The relationship of police-reported intimate partner violence during pregnancy and maternal and neonatal health outcomes

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Abstract

The relationship of police-reported intimate partner violence during pregnancy and maternal and neonatal health outcomes

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Background

Intimate partner violence (IPV) is a significant public health problem of particular concern during pregnancy. Adverse maternal and neonatal health outcomes may be associated with IPV although studies to date have been inconsistent. This study employed a novel approach to identify IPV exposure with the use of police records.

Methods

This is a retrospective cohort study of women reporting IPV during pregnancy from 1995 through 1998. Police records and Washington State birth and hospitalization files were linked and police records were abstracted to examine the relationship between IPV and maternal and neonatal outcomes. A new reference for small-for-gestational-age (SGA) infants was also developed. Unconditional logistic regression was used in bivariate and multivariate analyses to calculate odds ratios (OR) and 95% confidence intervals (CI).

Results

Women reporting any IPV were significantly more likely than women who did not report IPV to have a low birth weight (LBW) infant (adjusted OR [aOR] 1.70, CI 1.20, 2.40), a very LBW infant (aOR 2.54, CI 1.32, 4.91), a preterm birth (PTB) (aOR 1.61, CI 1.14, 2.28), a very PTB (aOR 2.90, CI 1.38, 6.12), and a neonatal death (aOR 3.18, CI 1.32, 7.63). Women reporting physical IPV also had a significantly greater risk of LBW, very LBW, and very PTB. Neonatal death was associated with both physical and nonphysical IPV. Only very LBW and very PTB were significantly associated with moderate physical IPV. Hospitalization during pregnancy was strongly associated with any IPV (aOR 2.39, CI 1.77, 3.24), particularly with substance abuse and mental health-related diagnoses. Premature rupture of membranes and abruptio placenta were associated with nonphysical IPV and moderate physical IPV.

Conclusions

IPV during pregnancy is significantly associated with adverse maternal and neonatal health outcomes. The findings in this study point to the critical need to identify pregnancy and provide health information and referrals to women at the time of an IPV incident and during subsequent contact with community service and domestic violence programs. These findings may also serve to better inform the legal and justice systems of the potential impact of IPV on the health of pregnant women and their offspring.

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Dedication

To my children, Nicholas and Sancia

and

To the women whose lives have been affected by violence

Chapter One

Small-for-Gestational Age: The Development of a Washington State Reference

Background

Infants born small for their gestational age are at increased risk for subsequent morbidity and mortality. Preterm, low birth weight infants and term infants at or below the third percentile of weight for gestational age may be the most vulnerable to adverse neonatal outcomes.[1] Although the long-term effects of fetal growth restriction remain uncertain, particularly regarding developmental delays and cognitive impairment, there is evidence to suggest that long-term functional outcomes may also be adversely affected in those born on the extreme end of the small-for-gestational age range (less than the third or fifth percentile of weight for gestational age).[2, 3] Standardized small-for-gestational age (SGA) reference curves have been developed primarily to assist health care providers in identifying at-risk infants. SGA standards also facilitate the identification of risk factors in public health research, which ultimately contributes to the development and promotion of appropriate public health interventions.

Numerous reference curves have been developed in the United States as well as internationally. The definition of SGA (variously defined in the medical and public health literature as less than or equal to the third, fifth or tenth percentile of birth weight for a given gestational age), sources of data, types of populations or samples upon which references are based, and methodologies vary widely even among U.S. references.[4] Consequently, controversies over these issues have arisen; in particular, which infants should be included in a population to define the reference (e.g. all infants or low risk infants) and whether specific groups (e.g. race/ethnicity) should be evaluated with separate references.

The more commonly used growth references for the U.S. have originated from the Denver data reported by Lubchenco, et al.[5] and, subsequently, the California data generated by Williams, et al.[6] The Denver reference was based on detailed clinical records from a low socioeconomic status population residing in an area of mile-high altitude. The population-based California reference was derived from statewide birth certificate data comprised of over two million births. These references were based, though, on studies conducted several decades ago. Alexander, et al. constructed a more recent reference based on the 1994-1996 U.S. population.[7] This reference drew upon data from the U.S. Natality files with a very large sample size (nearly 10 million births).

This paper presents a new population-based reference developed to update previous references and to provide a reference that more accurately represents the Washington State population. The new reference is compared to both the California and U.S. based references to determine whether a current, regional reference would identify a comparable or dissimilar proportion of SGA infants in Washington State.

Methods

Washington State birth certificate files for the years 1989-1998, provided by the Washington State Department of Health through the University of Washington, were used as the data source to develop the 3rd, 10th, 50th, and 90th percentiles. All singleton live births by Washington State residents were included (N=774, 974). Data preparation and analyses were performed with Stata 6.0 (Stata Corporation, College Station, TX, USA).

Gestational age in completed weeks was calculated as the interval from the last menstrual period (LMP) to birth. Day 15 was imputed if only day of LMP was missing; 9.9% of LMP data required imputation. After this imputation, gestational age data were available for 681,555 (88%) of all records. Gestational ages less than 20 weeks and greater than 44 weeks, 2.9% (n=22,191) of all recorded ages, were excluded from the analysis. Gestational age less than 20 weeks was considered be a non-viable live birth or represented inaccurate data; ages greater than 44 weeks were considered inaccurate data. Gestational age data were available for 85.1% of all records after these exclusions. Birth weight was available for 773,276 (99.8%) of all records. Records with birth weight greater than 7999 grams, 0.2% of all recorded birth weights, were excluded as implausible birth weights. A total of 99.6% of all records with birth weight data remained. The resulting sample sizes with valid data after gestational age and birth weight exclusions were 337,256 and 321,274 for males and females, respectively; this represents 85% of the original data.

In the next stage of data preparation, histograms of gestational age for male and female infants of all race/ethnicities were constructed for each 125-gram birth weight interval in order to screen for inconsistent birth weight for gestational age. An obstetrician (Thomas Easterling, M.D., Seattle, WA) reviewed each birth weight interval distribution for male infants to exclude gestational ages that were clinically implausible. For example, in the birth weight interval 500 to 624 grams, gestational ages greater than 32 weeks were excluded as implausible gestational lengths for that birth weight interval. Correcting gestational age rather than birth weight was employed as gestational age data have been shown to be less reliable than birth weight data on birth certificates.[8-11] The same exclusion criteria were applied to the data for female infants. This screening process excluded less than one percent of the original valid data. The remaining subjects used to calculate the 3rd, 10th, 50th, and 90th percentiles for each infant sex included 335,132 males and 319,547 females, 84.5% of the original data. The mean and standard deviation (SD) were then calculated for gestational age for males and females to allow calculation of z scores in addition to percentiles, where

$$z = \frac{\text{observed birth weight} - \text{mean birth weight}}{\text{SD}}$$ [12]

To compare percentiles to other references, the 3rd, 10th, 50th, and 90th percentiles for all births were also calculated using the same criteria as that of the male and female infants.

In the final phase of data preparation, a smoothing technique (Cleveland's lowess running line smoother, a robust locally weighted regression)[13, 14] was applied to each centile curve to 'smooth' or lessen the variation of each point and interpolate between each point in the data across gestational age.

Results

The racial/ethnic distribution of the final dataset consisted of 78.1% births to white mothers, 9.1% Hispanic, 4.5% Asian, 3.6% black, 2.1% Native American, 1.2% Pacific

Islander, 0.03% other race, and 1.4% unknown or refused. Males composed 51.2% and females 48.8% of these births.

The Washington State 3^{rd}, 10^{th}, 50^{th}, and 90^{th} raw centile curves (based on data prior to exclusions and corrections) are presented with the final (corrected and smoothed) centile curves for all infants in Figure 1.1. The main discrepancy between the two sets of data occurs with preterm births in the 90^{th} percentile. This is likely the result of inaccurate and/or underestimated gestational ages.

Figures 1.2 and 1.3 illustrate the final centile curves for males and females separately; the tabulated data, along with the means and SDs, are presented in Tables 1.1 and 1.2. Birth weights of male infants are consistently higher than female infants for each gestational age with few exceptions. This weight differential is most notable (≥100 grams) in the 10^{th} percentile beginning at week 34 and in the 3^{rd} and 50^{th} percentiles in term births (≥37 weeks). The 90^{th} percentile varied to a greater extent with a difference of ≥100 grams in weeks 26 through 28 and again at or near term.

Figure 1.4 compares the Washington State final 10^{th} percentile curve for all singleton births to those generated by the 1970-1976 California[6] and the 1994-1996 U.S. data[7]; the tabulated data are presented in Table 1.3. The Washington data most closely approximate the U.S. data, although the Washington birth weights for postterm infants (≥42 weeks) are about 60 to 75 grams higher. The California data consistently had the lowest centiles across gestational age except in weeks 43 and 44.

The Washington State final 10^{th}, 50^{th}, and 90^{th} centile curves for all births are compared to those generated by the U.S. data in Figure 1.5. The 10^{th} and 50^{th} percentile curves are comparable but the 90^{th} percentile curves diverge substantially. This is particularly evident in weeks 27 through 34, in which the U.S. birth weights exceed those of Washington by approximately 120 to 470 grams.

In applying the Washington State reference for all singleton births combined to singleton live births in Washington State for the years 1989 to 1998, 55,217 (8.4%) of the 654,679 births used to calculate the standard would be classified as SGA using $<10^{th}$ percentile as the definition. [Note: the percent identified as SGA does not approximate 10% due to data smoothing as described in the Methods section; using unsmoothed data, the percent of SGA infants would more closely approximate the 10^{th} percentile at 9.5%.] Utilizing the California reference, 5.5 percent (n=36,190) of Washington births would be classified as SGA. The U.S. reference lies in between, with 7.4 percent (n=48,335) of Washington births classified as SGA. The Washington State and U.S. references include weeks 20 and 21 but the California reference does not. Only nine SGA infants were detected in weeks 20 and 21 using the Washington State reference, however, and none detected using the U.S. reference. Therefore, this discrepancy does not substantially affect the comparison of these references.

The effect of applying the new Washington State reference to detect SGA infant clearly would be to increase the proportion of infants considered SGA across all gestational ages compared to the California reference. Compared with the U.S. reference, the increase using the Washington reference would occur mainly in gestational ages 41 weeks and beyond--about one-fourth of SGA infants.

Discussion

The new reference curves and data based on recent Washington State births provide methods for detecting SGA infants based on sex-specific, regional, population-based birth data. These data allow researchers and clinicians to utilize the constructed percentiles or to calculate z scores for assessment of individual newborns. The proportion of Washington infants identified as SGA using the Washington State reference was substantially higher than that identified using the California or U.S. reference. The differences may be explained by at least three factors.

First, the California reference is several decades old. This reference may have identified a smaller proportion of SGA infants in Washington due to temporal trends toward increasing birth weight at or near term.[12] Secondly, the populations utilized by the three references differed by race/ethnicity. The original California data consisted of a greater proportion of non-white infants, particularly Hispanics, compared to the Washington population (78% white, 9% Hispanic, 3.6% black). In the California data, 59.2% of infants were non-Spanish white, 25.8% Spanish-surname white, 9.9% black, and 5.1% other race/ethnicities. [These figures included multiple births; data was not available for population composition after exclusions.] The U.S. data, after exclusions, also included fewer white infants and a larger proportion of Hispanics, as well as African-Americans, than Washington State: 62% were non-Hispanic Whites, 17.5% Hispanics, 14.5% non-Hispanic African-Americans, 0.8% Native Americans, and 5.3% other race/ethnicities.

Finally, the findings of the current study may have differed from previous studies due to methodological differences. Clinical judgment, in conjunction with an examination of gestational age distribution by birth weight interval, was used to determine implausible data in this study. The California and U.S. studies employed statistical approaches that screened out a second peak of the birth weight distribution for particular gestations, although Alexander, et al. also used clinical consultation in their data cleaning process for the U.S. data. The Washington data also demonstrated a bimodal distribution, although to a lesser extent than the other two data sources (secondary perhaps to the smaller sample size), and influenced clinical decision-making. The referent studies, like the current study, did correct the age distribution for particular birth weights, recognizing that birth weight data is more reliable than gestational age when using birth certificate data.

Within the Washington State birth dataset, the birth weights of male and female infants were consistently different throughout all gestational ages, male infants having greater birth weights than females. Overall, the median birth weight for males was 130 grams greater than that of females. This confirms the need to define SGA separately for male and female infants, as the California[6] and U.S.[7] studies as well as others[4, 15] have also found.

Although many studies have demonstrated that birth weight varies among racial and ethnic groups in the U.S., this study did not attempt to define SGA by race/ethnicity. With approximately 300,000 births in each infant sex group with accurate data (a fraction of the U.S. and California data), the study population for each non-White race/ethnicity group would have been extremely small, thus decreasing the stability of the estimates. Secondly, socioeconomic and other related factors account for a significant portion, although not all, of the disparities in birth weight and gestational age between racial and ethnic groups.[16] Stratifying by race/ethnicity would decrease the number of African-American infants, who weigh on average 150 to 200 grams less than white infants,[4] classified as SGA. Likewise, certain subpopulations within Asian and Pacific-Islander groups, who have an increased rate of LBW compared to non-Hispanic whites,[17] would be less likely classified as SGA. The issue of race/ethnicity is complex, however, and has yet to be fully explored. Cogswell and Yip present convincing data that support the use of population-specific references, particularly in terms of controlling for potential genetic-constitutional differences in intrauterine growth.[15] Nevertheless, as Goldenberg and Cliver argue, until it is clear whether growth differences are genetic or a result of excess risk factors for poor growth, a single standard for all racial groups should be employed.[4]

Limitations

The limitations of using birth certificate data to develop SGA references mainly center on the inaccuracy of recorded gestational length. LMP, used in this and other studies to calculate gestational age from birth certificate records, has frequently been found to overestimate gestational age and thereby overestimate SGA.[18-22] In addition, mothers of high-risk infants, disproportionately represented in low socioeconomic populations, are more likely to receive late or inadequate prenatal care and have the poorest recall of LMP.[23, 24] If the data for these births are preferentially excluded from the development of reference curves, due to missing, incomplete, or inaccurate gestational age, the net result would be to increase birth weight for gestational age percentiles.

Although 12% of the data was missing in the Washington dataset, it is not out of the range of most studies. The California dataset had more than 16% missing. According to Alexander and Allen, about 20% of live birth certificates in the US have been reported to have a missing or incomplete date of LMP.[24] However, the use of LMP-based gestational age is a standardized method. It is also most commonly used in the development of SGA references.[4] The use of the clinical estimate for gestational age is an alternative method but was not employed in this study as there are still unresolved problem areas, particularly in terms of validity and reliability.[22, 23, 25]

Finally, the early gestational age data must be viewed with caution. The references for the 3rd and 10th percentiles were based on fewer than 50 cases for gestational ages 20 and 21 weeks for male infants, and for ages 20 through 22 weeks for female infants. This resulted in wide confidence intervals, making the estimates unstable compared to older gestational age estimates.

The reference developed for Washington State may be helpful in assessing regional data in future research and provide clinical guidance in the assessment of SGA infants, along with other clinical parameters. This study may also provide direction for the development of future references for the region, further delineated by race/ethnicity, multiple births, and other potentially important factors. Clearly, there are controversial issues surrounding the development of SGA references and we must continue to address them in future research.

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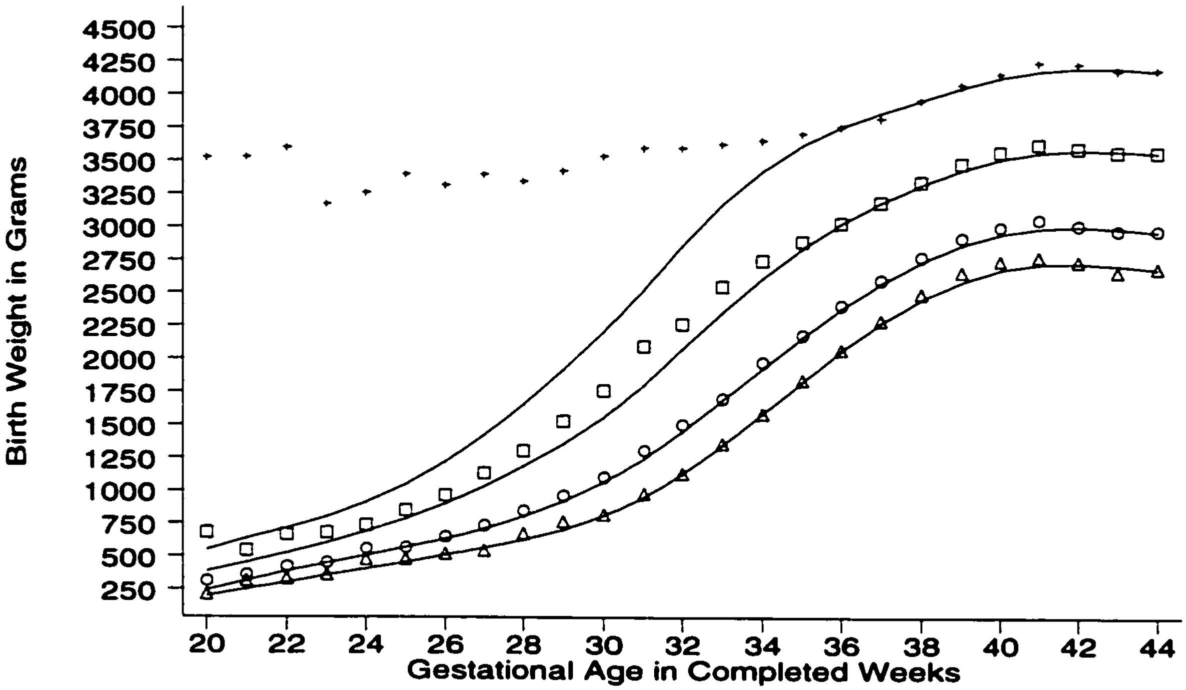

Figure 1.1. Comparison of the 3rd, 10th, 50th, and 90th raw (Δ, o, □, +) and corrected and smoothed (—) centile curves for birth weight (grams) by gestational age for all Washington State singleton births, 1989-1998.

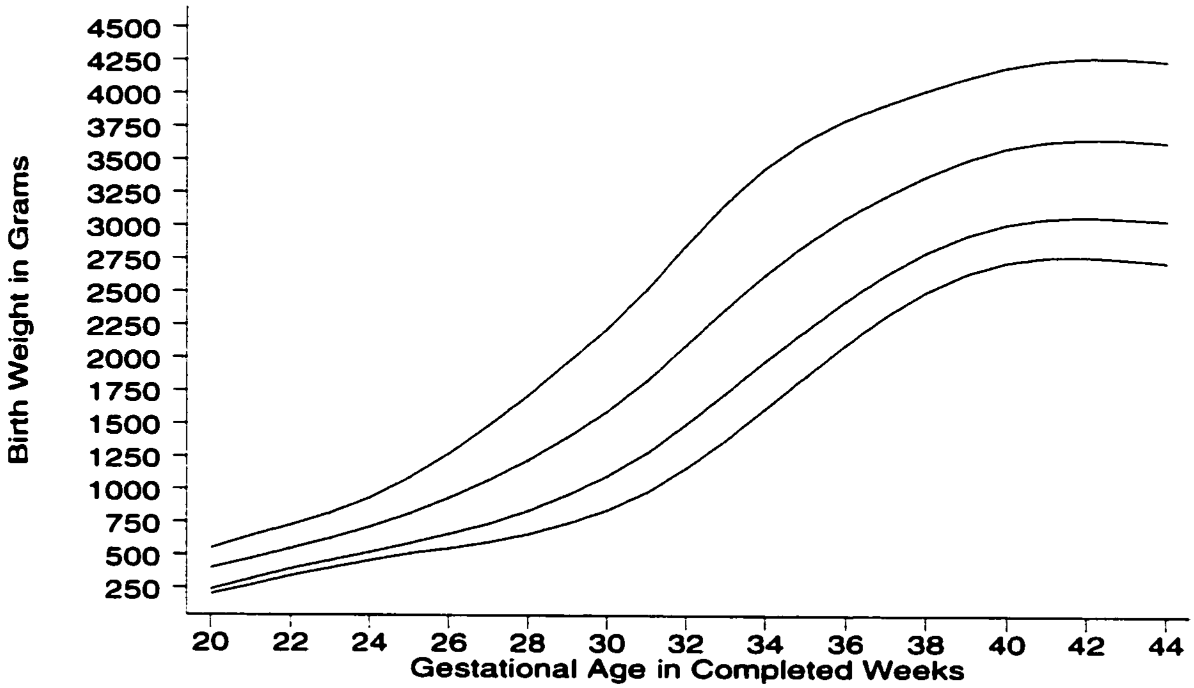

Figure 1.2. Corrected and smoothed 3rd, 10th, 50th, and 90th centile curves for birth weight (grams) by gestational age for Washington State singleton male infants, 1989-1998.

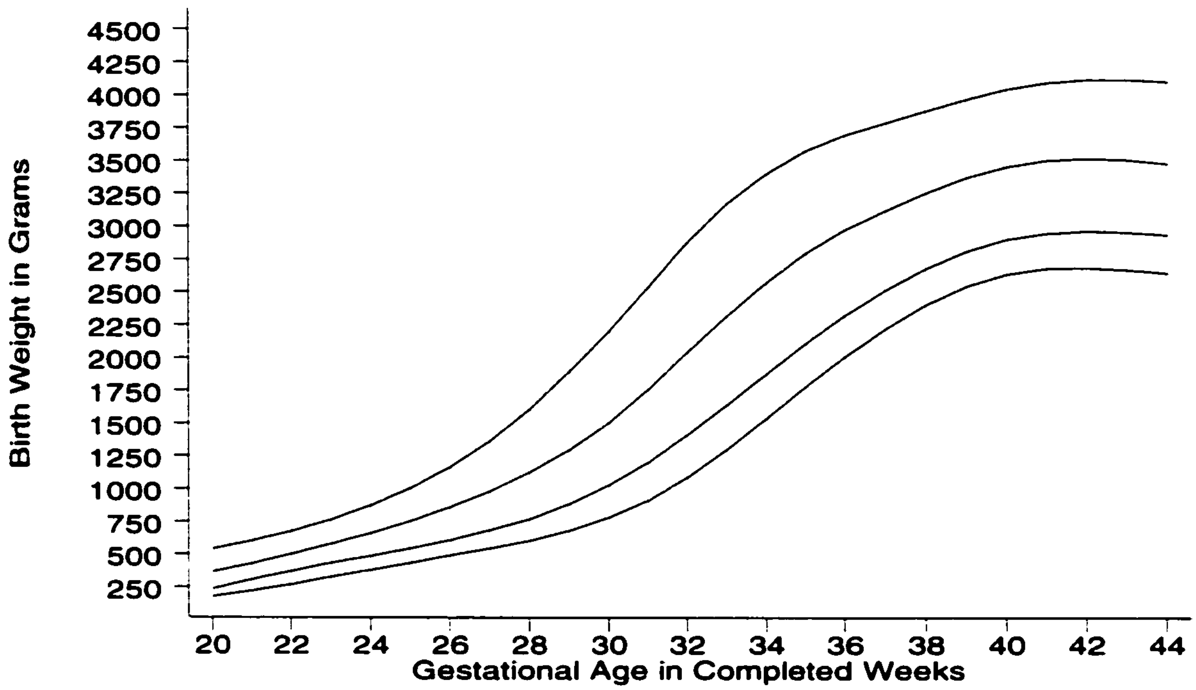

Figure 1.3. Corrected and smoothed 3rd, 10th, 50th, and 90th centile curves for birth weight (grams) by gestational age for Washington State singleton female infants, 1989-1998.

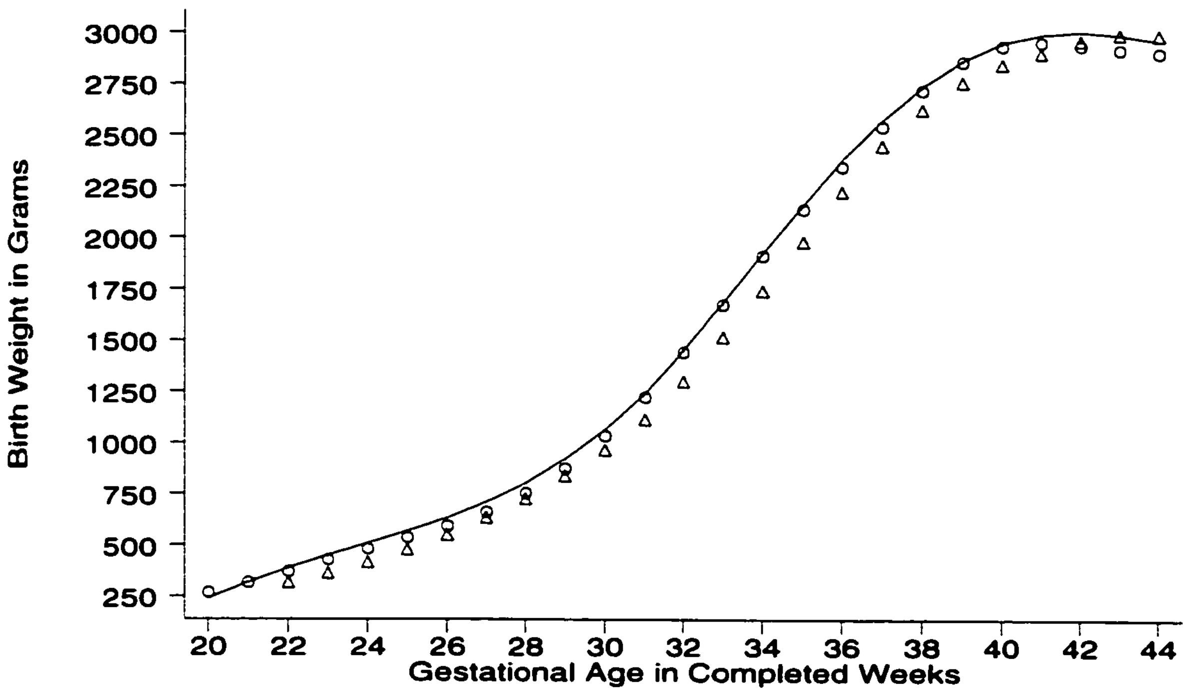

Figure 1.4. Comparison of the 10th percentile curve for birth weight (grams) by gestational age for all singleton 1989-1998 Washington State (—), 1994-1996 U.S.[7] (o), and 1970-1976 California[6] (Δ) infants.

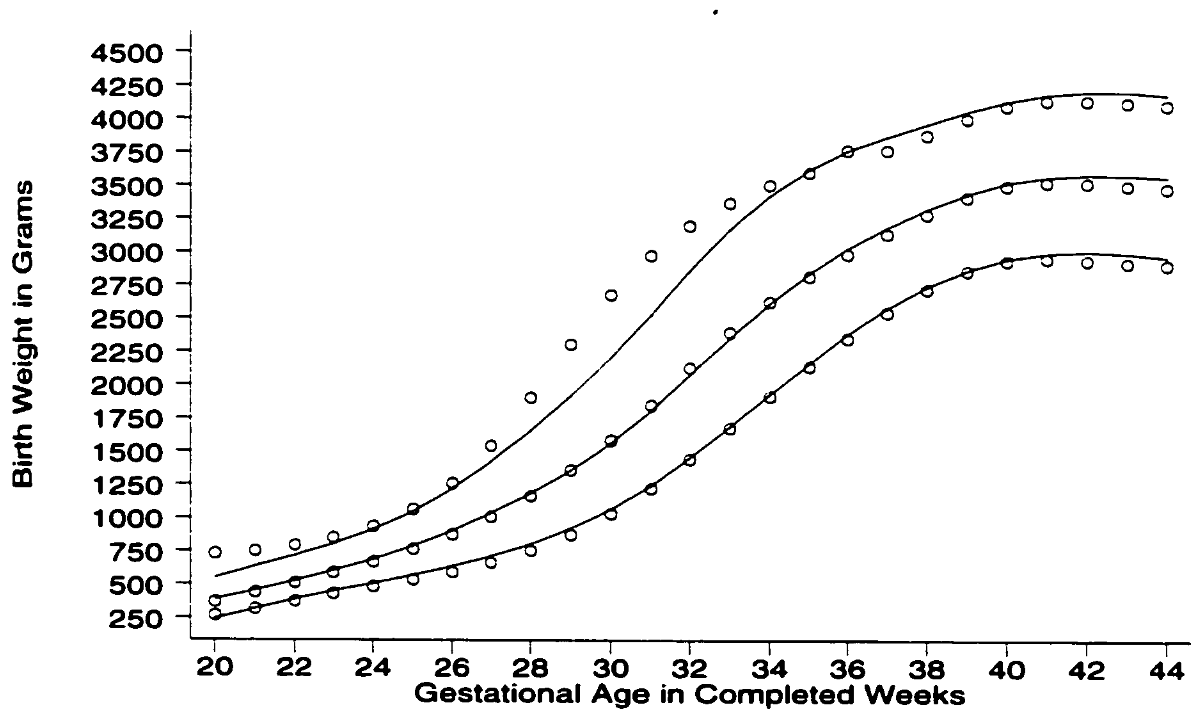

Figure 1.5. Comparison of the 10th, 50th, and 90th 1989-1998 Washington State (—) and 1994-1996 U.S. (o) centile curves for birth weight (grams) by gestational age for all singleton births.

Table 1.1. Washington State birth weight (grams) for gestational age for singleton male births, 1989-1998, corrected and smoothed.

Gestational age	n[1]	3rd Percentile	10th Percentile	50th Percentile	90th Percentile	Mean[2]	SD[3]
20	24	204	236	400	548	416	117
21	39	273	318	472	645	449	79
22	70	343	394	548	730	566	149
23	87	401	458	625	818	650	135
24	134	457	521	714	934	696	124
25	156	509	588	816	1087	782	186
26	202	552	658	933	1271	898	203
27	283	598	739	1069	1483	1095	308
28	311	661	838	1224	1715	1236	358
29	365	740	958	1396	1964	1390	374
30	464	841	1102	1594	2222	1544	379
31	706	983	1282	1831	2522	1835	483
32	984	1166	1498	2098	2854	2035	476
33	1952	1380	1735	2372	3174	2477	599
34	3569	1618	1978	2634	3443	2754	600
35	6214	1867	2217	2869	3657	2963	598
36	11659	2106	2437	3066	3810	3102	539
37	22879	2323	2634	3233	3924	3265	500
38	46238	2506	2803	3381	4028	3423	477
39	76348	2645	2934	3506	4127	3559	466
40	77741	2732	3020	3595	4206	3656	466
41	49841	2769	3063	3644	4256	3718	478
42	19952	2774	3075	3664	4280	3692	491
43	9408	2754	3064	3659	4278	3635	491
44	5506	2731	3046	3641	4258	3652	480

[1] Sample size at each gestational age after exclusions and corrections.
[2] Mean of birthweight for each gestational age after exclusions and corrections.
[3] Standard deviation of birthweight for each gestational age after exclusions and corrections.

Table 1.2. Washington State birth weight (grams) for gestational age for singleton female births, 1989-1998, corrected and smoothed.

Gestational age	n[1]	3rd Percentile	10th Percentile	50th Percentile	90th Percentile	Mean[2]	SD[3]
20	17	178	237	364	541	395	129
21	31	220	306	431	602	403	71
22	45	271	370	501	675	549	141
23	77	327	433	577	764	553	135
24	109	379	489	662	875	664	124
25	150	432	544	754	1005	768	187
26	176	491	610	860	1167	848	207
27	208	547	684	983	1365	977	284
28	229	605	769	1127	1604	1141	329
29	298	680	883	1298	1890	1317	368
30	379	781	1028	1506	2204	1477	429
31	507	913	1202	1760	2542	1798	540
32	844	1087	1410	2041	2879	2008	526
33	1657	1300	1641	2320	3174	2460	648
34	3044	1536	1877	2576	3405	2701	615
35	5238	1778	2108	2797	3577	2865	594
36	9692	2010	2324	2975	3697	3001	533
37	19381	2222	2515	3123	3792	3133	488
38	40429	2405	2681	3256	3881	3291	460
39	72041	2546	2813	3372	3969	3418	447
40	77807	2637	2902	3455	4045	3517	448
41	51684	2608	2949	3502	4094	3570	455
42	20576	2688	2965	3519	4118	3551	471
43	9409	2671	2956	3510	4121	3511	466
44	5520	2648	2939	3482	4106	3505	459

[1] Sample size at each gestational age after exclusions and corrections.
[2] Mean of birthweight for each gestational age after exclusions and corrections.
[3] Standard deviation of birthweight for each gestational age after exclusions and corrections.

Table 1.3. Comparison of 10th percentile of birth weight (grams) by gestational age for all singleton births for Washington State 1989-1998, California 1970-1976[6] and U.S. 1994-1996.[7]

Gestational Age	Washington State	California State	U.S.
20	240	...	267
21	316	...	316
22	387	318	371
23	449	364	428
24	508	417	483
25	568	479	536
26	634	550	593
27	711	632	662
28	804	727	753
29	921	838	876
30	1066	966	1033
31	1242	1114	1223
32	1452	1301	1442
33	1686	1516	1677
34	1927	1744	1914
35	2164	1983	2140
36	2383	2229	2349
37	2576	2452	2544
38	2739	2629	2722
39	2867	2761	2861
40	2952	2848	2937
41	2995	2904	2955
42	3008	2965	2942
43	2995	2996	2921
44	2967	2995	2906

Chapter Two

Making the link: The relationship of police-reported intimate partner violence and maternal and neonatal health outcomes

Background

Intimate partner violence (IPV) has been clearly established as a significant public health problem. Reducing physical abuse directed at women by male partners is one of nineteen violence prevention objectives addressed in Healthy People 2010.[1] While progress toward this objective has been made, violence directed against women by male partners remains common with 25% of U.S. women reporting a history of IPV.[2] The abuse of women during pregnancy is of particular concern. Between 1% and 20% of pregnant women experience IPV, with the majority of studies finding a prevalence of 3.9% to 8.3% during the index pregnancy.[3] Approximately 150,000 to 300,000 women who deliver live born infants each year in the U.S. are abused based on the latter estimates.

Pregnancy also has been identified as a potential period of increased risk for violence inflicted by intimate partners, although this has not been consistently demonstrated. One-fifth to two-thirds of women who experienced abuse prior to pregnancy have reported an increase in abuse during pregnancy, and women abused during pregnancy have been shown to have higher abuse scores and risk factors for homicide compared to women abused prior to, but not during, pregnancy.[4, 5]

Low birth weight (LBW; <2500 grams) also remains a major public health problem in the U.S. and improving LBW rates has been one of the nation's major health care objectives over the past decade.[1] In spite of this focus, the LBW rate has increased by nearly 9% during this period (1987 to 1997), largely due to the steady increase in preterm birth (PTB; <37 weeks gestation) associated with an increase in multiple gestation. PTB and LBW are among the leading causes of neonatal and infant death in this country.[1, 6] PTB and LBW, along with small-for-gestational-age (SGA), as discussed in Chapter One, are also major determinants of neonatal and infant morbidity, with neurological impairment and developmental delay during childhood substantially elevated for the smallest surviving infants, i.e. very preterm and very LBW.[7] Although the risk factors for LBW have been fairly well defined, only a few major risk factors for PTB, such as prior PTB, spontaneous abortion, and multiple gestation, have been well established; known risk factors account for only one-third of all preterm births.[1] Quality pre-conception and prenatal care can potentially prevent or diminish the effects of some risk factors known to be associated with these adverse outcomes; nevertheless, the complex nature of these outcomes has impeded the identification of high risk groups who would benefit from intervention.

While the occurrence of IPV during pregnancy has been well established, studies of the relationship of IPV and adverse birth outcomes such as LBW and PTB have produced conflicting results. Several studies have been conducted to examine these relationships, most of which have addressed physical violence, and no birth outcome has consistently been associated with IPV during pregnancy.[8-21] Adverse maternal outcomes such as premature rupture of membranes (PROM), abruptio placenta, and other pregnancy complications also may be associated with IPV.[8, 22-24] Pregnancy-associated hospitalization, an indicator of serious complications of pregnancy or underlying medical conditions that may affect pregnancy and birth outcomes, has been found to be associated with IPV as well.[18, 20]

This study, one of the few population-based studies conducted to date, examined the relationship of police-reported IPV during pregnancy and several maternal and neonatal adverse outcomes. The use of police data is a unique approach and offers objective exposure information determined independently of the outcomes under study and, for the majority of outcomes, the exposures of interest are known to have occurred prior to the outcomes.

Research Design and Methods

Study Design and Setting

This is a population-based retrospective cohort study. Women residing in the City of Seattle with a fetal death or birth certificate registered in the State of Washington from January 1995 through September 1999 constituted the base population.

Study Subjects

Exposed subjects were Seattle residents ≥16 years and <50 years of age who had one or more IPV incidents reported to the Seattle Police Department (SPD) in the years 1995 through 1998 and who subsequently had a singleton live birth or fetal death within a time frame that indicated they were pregnant at the time of the incident. The comparison or "unexposed" group was composed of randomly selected Seattle residents with a fetal death or singleton birth registered in the State of Washington and who did not have an IPV incident reported in Seattle during the study period, frequency matched (8:1) on race/ethnicity and five-year age groups to exposed subjects.

Data Linkage

The computerized SPD records were linked to the Washington State birth and fetal death certificate files. In addition, the Birth Event Records Database (BERD), composed of linked birth certificate files and the hospital discharge database (CHARS), was used to extract hospital discharge data for all hospitalizations that occurred during the gestational period not associated with delivery for the years 1995 through 1998. For 1999, CHARS was linked to the birth certificate files as BERD was unavailable. Study personnel performed the linkage using SAS 6.12 (SAS Institute Inc., Cary, NC, USA).

For the initial police file/birth certificate linkage, the subject's name from the computerized police incident file was matched to the mother's maiden name and father's last name on the birth certificate. The best and most conclusive matches were selected using a hierarchical set of match criteria (Appendix 1). Fifty-five percent (213) of the matches for the 389 births in the final dataset were made with the first criteria composed of the mother's maiden name, first name, middle name and date of birth. Two matches were made in part using the intimate partner's last name from the police incident file.

Data Abstraction

Data were abstracted from the police incident reports where available, after identification of cases from the initial data linkage procedure, in order to expand on the information obtained from the computerized data. Abstracted data included characteristics of the incident and the subject-intimate partner relationship.

Exposure Definitions

For the purpose of this study, any IPV exposure was defined as having one or more police-reported IPV incidents in Seattle, Washington during pregnancy, perpetrated by a male with whom the subject had an intimate relationship at the time of or prior to the incident. Incidents were further defined as physical or nonphysical (i.e. psychological or emotional) IPV based on the offense assigned to the case by the SPD (Table 2.1); in one case, missing data was supplemented with abstracted police report data. An incident involving physical assault or reckless endangerment constituted physical IPV; reckless endangerment was defined as an action that creates a substantial risk of death or serious physical injury. The remaining offenses were categorized as nonphysical IPV. In cases with more than one incident reported during the study period, the incident involving physical violence was selected for analysis; if the incidents were of the same category, the most recent incident was selected.

In the subset of cases abstracted from the incident reports, exposure was hierarchically categorized, from least severe to most severe, as verbal, moderate physical, and severe physical IPV (Table 2.2). The categories of abuse incorporated three of the four subcategories of the Conflict Tactics Scales used in IPV studies to measure the severity of IPV through the use of a questionnaire:[10, 25-26]

1. negative verbal interaction: insult/swear at you, make you cry, threaten to hit or throw something at you
2. moderate violence: throw something at you; push, shove, grab, slap

3. severe violence: kick, bite, hit with fist; hit/attempt to hit you with something; beat you up; threaten with weapon; use weapon

An IPV incident report was selected for this subset if the incident was determined by the SPD to be founded (incident assigned to an officer, charge made by an officer, incident deemed to be "family violence", or other relevant action taken). If more than one type of exposure (e.g. verbal and moderate physical IPV) occurred in a single incident, the most severe exposure was designated for that event. If more than one incident was reported during the study period, the most severe incident was selected, based on the incident reports available for abstraction. The most recent incident was selected if the incidents were of equal severity or if none of the reports for a subject were available for abstraction. Incidents with the same date for any one subject were considered duplicates and excluded from consideration.

Outcomes

Neonatal outcomes included all PTB (20-36 weeks gestation), very PTB (20-31 weeks gestation), LBW (<2500 grams), very LBW (<1500 grams), SGA (<10th percentile of birth weight for gestational age using Washington State birth data as described in Chapter One), neonatal death (live birth resulting in death prior to hospital discharge or submission of birth certificate for out-of-hospital births), and fetal death (≥20 weeks gestation). Spontaneous PTB (20-36 weeks gestation) was examined separately as a subgroup of all PTB to explore whether IPV had a direct effect on preterm delivery. A PTB was considered spontaneous if it met one of the following conditions:

1. associated with PROM

2. not associated with PROM and not associated with the diagnosis of preeclampsia, a labor induction, or an SGA infant.[27-28]

Maternal outcomes included PROM, abruptio placenta, preeclampsia, antepartum bleeding (any trimester), and any hospitalization during pregnancy not associated with delivery. The latter outcome was further classified as any pregnancy-related hospitalization, no hospitalization related to pregnancy, any substance abuse-related hospitalization, and any mental health-related hospitalization.

Data Analysis

Of the 487 police incident reports initially linked to births, 402 were singleton births meeting the match criteria. Three (1.3%) of the 231 cases reviewed during record abstraction were determined not to pertain to IPV and thus were excluded. Of these 399 births, 10 were excluded from the final analysis because they were a second (n=9) or third birth (n=1) linked to an incident report for the same woman during the study period.

For the hospitalization analyses, up to nine International Classification of Diseases, Ninth Revision (ICD9) codes and the first injury (E) code, for each of up to 10 hospitalizations, were examined. Pregnancy-related diagnoses at hospital discharge were selected using the following ICD9 codes: 640-648 (complications mainly related to or complicating pregnancy), 652 (malposition of fetus), 653-659 (other indications for care during pregnancy), 663 (umbilical cord complications), 671 (venous complications in pregnancy), and V23 (supervision of high-risk pregnancy). Non-pregnancy related codes included all others not described above, including those for normal pregnancy. Mental health-related codes included 293 to 316 (mental disorders excluding substance abuse related diagnoses) and 648.4 (mental disorders complicating pregnancy). Substance abuse-related codes were selected from the following: 291 to 292 (alcoholic or drug psychoses), 303 to 304 (alcohol or drug dependence), 305 (nondependent abuse of drugs), and 648.3 (drug dependence complicating pregnancy).

A woman was considered to have been hospitalized for a pregnancy-related problem if any of the ICD9 codes for any hospitalization was pregnancy-related. Conversely, she was considered to have a non-pregnancy-related hospitalization if no codes were pregnancy-related. If any codes were substance abuse-related or mental health-related, regardless of association with pregnancy, the subject was considered to have a substance abuse-related or mental health-related hospitalization, respectively. Hospitalization data for two unexposed cases were excluded from the analysis because the ICD9 codes suggested that these hospitalizations were associated with delivery, although the time from hospitalization to subsequent birth was incongruent.

All analyses were carried out with Stata 6.0 (Stata Corporation, College Station, TX, USA) unless otherwise noted. A descriptive, univariate analysis was performed to describe the characteristics of IPV incidents from the computerized records and from the abstracted records. Pearson χ^2 tests were calculated to compare demographic, behavioral, and obstetrical history characteristics of exposed and unexposed subjects. A p value of $<.05$ was considered statistically significant.

Unconditional logistic regression was used in bivariate and multivariate analyses to compute crude and adjusted odds ratios (OR) of the association between each outcome and each exposure type, and 95% confidence intervals (CI) were calculated. An association was considered significant if the CI did not include 1.0.

In the multivariate analyses, data for the potentially confounding factors (PCF) were obtained from the birth and fetal death certificate files. For each PCF, a separate category was created for missing data. In the analysis of each outcome and exposure type, factors were considered to be confounding if they individually altered the odds ratio of the crude estimate by ≥10%.[29] Two models were then constructed for each outcome and exposure type as described below. Potential confounding factors were sequentially added to the model if they altered the odds ratio of the exposure variable by ≥10%. Confounding by race/ethnicity and age was accounted for by frequency matching of exposed and unexposed subjects in the study design.

The first set of models considered as potential confounders the following demographic variables: marital status of the infant's parents (married, not married), level of education of the infant's mother and father (<12, 12, >12), age of the infant's father (<20, 20-29, 30-39, ≥40), primary payer on birth certificate (subsidized/no insurance/other, commercial insurance), and participation in any one of the following public health programs: Special Supplemental Nutrition Program for Women, Infants and Children (WIC), First Steps (an expanded Medicaid program for pregnant women), Aid to Families with Dependent Children (AFDC), or local health department prenatal care services. For each one of these four programs, the variable was coded on the birth certificate as 'yes' if used by the subject and coded 'no' if not recorded (i.e., 'no' includes missing values).

The second set of models additionally considered as potential confounders the following behavioral and obstetric history variables: smoking during pregnancy (yes, no), alcohol use during pregnancy (yes, no), late initiation of prenatal care (PNC; third trimester or none, first or second trimester), inadequacy of prenatal care [using Kotelchuck's Adequacy of Received Services Index (inadequate=less than 50% of expected visits once PNC begun) and the Summary Adequacy of PNC Utilization Index (inadequate=initiation of PNC begun in month 5 or later <u>or</u> less than 50% of expected PNC visits received)][30], parity (0, 1, ≥2), previous spontaneous abortion (fetal death <20 weeks; yes, no), previous induced abortion (yes, no), and previous fetal death (≥20 weeks; yes, no).

Unconditional logistic regression analysis was also utilized to examine the association between types of exposure and number of hospitalizations during pregnancy not associated with delivery (0, 1, 2, and ≥3). A test for trend using Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta, GA) was also conducted. A *p* value of <.05 was considered statistically significant.

Finally, IPV 'reporting rates' were calculated using the number of women during the four year study period with singleton live births reporting IPV (divided by four) as the numerator and the number of all women with a singleton live birth residing in Seattle, Washington in 1996 as the denominator; both numerator and denominator data excluded fetal deaths. The overall rate and the rates for each race/ethnicity group were calculated; data for Asian and Pacific Islander women were combined due to methods of reporting for population data.

Human Subjects

The source of research material on each subject was data previously collected by authorized city and state agencies. No contact was made with subjects. This study was approved by the University of Washington, the Washington State Department of Health Human Research Review Board, and the City of Seattle Police Department. All identifying information was removed from the data.

Results

Characteristics of Study Subjects

Women reporting any IPV (exposed subjects) were significantly more likely than women without reported IPV to have had a lower level of education (28% vs. 23% had <12 years of education, respectively), been unmarried (73% vs. 49%), used subsidized or no insurance during pregnancy (79% vs. 62%), and participated in a public health program (52% vs. 38%) (Table 2.3). Women reporting IPV, however, were no more likely than unexposed women to access maternal health services such as First Steps (22% vs. 23%, respectively) or WIC (55% vs. 52%), among those who were eligible according to their insurance status.

Exposed subjects also were significantly more likely than nonexposed subjects to have smoked or drank alcohol during pregnancy, and to have had inadequate PNC. In particular, exposed women were twice as likely (27% vs. 14%) to have smoked than unexposed women. Obstetric history differed significantly between exposed and unexposed subjects as well. Most notable were parity and previous induced abortion.

Thirty-six percent of exposed women compared to 20% of unexposed women had ≥2 previous live births, and 34% versus 24% had a previous induced abortion.

Women reporting nonphysical and physical IPV had similar demographic, behavioral and obstetric histories to those of women reporting any IPV. In addition, the educational levels of the fathers of infants whose mothers reported any IPV or physical IPV were significantly lower than those of the fathers of infants whose mothers who did not report IPV. There was a marginal association (p=.05) between reported physical IPV and the father of the infant having a greater educational level than the subject. Finally, the father being older than the infant's mother by 5 years or more was found to be significantly associated with nonphysical IPV, but not any IPV or physical IPV (data not shown).

Characteristics of women reporting IPV

Women who reported IPV in this sample were mainly white (32%) and African-American (35%); less than 10% were Hispanic, Asian, Pacific Islander, Native American, or of unknown race/ethnicity (Table 2.3). The overall rate of police-reported IPV during pregnancy was 16.1 per 1000 live births. The rate was nearly six times greater among African American and Native American women compared to white women (43.1, 43.0, and 7.4 per 1000 live births respectively). Hispanic women were nearly three times more likely than non-Hispanic white women to report IPV, with a rate of 20.7 per 1000 live births. The rate for Asian and Pacific Islander women combined was comparable to that of white women at 9.1 per 1000 live births.

Nearly 20% of exposed subjects were in their teens and nearly 60% were aged 20-29 years. Exposed subjects were three times more likely to be in their teens than all Seattle women with a singleton live birth in 1996 (19.5% and 6.5%, respectively), according to the Washington State Department of Health Center for Health Statistics. Furthermore, exposed women were disproportionately distributed across the age groups 20 to 29 years and 30 to 39 years (59.4% and 19.5%, respectively) compared to all Seattle women with a live birth (42.6% and 46.4%, respectively).

IPV Characteristics

Of the 389 exposed women in the final dataset, 342 (87.9%) reported one incident during the index pregnancy, 37 (9.5%) two incidents, and 10 (2.6%) three to five incidents. Of the 389 incidents selected for analysis, the majority (72%) were categorized as physical IPV using the computerized data (Table 2.4). All but one of the physical incidents involved a physical assault and the remaining incident was classified as reckless endangerment. Sexual violence was not reported in any incident. Very few reports noted the use of weapons. Over half of the incidents with recorded data, however, resulted in visible injury to the subject. Approximately 10% of the partners (current or previous) were under the influence of alcohol or other drugs at the time of the incident compared to less than 3% of the subjects.

The majority (62%) of subjects were dating or engaged at the time of the incident or prior to the incident, and 20% were married. Nearly half of all subjects were cohabiting with the abuser at the time of the incident. Fifteen percent of subjects had a child in common with their partners and were not dating, married, or divorced to that individual at the time of the incident. Further, approximately 50% of the partners were listed as father of the child on the birth certificate.

Data from incident reports were abstracted to obtain a more complete description of each incident and to more finely delineate the type of IPV. Of the 389 incidents selected for analysis, 231 (59%) of the police reports were available for abstraction. In the majority of abstracted reports, physical violence was reported; 31% were classified as moderate physical IPV and 47% as severe physical IPV (Table 2.5). Approximately one-fifth of reports consisted of verbal IPV alone. Sexual violence was not reported in any incident. Forty percent of the incidents resulted in visible injury to the subject, with injury to the head and neck reported most frequently (34%); 5% of incidents with available data involved injury to the abdomen.

The abstracted data also gave a more detailed description of subject-partner relationships compared to the computerized data. Over half of the subjects were in a current dating or unmarried relationship with their partner, one-fifth were married, and nearly one-quarter were divorced or separated at the time of the incident. Fifty-five percent of the couples were cohabiting, the majority (72%) had been a relationship for one year or longer, and most (87%) of those with known histories (n=121) reported a history of IPV with this partner. Over half of the 103 incidents with available information noted the presence of children during the incident.

<u>IPV and neonatal outcomes</u>

<u>Computerized data analyses</u>. All neonatal outcomes measured, with the exception of SGA and fetal death, were significantly associated with any reported IPV before and after adjusting for demographic factors and behavioral and obstetrical history factors (Table 2.6). Women reporting any IPV were more than 1.5 times as likely as women without

reported IPV to have a LBW infant (adjusted OR [aOR] 1.70, CI 1.20, 2.40) or a PTB (aOR 1.61, CI 1.14, 2.28) after adjustment for demographic or all factors. Spontaneous PTB was specifically examined as a subgroup of PTB to explore whether IPV had a direct effect on preterm delivery and similar results to the overall PTB analysis were found.

Twenty percent of all LBW infants were very LBW and 15% of all PTB were very PTB and thus were examined separately. Exposure to any reported IPV increased the risk of very LBW and very PTB by two to three-fold after adjustment for other factors. IPV also increased the risk of neonatal death by three-fold, although there were few deaths. Twelve (52%) of the 23 neonatal deaths had known, reliable gestational age data (20-44 weeks). Seven (58%) of these 12 deaths were PTBs; all but one of the PTBs were in the very PTB range of 20 to 31 weeks. The remaining five births resulting in neonatal death occurred at term (39-41 weeks). Of the 11 deaths with missing or out-of-range gestational age data, 4 deaths were among exposed women and 7 among unexposed women, representing 50% of neonatal deaths in each group.

SGA defined as less than the third percentile of birth weight for gestational age (see Chapter One) was also examined to determine if those infants in the extreme of the SGA range were more likely to be at risk if the mother reported any IPV. Of the 279 SGA infants below the 10^{th} percentile, 76 (27%) were below the third percentile and the majority (87%) of those were term or post-term births. Although 67% of SGA infants below the third percentile were classified as LBW, the majority (86%) of these infants were in the moderate LBW range (1500 to 2499 grams). IPV was not significantly associated with this outcome, either overall or within IPV subgroups (data not shown).

The risk estimates for most outcomes associated with physical IPV were similar to those associated with any IPV (Table 2.7). Women reporting physical IPV were 1.7 times more likely to have a LBW infant than unexposed women (aOR 1.67, CI 1.29, 5.00). The risk of very LBW increased nearly three-fold with physical IPV (aOR 2.78, CI 1.35, 5.74). Although PTB was marginally associated with physical IPV, the risk of very PTB was more than three times greater in women reporting physical IPV (aOR 3.41, CI 1.49, 7.77). Likewise, the risk of neonatal death was almost three times greater (aOR 2.85, CI 1.02, 7.98).

Only one outcome, neonatal death, was significantly associated with nonphysical IPV after taking into account demographic factors (Table 2.8). The risk of neonatal death increased nearly four-fold (aOR 3.80, CI 1.06, 13.65), although the relationship did not remain significant after adjusting for all factors (aOR 3.27, CI 0.87, 12.27).

Abstracted data analyses. None of the neonatal outcomes were significantly associated with severe physical violence (Table 2.9). Women reporting moderate physical IPV were six times as likely to have a very LBW infant as unexposed women (aOR 6.05, CI 2.04, 17.92), although the confidence intervals were very wide (Table 2.10). Similar results were found for very PTB. None of the outcomes were associated with verbal IPV (Table 2.11).

IPV and maternal outcomes

Computerized data analyses. IPV was significantly associated with hospitalization during pregnancy not associated with delivery (Table 2.12). Over 90% of the women hospitalized had pregnancy-related diagnoses for at least one of their hospitalizations. Women with any reported IPV were more than twice as likely to have been hospitalized with a pregnancy-related condition compared to unexposed women (aOR 2.38, CI 1.74, 3.25), and three times more likely to have a substance abuse-related hospitalization (aOR 2.97, CI 1.78, 4.96) and a mental health-related hospitalization (aOR 2.92, CI 1.62, 5.24) after adjusting for demographic factors. The estimates for substance abuse and mental health-related hospitalizations decreased substantially and only the former remained significant when all factors were taken into account.

Furthermore, women reporting any IPV were found to be more than twice as likely as unexposed women to have experienced two hospitalizations (OR 2.39, CI 1.13, 5.03) and nearly three times as likely to have had three or more hospitalizations (OR 2.92, CI 1.05, 8.08) compared to no hospitalization. The test for linear trend was significant. None of the remaining maternal outcomes were significantly associated with IPV overall.

Women reporting physical IPV were found to have similar results to those with any IPV, although the associations with physical IPV were relatively stronger (Table 2.13). Women with physical IPV were 2.7 times more likely than those without IPV to have had a pregnancy-associated hospitalization (aOR 2.73, CI 1.93, 3.85). Exposed women were nearly four times more likely to have had a substance abuse-related hospitalization and three times more likely to have had a mental health-related hospitalization than unexposed women after adjusting for demographic factors. Adjusting for behavioral and obstetric history factors substantially decreased the estimates for the latter two outcomes but substance abuse-related hospitalizations remained significant. The risk for hospitalization significantly increased monotonically as the number of hospitalizations increased.

Women reporting non-physical IPV were significantly more likely than those not reporting IPV to have experienced PROM and abruptio placenta (Table 2.14). The risk of PROM in exposed women was three times greater compared to unexposed women after adjusting for all factors (aOR 3.00, CI 1.34, 6.76). The risk for abruptio placenta was nearly five times greater in exposed women (aOR 4.81, CI 1.35, 17.16).

Abstracted data analyses. A similar pattern of results was obtained for hospitalizations during pregnancy and severe physical IPV (Table 2.15) as were found for any IPV. Exposed subjects were nearly twice as likely to have had a pregnancy-related hospitalization (aOR 1.98, CI 1.12, 3.50), although the association became marginal after adjusting for all factors. The risks for substance abuse-related and mental health-related hospitalizations were approximately three times greater for women with severe physical IPV after adjusting for demographic factors. The risk decreased considerably after adjusting for all factors and became non-significant for mental health-related hospitalizations. Analysis of most of the remaining outcomes was not possible due to insufficient data.

As in the severe physical IPV analysis, women with moderate physical IPV were twice as likely as women without any reported IPV to have had a pregnancy-related hospitalization (Table 2.16). These findings remained significant after adjusting for all factors. The remaining subcategories of hospitalization, however, were not significantly associated with exposure. The associations of moderate physical IPV with PROM and abruptio placenta demonstrated similar patterns with those of nonphysical IPV in the computerized data analysis. Exposed subjects were three times more likely than unexposed subjects to have experienced PROM and six times more likely to have had abruptio placenta after adjusting for all factors.

Finally, none of the hospitalization outcomes or PROM were significantly associated with verbal IPV (Table 2.17). The remaining outcomes did not have sufficient data to analyze.

Discussion

The key findings in this study are the significant associations of IPV with most adverse neonatal outcomes and with hospitalization during pregnancy not associated with delivery. The majority of these outcomes were not only associated with IPV overall, but also with physical IPV. Further, nearly all of the significant associations remained significant even after demographic as well as behavioral and obstetric risk factors were taken into account.

The associations of IPV with neonatal outcomes are noteworthy in light of the inconsistent results demonstrated in previously published studies.[8-21] PTB and LBW have been the most common outcomes studied. In a case-control study by Campbell et al., physical IPV during pregnancy was assessed postpartum prior to hospital discharge. Abuse was significantly associated with LBW in full term, but not preterm, infants (OR

3.78; CI 1.31, 10.90).[19] The association became non-significant, however, when adjusted for demographic and obstetric risk factors.

Similarly, Bullock and McFarlane interviewed women delivering in private and public hospital settings 24 hours postpartum.[9] Women delivering in a private hospital who were physically abused by their current male partners, either during or prior to pregnancy, were found to have an increased risk of LBW (OR 4.80; CI 1.79, 12.90). Abused women in public hospital settings were not at increased risk (OR 1.05; CI 0.45, 2.45). The association of physical abuse with LBW did remain significant ($p<0.05$) with the combined (public and private hospital) data after adjusting for race, substance use, prenatal care, prior abortions, maternal complications, and specific hospital. Adjustment for other potentially confounding factors, such as age, marital status, or other obstetric history factors, was not reported.

On the other hand, in two prospective studies of predominately low-income women receiving prenatal care in urban clinics, women experiencing physical or sexual abuse by <u>any</u> perpetrator were found to be at significantly greater risk of delivering a LBW infant. [11,17] Abused women were 1.5 times more likely than non-abused women to deliver a LBW infant in a study by Parker, et al. In a subsequent logistic regression analysis of Parker's data, abuse became non-significant when demographic, obstetric, and substance use variables were included in the model.[12] In the second study, Curry and colleagues did not report a crude risk estimate; analyses were reported for confounding only by individual factors and several were found to be statistically significant. In a third prospective clinic-based study, Covington, et al. found PTB and LBW PTB in teens, but not adults, to be associated with severe physical prenatal violence after taking race, behavioral, and obstetric history factors into account.[21]

Most of the remaining published studies of PTB and LBW did not find a significant association with IPV.[13-16, 18] This may be due to small sample size although other factors, such as biased sampling methods, diffuse exposure periods, and timing of interviews, may also have limited the findings in these studies.

What is not clear in several of the previously published studies is whether estimates would become or remain significant when demographic factors, but not behavioral or obstetric history factors, were included in the analyses. It is important to examine this issue in light of the fact that controlling for behavioral and obstetric risk factors may be 'over adjusting', since many of these factors may be a step in the causal pathway between IPV and outcomes. Factors such as substance abuse, unintended pregnancy (resulting in higher parity), and access to health care, for example, may occur as a result of IPV; controlling for these factors might then be inappropriate. This was addressed in the current study by conducting two sets of analyses; one retaining confounding demographic variables and the second retaining all three types of confounding variables. Nonetheless, the results suggest that IPV contributes a substantial risk to pregnant women and their newborns beyond both demographic factors and behavioral and obstetric history factors controlled for in the analysis.

The main finding among maternal outcomes significantly associated with IPV in this study was hospitalization during pregnancy not associated with delivery. In addition to the overall association of IPV with any hospitalization or pregnancy-related hospitalization, physical IPV in the computerized dataset and, to a lesser extent, moderate and severe physical IPV in the abstracted dataset were significantly associated with these outcomes as well. One of two published studies to evaluate the relationship between physical violence and maternal hospitalizations before delivery, the South Carolina Pregnancy Risk Assessment Monitoring System (PRAMS) study found that any hospitalization was significantly associated with physical violence (OR 1.5; CI 1.1, 2.0) as were hospitalizations due to kidney infection, premature labor, and physical trauma.[18] Age, poverty, prenatal care, and smoking during pregnancy were controlled for in each of these analyses.

One of the more notable findings related to hospitalization in the current study is the significant association of IPV and hospitalization with a substance abuse or mental health-related diagnosis. Kernic, Wolf and Holt reported similar findings in their population-based study on hospital admissions among women in violent intimate partner relationships in King County, Washington.[31] Women filing for protection orders were significantly more likely than nonexposed women to be hospitalized with psychiatric diagnoses in the year prior to filing a protection order after adjusting for age (relative risk 3.6, CI 2.8, 4.6). Several other studies have also found an association between IPV and psychiatric disorders or substance abuse and between IPV and hospitalization for psychiatric diagnoses.[17-20, 32-39]

Further, the current study found women with any IPV to be two times as likely as unexposed women to have experienced two hospitalizations compared to no hospitalization, and three times as likely to have had three or more hospitalizations.

Women with physical IPV were at even greater risk. Moreover, a significant trend of increasing risk with the increase in number of hospitalizations was detected with any IPV, physical IPV, and moderate physical IPV. Similar findings were reported in one other published study.[20] Australian pregnant women were categorized into three levels of severity of abuse (both current and historical) and compared to pregnant women reporting no history of abuse. There was a significant difference in the number of hospitalizations between groups; a larger proportion of moderately and severely abused women had two pregnancy admissions compared to the mildly abused and never abused groups, although no clear trend was evident when examining lower or higher admission rates.

The remaining two maternal outcomes that were significantly associated with IPV, PROM and abruptio placenta, were only associated with non-physical IPV and moderate physical IPV. One would expect to also have seen an association with severe physical IPV, which was more frequently reported than moderate physical IPV and would more likely result in substantial physical injury and pregnancy-related sequelae. This may be due to the small number of events that occurred or it may belie the underlying problem of attempting to classify IPV by police-reported events. This study was able to identify only 18 cases (8% of those with available information among abstracted police reports) of IPV involving abdominal injury or complaints, and 10 of these cases had visible injuries. Only two of these cases were associated with adverse outcomes (one PROM with an IPV incident reported 20 days prior to delivery and one spontaneous PTB with a reported incident one day prior to delivery). Other studies of blunt abdominal trauma in pregnant women, mostly case reports and case series, have documented pregnancy loss, maternal and fetal injuries and death, and complications of pregnancy (e.g. abruptio placenta, preterm labor and delivery).[8, 23, 40] Major blunt trauma, overall, has been found to result in pregnancy loss, including spontaneous abortion, 'previable death in utero', and fetal and neonatal death.[8, 41]

Even though this study did not demonstrate a clear 'dose-response' effect for neonatal outcomes (i.e. the risk estimates did not consistently increase when comparing levels of IPV), the hospitalization data did suggest a dose-response. Physical IPV in the computerized dataset demonstrated a 30 percent increase in risk for pregnancy-related hospitalizations over the risk associated with any IPV; the risk for substance abuse-related hospitalization increased by 60 percent; and the risk for mental health-related hospitalizations increased by 15 percent even after adjusting for all factors. These risks also were substantially higher compared to nonphysical IPV. Similarly, the risk of multiple hospitalizations in the physical IPV group increased by 100% compared to IPV overall.

In addition to the key findings related to adverse neonatal and maternal outcomes, important demographic associations with IPV were revealed in this study. Of particular note is the greater rate of IPV reporting to police among African American, Native American, and Hispanic women compared to white women. The number of subjects in groups other than white and African American were few (n<40), however, and those rates should be viewed with caution. The National Crime Victimization Survey found that the overall percentage of victims reporting IPV to police also differed by race and ethnicity.[42] Black women experiencing IPV reported those incidents to police at significantly higher percentages than did white women (67% and 50%, respectively), and Hispanic women reported incidents that occurred at significantly higher percentages than non-Hispanic women (62% vs. 52%). The National Violence Against Women Survey reported analogous results with self-reported survey data on lifetime IPV.[2] Other population-based studies, such as those using PRAMS data or the national household survey by the U.S. Department of Justice, have also detected higher rates of physical IPV by self-report in minority pregnant women.[33, 42–44] Like the current study, these surveys have also found low socioeconomic status to be significantly related to IPV.

Finally, the young age of exposed subjects in this study contrasts with the older age distribution of Seattle residents with a live birth in 1996. These findings are consistent with several previously published studies of IPV in pregnancy.[14, 26, 33, 43, 45]

Study Limitations

The main limitations of this study include those related to sample size, exposure misclassification, and nondifferential misclassification of covariates and outcomes. The sample size in this study was constrained by the length of time the police database had been in existence. This limited the assessment of IPV by type and the ability to control for a variety of potentially confounding factors for more rare outcomes, resulting in wide confidence intervals. For this reason, these estimates must be viewed with caution. Given that the vast majority of the outcomes under study were significant in the overall analysis, it is quite likely that significant findings for types of IPV might result in a study with larger subgroup sample sizes.

Exposure misclassification. In this study, physical IPV did not appear to increase the risk of adverse outcomes over that of physical and nonphysical IPV combined. This may be due to the limited scope of police incident reports, i.e. they do not measure the frequency or type of all incidents occurring during pregnancy. Thus, the distinction in the analysis of types of IPV may not be fully descriptive of the type of IPV incurred by the subjects throughout their pregnancies. These limitations, in addition to sample size, should be taken into account in drawing conclusions about the effect of type of IPV on the study outcomes.

While police report data may not represent the totality of IPV experience for individual women during pregnancy, verbal, psychological, and physical abuse often occur together. Police-reported IPV incidents are also likely indicators of ongoing IPV, as IPV tends to be chronic and often escalates over time. Nonphysical, as well as physical, IPV may function as an intermittent or chronic stressor. The association of IPV and psychosocial stress has been documented in several studies.[14, 20, 46-48] It has been suggested that stress in pregnancy may be associated with adverse birth outcomes through effects mediated by physiologic responses.[8, 49-51] Although police report data do not necessarily measure perceived stress but rather a stressful event, studies measuring the association between psychosocial stress and birth outcomes have found that both perceived stress and stressful events may be associated with adverse outcomes.[49, 52-55]

The inability to identify all cases of IPV generated misclassification of exposure status. Not all reported cases were entered into the computerized SPD database, as there were technical difficulties with the database in 1997. Consequently, 13% of the 389 cases analyzed in this study were reported in 1997 compared to approximately 30% in each of 1995 and 1996 and 24% in 1998. Further, approximately one percent (389 of the approximately 30,000 women with a registered birth or fetal death certificate residing in Seattle from 1995-1998) were classified as exposed. Based on the assumption that one-fourth to one-half of all incidents are reported to the police,[2, 56, 57] another one to two percent of the remaining 3090 subjects were potentially misclassified as unexposed.

While under-identification of exposed subjects would usually tend to bias the estimate of the effect toward the null, the use of police-reported incidents might result in higher risk estimates for adverse outcomes than would be found with all IPV since these incidents tend to be more severe than nonpolice-reported incidents.[56-57] Few previously published studies, examining either prevalence or outcomes, have differentiated between physical and nonphysical IPV but at least two self-report surveys revealed a higher prevalence of nonphysical than physical IPV in the current relationships of women.[58-59] Some evidence of this phenomenon was found in this study with the majority of incidents associated with physical IPV, although most incidents were not associated with serious injury according to the police data. On the other hand, an examination of hospital discharge data revealed that exposed women were five times more likely than unexposed women to have a violence-related hospitalization. Five women without reported IPV (2.2% of unexposed hospitalized subjects) were coded as either having been in a fight or raped, assaulted, or abused by an adult. Seven women with reported IPV (11.3% of exposed hospitalized subjects) were hospitalized with similar codes. This may well point toward more severe IPV in police-reported incidents or simply reflect an under-identification of exposed cases. In any case, the overall evidence suggests that the generalizability of this study's findings is limited to police-reported IPV.

To assess whether the comparison group was equally at risk for exposure (i.e. did the unexposed subjects reside in Seattle during the gestational period and therefore were eligible to report an incident), the length of maternal residence at the time of delivery as noted in the birth record was compared for each group. (Length of residence in this case indicates only how long the mother resided at the particular residence listed but is used here as a proxy for length of residence in Seattle.) Unexposed subjects were 1.7 (CI 1.4, 2.1) times more likely than exposed subjects to have resided at their current residence for 9 months or longer. In comparing gestational length and residence length for the two groups, unexposed subjects were 1.9 (CI 1.48, 2.45) times more likely than exposed subjects to have resided at their current residence for the length of the gestational period or longer (61% and 45%, respectively). After adjusting for socioeconomic status (marital status and primary payer on birth certificate), unexposed subjects remained significantly more likely to have resided at their current residence for the length of the gestational period or longer (aOR 1.6, CI 1.2, 2.1).

Exposure measurement has been a consistent problem in studies of both prevalence of IPV in pregnancy and outcomes related to IPV, the majority of which have been clinic or hospital-based. These studies have relied upon self-report which may be constrained by the subject's fear of her partner, shame/loss of self-esteem, entrapment/lack of empowerment, or rationalization/coping mechanisms.[60-61] Even though police report data have their own set of limitations, exposure data in this study was recorded at the time of the incident, independent of health care utilization and pregnancy outcome. This provides a clear time frame in which IPV occurred in relation to pregnancy and most outcomes studied.

Misclassification of covariates. Nondifferential misclassification occurred in the determination of a number of covariates assessed in this study. A substantial proportion of both exposed and unexposed subjects had missing data in the birth certificate file for education (approximately 30% each), education of the father's infant (61% and 49%, respectively), and age of the father's infant (27% and 43%, respectively). Approximately 20% of data for each exposure group was missing for primary payer on the birth certificate and PNC. Moreover, birth and fetal death certificate data provide only general estimates of exposure to smoking and alcohol (yes or no). Although the proportion of missing data on smoking during pregnancy was only 6% for unexposed and 7% for exposed subjects, and missing data on alcohol use was 15% and 13%, respectively, very few records had reliable quantitative data. While it is known that smoking is associated at least with LBW if not PTB, adjusting for smoking in this sample did not consistently alter the estimate for either outcome. Smoking was a confounding factor, though, in the SGA analysis with any IPV, non-physical IPV, and verbal IPV.

The birth certificate database also lacks information on illicit drug use, which is known to be associated with adverse maternal health and neonatal outcomes. The CHARS database is another source, however, for this information. In further adjusting the risk estimates for PTB by including substance (drug or alcohol) abuse-related hospitalizations during pregnancy (in place of alcohol use during pregnancy as indicated on the birth certificate), the risk decreases from 1.61 to 1.46 (CI 0.99, 2.15) with any reported IPV. The risk for LBW decreases from 1.70 to 1.41 (0.95, 2.08) with any IPV. Clearly, severe substance abuse accounts for a proportion of the risk for adverse outcomes in abused women.

The quality of birth certificate data may vary by type and location of birth facility as well, further increasing the possibility of nondifferential misclassification. Births in this study occurred at a variety of facilities in Seattle, in King County outside of Seattle, and in other counties; three births took place out of state but were recorded in Washington State. Nevertheless, 86% of births occurred in major Seattle hospitals and 14% in smaller Seattle hospitals, in hospitals outside of Seattle, or in non-hospital settings. Several demographic, behavioral, and obstetric history factors were likely to vary by birth facility. Approximately one-half of these factors were more likely to be missing in major Seattle facilities (e.g. educational level of infant's mother and father, primary payer, and smoking) and half were more likely to be missing in other facilities (e.g. drinking during pregnancy, PNC, obstetric history). By controlling for these factors in the multivariate analyses, with the inclusion of a separate category for missing data, a substantial amount of misclassification would have been minimized.

Misclassification of outcomes. In terms of misclassification of the outcomes studied, there are problems in assessment beyond the gestational age issues discussed in Chapter One. The accuracy of obstetric procedures and diagnoses on Washington State birth records in 1989 was evaluated by Parrish and Holt, et al.[62] An average of 10.6% of delivery information was missing on birth certificate records and 5.7 to 7% of cesarean sections were found to be incorrectly reported on the BC as vaginal delivery when compared to hospital discharge data. The mean sensitivity for induction of labor was 56% and the positive predictive value (accuracy of data once event identified) was 88%. Washington State birth data also have been assessed for validity of information regarding complications of pregnancy and number of intrapartum interventions and procedures in a low risk population.[63] These data elements were reported to be consistently underestimated when compared to clinic and hospital records. Missing data on the birth certificates ranged from 0% to 28%. Although missing data in the current study ranged from 0.03% to 4% for complications of pregnancy and delivery, these studies suggest that the estimates for spontaneous PTB and other pregnancy complications still may have been underestimated due to inaccurate rather than missing data.

Finally, as with the covariate data, the quality of birth certificate outcome data may vary by birth facility. The major neonatal and maternal outcomes did not significantly differ by hospital type with the exception of SGA, which was more likely to occur if the birth took place in a major Seattle hospital (OR 1.58, CI 1.05, 2.38). PTB was marginally associated with delivery in a major Seattle hospital (OR 1.59, CI 1.00, 2.52). Missing gestational age, but not out-of-range data, was significantly more likely to occur outside of major Seattle hospitals. Although few subjects had missing birth weight data, major Seattle hospitals had a greater proportion of missing data than other facilities (1.2% vs. 0.8%, respectively). These data suggest that cases of PTB and SGA may have been missed. Among maternal outcomes, only hospitalization during pregnancy varied by facility; hospitalizations were more likely to occur in pregnancies resulting in births at major Seattle hospitals. Missing data for two maternal outcomes, abruptio placenta and PROM, were more likely to occur with facilities outside of major Seattle hospitals, again indicating potential under-assessment of these adverse outcomes. Overall, however, neonatal and maternal outcome data were more likely to be missing for births at facilities outside of major Seattle hospitals, which represented only a small proportion of all births in this study.

Conclusions. This study is one of the few population-based studies conducted to date and one of the first to examine the relationship between IPV and maternal and neonatal outcomes utilizing police-reported data. The key findings in this study point to the critical need to identify women who are pregnant at the time of a reported incident and provide them health information and referrals to social, health, and crisis intervention services. Follow-up and assistance by police department personnel, such as community service officers, is also essential to ensure that women are able to access needed services. As illustrated in this study, a large proportion of women with IPV may not be adequately accessing maternal health services. Referrals to high-risk pregnancy programs, particularly preterm birth and low birth weight prevention programs, should be aggressively facilitated once IPV-affected women are identified. Domestic violence programs and support services should also focus on the specific needs of pregnant women and women with infants by facilitating referrals to these programs. Conversely, it is important that all avenues of IPV detection are utilized, including the incorporation of universal and systematic IPV screening throughout pregnancy and the postpartum period by all health care providers. This would serve to identify women at increased risk for adverse outcomes who clearly need intensive obstetric care as well as other social and health services. The findings in this study may also serve to better inform the legal and justice systems of the impact of IPV on the health of pregnant women and their offspring, thus underscoring the importance of enforcement measures, protection orders, and perpetrator treatment programs.

Notes to Chapter Two

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Table 2.1. Criteria for level of intimate partner violence (IPV) exposure for computerized police incident report data.[1]

Offense	Nonphysical IPV	Physical IPV
Criminal trespass	X	
Custodial interference	X	
Disturbance	X	
Harassment	X	
Menacing	X	
Property damage	X	
Stalking	X	
Threats	X	
Theft/Burglary	X	
Violation of court order	X	
Suspicious circumstances	X	
Warrant	X	
Assault		X
Reckless Endangerment		X

[1] Determined from offense assigned to case by police department

Table 2.2. Criteria for level of intimate partner violence (IPV) exposure for abstracted police incident report data.[1]

Characteristic of Incident	Verbal IPV	Moderate Physical IPV	Severe Physical IPV
Insult/swear at subject	X		
Threaten to hit or throw object at subject	X		
Damage/destroy subject's property	X		
Other nonphysical[2]	X		
Push/shove/grab/slap		X	
Throw object at subject		X	
Other physical[3]		X	
Kick/bite/hit with fist			X
Attempt to hit subject with object			X
Burn/choke/beat up subject			X
Threaten subject with weapon			X
Use weapon against subject			X

[1] Adapted from the Conflict Tactics Scales [25]
[2] Includes custodial interference, temporarily refused to leave or let subject leave scene, threatened to destroy subject's property, chased with car, stalking
[3] Includes abduction, caused auto accident, assaulted witness

Table 2.3. Demographic, behavioral, and obstetric history factors of study subjects by intimate partner violence (IPV) exposure.

Characteristic	No IPV (n=3090)		Any IPV (n=389)		Non-Physical IPV (n=109)		Physical IPV (n=280)	
Demographic	n	%	n	%	n	%	n	%
Race/ethnicity[1]								
Caucasian, non-Hispanic	983	31.8	123	31.6	40	36.7	83	29.6
African-American	1094	35.4	137	35.2	42	38.5	95	33.9
Hispanic	288	9.3	37	9.5	9	8.3	28	10.0
Asian	190	6.2	25	6.4	8	7.3	17	6.1
Pacific Islander	104	3.4	13	3.3	1	0.9	12	4.3
Native American	175	5.7	22	5.7	3	2.8	19	6.8
Unknown	256	8.3	32	8.2	6	5.5	26	9.3
Subject's age (in years)[1]								
<20	606	19.6	76	19.5	22	20.2	54	19.3
20-24	896	29.0	112	28.8	29	26.6	83	29.6
25-29	934	30.2	119	30.6	43	39.5	76	27.1
30-34	407	13.2	51	13.1	7	6.4	44	15.7
35-39	196	6.3	25	6.4	7	6.4	18	6.4
40+	51	1.7	6	1.5	1	0.9	5	1.8
Subject's education (in years)								
<12	502	22.6	75	28.4[2]	26	33.8[2]	49	26.2
12	734	33.0	99	37.5	28	36.4	71	38.0
>12	994	44.4	90	34.1	23	29.9	67	35.8
Marital status of infant's parents								
Married	1567	51.0	102	26.6[2]	25	23.6[2]	77	27.7[2]
Not married	1507	49.0	282	73.4	81	76.4	201	72.3
Age of infant's father (in years)								
<20	111	4.9	10	4.5	1	1.7	9	5.6
20-29	1078	47.9	116	52.5	28	47.5	88	54.3
30-39	863	38.3	74	33.5	21	35.6	53	37.2
≥40	200	8.9	21	9.5	9	15.3	12	7.4
Education of infant's father (in years)								
<12	205	12.9	33	22.0[2]	4	11.4	29	25.2[2]
12	517	32.5	64	42.7	18	51.4	46	40.0
>12	869	54.6	53	35.3	13	37.1	40	34.8
Primary payer on birth certificate								
Subsidized/no insurance/other	1543	61.7	247	79.4[2]	76	80.9[2]	171	78.8[2]
Commercial insurance	957	38.3	64	0.6	18	19.2	46	21.2
Public health benefit received[3]								
WIC	1089	35.2	192	49.4[2]	58	53.2[2]	134	47.9[2]
First Steps	503	16.3	88	22.6[2]	31	28.4[2]	57	20.4
AFDC	406	13.1	89	22.9[2]	27	24.8[2]	62	22.1[2]
Local health department	127	4.1	18	4.6	5	4.6	13	4.6
Any public health benefit received								
Yes	1180	38.2	203	52.2[2]	62	56.9[2]	141	50.4[2]
No	1910	61.8	186	47.8	47	43.1	139	49.6

Table 2.3, continued.

Characteristic	No IPV (n=3090)		Any IPV (n=389)		Non-Physical IPV[2] (n=109)		Physical IPV[2] (n=280)	
Behavioral	n	%	n	%	n	%	n	%
Smoked during pregnancy								
Yes	395	13.6	98	27.1[2]	31	30.7[2]	67	25.7[2]
No	2511	86.4	264	72.9	2970	69.3	194	74.3
Alcohol use during pregnancy								
Yes	57	2.1	20	6.0[2]	4	4.3	16	6.7[2]
No	2644	97.9	312	94.0	89	95.7	223	93.3
Initiation of prenatal care (PNC)								
First trimester	1920	77.6	215	69.8	63	68.5	152	70.4
Second trimester	411	16.6	67	21.8	19	20.7	48	22.2
Third trimester or none	144	5.8	26	8.4	10	10.9	16	7.4
Inadequate receipt of PNC[4]								
Yes	169	7.5	37	13.2[2]	8	10.4	29	14.3[2]
No	2089	92.5	243	86.8	69	89.6	174	85.7
Inadequate PNC utilization[5]								
Yes	409	18.1	76	27.1[2]	21	27.3[2]	55	27.1[2]
No	1849	81.9	204	72.9	56	72.7	148	72.9
Obstetric History								
Parity								
0	1501	51.0	136	36.5[2]	39	36.8[2]	97	36.3[2]
1	844	28.7	102	27.3	24	22.6	78	29.2
≥2	599	20.4	135	36.2	43	40.6	92	34.5
Previous spontaneous abortion								
Yes	536	18.2	96	25.7[2]	23	21.7	73	27.3[2]
No	2406	81.8	277	74.3	83	78.3	194	72.7
Previous induced abortion								
Yes	691	23.5	125	33.5[2]	32	30.2	93	34.8[2]
No	2252	76.5	248	66.5	74	69.8	174	65.2
Previous fetal death (≥20 wks)								
Yes	55	1.9	15	4.0[2]	2	1.9	13	4.9[2]
No	2885	98.1	358	96.0	104	98.1	254	95.1

[1] Exposed and unexposed subjects frequency matched on race/ethnicity and five-year age groups.
[2] Pearson's chi square $p<.05$ comparing IPV type to no IPV
[3] WIC=Special Supplemental Nutrition Program for Women, Infants and Children; First Steps= expanded Medicaid program for pregnant women, AFDC=Aid to Families with Dependent Children; Local Health Department=prenatal care received at health department clinic
[4] Less than 50% of expected visits once prenatal care begun
[5] Late initiation of prenatal care or less than 50% of total expected prenatal care visits received (summary index)

Table 2.4. Characteristics of police-reported intimate partner violence (IPV) during pregnancy, Seattle, Washington 1995-1998.[1]

Characteristic of Incident or Subject-IPV partner	n	%
Level of IPV[2]		
Nonphysical (verbal or psychological) abuse only	109	28.0
Physical violence	280	72.0
Weapon use against subject		
Gun	4	1.0
Knife	7	1.8
None	218	56.0
Unknown/none stated	160	41.1
Type of injury to subject		
No complaint	57	14.7
Complaint – injury not visible	62	15.9
Complaint – minor injury visible	133	34.2
Complaint – serious injury visible	12	3.1
Unknown/data missing	125	32.1
Medical Treatment of subject		
None/refused	174	44.7
Personal physician	11	2.8
Treated at scene	16	4.1
Transported to hospital	27	6.9
Unknown/data missing	161	41.4
Relationship type[3]		
Child in common	57	14.7
Dating/engaged	241	62.0
Divorced	11	2.8
Married	80	20.6
Cohabitation at time of incident		
Yes	178	45.8
No	211	54.2
IPV partner under influence of alcohol or other drugs		
Yes	38	9.8
No	351	90.2
Subject under influence of alcohol or other drugs		
Yes	10	2.6
No	379	97.4
Subject noted to be pregnant at incident		
Yes	103	26.5
No	286	73.5

Table 2.4, continued.

Characteristic of Incident or Subject-IPV partner	n	%
IPV partner relationship to subsequent offspring		
Father of child on birth/fetal death certificate[4]	200	51.4
Not father of child on birth/fetal death certificate	31	8.0
Father not listed on birth/fetal death certificate	158	40.6

[1] Based on computerized police records
[2] Determined from offense assigned to case by police department; see Table 2.1.
[3] Child in common: previous child in common and not dating, engaged, divorced, or married; dating/engaged: previous or current relationship at time of incident.
[4] Includes 2 cases linked to birth certificate in part using perpetrator's last name

Table 2.5. Characteristics of police-reported intimate partner violence (IPV) during pregnancy abstracted from incident reports, Seattle, Washington 1995-1998.

Characteristic of IPV incident	n	%
Level of IPV[1]		
Verbal abuse only	51	22.1
Moderate physical violence	71	30.7
Severe physical violence	109	47.2
Unknown (records not available for abstraction)	(158)	
Weapon use against subject		
Gun	7	3.0
Knife	7	3.0
Other weapon	6	2.6
None/none stated	211	91.3
Physical evidence of injury to subject		
Yes	93	43.3
No	122	56.7
(Unknown/not stated)	(16)	
Location of injury[2]		
Head/neck	73	34.0
Torso (back/chest)	28	13.0
Abdomen	10	4.7
Extremities	44	20.5
(Unknown/not stated)	(1)	
Medical care sought by subject after police response		
Yes	34	79.1
No	9	20.9
(Unknown/not stated)	(188)	
Relationship type at time of incident		
Dating/boyfriend-girlfriend	127	56.2
Divorced/Separated/Ex-partner	51	22.6
Married	48	21.2
(Unknown/not stated)	(5)	
Previous child in common		
Yes	61	91.0
No	6	9.0
(Unknown/not stated)	(164)	

Table 2.5, continued.

Characteristic of IPV incident	n	%
Cohabitation at time of incident		
Yes	101	54.9
No	83	45.1
(Unknown/not stated)	47	
Length of relationship		
<12 months	39	28.3
12-59 months	74	53.6
>59 months	25	18.1
(Unknown/not stated)	(93)	
History of IPV with IPV partner		
Yes	105	86.8
No	16	13.2
(Unknown/not stated)	(110)	
Children present during incident		
Yes	56	54.4
No	47	45.6
(Unknown/not stated)	(128)	

[1] See Table 2.2 for criteria of IPV categories

[2] More than one injury site could be recorded per incident; % represents frequency of injury location among cases with physical evidence of injury (n=215)

Table 2.6. The association between adverse neonatal outcomes and any police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV		No IPV		cOR[1]		aOR[2]		aOR[3]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Low birth weight (<2500 grams)	46	12.0	198	6.5	1.96	(1.39, 2.75)	1.70	(1.20, 2.40)[5]	1.70	(1.20, 2.40)[6]
Very low birth weight (<1500 grams)	13	3.7	36	1.2	3.04	(1.60, 5.79)	2.54	1.32, 4.91)[5]	2.54	1.32, 4.91)[6]
Spontaneous preterm birth (<37 weeks gestation)	33	11.4	167	7.8	1.53	(1.03 2.28)	1.53	(1.03 2.28)[7]	1.53	(1.03 2.28)[6]
All preterm birth (<37 weeks gestation)	45	15.6	222	10.3	1.61	(1.14, 2.28)	1.61	(1.14, 2.28)[7]	1.61	(1.14, 2.28)[6]
Very preterm birth (<32 weeks gestation)	12	4.7	28	1.4	3.40	(1.71, 6.78)	3.53	(1.72, 7.22)[8]	3.14	(1.50, 6.56)[9]
Small for gestational age[4]	39	13.6	240	11.2	1.24	(0.86, 1.79)	1.24	(0.86, 1.79)[7]	1.12	(0.77, 1.62)[10]
Infant death (prior to hospital discharge)	8	2.1	15	0.5	4.30	(1.81, 10.22)	3.18	(1.32, 7.63)[5]	3.18	(1.32, 7.63)[6]
Fetal death (≥20 weeks gestation)	1	0.3	18	0.6	0.44	(0.06, 3.30)	0.36	(0.05, 2.75)[11]	0.29	(0.04, 2.26)[12]

[1] Crude odds ratio and 95% confidence interval for outcome comparing any IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group

[2] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated

[3] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors

[4] Small for gestational age: <10th percentile gestational weight for age based on 1989-1998 Washington State birth data

[5] Adjusted for marital status

[6] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio

[7] Adjustment for demographic factors did not substantially alter the odds ratio

[8] Adjusted for age group of infant's father and any public health benefits received during pregnancy

[9] Adjusted for age group of infant's father, any benefits received, and parity

[10] Adjusted for any smoking during pregnancy

[11] Adjusted for age group of infant's father

[12] Adjusted for age group of infant's father and any alcohol use during pregnancy

Table 2.7. The association between adverse neonatal outcomes and physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Low birth weight (<2500 grams)	32	11.6	198	6.5	**1.88**	**(1.27, 2.80)**	**1.67**	**(1.12, 2.49)**[6]	**1.67**	**(1.12, 2.49)**[7]
Very low birth weight (<1500 grams)	10	3.9	36	1.2	**3.24**	**(1.59, 6.60)**	**2.78**	**(1.35, 5.74)**[6]	**2.78**	**(1.35, 5.74)**[7]
Spontaneous preterm birth (<37 weeks gestation)	22	10.8	167	7.8	1.44	(0.90 2.30)	1.44	(0.90 2.30)[8]	1.44	(0.90 2.30)[7]
All preterm birth (<37 weeks gestation)	30	14.7	222	10.3	*1.50*	*(1.00, 2.27)*	*1.50*	*(1.00, 2.27)*[8]	*1.50*	*(1.00, 2.27)*[7]
Very preterm birth (<32 weeks gestation)	9	4.9	28	1.4	**3.58**	**(1.66, 7.70)**	**3.87**	**(1.75, 8.58)**[9]	**3.40**	**(1.51, 7.65)**[10]
Small for gestational age[5]	28	13.8	240	11.2	1.27	(0.83, 1.93)	1.27	(0.83, 1.93)[8]	1.27	(0.83, 1.93)[7]
Infant death (prior to hospital discharge)	5	1.8	15	0.5	**3.73**	**(1.34, 10.33)**	**2.85**	**(1.02, 7.98)**[6]	**2.85**	**(1.02, 7.98)**[7]
Fetal death (≥20 weeks gestation)	1	0.4	18	0.6	0.61	(0.08, 4.60)	0.52	(0.07, 3.93)[11]	0.40	(0.05, 3.09)[12]

1 Exposure determined from offense assigned to case by police department using computerized police records; see Table 2.1.
2 Crude odds ratio and 95% confidence interval for outcome comparing any IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
3 Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
4 Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors.
5 Small for gestational age: <10th percentile gestational weight for age based on 1989-1998 Washington State birth data
6 Adjusted for marital status
7 Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
8 Adjustment for demographic factors did not substantially alter the odds ratio
9 Adjusted for age group of infant's father and any public health benefits received during pregnancy
10 Adjusted for age group of infant's father, any benefits received, and any smoking during pregnancy
11 Adjusted for age group of infant's father
12 Adjusted for age group of infant's father and any alcohol use during pregnancy

Table 2.8. The association between adverse neonatal outcomes and non-physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Low birth weight (<2500 grams)	14	13.0	198	6.5	**2.15**	**(1.20, 3.84)**	1.76	(0.98, 3.19)[6]	1.58	(0.87, 2.88)[7]
Very low birth weight (<1500 grams)	3	3.1	36	1.2	2.53	(0.77, 8.37)	1.98	(0.58, 6.73)[6]	1.74	(0.50, 6.02)[7]
Spontaneous preterm birth (<37 weeks gestation)	11	12.9	167	7.8	1.77	(0.92, 3.40)	1.77	(0.92, 3.40)[8]	1.77	(0.92, 3.40)[9]
All preterm birth (<37 weeks gestation)	15	17.7	222	10.3	**1.87**	**(1.05, 3.32)**	1.65	(0.91, 2.98)[6]	1.65	(0.91, 2.98)[9]
Very preterm birth (<32 weeks gestation)	3	4.1	28	1.4	2.96	(0.88, 9.98)	2.70	(0.78, 9.33)[10]	2.00	(0.55, 7.23)[11]
Small for gestational age[5]	11	13.1	240	11.2	1.19	(0.62, 2.28)	1.05	(0.55, 2.04)[6]	0.95	(0.48, 1.85)[12]
Infant death (prior to hospital discharge)	3	2.8	15	0.5	**5.80**	**(1.65, 20.34)**	**3.80**	**(1.06, 13.65)**[6]	3.27	(0.87, 12.27)[7]
Fetal death (≥20 weeks gestation)	0	0.0	18	0.6	...[13]	...	...	...	...	...

[1] Exposure determined from offense assigned to case by police department using computerized police records; see Table 2.1.
[2] Crude odds ratio and 95% confidence interval for outcome comparing any IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Small for gestational age: <10th percentile gestational weight for age based on 1989-1998 Washington State birth data
[6] Adjusted for marital status
[7] Adjusted for marital status and parity
[8] Adjustment for demographic factors did not substantially alter the odds ratio
[9] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[10] Adjusted for age group of infant's father and any public health benefits received during pregnancy
[11] Adjusted for age group of infant's father, any benefits received, parity, and any alcohol use during pregnancy
[12] Adjusted for marital status and any smoking during pregnancy
[13] ... Indicates insufficient data to model

Table 2.9. The association between adverse neonatal outcomes and severe physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Low birthweight (<2500 grams)	12	11.3	198	6.5	*1.84*	*(0.99, 3.42)*	1.59	(0.85, 2.97)[6]	1.59	(0.85, 2.97)[7]
Very low birthweight (<1500 grams)	3	3.1	36	1.2	2.53	(0.77, 8.37)	2.11	(0.63, 7.06)[6]	2.11	(0.63, 7.06)[7]
Spontaneous preterm birth (<37 weeks gestation)	5	6.3	167	7.8	0.80	(0.32 2.01)	0.80	(0.32 2.01)[8]	0.80	(0.32 2.01)[7]
All preterm birth (<37 weeks gestation)	9	11.4	222	10.3	1.12	(0.55, 2.28)	1.12	(0.55, 2.28)[8]	1.12	(0.55, 2.28)[7]
Very preterm birth (<32 weeks gestation)	1	1.4	28	1.4	0.99	(0.13, 7.37)	0.86	(0.12, 6.48)[9]	0.69	(0.09, 5.31)[10]
Small for gestational age[5]	14	18.0	240	11.2	*1.73*	*(1.00, 3.13)*	1.55	(0.85, 2.83)[6]	1.55	(0.85, 2.83)[7]
Infant death (prior to hospital discharge)	2	1.8	15	0.5	3.83	(0.87, 16.97)	2.73	(0.61, 12.18)[6]	2.73	(0.61, 12.18)[7]
Fetal death (≥20 weeks gestation)	0	0.0	18	0.6	…[11]	…	…	…	…	…

[1] Exposure based on abstracted police incident reports; see Table 2.2 for exposure criteria
[2] Crude odds ratio and 95% confidence interval for outcome comparing severe physical IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Small for gestational age: <10th percentile gestational weight for age based on 1989-1998 Washington State birth data
[6] Adjusted for marital status
[7] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[8] Adjustment for demographic factors did not substantially alter the odds ratio
[9] Adjusted for educational level of infant's father
[10] Adjusted for educational level of infant's father and any smoking during pregnancy
[11] … Indicates insufficient data to model

Table 2.10. The association between adverse neonatal outcomes and moderate physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	n	%	n	%	OR	(CI)	OR	(CI)	OR	(CI)
Low birth weight (<2500 grams)	8	11.3	198	6.5	1.83	(0.87, 3.88)	1.64	(0.77, 3.49)[6]	1.64	(0.77, 3.49)[7]
Very low birth weight (<1500 grams)	4	6.0	36	1.2	**5.04**	**(1.74, 14.58)**	**6.05**	**(2.04, 17.92)**[8]	**6.05**	**(2.04, 17.92)**[7]
Spontaneous preterm birth (<37 weeks gestation)	7	11.5	167	7.8	1.54	(0.69 3.44)	1.70	(0.76, 3.81)[8]	1.70	(0.76, 3.81)[7]
All preterm birth (<37 weeks gestation)	11	18.0	222	10.3	*1.92*	*(0.98, 3.74)*	*1.92*	*(0.98, 3.74)*[9]	*1.92*	*(0.98, 3.74)*[7]
Very preterm birth (<32 weeks gestation)	4	7.4	28	1.4	**5.53**	**(1.87, 16.37)**	**6.38**	**(2.13, 19.14)**[10]	**5.93**	**(1.92, 18.34)**[11]
Small for gestational age[5]	8	13.1	240	11.2	1.19	(0.56, 2.54)	1.19	(0.56, 2.54)[9]	1.19	(0.56, 2.54)7
Infant death (prior to hospital discharge)	0	0.0	15	0.5	…[12]	…	…	…	…	…
Fetal death (≥20 weeks gestation)	1	1.4	18	0.6	2.44	(0.32, 18.52)	2.44	(0.32, 18.52)[9]	2.88	(0.37, 22.23)[13]

[1] Exposure based on abstracted police incident reports; see Table 2.2 for exposure criteria
[2] Crude odds ratio and 95% confidence interval for outcome comparing moderate physical IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Small for gestational age: <10^{th} percentile gestational weight for age based on 1989-1998 Washington State birth data
[6] Adjusted for marital status
[7] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[8] Adjusted for primary payer on birth certificate
[9] Adjustment for demographic factors did not substantially alter the odds ratio
[10] Adjusted for any public health benefits received during pregnancy
[11] Adjusted for any benefits received, previous induced abortion, and any alcohol use during pregnancy
[12] … Indicates insufficient data to model
[13] Adjusted for previous spontaneous abortion

Table 2.11. The association between adverse neonatal outcomes and verbal police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	n	%	n	%	OR	(CI)	OR	(CI)	OR	(CI)
Low birth weight (<2500 grams)	4	7.8	198	6.5	1.23	(0.44, 3.44)	1.05	(0.37, 2.97)[6]	0.86	(0.30, 2.46)[7]
Very low birth weight (<1500 grams)	0	0.0	36	1.2	…[8]	…	…	…	…	…
Spontaneous preterm birth (<37 weeks gestation)	3	7.9	167	7.8	1.02	(0.31, 3.35)	1.02	(0.31, 3.35)[9]	1.02	(0.31, 3.35)[10]
All preterm birth (<37 weeks gestation)	4	10.5	222	10.3	1.03	(0.36, 2.92)	0.92	(0.32, 2.64)[11]	0.92	(0.32, 2.64)[10]
Very preterm birth (<32 weeks gestation)	0	0.0	28	1.4	…	…	…	…	…	…
Small for gestational age[5]	5	13.2	240	11.2	1.20	(0.46, 3.10)	1.20	(0.46, 3.10)[9]	0.92	(0.35, 2.42)[12]
Infant death (prior to hospital discharge)	0	0.0	15	0.5	…	….	…	…	…	…
Fetal death (≥20 weeks gestation)	0	0.0	18	0.6	…	…	…	….	…	….

1 Exposure based on abstracted police incident reports; see Table 2.2 for exposure criteria
2 Crude odds ratio and 95% confidence interval for outcome comparing verbal IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
3 Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
4 Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
5 Small for gestational age: <10th percentile gestational weight for age based on 1989-1998 Washington State birth data
6 Adjusted for marital status
7 Adjusted for marital status and any smoking during pregnancy
8 … Indicates insufficient data to model
9 Adjustment for demographic factors did not substantially alter the odds ratio
10 Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
11 Adjusted for age group of infant's father
12 Adjusted for any smoking during pregnancy

Table 2.12. The association between adverse maternal outcomes and any police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV		No IPV		cOR[1]		aOR[2]		aOR[3]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Hospitalized during pregnancy[4]	62	15.9	227	7.4	**2.39**	**(1.77, 3.24)**	**2.39**	**(1.77, 3.24)**[6]	**2.39**	**(1.77, 3.24)**[7]
Pregnancy-related	57	14.8	210	6.8	**2.38**	**(1.74, 3.25)**	**2.38**	**(1.74, 3.25)**[6]	**2.38**	**(1.74, 3.25)**[7]
Nonpregnancy-related	5	1.5	17	0.6	*2.58*	*(0.94, 7.03)*	2.15	(0.78,5.96)[8]	2.15	(0.78, 5.96)[7]
Substance abuse-related	24	6.8	52	1.8	**4.04**	**(2.46, 6.64)**	**2.97**	**(1.78, 4.96)**[9]	**2.09**	**(1.22, 3.59)**[10]
Mental health-related	17	4.9	41	1.4	**3.63**	**(2.04, 6.46)**	**2.92**	**(1.62, 5.24)**[8]	*1.79*	*(0.95, 3.37)*[11]
No. Hospitalizations[5]										
1	48	12.3	179	5.8	**2.35**	**(1.67, 3.29)**†	‡		‡	
2	9	2.3	33	1.1	**2.39**	**(1.13, 5.03)**				
≥3	5	1.3	15	0.5	**2.92**	**(1.05, 8.08)**				
Premature rupture of membranes	12	3.2	74	2.5	1.27	(0.68, 2.35)	1.27	(0.68, 2.35)[6]	1.43	(0.76, 2.67)[12]
Preeclampsia	13	3.4	141	4.8	0.70	(0.39, 1.24)	0.70	(0.39, 1.24)[6]	0.70	(0.39, 1.24)[7]
Abruptio placenta	4	1.1	16	0.5	1.95	(0.65, 5.87)	1.26	(0.36, 4.41)[13]	1.26	(0.36, 4.41)[7]
Antepartum bleeding	6	1.5	44	1.4	1.08	(0.46, 2.56)	1.08	(0.46, 2.56)[6]	1.08	(0.46, 2.56)[7]

[1] Crude odds ratio and 95% confidence interval for outcome comparing any IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[2] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[3] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[4] Any number of hospitalizations not associated with delivery compared to no hospitalization; subcategories of hospitalization compared to non-hospitalized subjects. Categories not mutually exclusive (except pregnancy and nonpregnancy-related)
[5] Number of hospitalizations during pregnancy not associated with delivery compared to no hospitalization
[6] Adjustment for demographic factors did not substantially alter the odds ratio
[7] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[8] Adjusted for marital status
[9] Adjusted for marital status and age group of infant's father
[10] Adjusted for marital status, age group of infant's father, any smoking during pregnancy, and parity
[11] Adjusted for marital status, any smoking or alcohol use during pregnancy, and parity
[12] Adjusted for parity
[13] Adjusted for marital status and educational level of infant's father
† Test for linear trend p<.001
‡ Adjusted OR not calculated

Table 2.13. The association between adverse maternal outcomes and physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	n	%	n	%	OR	(CI)	OR	(CI)	OR	(CI)
Hospitalized during pregnancy[5]	50	17.9	227	7.4	**2.74**	**(1.96, 3.83)**	**2.74**	**(1.96, 3.83)**[7]	**2.74**	**(1.96, 3.83)**[8]
Pregnancy-related	46	16.7	210	6.8	**2.73**	**(1.93, 3.85)**	**2.73**	**(1.93, 3.85)**[7]	**2.73**	**(1.93, 3.85)**[8]
Nonpregnancy-related	4	1.7	17	0.6	*2.93*	*(0.98, 8.78)*	2.32	(0.77, 7.03)[9]	2.32	(0.77, 7.03)[8]
Substance abuse-related	20	8.0	52	1.8	**4.79**	**(2.81, 8.16)**	**3.80**	**(2.21, 6.52)**[10]	**2.70**	**(1.52, 4.78)**[11]
Mental health-related	13	5.4	41	1.4	**3.95**	**(2.09, 7.47)**	**3.15**	**(1.65, 6.01)**[10]	*1.93*	*(0.96, 3.91)*[12]
No. Hospitalizations[6]										
1	36	12.9	179	5.8	**2.50**	**(1.71, 3.67)**†	‡		‡	
2	9	3.2	33	1.1	**3.39**	**(1.60, 7.18)**				
≥3	5	1.8	15	0.5	**4.15**	**(1.49, 11.52)**				
Premature rupture of membranes	5	1.8	74	2.5	0.73	(0.29, 1.82)	0.73	(0.29, 1.82)[7]	0.85	(0.34, 2.14)[13]
Preeclampsia	10	3.6	141	4.8	0.75	(0.39, 1.44)	0.75	(0.39, 1.44)[7]	0.75	(0.39, 1.44)[8]
Abruptio placenta	1	0.4	16	0.5	0.68	(0.09, 5.14)	0.56	(0.07, 4.28)[9]	0.56	(0.07, 4.28)[8]
Antepartum bleeding	3	1.1	44	1.4	0.75	(0.23, 2.43)	0.75	(0.23, 2.43)[7]	0.75	(0.23, 2.43)[8]

[1] Exposure determined from offense assigned to case by police department using computerized police records; see Table 2.1.
[2] Crude odds ratio and 95% confidence interval for outcome comparing any IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Any number of hospitalizations not associated with delivery compared to no hospitalization; subcategories of hospitalization compared to non-hospitalized subjects. Categories not mutually exclusive (except pregnancy and nonpregnancy-related)
[6] Number of hospitalizations during pregnancy not associated with delivery compared to no hospitalization
[7] Adjustment for demographic factors did not substantially alter the odds ratio
[8] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[9] Adjusted for age group of infant's father
[10] Adjusted for marital status
[11] Adjusted for marital status, any smoking during pregnancy, and parity
[12] Adjusted for marital status, any smoking or alcohol use during pregnancy, and parity
[13] Adjusted for parity
† Test for linear trend p<.001
‡ Adjusted OR not calculated

Table 2.14. The association between adverse maternal outcomes and non-physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Hospitalized during pregnancy[5]	12	11.1	227	7.4	1.56	(0.84, 2.89)	1.35	(0.73, 2.51)[7]	1.19	(0.63, 2.23)[8]
Pregnancy-related	11	10.2	210	6.8	1.55	(0.82, 2.93)	1.34	(0.70, 2.56)[7]	1.19	(0.62, 2.28)[8]
Nonpregnancy-related	1	1.0	17	0.6	1.74	(0.23, 13.18)	1.37	(0.18, 10.44)[9]	1.37	(0.18, 10.44)[10]
Substance abuse-related	4	4.0	52	1.8	2.27	(0.80, 6.40)	1.58	(0.55, 4.49)[7]	0.81	(0.26..2.48)[11]
Mental health-related	4	4.0	41	1.4	**2.88**	**(1.01, 8.20)**	2.15	(0.75, 6.17)[7]	1.37	(0.46, 4.08)[11]
No. Hospitalizations[6]										
1	12	11.0	179	5.8	**1.98**	**(1.07, 3.67)†**	‡		‡	
2	0	0.0	33	1.1	...[11]	...				
≥3	0	0.0	15	0.5	...	...				
Premature rupture of membranes	7	6.4	74	2.5	**2.67**	**(1.20, 5.95)**	**2.67**	**(1.20, 5.95)**[13]	**3.00**	**(1.34, 6.76)**[14]
Preeclampsia	3	2.8	141	4.8	0.57	(0.18, 1.81)	0.49	(0.15, 1.59)[7]	0.49	(0.15, 1.59)[10]
Abruptio placenta	3	2.8	16	0.5	**5.20**	**(1.49, 18.13)**	**4.81**	**(1.35, 17.16)**[15]	**4.81**	**(1.35, 17.16)**[10]
Antepartum bleeding	3	2.8	44	1.4	1.96	(0.60, 6.40)	1.96	(0.60, 6.40)[13]	1.67	(0.50, 5.51)[14]

[1] Exposure determined from offense assigned to case by police department using computerized police records; see Table 2.1.
[2] Crude odds ratio and 95% confidence interval for outcome comparing nonphysical IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Any number of hospitalizations not associated with delivery compared to no hospitalization; subcategories of hospitalization compared to non-hospitalized subjects. Categories not mutually exclusive (except pregnancy and nonpregnancy-related)
[6] Number of hospitalizations during pregnancy not associated with delivery compared to no hospitalization
[7] Adjusted for marital status
[8] Adjusted for marital status and parity
[9] Adjusted for primary payer on birth certificate
[10] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[11] Adjusted for marital status, any smoking during pregnancy, and parity
[12] ... Indicates insufficient data to analyze
[13] Adjustment for demographic factors did not substantially alter the odds ratio
[14] Adjusted for parity
[15] Adjusted for age group of infant's father and any public health benefits received during pregnancy
† Test for linear trend p<.01
‡ Adjusted OR not calculated

Table 2.15. The association between adverse maternal outcomes and severe physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Hospitalized during pregnancy[5]	17	15.6	227	7.4	**2.33**	**(1.37, 3.98)**	**2.07**	**(1.21, 3.55)**[7]	**1.81**	**(1.05, 3.13)**[8]
Pregnancy-related	15	14.0	210	6.8	**2.22**	**(1.27, 3.90)**	**1.98**	**(1.12..3.50)**[7]	*1.74*	*(0.98, 3.08)*[8]
Nonpregnancy-related	2	2.1	17	0.6	3.66	(0.83, 16.08)	2.85	(0.64, 12.68)[9]	2.85	(0.64, 12.68)[10]
Substance abuse-related	7	7.1	52	1.8	**4.19**	**(1.85, 9.47)**	**3.10**	**(1.36, 7.08)**[7]	**2.37**	**(1.02, 5.50)**[8]
Mental health-related	5	5.2	41	1.4	**3.80**	**(1.47, 9.83)**	**2.84**	**(1.09, 7.43)**[7]	1.79	(0.63, 5.06)[11]
No. Hospitalizations[6]										
1	12	11.0	179	5.8	**2.09**	**(1.12, 3.88)** †	‡		‡	
2	3	2.8	33	1.1	2.83	(0.85, 9.39)				
≥3	2	1.8	15	0.5	4.15	(0.94, 18.41)				
Premature rupture of membranes	0	0.0	74	2.5	...[12]	...	...	...	...	...
Preeclampsia	4	3.7	141	4.8	0.77	(0.28, 2.12)	0.77	(0.28, 2.12)[13]	0.87	(0.31, 2.41)[14]
Abruptio placenta	0	0.0	16	0.5	...	...	...	...	...	...
Antepartum bleeding	0	0.0	44	1.4	...	...	...	...	...	...

[1] Exposure based on abstracted police incident reports; see Table 2.2 for exposure criteria
[2] Crude odds ratio and 95% confidence interval for outcome comparing severe physical IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age groups
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Any number of hospitalizations not associated with delivery compared to no hospitalization; subcategories of hospitalization compared to non-hospitalized subjects. Categories not mutually exclusive (except pregnancy and nonpregnancy-related)
[6] Number of hospitalizations during pregnancy not associated with delivery compared to no hospitalization
[7] Adjusted for marital status
[8] Adjusted for marital status and parity
[9] Adjusted for father's age group
[10] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[11] Adjusted for marital status, any alcohol use during pregnancy, and parity
[12] ... Indicates insufficient data to model
[13] Adjustment for demographic factors did not substantially alter the odds ratio
[14] Adjusted for parity
† Test for linear trend p>.05
‡ Adjusted OR not calculated

Table 2.16. The association between adverse maternal outcomes and moderate physical police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Hospitalized during pregnancy[5]	11	15.5	227	7.4	**2.31**	**(1.20, 4.46)**	**2.31**	**(1.20, 4.46)**[7]	**2.31**	**(1.20, 4.46)**[8]
Pregnancy-related	10	14.3	210	6.8	**2.27**	**(1.15, 4.50)**	**2.27**	**(1.15, 4.50)**[7]	**2.05**	**(1.03, 4.07)**[9]
Nonpregnancy-related	1	1.6	17	0.6	2.81	(0.37, 21.43)	2.17	(0.28, 16.75)[10]	2.50	(0.32, 19.54)[11]
Substance abuse-related	2	3.2	52	1.8	1.84	(0.44, 7.71)	1.37	(0.32, 5.82)[12]	1.12	(0.25, 5.05)[13]
Mental health-related	1	1.6	41	1.4	1.16	(0.16, 8.60)	0.89	(0.12..6.63)[12]	0.68	(0.09, 5.34)[14]
No. Hospitalizations[6]										
1	8	11.3	179	5.8	**2.13**	**(1.00, 4.53)** †	‡		‡	
2	1	1.4	33	1.1	1.45	(0.19, 10.75)				
≥3	2	2.8	15	0.5	6.36	(1.42., 28.44)				
Premature rupture of membranes	5	7.3	74	2.5	**3.04**	**(1.19, 7.79)**	**3.04**	**(1.19, 7.79)**[7]	**3.04**	**(1.19, 7.79)**[8]
Preeclampsia	1	1.4	141	4.8	0.29	(0.04, 2.10)	0.29	(0.04, 2.10)[7]	0.29	(0.04, 2.10)[8]
Abruptio placenta	2	2.9	16	0.5	**5.49**	**(1.24, 24.35)**	**5.49**	**(1.24, 24.35)**[7]	**6.38**	**(1.41, 28.85)**[9]
Antepartum bleeding	3	4.2	44	1.4	3.05	(0.23, 10.07)	3.05	(0.23, 10.07)[7]	3.05	(0.23, 10.07)[8]

[1] Exposure based on abstracted police incident reports; see Table 2.2 for exposure criteria
[2] Crude odds ratio and 95% confidence interval for outcome comparing moderate physical IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Any number of hospitalizations not associated with delivery compared to no hospitalization; subcategories of hospitalization compared to non-hospitalized subjects. Categories not mutually exclusive (except pregnancy and nonpregnancy-related)
[6] Number of hospitalizations during pregnancy not associated with delivery compared to no hospitalization
[7] Adjustment for demographic factors did not substantially alter the odds ratio
[8] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[9] Adjusted for previous spontaneous abortion
[10] Adjusted for marital status and primary payer on birth certificate
[11] Adjusted for marital status, primary payer on birth certificate, and previous spontaneous abortion
[12] Adjusted for marital status
[13] Adjusted for marital status, any smoking during pregnancy, parity, and late or no prenatal care
[14] Adjusted for marital status, any smoking during pregnancy, previous spontaneous abortion, parity, and late or no prenatal care
† Test for trend $p<.05$
‡ Adjusted OR not calculated

Table 2.17. The association between adverse maternal outcomes and verbal police-reported intimate partner violence during pregnancy, Seattle, Washington 1995-1998.

	IPV[1]		No IPV		cOR[2]		aOR[3]		aOR[4]	
Outcome	**n**	**%**	**n**	**%**	**OR**	**(CI)**	**OR**	**(CI)**	**OR**	**(CI)**
Hospitalized during pregnancy[5]	5	9.8	227	7.4	1.37	(0.54, 3.48)	1.21	(0.47, 3.10)[7]	1.05	(0.41, 2.71)[8]
Pregnancy-related	4	8.0	210	6.8	1.19	(0.42, 3.32)	1.05	(0.37, 2.96)[7]	0.91	(0.32, 2.59)[8]
Nonpregnancy-related	1	2.1	17	0.6	3.66	(0.47, 28.09)	2.62	(0.33, 20.53)[9]	2.62	(0.33, 20.53)[10]
Substance abuse-related	1	2.1	52	1.8	1.20	(0.16, 8.84)	0.87	(0.12, 6.50)[7]	0.37	(0.05,.2.95)[11]
Mental health-related	2	4.2	41	1.4	3.04	(0.71, 12.93)	2.29	(0.53, 9.85)[7]	1.07	(0.23, 5.11)[12]
No. Hospitalizations[6]										
1	5	9.8	179	5.8	1.74	(0.68, 4.43)	†		†	
2	0	0.0	33	1.1	...[13]	...				
≥3	0	0.0	15	0.5	...	...				
Premature rupture of membranes	3	5.9	74	2.5	2.44	(0.74, 8.00)	2.74	(0.83, 9.06)[14]	3.03	(0.90, 10.13)[15]
Preeclampsia	0	0.0	141	4.8	...	...	...	...	...	...
Abruptio placenta	0	0.0	16	0.5	...	...	...	...	...	...
Antepartum bleeding	0	0.0	44	1.4	...	...	...	...	...	...

[1] Exposure based on abstracted police incident reports; see Table 2.2 for exposure criteria
[2] Crude odds ratio and 95% confidence interval for outcome comparing verbal IPV to no IPV; exposed and unexposed subjects frequency matched on maternal race/ethnicity and age group
[3] Adjusted odds ratio and 95% confidence interval: adjusted for demographic factors as indicated
[4] Adjusted odds ratio and 95% confidence interval: adjusted for behavioral and obstetric risk factors as indicated after adjustment for demographic factors
[5] Any number of hospitalizations not associated with delivery compared to no hospitalization; subcategories of hospitalization compared to non-hospitalized subjects. Categories not mutually exclusive (except pregnancy and nonpregnancy-related)
[6] Number of hospitalizations during pregnancy not associated with delivery compared to no hospitalization
[7] Adjusted for marital status
[8] Adjusted for marital status and smoking
[9] Adjusted for father's age group and primary payer on birth certificate
[10] Adjustment for behavioral and obstetric risk factors did not substantially alter the odds ratio
[11] Adjusted for marital status, any smoking during pregnancy, and parity
[12] Adjusted for marital status, any smoking or alcohol use during pregnancy, and parity
[13] ... Indicates insufficient data to model
[14] Adjusted for age group of infant's father
[15] Adjusted for age group of infant's father and any smoking during pregnancy
† Adjusted OR not calculated

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Appendix A: Matching criteria used to link police incident files with birth and fetal death certificate files

Criteria	Code	n	%	Cumulative %
Maiden + M fname + M mname + DOB	1	213	54.76	54.76
Maiden + M fname + M mname(missing) + DOB	2	59	15.17	69.92
Maiden(5) + M fname(3) + DOB	3	6	1.54	71.47
DOB + Maiden + M fname +M mname + DOB	11	9	2.31	73.78
DOB + Maiden + M mname	12	13	3.34	77.12
DOB + Maiden(3) + M fname + M mname	13	7	1.80	78.92
DOB + Maiden + M fname + M mname(different)	14	2	0.51	79.43
Maiden + M fname + DOB (within 1 day)	22	6	1.54	80.98
Maiden + M fname + DOB (year) + DOB (month)	23	6	1.54	82.52
Maiden + M fname + DOB (year) + DOB (day)	24	2	0.51	83.03
Maiden + M fname + DOB (month) + DOB (year)	25	5	1.29	84.32
DOB + F lname + M fname+ M mname	51	33	8.48	92.80
F lname + M fname + M mname(missing) + DOB	52	12	3.08	95.89
F lname(5) + M fname(3) + DOB	53	11	2.83	98.71
DOB + F lname + M mname	62	1	0.26	98.97
F lname + M fname + DOB (month) + DOB (year)	75	2	0.51	99.49
DOB + Maiden(3) + lname of intimate partner	114	2	0.51	100.00

NOTE: Maiden=subject's maiden name; M= mother (subject); F= father of infant; fname=first name; mname=middle name; lname=last name; DOB=date of birth; numbers in ( )=first (number) of characters in name

Vita

Sherry Lipsky obtained a Physician's Assistant certificate from Medex Northwest in 1976 and subsequently worked as a physician's assistant for several years in women's, community, and public health. During this time, she earned a Bachelor of Science degree from the University of Washington, Seattle in 1980 and a Master of Public Health in Health Services, International Health from the University of Washington in 1989. After working for several years in public health epidemiology, she earned a Doctor of Philosophy from the Department of Epidemiology at the University of Washington in 2002.