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Document Title: Violent Victimization Known to Law Enforcement in the Bakken Oil-Producing Region of Montana and North Dakota, 2006-2012

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Abstract:

The authors of this report compared patterns of violent victimization in the Bakken oil-producing region to those in surrounding counties outside of the Bakken region. This report focuses on trends in violent crime from 2006 to 2012, a period during which regions of Montana and North Dakota that contain parts of the Bakken shale formation experienced relatively rapid growth in oil and gas production, an influx of new residents to work in oil sector–related jobs, and according to reports from the area, a corresponding increase in calls for service to local law enforcement. The information in this report comes from Bureau of Justice Statistics (BJS)-sponsored analysis of data from the Federal Bureau of Investigation's (FBI's) National Incident-Based Reporting System (NIBRS). From 2006 to 2012, the rate of violent victimization known to law enforcement in the Bakken oil-producing region of Montana and North Dakota increased, particularly the rate of aggravated assault, which increased 70%. There was no similar increase in rates of violent crime in the counties surrounding the Bakken oil region. Rates of male and female violent victimization in the Bakken region increased during this period, with the increase being higher for males (up 31%) than females (up 18%).

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Violent Victimization Known to Law Enforcement in the Bakken Oil-Producing Region of Montana and North Dakota, 2006-2012

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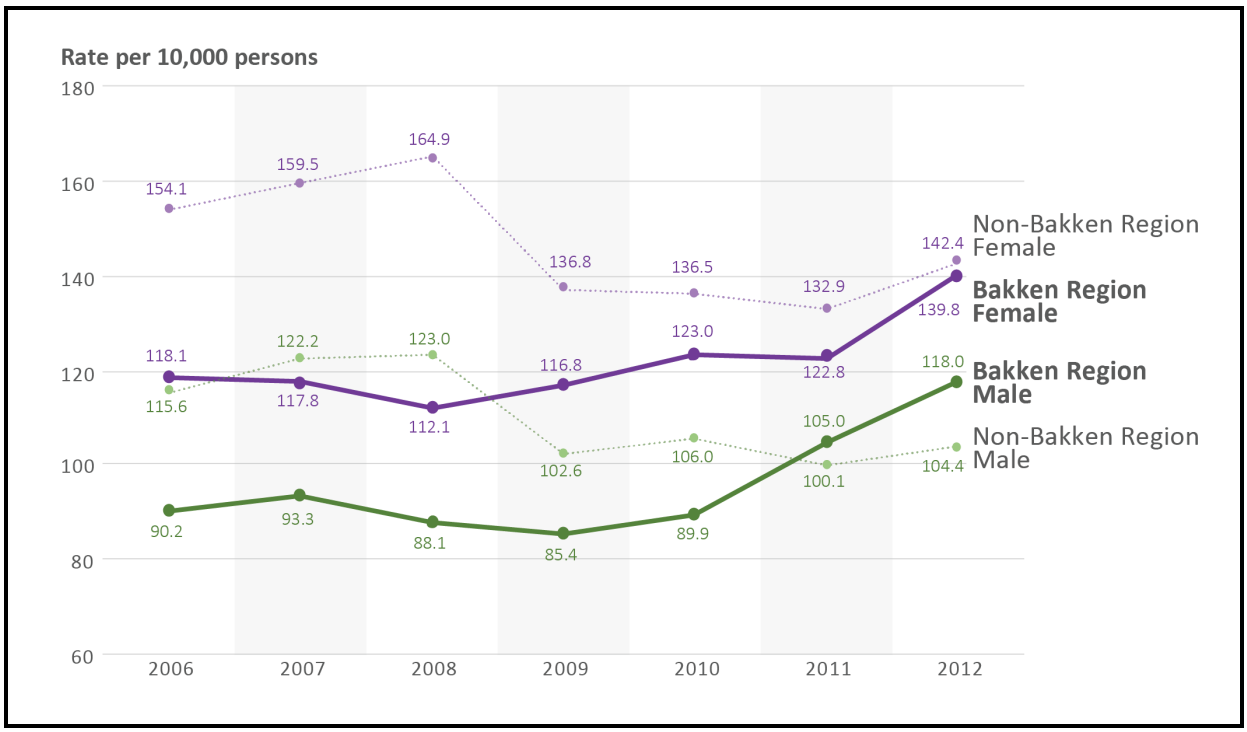
1. Introduction

From 2006 to 2012, the rate of violent victimization known to law enforcement in the Bakken oil-producing region of Montana and North Dakota increased for males and females (**figure 1**). The violent victimization rate for males increased by 31%, from 90.2 per 10,000 males in 2006 to 118.0 per 10,000 males in 2012, whereas the comparable rate for females increased by 18%, from 118.1 per 10,000 females in 2006 to 139.8 per 10,000 females in 2012. Violent victimizations include the offenses of murder, rape and sexual assault, other unlawful sexual contact, robbery, aggravated and simple assault, kidnapping, and intimidation. During this same period, the rate of violent victimization in the non-Bakken counties of Montana, North Dakota, and South Dakota, decreased for males (−10%) and females (−8%).

Figure 1. Rate of violent victimization known to law enforcement in the Bakken and non-Bakken regions, by victim sex, 2006–2012



Sources: Bureau of Justice Statistics analysis of data from the Federal Bureau of Investigation's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

The authors analyzed patterns of violent victimization in the Bakken oil-producing region from 2006 to 2012. The Bakken region is defined as counties in Montana and North Dakota that contain the Bakken shale formation, a site that saw significant growth in oil drilling and production during the study period. Violent victimization in the Bakken region was also

compared with violent victimization in non-Bakken counties that do not contain Bakken shale formation resources or Bakken-related oil production activity.

The information in this report comes from Bureau of Justice Statistics (BJS)-sponsored analysis of data from the Federal Bureau of Investigation's (FBI's) National Incident-Based Reporting System (NIBRS). NIBRS contains detailed data on all crime incidents reported by participating state and local law enforcement agencies. From 2006 to 2012, all law enforcement agencies in Montana, North Dakota, and South Dakota were certified to report their crime incident data to NIBRS. For more information about NIBRS, the offense types analyzed for this report, and about how counties included in the Bakken and non-Bakken regions were determined, see Section 3.

Highlights

Between 2006 and 2012 in the Bakken region of Montana and North Dakota, the following changes occurred:

- The total rate of violent victimization reported to law enforcement increased 23%, whereas it declined 8% in the non-Bakken region.
- Most of the increase in the rate of violent victimization known to law enforcement occurred between 2009 and 2012, increasing 18%, from 102 to 130 victimizations per 10,000.
- The rate of serious violent victimization, consisting of homicide, sexual assault, aggravated assault and robbery, increased 38%, while it declined 4% in the non-Bakken region.
- Rates of violent victimization reported by law enforcement increased for all violent offense types except rape and sexual assault, which declined 3%.
- The rate of aggravated assaults reported to police increased 70%, an increase higher than all other violent crime types.
- The increase in the male violent victimization rate (up 31%) exceeded the increase for female violent victimization (up 18%).
- The female intimate partner violent victimization rate increased 33%, while male intimate partner victimization declined 5%.
- Male victims experienced a slightly higher increase in the rate of aggravated assault victimization (up 72%) than did female victims (up 67%).

2. Background

From 2009 to 2012, the regions of Montana and North Dakota that contain parts of the Bakken shale formation experienced relatively rapid growth in oil and gas production and an influx of new residents to work in oil sector–related jobs. Media reports and interviews conducted by researchers in the Bakken region indicated that this swift socioeconomic change coincided with an increase in the daily number of calls for service to law enforcement, an increase in reports of more serious violent crime, and in particular, an increase in reports of violence against women and intimate partner violence.[1]

BJS sponsored this analysis to examine whether empirical evidence supported media reports and interview findings of increased violence. This report presents estimated annual rates of violent victimization in the Bakken oil-producing region from 2006 to 2012. This period was selected to include years immediately before the oil production boom in the Bakken region—2006 to 2008—and the period during the oil production boom—2009 to 2012. Findings are from crime incident data submitted by NIBRS-participating law enforcement agencies from three states in and around the Bakken region: Montana, North Dakota, and South Dakota. NIBRS compiles incident-based crime data from participating agencies throughout the United States.[2] NIBRS contains detailed information on criminal incidents known to law enforcement, including the demographic characteristics of victims, offenders, and arrestees; the relationship of victims to offenders; the location and timing of incidents; the presence of weapons; and the nature of injuries experienced by victims of violent crime.

The crime incidents recorded in NIBRS were analyzed at local levels of geography, allowing for county- and region-level comparisons of crime trends in and across the states in the Bakken region. BJS examined two questions using these data: (1) whether violent crimes reported to law enforcement in the Bakken oil region increased in frequency and severity after 2008, the point at which the region experienced a precipitous increase in oil production, jobs, and population, and (2) if the rise in violent crimes reported by law enforcement in the Bakken region was part of broader geographic changes in violent crime that extend to non–oil producing counties outside the Bakken region.

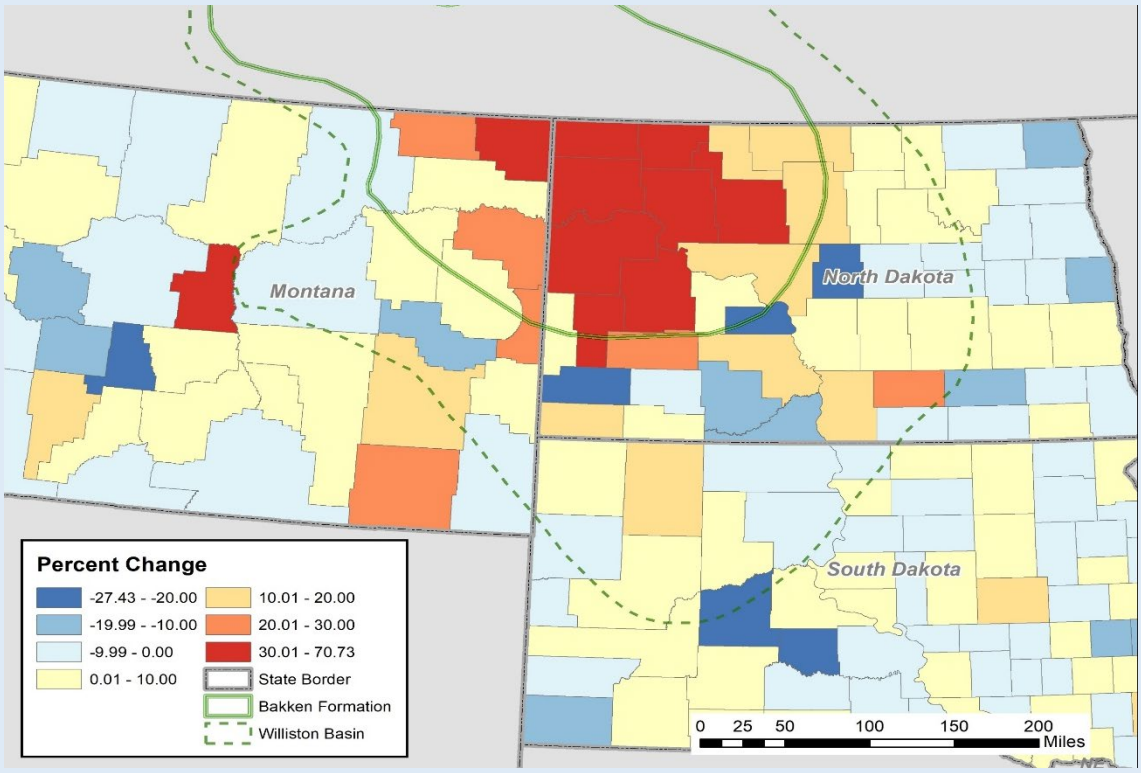
[1] Jayasundara, D. S., Heitkamp, T., Mayzer, R., Legerski, E., & Evanson, T. A. (2016, November). *Exploratory Research on the Impact of the Growing Oil Industry in North Dakota and Montana on Domestic Violence, Dating Violence, Sexual Assault, and Stalking: A Final Summary Overview*. National Institute of Justice, Office of Justice Programs, US Department of Justice. Retrieved from https://www.ncjrs.gov/pdffiles1/nij/grants/250378.pdf

[2] In 2016, 6,849 police organizations submitted NIBRS data to the FBI's Uniform Crime Reporting (UCR) Program, up from 6,115 reporting organizations in 2012. For additional information on agencies that report to NIBRS each year, please refer to the FBI UCR Program Data Collections resource: https://ucr.fbi.gov/ucr-program-data-collections#National.

Socioeconomic change in the Bakken region

The Bakken shale formation underlies portions of eastern Montana and western North Dakota and provides a rich source of oil and natural gas. Most of the counties that comprise the Bakken region are in western North Dakota, and much of the population growth associated with oil production in the Bakken region from 2006 to 2012 occurred in western North Dakota counties. Referred to as a "man rush,"[3] growth in the population of males—particularly young males aged 15 to 29—in the Bakken region was concentrated in eight counties in North Dakota and one county in Montana. The increase in the young male population in those counties ranged from 30% to 70%, far outpacing increases in the young male population in other counties in the states (**figure 2**).

Figure 2. Percent change in male population aged 15 to 29, by county and Bakken region, 2006–2012



Source: U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

In addition to the population growth, the expansion of oil production in the region ushered in a period of significant economic growth. From 2007 to 2011, employment rates in counties in the Bakken region increased 40%, while national employment rates during this period decreased 4%. From 2007 to 2011, the average annual pay for workers in the Bakken counties increased by 53% from $33,040 to $50,553 and exceeded the national average of $48,043.[4]

[3] Krogstad, J. M. (2014). *How North Dakota's "man rush" compares with past population booms*. Pew Research Center. Retrieved from http://www.pewresearch.org/fact-tank/2014/07/16/how-north-dakotas-man-rush-compares-with-past-population-booms/

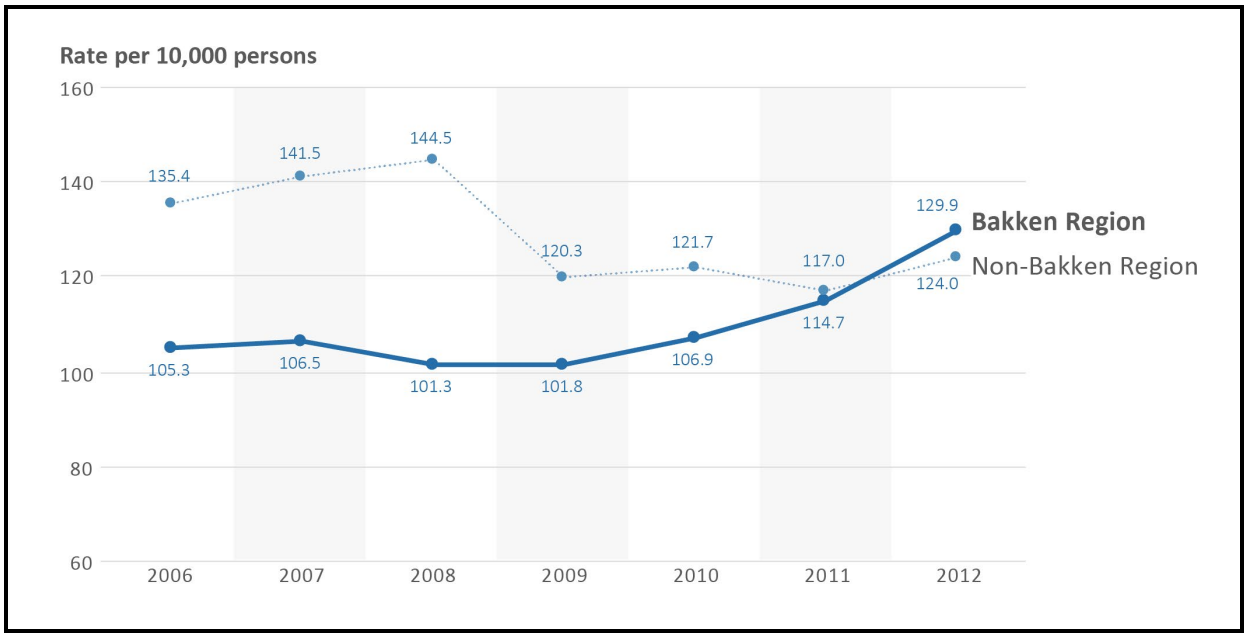
[4] Ferree, P., & Smith, P. W. (2013, April). Employment and wage changes in oil-producing counties in the Bakken Formation, 2007–2011. *Beyond the Numbers*, 2:11. Retrieved from https://www.bls.gov/opub/btn/volume-2/employment-wages-bakken-shale-region.htm

3. Violent Victimization in the Bakken Region—Patterns and Trends

Violent victimizations reported by police in the Bakken region began to increase annually after 2009.

From 2006 to 2009, the violent victimization in the Bakken region was lower than 106 per 10,000 persons (**figure 3**). During 2006 to 2012, the total number of violent victimizations reported by law enforcement in the Bakken region began to increase annually in 2009. Law enforcement agencies reported 107 violent victimizations per 10,000 persons in 2010, up 5% from 2009 (102 per 10,000). In 2012, law enforcement agencies in the Bakken region reported the highest levels of violent victimization during the 2006 to 2012 period—130 per 10,000 persons—up 13% from 2011 (115 per 10,000) and up 27% from 2009 (102 per 10,000).

Figure 3. Rate of violent victimization known to law enforcement, for the Bakken and non-Bakken regions, 2006–2012



Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

The increase in violent victimizations in the Bakken region counties was not part of a broader increase in violent victimizations reported by law enforcement across Montana, North Dakota, and South Dakota. In contrast to the rise in violent victimizations reported by police in the Bakken region, the rate of violent victimization reported by law enforcement in the non-Bakken counties declined 8% from 2006 to 2012, from 135.4 to 124 per 10,000 persons.

From 2006 to 2012, the violent victimization rate in the Bakken region increased for every type of violent offense other than rape and sexual assault (**table 1**). In 2006, the rate of violent victimization was higher in the non-Bakken region (135 per 10,000 persons) than in the Bakken region (105 per 10,000 persons) (**table 1**). By 2012, the rates in the two regions had converged to be nearly equal. Between 2006 and 2012, the rate of violent victimization increased 23% in the Bakken region but decreased 8% in the non-Bakken region.

Assaults accounted for most of the increase in violent victimization in the Bakken region.

Law enforcement agencies in the Bakken region recorded more assaults per capita than any other violent crime type. In 2012, police data indicate 102 assaults per 10,000 persons in the Bakken region, a rate nearly seven times higher than the second most common type of violent victimization involving other violent offenses (15 per 10,000 persons) (**table 1**).[5] Simple assaults, which do not involve weapons or serious injury to the victim, were the most common type of violent crime reported to law enforcement in both regions during this period. During 2006 to 2012, the simple assault victimization rate increased 21% in the Bakken counties and decreased 8% in the non-Bakken counties.

Serious violent victimization increased 38% in the Bakken region.

During the study period, the rate of serious violent crime in the Bakken region increased by 38%, from 22 per 10,000 persons in 2006 to about 31 per 10,000 persons in 2012 (**table 1**). In comparison, the rate of serious violent victimization declined by 4% in the non-Bakken region. The 38% increase in serious violent victimization, which includes the offenses of homicide and non-negligent manslaughter, rape and sexual assault, robbery, and aggravated assault, exceeded the 23% increase in overall violence.

The assault rate increased by 28%; the largest increase was in the aggravated assault rate.

Much of the 38% increase in overall serious violent victimization in the Bakken region during the study period can be attributed to the 70% increase in aggravated assault victimizations known to law enforcement (**table 1**). The increase in the aggravated assault rate was three times higher than the comparable rate for simple assault, which rose by about 21%. The number of aggravated assaults reported to police—assaults that involve the presence of a weapon or intended or actual serious bodily harm to the victim—increased to a rate of 20.3 per 10,000 persons in 2012, up from 11.9 in 2006. In contrast, the aggravated assault victimization rate in the non-Bakken region remained relatively unchanged, decreasing 4% during this period, from 19 to 18 per 10,000 persons.

[5] Other violent offenses consist of kidnapping, abduction, and intimidation.

Table 1. Rate of violent victimization known to law enforcement in the Bakken and non-Bakken regions, by type of crime, 2006–2012

Type of crime	Bakken region Rate per 10,000 persons		Percent change	Non-Bakken region Rate per 10,000 persons		Percent change
	2006	2012	2006–2012	2006	2012	2006–2012
Violent crime	105.3	129.9	23.4	135.4	124.0	−8.4
Offense type						
Homicide; non-negligent manslaughter	0.5*	0.7	65.9	0.2	0.2	−15.0
Rape/sexual assault	9.2	9.0	−2.5	11.7	11.0	−5.4
Unlawful sexual contact[a]	1.7	2.5	44.8	1.7	1.6	−6.7
Robbery	0.7	0.7	−7.7**	1.9	2.0	6.2
Assault	79.4	101.9	28.2	108.3	99.5	−8.1
Aggravated assault	11.9	20.3	70.1	19.3	18.4	−4.4
Simple assault	67.5	81.6	20.8	89.0	81.1	−8.9
Other violent offenses[b]	13.8	15.1	9.7	11.6	9.7	−16.8
Victim-offender relationship						
Domestic violence[c]	42.8	54.3	26.7	54.6	51.4	−5.9
Intimate partner violence[d]	28.5	35.0	22.8	36.9	33.8	−8.3
Stranger violence	8.0	12.2	52.6	9.6	9.4	−2.3
Acquaintance violence	36.1	37.0	2.4	36.6	27.7	−24.2
Serious violent crime[e]	22.3	30.7	38.1	33.1	31.7	−4.2
Victim-offender relationship						
Serious domestic violence	6.1	9.0	47.1	8.2	9.1	11.1
Serious intimate partner violence	3.1	5.0	59.2	3.8	4.7	23.6
Serious stranger violence	2.4	3.5	47.4	3.1	2.9	−6.3
Serious acquaintance violence	8.3	10.6	27.2	10.1	8.2	−19.3

[a]Unlawful sexual contact consists of incest and statutory rape.

[b]Other violent offenses consist of kidnapping, abduction, and intimidation.

[c]Domestic violence consists of violent crimes committed by intimate partners and non-intimate family members.

[d]Intimate partner violence consists of violent crimes committed by current or former spouses, current or former common-law spouses, boyfriends, and girlfriends.

[e]Serious violent crime consists of murder, non-negligent manslaughter, rape, sexual assault, aggravated assault, and robbery.

*Estimate is based on 10 or fewer cases.

**Because of rounding, the robbery rates in 2006 (0.650) and 2012 (0.700) appear identical.

Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

The rate of sexual violence in the Bakken region remained unchanged.

The rate of rape and sexual assault victimization in the Bakken region remained relatively unchanged from 2006 to 2012, at about 9 per 10,000 persons (**table 1**). However, the overall rate of other unlawful sexual contact—the offenses of incest and statutory rape—increased by 45% from 2006 to 2012 (**table 1**). The magnitude of the percentage increase in other unlawful sexual contact during this period (up 45%) is due to the relatively low rate of these crimes compared with other types of violent sex offenses recorded in NIBRS. For example, although the rate of other unlawful sexual contact increased during the study period, the rate of violent sex offenses in 2012 (9.0 per 10,000) was more than four times higher than the comparable rate of other unlawful sexual contact (2.5 per 10,000).

Domestic violence in the Bakken region increased from 2006 to 2012

Victimization rates for males (31%) and females (18%) increased from 2006 to 2012 in the Bakken region. For males, the increase was greatest for rates of family (56%) and stranger (51%) violence (**table 2**).

Females in the Bakken region experienced a 33% increase in the rate of intimate partner violence, while males in the Bakken region experienced a decline in intimate partner violence. Nearly all of the increase in female intimate partner violence occurred between 2009 and 2012, when the rate of intimate partner violence against females rose from 48.2 to 60.4 per 10,000 females. By comparison, the rate of female intimate partner violence declined in the non-Bakken region during this same period.

Table 2. Rate of violent victimization known to law enforcement in the Bakken and non-Bakken regions, by victim sex and victim-offender relationship, 2006–2012

Relationship of victim to	Male victims Rate per 10,000 males			Percent change 2006–2012	Female victims Rate per 10,000 females			Percent change 2006–2012
	2006	2009	2012		2006	2009	2012	
Bakken region								
Total victimization	90.2	85.4	118.0	30.8	118.1	116.8	139.8	18.3
Stranger violence	10.8	7.8	16.3	50.5	5.1	3.7	7.3	44.7
Acquaintance violence	39.1	34.1	42.4	8.5	31.6	28.8	30.3	−4.3
Domestic violence[a]	22.6	23.5	28.3	25.2	63.0	66.8	81.2	29.0
Family violence	11.2	12.4	17.5	56.0	17.5	18.7	20.8	19.2
Intimate partner violence	11.4	11.1	10.8	−5.1	45.5	48.2	60.4	32.8
Other/unknown relationship	17.8	20.0	31.1	74.9	18.5	17.5	20.9	13.4
Non-Bakken region								
Total victimization	115.6	102.6	104.4	−9.7	154.1	136.8	142.4	−7.6
Stranger violence	13.9	11.9	13.2	−5.3	5.2	5.1	5.5	5.3
Acquaintance violence	38.3	31.3	27.8	−27.5	34.4	28.6	27.5	−20.1
Domestic violence	26.2	27.0	27.7	5.9	82.9	74.8	75.2	−9.4
Family violence	13.2	13.8	14.0	6.1	22.2	21.0	21.1	−5.1
Intimate partner violence	13.0	13.1	13.7	5.7	60.7	53.8	54.1	−10.9
Other/unknown relationship	37.2	32.4	35.7	−4.1	31.6	28.4	34.3	8.5

[a]Domestic violence consists of violent crimes committed by intimate partners and non-intimate family members.

Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

4. Characteristics of Violent Victimization in the Bakken Region

From 2006 to 2012, violence committed by strangers increased 53% in the Bakken region.

The magnitude of the increase in violent victimization in the Bakken region varied depending on the relationship of the victim to the offender. During the study period, the overall rate of violent victimization committed by strangers increased by 53% in the Bakken region. Serious stranger violence—murder, rape, sexual assault, aggravated assault, and robbery—increased by 47%. Despite this increase, violence committed by strangers remains less common than domestic violence and acquaintance violence.

The overall rate of domestic violence —violence committed by a family member or an intimate partner—also increased in the Bakken region from 2006 to 2012, rising 27% from 42.8 to 54.3 per 10,000 persons. The increase was higher (up 47%) for serious domestic violence, which consists of homicides, robberies, sexual assaults, and aggravated assaults committed by a family member or intimate partner.

In the non-Bakken counties, the violent victimization rate declined by 8% during the study period. Despite this overall decrease in violence known to law enforcement, the non-Bakken region experienced an increase of 11% in the rate of serious domestic violence and an even larger increase—24%—in serious intimate partner violence from 2006 to 2012.

The rate of violence committed by males increased by 20% to 30% from 2006 to 2012.

The male-on-female violent victimization rate in the Bakken region increased by 19% from 2006 to 2012, and the corresponding rate of male-on-male violent victimization increased by 30% (**table 3**). Nearly all of the increase in the violent victimization rate of males was due to a rise in male-on-male violence, which increased from 82 per 10,000 males in 2006 to 107 per 10,000 males in 2012. There was no similar increase observed in the non-Bakken region, where rates of male-on-male victimization decreased 13% during the same period.

The violent victimization rate of blacks and Native Americans in the Bakken region was approximately 2.5 times higher than the corresponding rate for whites.

In the Bakken and non-Bakken areas, the violent victimization rate was higher for blacks and Native Americans than for whites and Asians across the entire study period (**table 4**). In 2012, the rate of violent victimization for Native Americans in the Bakken region was 294.9 per 10,000 Native Americans; the rate for blacks was 264.8 per 10,000 blacks. Both of those rates were more than 2.5 times higher than the rate for whites—111.5 per 10,000 whites—and more than 4 times higher than the rate for Asians—65.4 per 10,000 Asians.

Table 3. Rate of violent victimization, by region and victim and offender sex, 2006 and 2012

Victim demographic characteristic	Bakken region Rate per 10,000 persons		Percent change	Non-Bakken region Rate per 10,000 persons		Percent change
	2006	2012	2006–2012	2006	2012	2006–2012
Total	105.3	129.9	23.4	135.4	124.0	−8.4
Sex						
Male victimization	90.2	118.0	30.8	115.6	104.4	−9.7
By male offender	82.3	106.9	29.8	96.7	83.8	−13.4
By female offender	26.2	27.3	3.9	30.2	31.6	4.8
Female victimization	118.1	139.8	18.3	154.1	142.4	−7.6
By female offender	33.8	33.8	0.1	39.0	38.2	−2.2
By male offender	95.7	114.2	19.4	120.0	111.3	−7.3

Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

Table 4. Rate of violent victimization, by region and victim demographic characteristics, 2006 and 2012

Victim demographic characteristic	Bakken region Rate per 10,000 persons		Percent change	Non-Bakken region Rate per 10,000 persons		Percent change
	2006	2012	2006–2012	2006	2012	2006–2012
Total	105.3	129.9	23.4	135.4	124.0	−8.4
Race						
White	89.6	111.5	24.4	113.9	102.3	−10.1
Black	241.2	264.8	9.8	501.9	359.3	−28.4
Native American	238.7	294.9	23.5	344.1	305.9	−11.1
Asian	26.5*	65.4	147.2*	50.1	58.3	16.4
Age						
Younger than 5	43.5	41.8	−4.0	39.9	45.3	13.6
5–9	61.3	74.0	20.7	64.2	57.8	−9.9
10–14	105.3	138.6	31.6	143.4	124.1	−13.5
15–19	214.4	201.3	−6.1	270.5	223.7	−17.3
20–24	242.6	260.5	7.4	290.2	263.4	−9.2
25–34	197.1	243.5	23.6	256.7	244.6	−4.7
35–49	110.2	172.7	56.7	140.4	153.4	9.2
50–64	30.7	51.5	67.7	43.4	50.2	15.5
65 or older	6.2	9.1	45.2	9.2	11.6	26.8

*Estimate is based on 10 or fewer cases.
Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006−2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

In the Bakken, whites and Native Americans experienced a 24% increase from 2006 to 2012 in their rate of violent victimization. Although the victimization rate for Asian people was the lowest compared with other races, the rate of violence against Asians increased more than any other group, from 26 to 65 per 10,000 Asians, up 147% across the study period. In the non-Bakken region, the rate of violent victimization known to law enforcement declined for whites (−10%), blacks (−28%), and Native Americans (−11%) during this period.

Adults aged 35 to 64 experienced the greatest increase in violent victimization.

Adults aged 20 to 34 in the Bakken region had the highest rate of violent victimization during 2006 to 2012 (**table 4**). Adults aged 35 or older had relatively lower rates of violent victimization overall, but they experienced the largest increase in violent victimization compared with other age groups. In the non-Bakken region, people aged 35 or older also experienced an increase in violence, but the increase was of a lower magnitude than in the Bakken.

Children aged 5 to 14 experienced an increase in violent victimization in the Bakken region and a decrease in violence outside the region during this same period. In contrast, violent victimization against juveniles aged 15 to 19 declined in the Bakken region (−6%) and outside of the Bakken region (−17%).

Aggravated assaults accounted for the increase in male violent victimization in the Bakken region.

By 2012, the violent victimization rate for males (118 per 10,000) was 30% higher than in 2006 (90.2 per 10,000 males) (**table 5**). The increase was driven primarily by an increase in assaults against males, up 33% during the study period. Aggravated assaults against males increased by 72% from 2006 to 2012, while simple assaults increased by 23%. The rate of male victimization from violent crimes involving weapons that resulted in injury increased by 24%, rising from 50.6 to 62.5 per 10,000 males from 2006 to 2012.

After remaining stable from 2006 to 2009, the rate of male victimizations that involved injury to the victim increased by nearly 30% between 2009 (56 per 10,000 males) and 2012 (73 per 10,000 males). After a period of decline from 2006 to 2009, the rate of male firearm victimizations more than doubled (from 1.4 to 3.3) from 2009 to 2012.

Table 5. Male violent victimization rate in the Bakken region, by type of crime, 2006–2012

Type of crime	Rate per 10,000 males			Percent change 2006–2012
	2006	2009	2012	
Violent crime	90.2	85.4	118.0	30.8
Homicide and non-negligent manslaughter	0.4*	0.3*	1.2	161.3
Rape/sexual assault	3.0	2.0	3.1	5.0
Unlawful sexual contact[a]	0.4*	0.3*	0.4*	1.0
Robbery	0.7*	0.8	1.0	32.5
Assault	73.4	75.1	97.3	32.5
Aggravated assault	14.7	15.8	25.4	72.4
Simple assault	58.7	59.3	71.9	22.5
Other violent offenses[b]	12.3	6.9	15.1	22.7
Violent crime involving weapons	78.0	69.4	98.6	26.4
Firearm violence	2.8	1.4	3.3	17.0
Violence involving weapons that resulted in victim injury	50.6	48.8	62.5	23.5

[a]Unlawful sexual contact consists of incest and statutory rape.
[b]Other violent offenses include kidnapping, abduction, and intimidation.
*Estimate is based on 10 or fewer cases.
Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006—2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

Female violent victimization in the Bakken region declined for all violent crime types except assault.

In 2012, the female violent victimization rate in the Bakken region was 139.8 per 10,000 females, an 18% increase from the rate of 118.1 per 10,000 females in 2006 (**table 6**). The increase in the overall rate of female violent victimization was due primarily to a rise in assaults reported to police, which increased 24% between 2006 (84 per 10,000) and 2012 (104 per 10,000). Females in the Bakken region were more likely to experience simple assault than aggravated assault. In 2012, the simple assault rate for females—89.8 per 10,000—was six times higher than the aggravated assault rate for females—14.6 per 10,000. However, similar to the trend for males, females experienced an increase in the aggravated assault rate (67%) that was three times greater than the increase in simple assault (20%) (**table 6**). Females in the Bakken region also experienced a 54% increase in their rate of other unlawful sexual contact during the study period, which was due to a rise in reports of statutory rape.

Table 6. Female violent victimization rate in the Bakken region, by type of crime, 2006–2012

Type of crime	Rate per 10,000 females			Percent change 2006–2012
	2006	2009	2012	
Bakken region				
Violent crime	118.1	116.8	139.8	18.3
Homicide, non-negligent manslaughter	0.5*	0.4*	0.3*	−30.7
Rape/sexual assault	15.5	14.7	15.2	−2.0
Unlawful sexual contact[a]	3.0	3.6	4.7	53.9
Robbery	0.6*	0.5*	0.4*	−26.4
Assault	83.9	85.3	104.4	24.4
Aggravated assault	8.7	11.8	14.6	67.3
Simple assault	75.2	73.5	89.8	19.5
Other violent offenses[b]	14.6	12.2	14.8	0.9
Violent crime involving weapons	96.7	93.1	113.3	17.2
Firearm violence	1.8	1.3	1.3	−26.6
Violence involving weapons that resulted in victim injury	60.8	59.0	72.2	18.7

[a]Unlawful sexual contact consists of incest and statutory rape.

[b]Other violent offenses include kidnapping, abduction, and intimidation.
*Estimate based on 10 or fewer cases.
Source: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

Females in the Bakken region experienced reductions in the rate at which they experienced homicide, rape and sexual assault, and robbery from 2006 to 2012. The rate of other violent offenses against females, a category which includes kidnapping and intimidation, remained relatively unchanged during this period.

Males and females experienced a significant increase in rates of violent victimization involving weapons that resulted in injuries to the victim, although the increase was slightly greater for males (24%) than for females (19%) (**tables 5** and **6**). Similar to males, the females' rate of violence involving weapons also increased from 2006 to 2012, although the magnitude of the increase (17%) was smaller than the increase for male victims (26%) (**tables 5** and **6**).

5. Methodology

5.1 NIBRS coverage

The FBI's NIBRS is a data collection system that compiles data on all crime incidents reported by participating state and local law enforcement agencies. The system was designed to capture detailed information on each incident known to law enforcement for 52 specific crime types in 24 major offense categories. In addition to capturing information on a wide variety of different crime types, the data also include details about the incident, such as victim and offender demographics, date and time of the incident, location where the incident occurred, type of weapon involved, whether the victim was injured, relationship of the victim to the offender, and whether the incident resulted in an arrest or other type of clearance.

Participation by law enforcement in NIBRS is voluntary and requires certification by the FBI. In 2016, approximately 6,900 law enforcement agencies across 32 states contributed data to NIBRS. These agencies represented 37% of all police departments reporting crime statistics to the FBI. In 2012, BJS, in collaboration with the FBI and other Department of Justice agencies, launched the National Crime Statistics Exchange (NCS-X), an effort to expand the number of law enforcement agencies reporting crime data to NIBRS. The goal of NCS-X is to build a statistical system that can generate detailed national estimates of the volume and characteristics of crimes known to law enforcement based on the detailed incident-based data reported to NIBRS. Additional information about the history and coverage of NIBRS can be found at https://ucr.fbi.gov/nibrs-overview.

5.2 Unit non-response and items missing in NIBRS

This report examines trends from 2006 to 2012 in rates of violent crime in Montana, North Dakota, and South Dakota. Each of these states are classified as "full reporter states," meaning that all the crime reporting agencies in those states are certified to report their crime data to NIBRS. However, not all agencies in these full reporter states reported crime data to NIBRS in every year of the study period; some agencies did not report any data for some years. The study first examined the number and type of agencies reporting to NIBRS for each year from 2006 to 2012. This preliminary assessment revealed that most NIBRS reporting agencies are at the city and county levels. State police and special jurisdiction agencies (e.g., university, special agencies, and other state agencies) did not often report to NIBRS, and no federal or tribal agencies reported to NIBRS in the states in this study.

Estimating the volume of missing crime from state, special jurisdiction, and tribal agencies required an examination of the proportion of violent and property crime reported by NIBRS

agencies in the state relative to all agencies in the three states in this study.[6] To make this determination, analysts used data from the FBI's Summary Reporting System (SRS), a data source that collects aggregate crime data from nearly all agencies in the study states. Overall, state and special jurisdiction agencies contributed a small fraction of violent and property crimes to the SRS, less than 1% each of property and violent crime per year from 2006 to 2012. Given that these types of agencies accounted for a small proportion of reported crime in the states, data reported by state agencies and special jurisdictions were excluded from the analysis.

Tribal agencies accounted for a relatively larger proportion of crime reported to the SRS compared with state and special jurisdiction agencies. This was particularly true for violent crimes; for instance, in 2009, more than 15% of the violent crimes reported in the SRS in the study states were reported by tribal agencies. However, because tribal agencies do not report any incident-based data to NIBRS, it was not possible to include crime reported to tribal agencies in this report. Many tribes are in these three states, and the lack of incident data from tribal agencies is a weakness of NIBRS as a data source for studying victimization in the Bakken region.

5.2.1 Measuring the rate and pattern of non-response

Non-response in NIBRS is hierarchical in nature; data can be missing at the unit and item levels. There is unit non-response at the agency level such that some agencies do not report to NIBRS at all in a given year, and others report for a partial year (e.g., 4 months). The NIBRS response rate was defined as the percentage of "active" agencies in a given year that also reported to NIBRS at least 6 months in a given year. "Active" was defined as those agencies that were identified by the FBI as eligible to report crime data (regardless of whether they contributed data) and were not covered by another agency for crime data reporting purposes. In Montana and North Dakota, the state program managers responsible for overseeing crime reporting in the state provided information on agencies that were classified as inactive (e.g., disbanded, consolidated with another agency) or covered by another agency. Similar state-specific information was not provided for South Dakota; therefore, the study relied on information contained in the SRS.

During the study period, the total percentage of agencies that reported at least 6 months of data to NIBRS each year increased from about 71% in 2006 to 86% in 2012 (**table 7**).

[6] Throughout this report, NIBRS agencies are defined as law enforcement agencies that reported at least 6 months of data to NIBRS for each year of the 2006–2012 period.

Table 7. Number of agencies reporting 6 or more months of incident data to NIBRS

UCR-participating agencies	2006	2007	2008	2009	2010	2011	2012
Active agencies	360	361	362	362	359	352	353
NIBRS agencies	254	280	285	293	301	299	305
Response rate*	70.5%	77.6%	78.7%	80.9%	83.8%	84.9%	86.4%

Note: Includes agencies in Montana, North Dakota, and South Dakota.

*The response rate is calculated as the number of agencies reporting 6 or more months of data to NIBRS divided by the total number of Uniform Crime Reporting Program–participating law enforcement agencies.

Source: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System and the FBI's Uniform Crime Reporting System, 2006–2012.

It was relatively uncommon for a crime incident to be missing information about victim demographics (e.g., sex, race, age). Other variables, such as the circumstance of homicides and aggravated assaults, and Hispanic origin of victims and offenders, were missing in relatively high proportions and for reasons that were not random, such that those variables were excluded from the study.

To optimize the information collected through NIBRS in our descriptive analysis, this study developed a statistical procedure to impute missing values for key variables. Given the hierarchical structure of NIBRS, an imputation method was developed to treat data missingness occurring at two difference levels: (1) victim level, due to item missingness in each incident, and (2) agency level, due to unit non-response by some agencies. Data from NIBRS, along with other external data sources, were used in the imputation and estimation procedures. The external data sources used to develop the imputation procedures include (1) FBI SRS data, (2) FBI Law Enforcement Officers Killed and Assaulted (LEOKA) data, (3) BJS's Law Enforcement Agency Identifiers Crosswalk (LEAIC) data, and (4) annual population estimates from the U.S. Census Bureau. To evaluate the impact of the statistical imputation on the final estimates, imputation sensitivity analysis was performed by comparing the violent victimization rates at the state-region level based on the imputed data with their counterparts that are based on the unimputed data (**table 8**).

Table 8. Imputation sensitivity analysis: Violent victimization, by state and region, and by imputation strategy, 2006–2012

	Violent victimization rate, per 10,000 residents							
State	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Percent change 2006–2012**
Montana								
Total								
Imputed	134.6	140.5	130.1	124.2	120.8	110.3	119.9	−10.9
Not imputed[a]	116.8	125.1	114.2	112.6	108.6	99.4	109.3	−6.4
Bakken								
Imputed	167.8	157.0	155.7	146.6	143.9	148.7	183.5	9.3
Not imputed[a]	90.0	92.7	109.4	127.4	119.4	121.9	155.5	72.9
Non-Bakken								
Imputed	132.4	139.4	128.4	122.7	119.2	107.7	115.6	−12.7
Not imputed[a]	118.6	127.3	114.5	111.6	107.8	97.9	106.2	−10.5
North Dakota								
Total								
Imputed	112.9	115.2	115.6	119.8	118.1	118.3	126.0	11.6
Not imputed[a]	102.9	104.3	108.9	112.5	113.5	113.2	121.8	18.4
Bakken								
Imputed	85.7	90.7	84.5	88.0	95.6	104.7	114.3	33.3
Not imputed[a]	68.0	70.8	77.0	79.2	88.4	97.7	109.8	61.4
Non-Bakken								
Imputed	124.3	125.5	128.7	133.4	127.8	124.4	131.3	5.6
Not imputed[a]	117.5	118.4	122.3	126.7	124.3	120.0	127.2	8.3

[a] Non-imputed rates are smaller than imputed rates because imputed values were added to the numerator when calculating the total number of victimizations, while the denominator (i.e., census population size) remained the same.

Sources: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012; and U.S. Census Bureau, Annual Population Estimates Program, 2006–2012.

5.3 Adjustments for non-response

5.3.1 Imputation at the victim level

Item missingness at the victim level can be quite variable. For example, general victim demographic variables had high response rates with less than 5% missing, such as age, sex, and race, whereas other variables, such as gang involvement, have lower response rates. For at least 5% of the victimizations analyzed in this study, information was missing for three variables: (1) presence of a weapon during the incident, (2) whether the victim

sustained an injury, and (3) the relationship of the victim to the offender. A hot deck imputation procedure was employed using matching variables to identify a donor for each missing value (see Ford[7] for more details on the hot deck imputation procedure).

Choices of matching variables were based primarily on the strength of their association with the variables to be imputed. To assess these correlations, all the external data sources were merged to the NIBRS data at the victim level. Next, a list of candidate variables were identified that might be correlated with the three variables to be imputed. Included were some incident-specific variables, such as offense type, characteristics of the victim(s) and offender(s), and the location and time period of the incident. Also considered were some agency-specific variables, such as agency type and the total number of officers in the agency. For each categorical variable in this list, two-way frequency tables were generated to examine the relationship between the candidate variable and each of the three variables to be imputed. For each continuous variable on this list, scatter plots were produced to examine the relationship between the candidate variable and each of the three variables to be imputed. Scatter plots, rather than regression models, were used in case of outliers or the existence of a nonlinear relationship. If the analysis revealed that a variable did not have a moderate to strong relationship with any of the three variables to be imputed, that variable was dropped from the list of potential matching variables. To narrow the list of potential matching variables to identify donor cases, regression models were then applied to select the matching variables most correlated with the three variables to be imputed. Note that the number of matching variables to be used was limited in order to ensure an adequate number of donors in each of the donor groups.

Using a hot deck imputation procedure, the selected matching variables were ordered from most important to least important, denoted as "x(*1)*, x(*2)*… x(*m-2),* x(*m-1),* x(*m)*," such that x(*1)* is the most important matching variable and x(*m)* is the least important. A group defined by these matching variables must meet two criteria to be eligible as a donor group: (1) the number of donors in the group must be equal to or greater than 10, and (2) the number of donors in the group must be larger than the number of donees (i.e., cases with missing data) in the same group. The use of these two criteria provided some confidence that the imputation procedure was random and that a donor would not be used repeatedly for a considerable number of donees. If a donor group failed one or two of these criteria, the donor group's neighboring groups were combined to form a larger group defined by the variable "x(*1)*, x(*2)*… x(*m-2),* x(*m-1)*." If the larger group still failed one of the two donor group criteria, the next level of neighboring groups were combined into an even larger group until the resulting group met both specified criteria. For example, for victim-offender relationship, 3,921 groups were defined by the matching variables and 343 donor groups

[7] Ford, B. M. (1983). An overview of hot deck procedures. In *Incomplete Data in Sample Surveys*, vol. 2, pp. 185–207. New York: Academic Press.

remained after the collapsing of donor groups. Once the donor groups were all defined, a donor was randomly drawn and its value assigned to a donee. This procedure was completed through PROC IMPUTE in SUDAAN 11.[8] Matching variables used to define donor groups for each variable to be imputed were listed in **table 9** in the order in which they were entered into the imputation procedure.

Table 9. Matching variables used to define donor groups for each variable to be imputed in the order in which they were entered into the imputation procedure

Ordered matching variable	Variable to be imputed		
	Weapon	**Injury**	**Victim-offender relationship**
x(1)	Year of oil boom onset	Year of oil boom onset	Year of oil boom onset
x(2)	State (1=MT, 2=ND/SD)	State (1=MT, 2=ND/SD)	State (1=MT, 2=ND/SD)
x(3)	Victim's age	Victim's age	Type of victim (1=individual; 2=police officer)
x(4)	Victim's race	Victim's race	Victim's age
x(5)	Offender's age	Offender's age	Victim's race
x(6)	Offender's race	Offender's race	Offender's age
x(7)	Victim's gender	Victim's gender	Offender's race
x(8)	Offender's gender	Offender's gender	Victim's gender
x(9)	Victim's ethnicity	Victim's ethnicity	Offender's gender
x(10)	—	—	Victim's ethnicity

Source: Bureau of Justice Statistics analysis of data from the FBI's National Incident-Based Reporting System, 2006–2012

5.3.2 Imputation at the agency level

Some agencies did not report data for the full year or did not report at all during the year. To address this unit non-response, the study aggregated the NIBRS data at the agency level by month (referred to as "monthly agency level"). To generate aggregate victimization information at the monthly agency level, a series of monthly agency level count variables were constructed, including the total number of violent victimizations, the total number of victimizations of females, and the total number of victimizations where a weapon was present. The count variables were used to calculate the overall yearly crime rates and yearly rates for male and female victims separately. These data were then merged with all the external data sources. In addition, SRS, LEOKA, and LEAIC data were used to fill out a

[8] RTI International. (2012). *SUDAAN® language manual, volumes 1 and 2, release 11.0.0*. Research Triangle Park, NC: RTI International.

complete list of all crime data reporting agencies[9] in Montana, North Dakota, and South Dakota from 2006 to 2012. If an agency on the list was not listed in the NIBRS data at the agency level, the agency was considered missing.

The first step in imputing missing crime counts at the monthly agency level was to distinguish the agencies that had no crime to report that month ("truly zero") from agencies that did not report crime that month although reportable crime did occur ("truly missing"). If an agency's aggregated NIBRS count variables were missing in a particular month, but the agency reported a monthly crime count of zero, this study assigned all its crime counts as zero for that month. After this step, if an agency was still missing crime counts, it was considered truly missing and imputed through the hot deck imputation procedure using matching variables to identify a donor agency.

The method used to select matching variables for donor imputation at the monthly agency level was similar to the method used at the victim level. A list of candidate variables were first identified and their relationships with the total number of violent and property victimizations in NIBRS at the monthly agency level were examined. Because a small number of agencies did not report to NIBRS but reported crime counts to the SRS, the relationship between the candidate variables and the monthly crime counts in SRS were also examined. The candidate variables most highly correlated with the SRS monthly crime counts and the total number of violent and property victimizations in NIBRS were used as matching variables.

The hot deck imputation procedure at the monthly agency level was also similar to the procedure used at the victim level. Matching variables were ordered from the most important to the least important, and small groups were collapsed to make a donor group of adequate size. However, the criteria used to collapse the donor groups were slightly different for the monthly agency imputation compared with the method used for the victim-level imputations. The first criterion specified that the number of donors in the group must be equal to or greater than 10. The second criterion specified that the number of donors in the group must be greater than 25% of the total number of cases including donors and donees. This criterion is slightly different than the criterion used in the imputation procedure at the victim level described previously. The requirement was relaxed here so that some of the key matching variables can be reserved in the definition of the donor groups, such as Bakken versus non-Bakken region, state, and agency type.

Use of these criteria yielded 144 groups defined by the matching variables and 65 donor groups after group merging. Once the donor groups were defined, a donor agency was randomly drawn from each donor group, and the entire series of NIBRS count values from

[9] This list was shared with the state UCR Program managers responsible for managing crime data submissions, to ensure that agencies that had been disbanded, consolidated, or covered by another agency were not mistakenly classified as non-response agencies.

this donor agency was assigned to a donee in the same group. The monthly crime counts reported to SRS were combined with NIBRS data to identify a group of matching variables at the monthly agency level that were moderately correlated with the observed crime counts, such that the p value of the chi-square test was smaller than 0.10. The matching variables used for imputation at the monthly agency level, in order of use, were boom period onset, state (Montana, North Dakota, or South Dakota), metropolitan statistical area indicator, agency type, population size, and number of full-time sworn officers.

5.4 Variance estimation procedure

5.4.1 Multiple imputation for variance estimation

This study employed a multiple imputation procedure[10] to compensate and estimate for the uncertainties introduced by imputation. First, missing data at the victim level were imputed five times, which generated five separate imputed datasets. Second, five monthly agency-level datasets were created by aggregating each of the five imputed victim-level datasets, then the missing data in each of the five monthly agency-level files were imputed five times. Overall, the imputation procedure created 25 unique datasets at the monthly agency level.

For each outcome variable (e.g., total crime count), the final imputed estimate consisted of the mean value of the 25 imputed estimates for a given variable,

$$\bar{\theta} = \frac{1}{25}\sum_{i=1}^{5}\sum_{j=1}^{5}\hat{\theta}_{i(j)},$$

where *i* represents the *i*th imputed dataset at the victim level, *i(j)* represents the *j*th imputed dataset at the monthly agency level with the *i*th imputed dataset at the victim level, $\hat{\theta}_{i(j)}$ is the estimate derived from the *i(j)*th imputed dataset, and $\bar{\theta}$ is the final estimate.

With this multiple imputation method, the total variance estimator for the 25 imputed datasets can be expressed as

$$T = \bar{U} + \left(1 + \frac{1}{25}\right) B,$$

where $\bar{U}$ is the average of the variances estimated for each of the 25 imputed datasets ("within imputation" component) and $B = (25-1)^{-1}\sum_{i=1}^{5}\sum_{i=1}^{5}(\hat{\theta}_{i(j)} - \bar{\theta})^2$, which is the variance estimated from across the 25 imputed datasets ("across imputation" component). From the design-based perspective, the imputed variance in each imputed dataset is equal to zero, because the NIBRS data used in this study were from a population, rather than a probability sample of the population. Therefore, we have $\bar{U} = 0$, and the total variance estimator based on the 25 imputed datasets in our case can be simplified as

[10] Rubin, D. B. (1987). Multiple imputation for nonresponse in surveys. New York: Wiley.

$$T = \left(1 + \frac{1}{25}\right) B,$$

where

$$B = (25 - 1)^{-1} \sum_{i=1}^{5} \sum_{j=1}^{5} (\hat{\theta}_{i(j)} - \bar{\theta})^2.$$

5.4.2 Standard error computations and statistical significance of differences

The observed difference between estimates was evaluated for statistical significance. When comparing the crime rate estimates in this study, the null hypothesis—that there was no difference between the two estimates—was tested against the alternative hypothesis—that there was a difference between the two estimates—using the standard *t* test, with the appropriate degrees of freedom, for the difference in proportions test, expressed as

$$t_{df} = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{var(\bar{p}_1) + var(\bar{p}_2)}},$$

where *df* = the appropriate degrees of freedom, = the first crime rate estimate, $\hat{p}_1$ = the $\hat{p}_2$ second crime rate estimate, $\text{var}(\hat{p}_1)$ = the variance of the first crime rate estimate $\text{var}(\hat{p}_1)$ and $\text{var}(\hat{p}_2)$ = the variance of the second crime rate estimate. Because the imputation procedures were performed separately for the two estimates at the victim level, the covariance between $\text{var}(\hat{p}_2)$ and $\hat{p}_1$ is considered to be equal to 0 and thus $\hat{p}_2$ not included in the aforementioned formula.