0.004	-0.008	-0.0003	-0.004	-0.001
	(0.008)	(0.008)	(0.008)	(0.005)	(0.006)	(0.006)
Watching TV	0.004	-0.016	0.008	-0.014	0.015	0.007
	(0.043)	(0.044)	(0.034)	(0.050)	(0.048)	(0.048)
Playing on a sports team	0.022	0.028*	0.030**	-0.008	-0.016	-0.026

	(0.016)	(0.015)	(0.015)	(0.022)	(0.020)	(0.021)
Constant	-0.020	-0.020	-0.023	-0.021	0.001	-0.009
	(0.047)	(0.049)	(0.042)	(0.059)	(0.055)	(0.057)

Notes: *: < 0.10; **: < 0.05; ***: < 0.001; linearized standard errors in parentheses.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

The "interactions effects" estimated by Oaxaca decomposition are presented in Appendix D. Being raped and feeling sad contributed to the "interactions effects" on disparities in suicide planning and attempts between indigenous and non-indigenous male adolescents.

Sensitivity analyses' results can be seen in Appendix E.

Discussion

This study examined disparities in suicidal behaviors between indigenous and non-indigenous adolescents. It found that indigenous male and female adolescents had significantly higher prevalence of suicide consideration, planning, and attempts than their non-indigenous counterparts. These disparities can be attributed to differences in both the prevalence and the effects of suicidal risk factors, as well as their interactions, between indigenous and non-indigenous adolescents.

The study identified important risk or protective factors that were associated with indigenous adolescents' suicidal behaviors and contributed to disparities in suicidal behaviors between them and their non-indigenous counterparts.

Being raped and feeling sad were important risk factors for suicidal behaviors among both male and female indigenous adolescents. Both factors were much less prevalent in male indigenous adolescents than in female indigenous adolescents but had stronger associations with the former's suicidal behaviors than with the latter's. The study found that being raped was a stronger predictor of male indigenous adolescents'

suicidal behaviors than of females', which is consistent with Borowsky et al. (1999), who also found that sexual abuse had a higher odds ratio on suicide attempts in American Indian and Native Alaskan males than in females. Borowsky et al. (1999) attributed this gender difference to "(American) culture's emphasis on male strength and control" and hypothesized that gender stereotyping may prevent indigenous male adolescents from reporting sexual abuse and seeking help. The same assumption could also be applied to explain differences discovered in the effects of feeling sad on suicidal behaviors, i.e., male indigenous adolescents with depression symptoms were less likely than their female counterparts to seek health care. Compared to the general male adolescent population, for male indigenous adolescents, being raped and feeling sad were more important suicide behavior risk factors, and playing on a sports team was a more important suicide behavior protective factor. Artiga, Arguello, and Duckett (2013) reported that the indigenous population had inadequate insurance coverage and limited access to mental health care relative to the general population. Therefore, when male indigenous adolescents are sexually abused or have depression symptoms, they are less likely than male non-indigenous adolescents to seek psychological consultation or receive mental illness treatments. In addition, a survey conducted by National Public Radio, Robert Wood Johnson Foundation, and Havard T.H. CHAN School of Public Health (2017) reported that a large proportion of Native Americans believed they were discriminated against by police. This distrust in law enforcement may prevent them from reporting sexual abuse.

For female indigenous adolescents alone, being threatened and marijuana usage were also important risk factors, even though the prevalence of the two risk factors was lower among them than among their male counterparts. Harris, Jenkins, and Glaser

(2006) found that females were more likely to perceive negative consequences and tended to overestimate the severity of perceived negative consequences more than males. This might explain why being threatened and marijuana usage affected female indigenous adolescents more than their male counterparts. Compared to the general female adolescent population, using marijuana was a more important risk factor associated with indigenous female adolescents' suicidal behaviors. No previous studies have been found to explain these two findings. From the descriptive statistics (Table 1), 25.0% of indigenous female adolescents versus 18.4% of their non-indigenous counterparts had used marijuana in the past 30 days, indicating that indigenous female adolescents tended to use marijuana more frequently. The differences in marijuana use frequencies might be the reason for its stronger risk effects on indigenous female adolescents' suicidal behaviors.

The study also identified a protective factor against male indigenous adolescents' suicidal behaviors: playing on a sports team. This is consistent with findings by Dalton, Wilson, Evans, and ochrane (2015), who suggested that Australian indigenous adolescents who participated in team sports were less likely to experience serious mental illnesses. As isolation is a unique suicide risk factor for indigenous adolescents (Turecki & Brent, 2016), the stronger protective effects of participating in team sports on male indigenous adolescents might work through reducing their isolation and increasing their acceptance. Weiss and Duncan (1992) found that children with higher physical competence had better perceived peer acceptance in a sports setting, which might be used as evidence to support this hypothesis.

This study is the first to quantify behavioral suicide risk factors' effects on disparities in suicidal behaviors between indigenous and non-indigenous adolescents. In addition, the study also decomposed the disparities into "endowments effects," "coefficients effects," and "interactions effects" of different risk factors.

The study has its limitations. First, the study combined four different groups of indigenous adolescents together and provided only estimates of the average effects, which neglects the heterogeneity among the four groups (Balis & Postolache, 2008; Goldston et al., 2008). Furthermore, suicide rates in different indigenous communities can vary from zero to much higher than those in the general population (King, Smith, & Gracey, 2009). However, the data do not provide adequate geographic information to address this heterogeneity. Second, this study used binary variables to measure suicide risk factors. The results cannot instruct how the frequencies of important risk factors, such as being raped, feeling sad, marijuana use, and playing on a sports team, were associated with suicidal behaviors. Future researchers may collect more detailed data on these risk factors and explore the effects of their frequencies on indigenous adolescents' suicidal behaviors and disparities. Third, due to data limitations, the study did not examine how suicidal behavior risk factors, such as being raped, feeling sad, being threatened, and using marijuana, were associated with indigenous adolescents' suicidal behaviors, nor how the suicidal behavior protective factor, playing on a sports team, was associated with fewer suicidal behaviors among indigenous adolescents. Understanding the mechanism is important in controlling these risk factors' effects on indigenous adolescents and reducing their suicidal behaviors.

The study identified several important risk factors associated with indigenous adolescents' suicidal behaviors and disparities in suicidal behaviors between them and non-indigenous adolescents. These risk factors include being raped, feeling sad, being threatened, and using marijuana. Reducing these factors' prevalence in indigenous communities or controlling their effect sizes on indigenous adolescents would not only reduce indigenous adolescents' suicidal behaviors but also address disparities in suicidal behaviors between indigenous and non-indigenous adolescents. Specifically, among both male and female indigenous adolescents, measures such as increasing access to health care and building trust between law enforcement and the indigenous community can be taken to prevent sexual abuse and mental disorders. Among female indigenous adolescents, measures that can be taken include building a safe school environment, as well as detecting and responding to their substance use.

The study also found participating in team sports as a protective factor against suicidal behaviors for male indigenous adolescents that also reduced disparities in suicidal behaviors between indigenous and non-indigenous male adolescents. This may indicate that encouraging male indigenous adolescents to participate in team sports is a way to protect them from suicidal behaviors. Suicidal behaviors are important predictors of suicide completion. Among indigenous adolescents, every 13 suicide attempts lead to one suicide completion (Middlebrook, LeMaster, Beals, Novins, & Manson, 2001). Therefore, this study also provides important insights on measures that can be taken to reduce indigenous adolescents' high suicide rates.

Chapter Five

Conclusions

Vulnerable populations often lack access to healthcare and have poorer health. Government intervention can reduce their healthcare and health disparities, as well as disparities' effects on their employment.

The first study found that being employed does not significantly affect male and female adult children's caregiving to aging parents. This indicates that female adult children will not withdraw from their primary informal caregiving roles despite their increased labor force participation rates. Managing both work and caregiving might increase their stress and affect the quantity and quality of care they provide. Federal and state governments can reduce female caregivers' burden by expanding work–life balance policies and motivating male children to increase caregiving. Only when the sustainability of informal care is addressed can elderly people's access to informal care be guaranteed.

The second study found that the passage of recreational marijuana laws reduces youth employment. The effects may work through marijuana-induced health deterioration or the conflicts between marijuana legalization and workplace drug-free policies. In order to prevent job and income loss among young marijuana users, the government may consider raising the minimum marijuana use age or passing laws to stop the enforcement of workplace drug-free policies.

The third study identified important factors that contribute to male and female indigenous adolescents' suicidal behaviors and suicidal behavior disparities. The results of the chapter indicate that indigenous adolescents' suicide can be prevented with better

access to mental healthcare, safer school and community environments, and more participation in team sports.

Appendices

Appendix A

Table A.1. HRS variables and corresponding survey questions

Variable	HRS Item	Dataset
Dependent variables		
Any care in the past month	"*Whether child is a helper from the helper file and helps respondent with either ADLs or IADLs*"	RAND resp-kid file
Intensive care in the past month	"*The total hours children helped the respondent last month*"	RAND resp-kid file
ADL care in the past month	"*Whether a child (or child-in-law or grandchild) helps with the respondent's ADLs (dressing, walking, bathing, eating, getting in/out of bed, toileting)*"	RAND resp-kid file
Financial transfer in the past two years	"*Whether the respondent received financial help from any child (or grandchild)*"	RAND resp-kid file
Independent variable		
Adult children employed	"*Working full-time if the child is working 30 hours or more per week; working part-time if the child is working under 30 hours per week; or not working at all*"	RAND resp-kid file
Covariates		
Adult children		
Age	"*Child age*"	RAND resp-kid file
Male	"*Child's gender*"	RAND resp-kid file
Married	"*Child's current marital status*"	RAND resp-kid file
Number of kids	"*The number of children that kid has*"	RAND resp-kid file
Number of grandkids	"*The number of grandchildren that child has*"	RAND resp-kid file
Living within 10 miles of parents	"*How close the child lives to the respondent's home*"	RAND resp-kid file
Aging parents		
Age	"*Respondent birthdate and beginning interview date*"	RAND HRS
Male	"*Respondent gender*"	RAND HRS
Nonwhite	"*Respondent race*"	RAND HRS
Hispanic	"*Respondent Hispanic or not*"	RAND HRS

Married	"*Respondent current marital status*"	RAND HRS
Number of children in household	"*The number of living children of the respondent and spouse or partner*"	RAND HRS
Non-housing wealth (in 2011 $)	"*The net value of non-housing financial wealth is calculated as the sum of the appropriate wealth components less debt.*"	RAND HRS
First residency net value (in 2011 $)	"*The net value of housing is calculated as the value of the primary residence less mortgages and home loans.*"	RAND HRS
Annual household income (in 2011 $)	"*The sum of all income in a household*"	RAND HRS
Self-rated health	"*Respondent self-report general health status*"	RAND HRS
CESD	"*CESD is the sum of felt depressed, everything an effort, sleep was restless, felt lonely, felt sad, could not get going, (1–Was happy) and (1–Enjoyed life). Thus, the higher the score, the more negative the respondent's feelings in the past week.*"	RAND HRS
ADL	"*Respondent has difficulty bathing, dressing, eating, getting in/out of bed, and walking across a room.*"	RAND HRS
IADL	"*Respondent has difficulty using the phone, managing money, and taking medications, shopping for groceries and preparing hot meals.*"	RAND HRS
Medicare coverage	"*Respondent covered by Medicare or not*"	RAND HRS
Medicaid coverage	"*Respondent covered by Medicaid or not*"	RAND HRS
LTCI coverage	"*Respondent covered by LTCI or not*"	RAND HRS

Sources: RAND HRS Family Data Documentation, Version C, and RAND HRS Data Documentation, Version N.
Abbreviations: HRS = Health and Retirement Study; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living; CESD = the Center for Epidemiologic Studies Depression Scale; LTCI = Long-Term Care Insurance.

Appendix B

Results comparison with He and McHenry (2015)

This study took the same approach to controlling for employment's endogeneity as He and McHenry (2015). As discussed in the introduction, the study considered not controlling for parents' level variable as a limitation for He and McHenry (2015). In order to exhibit the importance of controlling for parents' level variables, this study repeated analyses in He and McHenry (2015) using the same sample, i.e., female adult children aged 40–64 years, and a similar set of covariates, with values retrieved from the HRS.

Table B.1 presents the comparison between the main SIPP variables analyzed by He and McHenry (2015) and the corresponding HRS variables included in this study. The means of most variables are comparable.

Table B.1. Descriptive Statistics Comparison with He & McHenry (2015)

SIPP (1997–2005)[a]		HRS (2001–2005)	
Adult children – Care	0.08 (0.28)	Adult children – Care	0.052 (0.002)
Adult children – Employed	0.66 (0.47)	Adult children – Employed	0.799 (0.003)
Adult children – Age	50.55 (6.95)	Adult children – Age	48.261 (0.048)
Adult children – Married	0.64 (0.48)	Adult children – Married	0.652 (0.004)
Adult children – Education	High school: 0.31 (0.46) Some college: 0.32 (0.47) College degree: 0.15 (0.36) Graduate degrees: 0.09 (0.29)	Adult children – Education years	14.210 (0.077)
Adult children – Number of kids ≤ 18	0.63 (1.01)	Adult children – Number of children	2.034 (0.011)
		Adult children – Number of grandchildren	0.053 (0.002)
Adult children – Race	White: 0.74 (0.44) Black: 0.13 (0.34)	Aging parents – % nonwhite	0.148 (0.003)
Adult children – % Hispanic	0.08 (0.28)	Aging parents – % Hispanic	0.060 (0.002)

Adult children – Household net assets ($1,000s)	235.691 (1127.36)	Adult children – % own a home	0.705 (0.003)
Adult children – Household income net of self-earning ($1,000s)	3.93 (4.37)	Adult children – % with income < 35K	0.320 (0.005)
State – Unemployment rate	1997: 4.77 (1.18) 2002: 5.45 (0.96) 2005: 5.02 (1.04)	State – Unemployment rate	5.621 (0.007)
State – Medicaid spending per enrollee ($1,000s)	1997: 6.10 (1.84) 2002: 6.66 (1.86) 2005: 6.82 (1.87)	Aging parents – % with Medicaid	0.110 (0.002)
State – Medicaid LTC spending per enrollee ($1,000)	1997: 1.10 (0.62) 2002: 1.02 (0.62) 2005: 0.99 (0.55)	-	-
State – Medicare spending per enrollee ($1,000s)	6.06 (0.99) 6.60 (0.89) 7.46 (0.96)	Aging parents – % with Medicare	0.846 (0.003)

Note: [a]Retrieved from He & McHenry (2015).
Abbreviations: SIPP = Survey of Income and Program Participation; HRS = Health and Retirement Study; LTC = Long-Term Care Insurance.

Table B.2 presents the comparison between effects estimates using the HRS data and He and McHenry's (2015) estimates. The results show that the average marginal effects of employment on middle-aged female adult children's caregiving were blown up when including and excluding parents' health variables, which might be caused by the weak instrument problem.

Table B.2. Effects Estimates Comparison with He and McHenry (2015)

SIPP (1997–2005)[a]		HRS (2001–2005)		
Work	-0.255	Work	2.437***	2.488***
	(0.310)		(0.421)	(0.248)
High school	0.067	Education years	-0.079**	-0.054**
	(0.066)		(0.026)	(0.020)
Some college	0.175			
	(0.081)			
College	0.123			
	(0.092)			
Graduate school	0.160			
	(0.114)			
White	0.119			
	(0.059)			
Black	0.092	Nonwhite	-0.338**	-0.571
	(0.068)	parents	(0.152)	(0.360)
Hispanic	0.088	Hispanic parents	-0.021	0.006
	(0.062)		(0.171)	(0.199)
Married	-0.009	Married	0.100	0.043

	(0.026)		(0.227)	(0.137)
Number of children	-0.025	Number of	0.046	0.053
	(0.013)	children	(0.029)	(0.044)
		Number of	0.082	0.096
		grandchildren	(0.199)	(0.137)
Household wealth	-0.000	Own a home	-0.073	-0.106
	(0.000)		(0.365)	(0.305)
Household income	-0.006	Income < 35K	0.356	0.365**
	(0.004)		(0.233)	(0.134)
State Medicaid per	0.012	Parents'	0.028	-0.106
enrollee	(0.134)	Medicaid	(0.337)	(0.203)
		coverage		
State Medicare per	0.086	Parents' Medicare	0.147	-0.020
enrollee	(0.047)	coverage	(0.111)	(0.172)
		Self-rated health		0.080
				(0.094)
		CESD		-0.016
				(0.058)
		ADL		0.116
				(0.102)
		IADL		0.055
				(0180)
Observations	38,506	Observations	602	525
First-stage F-statistic	4.58	First stage F-statistic	11.18	9.62

Note: [a]Retrieved from He and McHenry (2015).

Abbreviations: SIPP = Survey of Income and Program Participation; HRS = Health and Retirement Study; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living; CESD = the Center for Epidemiologic Studies Depression Scale; LTCI = Long-Term Care Insurance.

Appendix C

Table C.1. YRBS variables and corresponding survey questions

Variable	YRBS Question	Value code
Dependent variables		
Suicide consideration	"*During the past 12 months, did you ever seriously consider attempting suicide?*"	1 = "*Yes*" 0 = "*No*"
Suicide planning	"*During the past 12 months, did you make a plan about how you would attempt suicide?*"	1= "*Yes*" 0 = "*No*"
Suicide attempts	"*During the past 12 months, how many times did you actually attempt suicide?*"	1 = "*1 time*," "*2 or 3 times*," "*4 or 5 times*," or "*6 or more times*" 0 = "*0 times*"
Independent variables		
Being indigenous	*7-level race and ethnicity variable*	1 = "*American Indian/Alaska Native*" or "*Native Hawaiian/Other Pacific Islander*" 0 = "*Asian*," "*Black or African American*," "*Hispanic/Latino*," "*White*," or "*Multiple Races (Non-Hispanic)*"
Age ≥ 18	"*How old are you?*"	1 = "*18 years old or older*" 0 = "12 years old or younger," "13 years old," "14 years old," "15 years old," "16 years old," or "17 years old"
Male	"*What is your sex?*"	1 = "*Male*" 0 = "*Female*"
Obese	*Is a student "at or above the 95th percentile for body mass index, by age and sex?"*	1 = "*Yes*" 0 = "*No*"
Being threatened	"*During the past 12 months, how many times has someone threatened or injured you with a weapon such as a gun, knife, or club on school property?*"	1 = "*1 time*," "*2 or 3 times*," "*4 or 5 times*," "*6 or 7 times*," "*8 or 9 times*," "*10 or 11 times*," or "*12 or more times*" 0 = "*0 times*"

In a fight	"*During the past 12 months, how many times were you in a physical fight?*"	1 = "*1 time*," "*2 or 3 times*," "*4 or 5 times*," "*6 or 7 times*," "*8 or 9 times*," "*10 or 11 times*," or "*12 or more times*" 0 = "*0 times*"
Being raped	"*Have you ever been physically forced to have sexual intercourse when you did not want to?*"	1= "*Yes*" 0 = "*No*"
Feeling sad	"*During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?*"	1= "*Yes*" 0 = "*No*"
Smoking	"*During the past 30 days, on how many days did you smoke cigarettes?*"	1 = "*1 or 2 days*," "*3 to 5 days*," "*6 to 9 days*," "*10 to 19 days*," "*20 to 29 days*," or "*All 30 days*" 0 = "*0 days*"
Drinking	"*During the past 30 days, on how many days did you have at least one drink of alcohol?*"	1 = "*1 or 2 days*," "*3 to 5 days*," "*6 to 9 days*," "*10 to 19 days*," "*20 to 29 days*," or "*All 30 days*" 0 = "*0 days*"
Using marijuana	"*During the past 30 days, how many times did you use marijuana?*"	1 = "*1 or 2 times*," "*3 to 9 times*," "*10 to 19 times*," "*20 to 39 times*," or "*40 or more times"* 0 = "*0 times*"
Multiple sex partners	"*During the past 3 months, with how many people did you have sexual intercourse?*"	1 = "*2 people*," "*3 people*," "*4 people*," "*5 people*," or "*6 or more people*" 0 = "*I have never had sexual intercourse*," "*I have had sexual intercourse, but not during the past 3 months*," or "*1 person*"
Watching TV	"*On an average school day, how many hours do you watch TV?*"	1 = "*Less than 1 hour per day*," "*1 hour per day*," "*2 hours per day*," "*3 hours per day," "4 hours per day*," or "*5 or more hours per day*" 0 = "*I do not watch TV on an average school day*"

Playing on a sports team	"*During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)*"	1 = "*1 team*," "*2 teams*," or "*3 or more teams*" 0 = "*0 teams*"

Source: 2013 YRBS National, State, and District Combined Datasets User's Guide, May 2015.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

Appendix D

Table D.1. Oaxaca decomposition "interactions effects" estimation, 2001–2013 combined YRBS

	Male			Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Age ≥ 18	0.001	0.0001	0.0001	-0.001	-0.001	-0.0004
	(0.001)	(0.0004)	(0.0003)	(0.001)	(0.001)	(0.001)
Obese	-0.0001	-0.0003	-0.0001	0.001	0.0005	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.001	0.001	-0.0002	0.0004	0.001	-0.0001
Being threatened	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.000)
In a fight	0.002	-0.001	0.002	-0.006	-0.004	-0.001
	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)
Being raped	0.003	0.006*	0.004	-0.002	0.0002	0.001
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Feeling sad	0.002	0.002	0.006*	0.0003	-0.001	0.0001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Smoking	-0.00002	-0.002	-0.001	-0.004	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)
Drinking	0.0003	0.0004	0.001	0.001	0.0002	0.0001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
	-0.003	-0.002	-0.002	0.002	0.007	0.004
Using marijuana	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)
Multiple sex	0.002	0.001	0.003	0.00003	0.0004	0.0001
partners	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)
Watching TV	0.00001	-0.00004	0.0001	-0.0002	0.0002	0.0001
	(0.0002)	(0.0002)	(0.000)	(0.001)	(0.001)	(0.001)
Playing on a	0.003	0.004	0.005	-0.0003	-0.001	-0.0005
sports team	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)

Notes: *: < 0.10; **: < 0.05; ***: < 0.001; linearized standard errors in parentheses.
Abbreviation: YRBS = Youth Risk and Behavior Survey.

Appendix E

Sensitivity Analyses

The study was a pooled cross-sectional design. To check the robustness of the results, the most important suicidal behavior predictors in male and female indigenous adolescents, i.e., being raped and feeling sad in male indigenous adolescents and feeling sad in female indigenous adolescents, were excluded from the model, respectively. The results are displayed in Table E.1. Most effects estimates remain the same in significance and direction and have similar magnitudes to their baseline counterparts. Differences in the significance and direction of a few of the effects estimates from the baseline results might be caused by correlations between corresponding risk factors and the excluded risk factor.

Table E.1. Sensitivity analyses' results, 2001–2013 combined YRBS

	Male						Female		
	Consideration	Planning	Attempts	Consideration	Planning	Attempts	Consideration	Planning	Attempts
Age ≥ 18	-0.085**	-0.023	0.012	-0.060	-0.004	0.043	-0.153*	-0.132	-0.099
	(0.036)	(0.043)	(0.040)	(0.044)	(0.049)	(0.036)	(0.087)	(0.087)	(0.084)
Obese	0.028	0.015	-0.001	0.023	0.007	0.007	0.020	0.041	0.076
	(0.037)	(0.039)	(0.035)	(0.042)	(0.044)	(0.042)	(0.068)	(0.055)	(0.060)
Being threatened	0.169**	0.135**	0.028	0.173**	0.173**	0.106	0.221**	0.240**	0.097
	(0.061)	(0.057)	(0.058)	(0.070)	(0.061)	(0.065)	(0.099)	(0.096)	(0.069)
In a fight	0.026	0.016	0.018	0.065**	0.024	0.045	-0.006	-0.011	0.057
	(0.028)	(0.028)	(0.029)	(0.030)	(0.030)	(0.029)	(0.045)	(0.036)	(0.042)
Being raped				0.367***	0.473***	0.439***	0.146**	0.159**	0.175**
				(0.096)	(0.088)	(0.105)	(0.059)	(0.055)	(0.055)
Feeling sad	0.372***	0.306***	0.249***						
	(0.041)	(0.045)	(0.038)						
Smoking	0.005	0.000	0.003	0.031	0.002	0.002	0.025	0.073	0.084*
	(0.041)	(0.041)	(0.038)	(0.056)	(0.051)	(0.051)	(0.055)	(0.051)	(0.046)
Drinking	0.010	0.061	0.002	0.023	0.042	0.033	0.088*	0.042	-0.023
	(0.035)	(0.042)	(0.032)	(0.034)	(0.043)	(0.036)	(0.049)	(0.044)	(0.042)
Using marijuana	0.037	0.008	0.023	-0.022	-0.028	-0.028	0.074	0.131**	0.139**
	(0.036)	(0.038)	(0.035)	(0.046)	(0.042)	(0.039)	(0.058)	(0.052)	(0.051)
Multiple sex partners	0.042	0.030	0.123**	0.035	0.015	0.078	0.026	0.058	0.017
	(0.045)	(0.047)	(0.048)	(0.058)	(0.055)	(0.062)	(0.084)	(0.092)	(0.090)
Watching TV	-0.038	-0.027	-0.034	-0.097*	-0.07633	-0.06498	-0.057	-0.076	-0.065
	(0.050)	(0.055)	(0.047)	(0.053)	(0.051)	(0.040)	(0.063)	(0.056)	(0.051)
Playing on a sports team	-0.069**	-0.099**	-0.064**	-0.085**	-0.096**	-0.088**	0.002	0.018	0.039
	(0.028)	(0.030)	(0.025)	(0.030)	(0.029)	(0.030)	(0.042)	(0.038)	(0.035)
N	62,904	62,902	62,816	57,634	57,632	57,562	59,003	59,002	58,926

R-squared	0.330	0.260	0.254	0.168	0.1889	0.241	0.090	0.142	0.149

Notes: *: < 0.10; **: <0.05; ***: < 0.001; estimation was conducted with Stata *svy: regress* command; linearized standard errors in parentheses; school grade and year variables were controlled for.

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Honors and Awards

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IUPUI Graduate-Professional Educational Grant	2016
Golden Key International Honour Society	Since 2015
ISPOR Best Student Poster Research Presentation	2011
Shanghai Social Science Academy Research Paper Award	2009
Fudan University Outstanding Graduate	2009
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University of Tokyo Horiba–APRU Research Conference Travel Grant	2008
Fudan University Outstanding Teaching Assistant Award	2008
Shandong University Outstanding Student Leadership Award	2002

Professional Experience

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Conference Presentations

ISPOR 22nd Annual International Meeting	2017
Cost-Effectiveness Analysis of Dabigatran versus Rivaroxaban for Non-Valvular Atrial Fibrillation Using Real-World Evidence in Medicare Beneficiaries	Poster Presentation
APHA Annual Meeting	2016
National Instant Criminal Background Check System and High School Students' Gun Carrying	Poster Presentation
An Analysis of Marketplace Child Dental Plan Premium Variations	Poster Presentation
ASHEcon 6th Biennial Meeting	2016
Does Work Affect Adult Children’s Informal Care Supply? Evidence from the Great Recession	Poster Presentation
PAA Annual Meeting	2016
Does Work Affect Adult Children’s Informal Care Supply? Evidence from the Great Recession	Poster Presentation
APHA Annual Meeting	2015
Causes of Non-Fatal and Fatal Violence-Related Injuries among Children in the United States, 2001–2013	Oral Presentation
AcademyHealth Annual Research Meeting	2014
The Impact of State Distracted Driving Laws on Adolescents' Driving Behavior	Poster Presentation

QCOR Scientific Sessions	2014
Cost-Benefit Analysis of Home Blood Pressure Monitoring: A Business Case	Oral Presentation
ISPOR 14th Annual European Congress	2011
Cost-effectiveness Analysis of Different Cervical Cancer Prevention Approaches in the United States	Poster Presentation
ISPOR 12th Annual European Congress	2009
Cost-Effectiveness of Erlotinib in the Treatment of Advanced Non-Small Cell Lung Cancer in China	Poster Presentation
ISPOR 3rd Asia-Pacific Conference	2008
Economic Evaluation of Adjuvant Therapy with Trastuzumab for HER2-Positive Breast Cancer	Oral Presentation
7th iHEA World Congress	2008
Introduction of the establishment of Shanghai comprehensive community health reform's evaluation system	Oral Presentation
19th IAGG World Congress	2008
Inequality in Utilizing Community-based Health Services for Aging Hypertension Outpatients	Poster Presentation
An Analysis of Informal Care across Six Asia-Pacific Countries: A Policy Makers' Perspective	Poster Presentation
International Forum on Ageing in Place & Age Friendly Cities	2008
Showing a 'Big Picture' of What Other Countries Are Doing: A Cross-Cultural Study of Informal Care Policies Across Six Asia-Pacific Countries	Oral Presentation
University of Tokyo Horiba–APRU Research Conference	2008
Elderly People's Demand for Home Care in Shanghai Metropolitan Areas	Oral Presentation

Publications

Qiao, N., Carroll, A. E., & Bell, T. M. (2018). Factors affecting the Affordable Care Act marketplace stand-alone pediatric dental plan premiums. *Journal of Public Health Dentistry*. Advance online publication. doi: 10.1111/jphd.12287

Peng, S., Deger, K. A., Ustyugova, A., Gandhi, P., **Qiao, N.**, Wang, C., & Kansal, A. R. (2017). Cost-effectiveness analysis of Dabigatran versus Rivaroxaban for stroke prevention in patients with non-valvular atrial fibrillation using real-world evidence in elderly US Medicare beneficiaries. *Current Medical Research and Opinion, 34*(1), 55–63. doi:10.1080/03007995.2017.1375470

Qiao, N., & Bell, T. M. (2016). Indigenous adolescents' suicidal behaviors and risk factors: Evidence from the National Youth Risk Behavior Survey. *Journal of Immigrant and Minority Health, 19*(3), 590–597. doi:10.1007/s10903-016-0443-x

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Arrieta, A., Woods, J. R., **Qiao, N.**, & Jay, S. J. (2014). Cost-benefit analysis of home blood pressure monitoring in hypertension diagnosis and treatment: An insurer perspective. *Hypertension, 64*(4), 891–896. doi: 10.1161/hypertensionaha.114.03780

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Jiang, H. L., Chen, W., Hu, M., & **Qiao, N.** (2009). Problems and solutions of drug administration system in china. *Chinese Health Economics, 28*(8), 69–71. *(In Chinese)*

Hu, M., Chen, W., Jiang, H. L., & **Qiao, N.** (2009). Development and reform of the drug administration system in China. *Chinese Health Economics, 28*(8), 71–74. *(In Chinese)*

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Qiao, N., Xu, L. Z., Wang, X. Z., Sun, H., & Li, R. Y. (2009). The study on Weihai residents' AIDS awareness status and knowledge acquirement channels. *Chinese Primary Health Care, 23*(3): 69–70. *(In Chinese)*