Unfinished Lives: The effect of domestic violence on neonatal and infant mortality

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Abstract

India accounts for 1.7 million child deaths, a quarter of global child mortality. The current literature has succeeded in establishing an association between domestic violence and child mortality, but has yet to present evidence of a causal relationship. In this paper we use an instrumental variable approach to analyse the causal impact of domestic violence against the mother on child mortality in the Indian context. Domestic violence is instrumented with the real price of gold at the time of marriage of the mother. Results lend evidence to a bias in OLS estimates and show a significant positive relationship between domestic violence and mortality. A one standard deviation increase in domestic violence translates to a 6 percentage point increase in both neonatal and infant mortality.

Keywords: domestic violence; dowry; instrumental variable

JEL Codes: C26, J16 & J14

1. Introduction

According to the World Health Organisation classification, India falls within a region characterised by high mortality. Even within this region, with a child mortality rate of 56 per 1000 live births, India has higher child mortality than most of its neighbours. Over the years, India has established several programmes aimed at reducing child mortality, from the Family Welfare Programme in 1977 to the National Rural Health Mission in 2005[1]. These programmes rely on equitable healthcare and improved access to public health services with a distinct focus on rural areas and low socio economic status groups. Despite these efforts, India failed to achieve its former objective to reduce the Under Five Mortality Rate(U5MR) to less than 100 per 1000 births by the year 2000 (Unicef Report, 2012). Several social and economic factors beyond access to healthcare can have an effect on child mortality. This paper aims to test the existence of a causal pathway between domestic violence against the mother and child mortality in India and provide new insight into the magnitude of its impact.

Violent behaviour is a recognised multifaceted problem with negative consequences for the individual, the economy and for the society as a whole. Unfortunately women, solely on account of their gender, face an increased threat of violent behaviour. Gendered violence is present without boundaries in every country irrespective of diverse social, economic and political backgrounds. In developing countries, violence against women causes more death and disability than cancer, malaria, traffic accident and wars combined (Morrison and Orlando, 1999). Although most societies look down upon gendered violence, in India the reality is that they are often endorsed under the garb of cultural practices, collective norms or religious beliefs. India is ranked 133 among 135 countries in terms of sex ratio in the Global Gender Gap Report (2011). The poor ranking is attributed to female infanticide and the systematic neglect of daughters relative to sons. The prevalence rate of domestic violence in itself occupies a large variation among differing reports, from 17% (Martin, Tsul et al., 1999) to 41% (Peedicayil, Sadowski et al., 2004). One possible explanation for this is the non-standardisation of survey questions regarding violence in the various reports and differences in the subjective interpretation of violence. However, a more plausible explanation is the under-reporting of incidences due to the social stigma attached to violence and the underestimation of violence in itself. Actual prevalence of violence in India is therefore at a risk of underestimation and is thought by experts to be much higher than reported.

The theories on the existence of domestic violence can be broadly classified into two: the feminist theory and the evolutionary theory. The former identifies patriarchy as the root cause of domestic violence, whereby males use violence to exercise control over women (Dobash and Dobash, 1979; Martin, 1976; Yllo and Strauss, 1990). Evolutionary theory posits that domestic violence stems from paternity uncertainty. In this view, violence stems from the insecurity that males feel when their partners are exposed to the possibility of sexual encounters with other males (Wilson and Daly, 1993, 1996). In India, where dowry practices still exist on a large scale, violence may also be used as a means of redistributing resources through extracting assets from the wife (Chin, 2011) or the wife's family (Bloch and Rao, 2002).

Domestic violence has far reaching consequences not just for the victim of abuse and for the household, but also for the economy of the country as a whole. The medical, policing and judicial costs due to violence have been quantified in a few developed countries as staggering

[1] A comprehensive list of initiatives can be found in *Infant and Child Mortality in India – Levels, Trends and Determinants*, NIMS, ICMR and Unicef, 2012.

amounts, such as 1.1 billion Dollars (Canadian) in Canada (Health Canada, 2002) to 23 billion British Pounds per annum in Great Britain (Walby, 2004). Over the years, a number of in-depth analyses have been conducted in the West to determine the causes and quantify the effects of domestic violence (Tauchen, et al., 1991; Farmer and Tiefenthaler, 1997; Iyengar, 2007). In contrast, the number of studies done in developing countries is extremely limited due to the lack of quality nationally representative data. This void in literature is of particular significance as the negative effects of violence have a multiplier effect in these countries due to the continued persistence of adverse social and economic conditions. Predictably, the estimated rate of violent death in low and middle income countries is twice that of a high income country (WHO Report, 2004).

One of the detrimental effects of domestic violence arises from the fact that women are abused during pregnancy. In addition to the apparent and well researched reduction in women's welfare, violence during pregnancy can have an impact on child mortality through various mechanisms. The most direct mechanism is through the effect of blunt physical trauma and the resulting harm caused to the foetus (Nasir and Hyder, 2003). A second mechanism is through the deterrent effect that violence has on women's access to pre-natal healthcare (Petersen, et al., 2001). Third, persistence of post natal domestic violence also has a negative impact on child care, especially in terms of restricted access to post-natal healthcare and inadequate nutrition. Fourth, women who experience violence also tend to have higher levels of psychological stress, which is associated with low birth weight or pre-term delivery and are well known risk factors for neonatal and infant mortality (Campbell, et al., 1999).

Peedicayil, et al. (2004) estimate the prevalence of physical violence and determines the factors associated with the violence during pregnancy in India. Overall, 41% of the sample had experienced some form of physical violence, out of which 12.9% also experienced violence during pregnancy. Factors that are associated with the risk of domestic violence are having husbands who consume alcohol, husbands having an affair, dowry harassment and husbands accusing the wife of having an extramarital affair. Other significant risk factors include a husband's low education, a husband's substance abuse, no social support, three or more children and household crowding. Recently, several studies have also identified financial stress faced by the household as a significant risk factor in determining domestic violence. Being an agrarian society, local precipitation shocks, too, have shown to have a significant effect on domestic violence. In periods of drought, husbands may attempt to extract more surplus from the wife to smooth their own consumption and thereby increase domestic violence and dowry deaths (Sekhri and Storeygard, 2011).

A few studies have established an association between domestic violence and child mortality in India. Jejeebhoy (1998) explores the link between wife beating during pregnancy and foetal and infant death. Data from a community based survey during 1993-94 in North India's Uttar Pradesh and in South India's Tamil Nadu is used. These data enabled the authors to test for regional and religious differences within India. For the sample as a whole, 40% of women experienced violence. They highlight the association between women's experiences of wife beating and infant and foetal loss, even when conditioning on several social, economic and geographical factors. The paper concludes that these associations are stronger and more significant in Uttar Pradesh than in Tamil Nadu, as women in Tamil Nadu have some measure of autonomy due to the state's egalitarian setting and kinship patterns (Dyson and Moore, 1983). A more recent investigation conducted by Koenig, et al. (2010) is based upon a 2002-2003 follow-up study of a cohort selected from the 1998-99 National Family and Health Survey (NFHS 2) in four Indian states. The authors find that births to mothers who

experienced multiple incidents of domestic violence had a 68% higher risk of perinatal and neonatal mortality. No differences in mortality rates were observed for births where the mother had experienced only one episode of violence. The research by Ackerson and Subramanian (2009) analyses the effect of domestic violence on child mortality using the more recent 2005-06 National Family Health Survey (NFHS 3). They find that maternal experience of physical violence increased mortality rates among all children and these associations do not differ according to the child's gender. Sexual and psychological violence were less strongly associated.

However, a limitation in all the studies thus far is that none of them account for the potential endogeneity of domestic violence. Endogeneity in this instance may arise due to three concerns. The first of these is the high plausibility of systematic underreporting of domestic violence in India. For instance, women from rural areas may systematically underestimate their experience of violence and thus unknowingly underreport it. Similarly, women who do not work outside the house may have a systematically higher threshold of privacy and so withhold information about the existence and extent of domestic violence. This can lead to measurement error in the data generating process. The second concern arises due to the problem of omitted variable bias in OLS estimation procedures of child mortality. For example a low level of confidence of the mother, which is not captured in the data, may make her more vulnerable to domestic violence and simultaneously restrict the level of childcare she chooses to access. This is non-ignorable selection that can lead to inconsistent estimation in standard OLS models (Clarke & Windmeijer, 2013). The third is the possibility of reverse causality of domestic violence and child mortality. Since the timing of the violence is not available in the data, it is impossible to ascertain whether the experience of violence caused child mortality or the loss of a child subsequently led to domestic violence within the marriage. Thus the outcome variable may impinge on the independent variable, causing OLS estimates of the impact to be biased.

This paper empirically tests if the positive association between domestic violence and mortality is just indicative of an association or represents a causal mechanism by exploiting exogenous variation in domestic violence through the real price of gold in India. A higher price of gold at the time of marriage of the mother may reduce the share of gold jewellery in the dowry basket. This may reduce the amount of valuable assets the bride has direct control over, which in turn exposes her to a higher risk of domestic violence. The IV estimates suggest that a one-step[2] change in domestic violence against the mother increases the likelihood of both neonatal mortality and infant mortality by 6 percentage points.

To our knowledge, domestic violence has rarely been instrumented in studies assessing its impact on socio-economic outcomes. An exception is Eswaran and Malhotra (2009), who test whether domestic violence reduces women's autonomy. The authors use an index of the women's height relative to the average height within the state as an instrument for domestic violence.

This paper is organised as follows. Section 2 provides a detailed data description. Section 3 outlines the identification strategy. Section 4 presents the main results. Section 5 tackles several robustness checks and heterogeneity tests and Section 6 concludes.

[2] Domestic violence in the principle model of this paper is an ordinal index with a range of 0 to 7.

2. Data Description

Data from the National Family and Health Survey (NFHS 3), India's version of the Demographic Health Survey (DHS 5), is used for this study. The survey was fielded between November, 2005 and August, 2006, and is the third of a series of cross-sectional NFHS surveys. It is based on a sample of households which is representative both at national and state level; 124,385 eligible women of reproductive age (15-49) have completed interviews. The dataset contains a rich variety of information, including background characteristics, reproductive histories, antenatal, delivery and post natal care and husband's background. Within reproductive histories, births and deaths for children were recorded with the total number of births recorded at 256,782. A Status of Women and Spousal Violence module was also carried out in each of India's 29 states. Mother level data has been merged with birth level data in order to evaluate mothers' socio economic characteristics at the birth level.

2.1 Analytical Sample

The analysis is restricted to ever–married women who have had at least one birth. In addition, we restrict the sample to single live births. We also include only marriages that occurred after 1991 to improve the strength of the identification of the instrument (See discussion in Section 3.2).

We condition our analysis on various sociodemographic factors that have a proven association with child mortality in the given context. These are classified into child, mother, household and father level characteristics. Table 1 presents the summary statistics of the control variables, the dependent variables and the independent variable of interest for the analytical sample.

Table 1 – Descriptive Statistics

	Controls	**N/Freq. as applicable**	**Mean**	**Standard Deviation**
Child level controls	**Child Gender**			
	Male	12,433	52.06	
	Female	11,449	47.94	
	Birth Order Number	23882	1.80	0.99
	Year of Birth	23882	2000.5	3.43
Mother level controls [1]	Mother's Education (Years)	23882	5.96	5.58
	Mother's Age at Birth (Years)	23882	23.02	4.47
	Mother's Height (Millimetres)	23882	1522.94	58.98
Household level controls	**Location of Household**			
	Urban	10,394	43.52	
	Rural	13,488	56.48	
	Wealth [2]			
	Poorest	2,792	11.69	1.35
	Poorer	3,781	15.83	

	Middle	5,089	21.31	
	Richer	5,573	23.34	
	Richest	6,647	27.83	
	Religion			
	Hindu	16,391	68.63	
	Muslim	2,503	10.48	0.96
	Christian	3,450	14.45	
	Others	1,538	6.44	
	Caste Membership			
	Schedule Caste	3,942	16.51	
	Schedule Tribe	4,812	20.15	1.08
	Other Backward Class	6,923	28.99	
	High Caste	8,205	34.36	
Dependent variables	**Neonatal Morality**			
	Child is dead	730	3.06	17.2
	Infant Morality			
	Child is dead	1,063	4.45	21
Violence variables	**Domestic Violence**			
	No Violence	16,933	70.90	
	Slap you?	6,579	27.55	
	Twist your arm or pull your hair?	2,779	11.64	
	Push you, shake you, or throw something at you?	2,452	10.27	
	Kick you, drag you or beat you up?			
	Punch you with his fist or something that could hurt you?	2062 1772	8.63 7.42	
	Threaten to attack you with a knife, gun or any other weapon?	260	1.09	
	Try to choke you or burn you on purpose?	402	1.68	
Independent variable of interest	Index of domestic violence (0-7)	23882	0.68	1.37

[1] Mother included multiple times in case of multiple births.

[2] Quintiles of a wealth index, which is a factor score of the household's cumulative living standard based on asset ownership.

Our analytical sample contains more male births than female births, which is unsurprising given the permeation of ultrasound technology and the rampant sex selection in India (Bhalotra & Cochrane, 2010). On average, mothers in the sample have two reported births. The sample mean of number of years of education of the mother is 6 years, which translates into secondary education. More than half of the sample births occurred when the mother was

between 20 and 26 years of age, with the average age of the mother at the time of birth at 23 years. The average height of mothers in the sample is 1522 millimetres and is thus representative of the national average. More than half (56.5%) of the analytical sample is from a household located in a rural area and 48.8% is from middle or lower categories of the wealth quintile. In addition to the religious composition of India, the religious distribution of the analytical sample is indicative of differences in the average number of births according to religion. Specifically, 59.71% of the Christian households have more than one birth recorded as compared to Muslim and Hindu households where 57.54% and 41.81% have more than one birth recorded respectively. 34.36% of the sample belongs to a high caste.

2.2 Domestic Violence

One woman was selected at random from each household for the domestic violence module. Rural and urban samples were drawn within each state. Violence in the DHS 5 is measured using the modified Conflict Tactics Scale (CTS) (Strauss, 1990) using the following set of questions:

(Does/Did) your (last) husband ever do any of the following things to you?

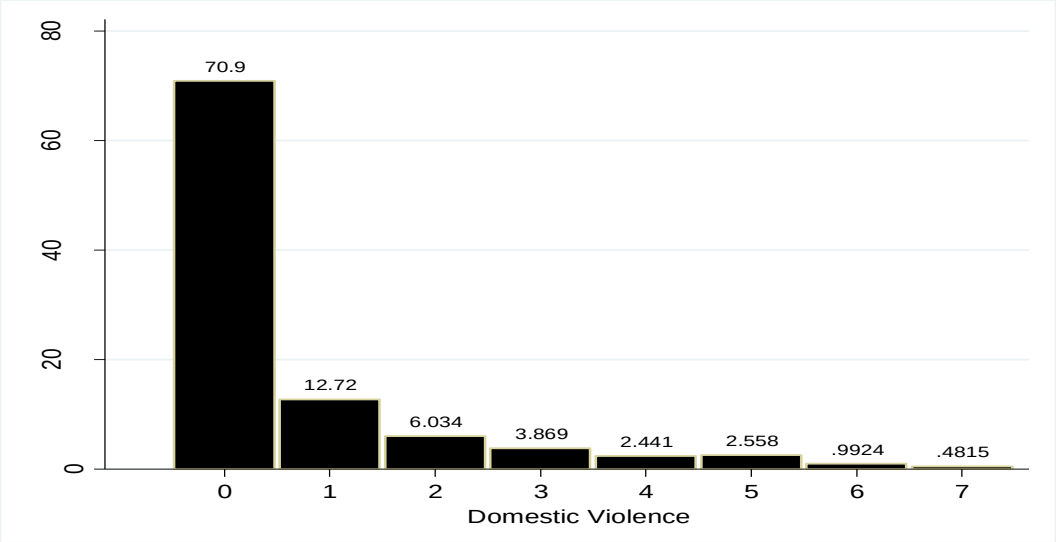
1. Slap you?
2. Twist your arm or pull your hair?
3. Push you, shake you, or throw something at you?
4. Punch you with his fist or something that could hurt you?
5. Kick you, drag you or beat you up?
6. Threaten to attack you with a knife, gun or any other weapon?
7. Try to choke you or burn you on purpose?

Out of a total sample of 124,385 mothers, 40,682 were not eligible for the domestic violence module as there was more than one eligible respondent within the household. 477 eligible respondents were not surveyed as privacy could not be obtained. Subject to these criteria, 83,703 eligible respondents were interviewed. Each of the above questions was allowed five responses that are coded as follows:

0 – No
1 – Often during the last 12 months
2 – Sometimes during the last 12 months
3 – Not in the last 12 months
4 – Yes, but currently a widow or timing missing

We create an ordinal measure of domestic violence that is equal to the number of kinds of physical violence the respondent is exposed to. The independent variable is thus an index (0, 7) which is 0 if domestic violence does not exist in the household and progressively adds 1 for a non-zero response to each of the 7 questions mentioned above. 29.1% of the analytical sub-sample has experienced at least one form of physical violence. Figure 1 provides a histogram of the index.

Figure 1 – Index for Domestic Violence



2.3 Mortality

The dependent variable is a binary variable with 1 indicating mortality and 0 indicating survival. Sample selection problems are eliminated since the birth histories are retrospective and inclusion in the sample is not restricted to survival at survey date. We created subsets of the data based on age at the time of death and 2 models are estimated on the following dependent variables:

1. **Neonatal Mortality** – All deaths from the first day of life to 30 days of life, conditional on children who were born 30 days before the date of the survey to allow for full exposure to the risk of neonatal mortality. Thus children who are less than 30 days old at the time of the survey have been excluded from the model.
2. **Infant mortality** – All deaths from the first day of life up to the first year of life, conditional on children who were born 1 year before the date of the survey to allow for full exposure to the risk of infant mortality. Thus children who are less than 1 year old at the time of the survey have been excluded from the model.

Table 2 – T-Tests of Difference in Means of Mortality

	All	No Violence Reported	Violence Reported	t-test of equality*
Neonatal Mortality				
Child is Dead	3.06	2.89	3.47	0.02
Infant Mortality				
Child is Dead	4.45	4.11	5.28	0.00

* Two tailed t statistics without assuming equal variances.

The proportion of births that resulted in a death in the neonatal and infant model is 3.06% and 4.45% respectively as reported in Table 2. In the sample, a total of 6,708 births occurred to mothers who have reported at least one form of domestic violence. Out of these, 241 births

resulted in a death within the first 30 days of life and 367 deaths occurred within the first year of life. There is a statistically significant difference in mortality between respondents who report the presence of domestic violence and respondents who do not report domestic violence in both the neonatal and infant stages of life.

3. Identification Strategy

To overcome the potential endogeneity of domestic violence, we need a valid instrument that is strongly correlated with the domestic violence and is uncorrelated with child mortality. This section first outlines the empirical specification and proceeds to discuss the validity of the real price of gold in India as a plausible source of exogenous variation.

3.1 Econometric Specification

We seek to estimate the following equation:

$$Y_{ist} = \beta_1 X_{is} + \beta_2 C_{is} + \beta_3 S_s + \beta_4 M_i + \beta_5 t + \beta_6 S_s * t + \varepsilon_{ist}$$

where,

$\boldsymbol{Y_{ist}}$ is the outcome for each birth *i* in state *s* and year *t* ;
$\boldsymbol{X_{is}}$ is the domestic violence experienced by the mother of child *i* ;
$\boldsymbol{C_{is}}$ is a vector of socio demographic controls;
$\boldsymbol{S_s}$ is a state dummy to control for state fixed effects;
$\boldsymbol{M_i}$ is month of birth fixed effects;
$\boldsymbol{S_s * t}$ is an interaction effect between the state and the year of birth of the child;
$\boldsymbol{\varepsilon_{ist}}$ is the error term.

India's socioeconomic conditions vary considerably, especially between northern and southern states. Table 4 in the appendix provides a description of the prevalence of violence across the various states. State fixed effects have been included in all models to capture state specific effects. An interaction term for state specific trends has also been included to account for the different trends of mortality rates within each of the states. Further, fixed effects for the month of birth have been included to account for seasonal variations in mortality, which is of particular significance in an agrarian society.

Due to the potential endogeneity of domestic violence, we estimate an IV where violence is instrumented by the price of gold at the time of marriage of the mother. β_1 is the coefficient of interest that defines the causal relationship between domestic violence and mortality.

3.2 Instrument for Domestic Violence

A number of studies have documented the effect of economic independence on domestic violence, both in developed and developing countries. A majority of them find that greater economic independence of the wife increases her options outside marriage, thereby reducing the risk of domestic violence (Farmer and Tifenthaler, 1997, Tauchen, Witte and Long, 1991). Economic independence of an individual can be enhanced through several mechanisms. While perhaps the most extensively researched mechanism is through the

employment of the woman[3], the examination of effects of alternative variables that enhance the bargaining power of women within the household has been limited.

One such variable in the context of India is dowry. Dowry practices continue to be widespread in spite of being prohibited by law[4]. Historically, dowry was given as a voluntary gift to the bride. The groom or the groom's family had no claims to the dowry even after the death of the bride[5] (Muller, 1886). It was anticipated to be an economic safety net for the bride. Nowadays, the value of the dowry given is dependent upon the financial capacity of the bride's family and increases with the positive attributes of the prospective groom (Becker, 1991, Anderson, 2007). Cash and gold are two of the most prevalent forms of dowry in India in addition to silver, land, car, house etc.

Recent research into dowry in South Asia has led to two distinct theories of dowry motives: bequest as a pre-mortem inheritance and groomprice as a price that clears the marriage market. Although scholars have documented an increasing transformation of dowry from bequest to groomprice (Srinivas, 1984, Banerjee, 1999), a dowry basket characteristically has elements of both. Research has also found these different regimes of dowry to have heterogeneous effects on women's welfare (Arunachalam and Logan, 2006). Bequest dowries improve the bargaining power of the woman within the household and may thus mitigate domestic violence against women within the household (Brown, 2003). This has also been cited as the reason why Indian women continue to support dowry practices, despite it being against the law.

Dowry elements with the motive of groomprice are usually direct transfer of assets to the groom or the groom's family in the form of cash, land, residential property etc. Bequest dowries are less likely to involve cash only transfers as brides have limited control on cash only transfers. In contrast, dowry elements with the motive of bequest are usually a direct transfer of assets to the bride in the form of property or jewellery. India holds 11% of the world's gold stock. 70% of this stock is in the form of jewellery (Financial Times, 2011). Gold, one of the primary elements of dowry in India, is almost always given in the form of jewellery to the bride. Studies show that 75% of women in India claimed that their jewellery remained with them after marriage (Basu, 1999). Often a woman has her own locked trunk or a locker at a bank in which she stores her jewels (Herschman, 1981).

We speculate that a high price of gold at the time of marriage reduces the share of gold jewellery in the dowry basket. This reduces the value of assets the bride has direct control over, and in turn exposes her to a higher risk of domestic violence. As a result, the real price of gold at the time of marriage of the mother is used as an instrument in this study.

We conducted an exploratory analysis of this mechanism using the Status of Women and Fertility (SWAF) data, which included questions regarding dowry types. The survey was fielded in 1993-1994 in the two districts of Uttar Pradesh and Tamil Nadu. Since the practice

[3] Although employment does improve the bargaining power of the woman within the household, research shows divergent effects of women's employment on domestic violence in developing countries (Chin, 2011).

[4] The Dowry Prohibition Act, 1961.

[5] "*What (was given) before the (nuptial) fire, what (was given) on the bridal procession, what was given in token of (Such Property), as well as a gift subsequent and what was given (to her) by her affectionate husband, shall go to her offspring (even) if she dies in the lifetime of her husband.*" – The Laws of Manu (c. 200 AD).

of dowry is illegal, the questions framed were imprecise and only provide an indication of dowry practices within the family. We coded a variable for the presence of gold dowry tradition within the family from information collected from answers to the question – "Generally, in your family, is gold given as dowry?" The answers are coded as yes and no. This it is not a direct reference to one's own marriage but nonetheless provides a basis for tentative analysis of gold as a form of dowry and its impact on domestic violence.

Table 3 – Descriptive Statistics of SWAF Data

Variable	Obs.	Mean	Std. Dev.
Domestic violence – binary variable with 1 indicating the presence of domestic violence.	1650	0.39	0.49
Gold dowry – binary variable with 1 indicating the prevalence of giving gold dowry in the community.	1650	0.95	0.22
Cash dowry – binary variable with 1 indicating the prevalence of giving cash dowry in the community.	1650	0.45	0.5
Religion[1] – binary variable with 1 indicating Muslim	1650	1.52	0.50
Household income - for the past 12 months (Indian Rupees)	1650	20865	27589
State – binary variable with 1 indicating Uttar Pradesh	1650	1.43	0.5
SC/ST Membership – binary variable with 1 indicating high caste	1650	2.78	0.63

[1] The SWAF dataset for India has a single Christian respondent who has been excluded from this analytical sample.

Table 4 - Association between Gold Dowry and Domestic Violence

Variables	Domestic Violence
Gold dowry	-0.18***
	(0.06)
Cash dowry	-0.05**
	(0.03)
Muslim	-0.04
	(0.03)
Household income for the past 12months	-0.08***
	(0.02)
Uttar Pradesh	0.10***
	(0.03)
High Caste	-0.08**
	(0.02)
Observations	1,650
Mean (dep var)	0.39
s.d (dep var)	0.49
Mean (gold dowry)	0.95
s.d (gold dowry)	0.22

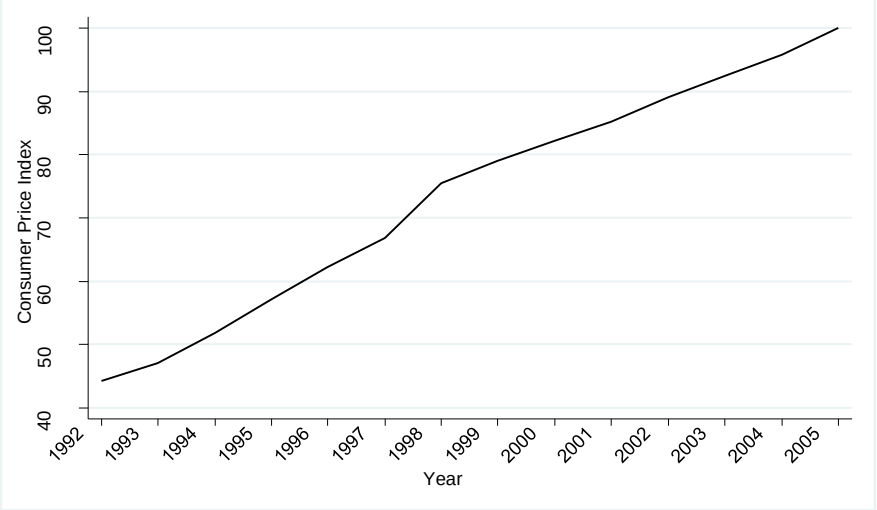
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Standard Errors Clustered at Household Level
Additional Controls: Fixed effects for the year of birth of respondent
Source: SWAF 1994-95, Uttar Pradesh & Tamil Nadu

Table 3 provides a summary of the relevant variables from the SWAF dataset. The question on domestic violence was framed as "Does your husband ever hit or beat you?" The Yes/No answers were coded into a binary variable. On average, about 40% of the respondents acknowledged the presence of domestic violence in the marriage, which is consistent with national estimates. 94% of the eligible respondents reported the giving of gold as a form of dowry as a social norm while 45% of the respondents reported the giving cash as a form of dowry as a social norm. There is a slight Muslim majority in the data with 861 Muslims and

789 Hindus. Average household income is at Rs.20,865 and 56.7% of them belong to the state of Tamil Nadu. Only 11% of the sample belongs to a low caste.

Table 4 presents the linear probability estimation results based on the SWAF data. Domestic Violence is the binary outcome variable while the regressor of interest is Gold Dowry. In this analysis, gold as a form of dowry has a negative association with the prevalence of domestic violence, reducing its likelihood by 18 percentage points. This relationship remains significant after conditioning on several variables such as religion, amount of cash dowry given, household income, caste membership, state fixed effects and fixed effects for the year of birth of the respondent. This is consistent with the assumed negative impact of gold dowry on domestic violence.

Figure 2: Consumer Price Index in India



The nominal price of gold is deflated using the Consumer Price Index statistics from the world development indicators from the World Bank (International Monetary Fund and International Financial Statistics). Figure 2 plots the deflator by year. India imports 92% of its gold demand. The price of gold is determined by the London Price Fix twice a day and is external to the country. The national demand for gold in India is then determined through the interplay of this international gold price, share prices (rate of return on alternative financial assets), GDP, the exchange rate and rate of household financial savings (Vaidyanathan, 1999).

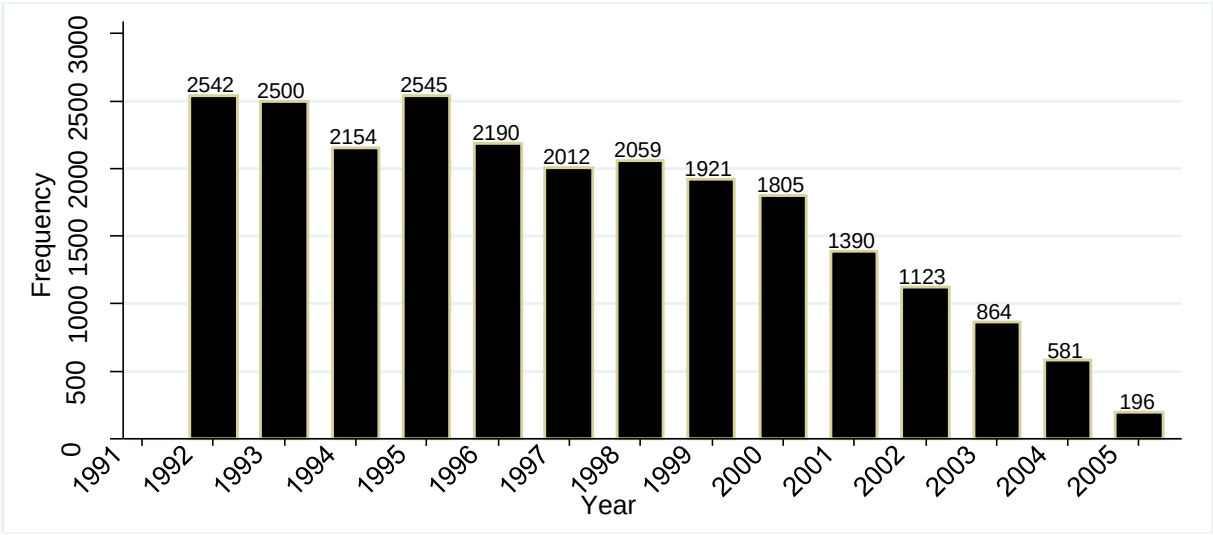
Figure 3 is a graphical representation of the time series of the real price of gold and the nominal price of gold by year.

Figure 3: Price of Gold Trends

Post-independence India had a closed economy characterised by a desire for self-sufficiency. Rigid control of gold sales and taxation led to an extensive black market of gold through smuggling. Gold prices within the country were thus not determined through previously mentioned global market forces, but by local market forces (Vaidyanathan, 1999). In 1991, on the verge of bankruptcy, India's economy changed drastically when it adopted more liberal economic policies. Due to this structural break, the estimation is restricted to mother's who were married post 1991, after which we expect the world price of gold to be a more accurate measure of the Indian price of gold.

Figure 4 is a histogram representing the number of births within each year of marriage in our sample range. As can be seen, there is a sufficient number of observations within each year to enable identification of the first stage IV regression. The proportion of the estimation sample with the presence of domestic violence by the year of marriage is provided in the appendix (Table 5, Appendix).

Figure 4: Frequency distribution by year of marriage in the estimation sample



Note: Sample of marriages after the year 1991 for respondents aged 15-49 years at survey date - November 2005 – August 2006

4. Results

We present a discussion of the IV first stage statistics followed by the instrumental variable estimation results.

Table 5 - IV First Stage Statistics

VARIABLES	Domestic Violence
Price of Gold at Marriage	0.04***
	(0.01)
Price of Gold at Marriage^2	-0.00***
	(0.00)
Female Child	0.01
	(0.02)
Income Category: Poor	0.00
	(0.07)
Income Category: Middle	-0.10
	(0.06)
Income Category: Richer	-0.19***
	(0.06)
Income Category: Richest	-0.38***
	(0.07)
Mother's Age at Birth	-0.14*
	(0.08)
Mother's Age at Birth^2	0.01
	(0.00)
Mother's Height	-0.04
	(0.03)
Household located in Rural Area	-0.16***
	(0.03)
Muslim	0.13**
	(0.05)
Christian	0.01
	(0.06)

Other Religion	0.05
	(0.07)
Scheduled Caste	0.25***
	(0.05)
Scheduled Tribe	-0.02
	(0.06)
Other Backward Class	0.03
	(0.04)
Birth Order Number	0.10***
	(0.02)
Mother's Years of Schooling	-0.03***
	(0.00)
Observations	23,882
Durbin-Wu-Hausman (p value)	**0.00**
Sargan's test of over-identifying restrictions (p value)	**0.81**
F Statistic	**18.02**

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors Clustered at Mother Level

Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth[3]

Table 5 presents the first stage statistics of the two-stage least square estimation. We have also included a square term of the real price of gold to capture the non-linearity evident in the price of gold plots (Figure 2). The Durbin-Wu-Hausman test rejects the null that the variables are exogenous with a p-value of 0.00. This test itself relies on the assumption that the instrument is valid and therefore is limited in terms of reliability. The instrument must be uncorrelated with the outcome variable, which is theory driven. The instrument must be strong to account for significant variation in the endogenous regressor. The stronger association between the price of gold and domestic violence, the stronger will be the identification of the model, leading to higher efficiency. The test of strength is an F-Test for the significance of the instrument in the first stage of the IV Model. Price of gold exceeds the Stock & Yogo critical value of 10 with a test statistic of 18.02. Price of gold at marriage is a significant predictor of domestic violence. A one standard deviation increase in the price of gold increases the likelihood of domestic violence by 4 percentage points. The square term of the instrument has a negative relationship with violence but the magnitude of the effect is small.

Table 6 - Instrumental Variable Estimation

VARIABLES	Neonatal Mortality		Infant Mortality	
	(1) IV 2sls	(2) IV Probit	(3) IV 2sls	(4) IV Probit
Domestic Violence	0.06**	0.09**	0.06**	0.07*
	(0.03)	(0.04)	(0.03)	(0.04)
Female Child	-0.01***	-0.02***	-0.01***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Income Category: Poor	0.00	0.00	-0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Middle	0.00	0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Richer	0.00	0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Richest	0.01	0.01	-0.01	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)
Mother's Age at Birth	-0.01	0.01	-0.02	0.00
	(0.01)	(0.02)	(0.01)	(0.02)
Mother's Age at Birth^2	0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Height	-0.01***	-0.01**	-0.01***	-0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Household located in Rural Area	0.02***	0.02**	0.02***	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)
Muslim	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Christian	-0.00	-0.01	-0.01	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)
Other Religion	-0.01*	-0.01	-0.01	-0.01
	(0.00)	(0.01)	(0.01)	(0.01)
Scheduled Caste	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Scheduled Tribe	0.01	0.01	0.01*	0.01*
	(0.01)	(0.01)	(0.01)	(0.01)
Other Backward Class	0.01	0.01	0.01	0.01
	(0.00)	(0.01)	(0.01)	(0.01)
Birth Order Number	-0.01***	-0.01**	-0.01*	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Years of Schooling	0.00*	0.00*	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	23,792	23,792	22,245	22,245
Mean (dep var)	3.06	3.06	4.45	4.45
s.d (dep var)	17.2	17.2	21	21

Coefficients for maximum likelihood model report marginal effects, Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors Clustered at Mother Level

Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth^3

Column 1 and Column 3 in Table 6 present the second stage results of the two-stage least squares estimation. Violence is a significant predictor of child mortality in both stages of the child's life. In the first 30 days a one-step increase in domestic violence increases the likelihood of both neonatal mortality and infant mortality by 6 percentage points relative to the mean. The fact that the coefficient of domestic violence in the neonatal model is equal to the coefficient of domestic violence in the infant model suggests that all of the infant effect is driven by neonatal mortality.

There is considerable debate over the choice of IV estimators with a binary dependent variable where the conditional expectation function is non-linear. Given the binary nature of mortality, a model with a linear probability model in the first stage and a probit model in the second stage is a possible option. Column 2 and column 4 in Table 6 present the results of this maximum likelihood estimation. The results continue to be consistent with the baseline IV linear probability model. Applying maximum likelihood estimation maintains the positive relationship between domestic violence and child mortality in both models. The implied marginal effects of the maximum likelihood model are similar to that of the baseline 2sls model.

Being a female child reduces the risk of mortality in both models. A possible explanation is that since female infanticide is rampant in India, the girl children that are eventually born are only desired births (Bhalotra & Cochrane, 2010). This is explored further in Section 5. Mother's age at birth significantly reduces the risk of mortality in both models. This is consistent with previous research, which suggests children born to adolescent mothers are at a higher risk of mortality. The height of the mother is an index of the mother's nutritional status. It has a negative relationship with the likelihood of mortality in both models, which is in line with the existing literature (Bhalotra and Rawlings, 2011, Monden and Smits, 2009). Rural location of household increased the risk of death in both models. This is congruent with the well documented lack of adequate health- and post-natal care available for the inhabitants of rural India (See Section 5). Membership of a scheduled caste/tribe or other backward class increases the likelihood of mortality. Children born later in the birth order have a higher chance of survival in the neonatal model. The effect of this variable is ambiguous as the models also control for mother's age at birth. Excluding this control neither improves nor worsens the precision of our main results significantly. Mother's number of years of schooling has a significant negative relationship to mortality in the infant mortality model.

In addition to the above model, we also estimated a specification conditioning on year of birth fixed effects (Table 2 and 3, Appendix). The coefficients remain stable and continue to maintain their magnitude with a slight drop in statistical significance. Since the instrument is state-fixed and time-varying, inclusion of year of birth-fixed effects weakens the instrument with a lower F Statistic.

We also present the OLS results in the appendix. OLS estimations have a small but highly significant positive effect of domestic violence on the likelihood of both neonatal and infant mortality (Columns 1 and 3, Table 1, Appendix). The domestic violence coefficient is not statistically significant in the stringent OLS specification (Columns 2 and 4, Table 1, Appendix), which is inclusive of all controls.

In the presence of endogeneity due to reverse causality or unobserved heterogeneity, we would expect OLS to be upward biased. Our IV models suggests that OLS is downward

biased in both stages of the child's life which is consistent with a systematic underreporting of domestic violence.

5. Robustness Checks

In this section we test the robustness of the estimates based on different specifications of domestic violence and by exploring heterogeneous effects.

5.1 Alternate Measures of Violence

Columns 1 and 3 in Table 7 report the results for estimations when domestic violence has been coded as a binary variable with 1 indicating the existence of domestic violence (of any form). As can be seen, the coefficients are consistent with the baseline IV estimation with a 19 and 23 percentage point increase in risk of mortality in neonatal and infant models respectively. Columns 2 and 4 report the results of specifying domestic violence as a factor score using principle component analysis.

Table 7 – Alternative Definitions of Domestic Violence

	Neonatal Mortality		Infant Mortality	
VARIABLES	**(1)** **Binary Violence**	**(2)** **PCA**	**(3)** **Binary Violence**	**(4)** **PCA**
Domestic Violence	0.19**	0.09**	0.23*	0.09*
	(0.09)	(0.04)	(0.10)	(0.05)
Female Child	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Income Category: Poor	0.00	0.00	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Middle	0.00	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Richer	0.00	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Richest	0.01	0.01	0.00	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)
Mother's Age at Birth	-0.02	-0.01	-0.02*	-0.02
	(0.01)	(0.01)	(0.01)	(0.02)
Mother's Age at Birth^2	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Height	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Household located in Rural Area	0.02***	0.02***	0.02***	0.02***

	(0.01)	(0.01)	(0.01)	(0.01)
Muslim	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Christian	-0.00	-0.00	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Other Religion	-0.01	-0.01*	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Scheduled Caste	-0.00	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Scheduled Tribe	0.01	0.01	0.01*	0.01*
	(0.01)	(0.01)	(0.01)	(0.01)
Other Backward Class	0.01*	0.00	0.01*	0.01
	(0.00)	(0.00)	(0.01)	(0.01)
Birth Order Number	-0.01***	-0.01***	-0.01*	-0.01*
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Years of Schooling	0.00*	0.00*	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	23,792	23,792	22,245	22,245

Coefficients Report Marginal Effects, Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors Clustered at Mother Level

Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth[3]

Each of the 5 responses to the 7 dimensions of domestic violence questions is used to predict a factor score for the violence. The coefficients continue to maintain a positive relationship between domestic violence and mortality in both models as in the baseline IV estimation. A one standard deviation increase in domestic violence increases the risk of neonatal and infant mortality by 9 percentage points. All other covariates also continue to maintain the same relationship as in the baseline IV model.

5.2 Heterogeneous Effects

We now investigate whether the effect of violence on mortality varies depending on the gender of the child, the location and the socioeconomic status of the household. The first estimations are done separately based on the gender of the child.

Table 8 - Split Sample Test: Child Gender

	Neonatal Mortality		**Infant Mortality**	
VARIABLES	**(1)** **Male**	**(2)** **Female**	**(3)** **Male**	**(4)** **Female**
Domestic Violence	0.04	0.07	0.03	0.09
	(0.03)	(0.05)	(0.03)	(0.05)

Income Category: Poor	0.01	-0.00	0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Middle	-0.00	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Income Category: Richer	-0.01	0.01	-0.01	0.00
	(0.01)	(0.02)	(0.01)	(0.02)
Income Category: Richest	0.00	0.02	-0.01	0.01
	(0.01)	(0.02)	(0.02)	(0.03)
Mother's Age at Birth	-0.02	-0.01	-0.03	-0.01
	(0.02)	(0.01)	(0.02)	(0.02)
Mother's Age at Birth^2	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Height	-0.01***	0.00	-0.02***	0.00
	(0.00)	(0.00)	(0.00)	(0.01)
Household located in Rural Area	0.02***	0.02**	0.02***	0.02
	(0.01)	(0.01)	(0.01)	(0.01)
Muslim	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Christian	0.01	-0.01	0.01	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
Other Religion	-0.00	-0.02*	-0.00	-0.03*
	(0.01)	(0.01)	(0.01)	(0.02)
Scheduled Caste	-0.00	-0.01	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)
Scheduled Tribe	0.00	0.01	0.01	0.02
	(0.01)	(0.01)	(0.01)	(0.01)
Other Backward Class	0.00	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Birth Order Number	-0.01***	-0.01	-0.01***	-0.00
	(0.00)	(0.01)	(0.00)	(0.01)
Mother's Years of Schooling	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	12,392	11,400	11,631	10,614

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors Clustered at Mother Level

Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth^3

A χ^2 test of statistical difference in the estimated parameters of violence for male versus female child results in a p-value of 0.00 in the neonatal and infant model. The coefficient of domestic violence remains positive but is insignificant in all models. This is consistent with previous findings (Ackerson and Subramanian, 2009) and is likely the result of a loss in precision of the estimator caused by splitting the sample by the gender of the child. All other results are consistent with the IV estimates.

We now investigate if violence has a different impact depending on the location of the household. India has a large divide in terms of access to resources between rural and urban areas. There have also been recent suggestions of a widening disparity between rural and urban development structures in India.

Table 9 - Split Sample Test: Location of Household

	Neonatal Mortality		**Infant Mortality**	
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**
	Urban	**Rural**	**Urban**	**Rural**
Domestic Violence	0.01	0.09**	0.04	0.07*
	(0.03)	(0.04)	(0.05)	(0.04)
Female Child	-0.01***	-0.02***	-0.01	-0.02***
	(0.00)	(0.00)	(0.00)	(0.01)
Income Category: Poor	-0.00	0.00	-0.01	0.00
	(0.01)	(0.01)	(0.02)	(0.01)
Income Category: Middle	0.01	0.00	0.01	-0.01
	(0.01)	(0.01)	(0.02)	(0.01)
Income Category: Richer	-0.01	0.01	-0.01	0.00
	(0.02)	(0.01)	(0.02)	(0.01)
Income Category: Richest	-0.01	0.01	-0.01	-0.00
	(0.02)	(0.02)	(0.03)	(0.02)
Mother's Age at Birth	-0.00	-0.02	0.01	-0.03*
	(0.02)	(0.02)	(0.03)	(0.02)
Mother's Age at Birth^2	-0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Height	-0.01	-0.01***	-0.00	-0.01***
	(0.00)	(0.01)	(0.01)	(0.01)
Muslim	0.00	-0.02	-0.00	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)
Christian	-0.01	0.01	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Other Religion	-0.01	-0.01	-0.02*	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Scheduled Caste	-0.00	-0.02	-0.01	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)
Scheduled Tribe	0.01	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Other Backward Class	0.00	0.01	0.00	0.01
	(0.00)	(0.01)	(0.01)	(0.01)
Birth Order Number	-0.00	-0.01**	-0.01	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Years of Schooling	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	10,364	13,428	9,752	12,493

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors Clustered at Mother Level

Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's Age at Birth^2

In households located in rural areas, domestic violence increases the likelihood of neonatal and infant mortality by 9 and 7 percentage points respectively. A χ^2 square test of statistical difference in the estimated parameters for an urban versus a rural household results in a p value of 0.00 in the neonatal model and the infant model. There are no significant effects in households located in urban areas. This could be due to the fact that in urban areas the negative impact of violence is mitigated by a better access to resources in terms of social support, child care and health care. Moreover, the effect of mother's height on child survival remains significant only in households located in rural areas. The height of the mother is acting as a proxy for nutritional status of the mother and this nutritional status is likely to be reflected on subsequent child nutritional status as well.

Table 10 presents the results of a split sample test based on the wealth of the household as classified within the DHS. DHS constructs the wealth index from household-level data using principle component analysis. It is a composite index based on information regarding ownership of household items, dwelling characteristics, home construction materials and access to a bank or post office account. This score is then divided into population quintiles with each quintile given a rank from 1 (poorest) to 5 (richest). For the purpose of this analysis, we classified households from the bottom two quintiles as Low Socioeconomic Status (SES), while households from Middle, Rich and Richer categories have been coded as High SES. This simple classification allows us to estimate the effects of domestic violence on mortality in poorer families where such effects are likely to be magnified.

Table 10 - Split Sample Test: Socio Economic Status

	Neonatal Mortality		**Infant Mortality**	
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**
	Low SES	**High SES**	**Low SES**	**High SES**
Domestic Violence	0.07**	0.04	0.06*	0.06
	(0.03)	(0.04)	(0.03)	(0.05)
Female Child	-0.02***	-0.01***	-0.03***	-0.01***
	(0.01)	(0.00)	(0.01)	(0.00)
Mother's Age at Birth	0.00	-0.02	-0.01	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Mother's Age at Birth^2	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Mother's Height	-0.01**	-0.01*	-0.02**	-0.01
	(0.01)	(0.00)	(0.01)	(0.00)
Household located in Rural Area	0.03**	0.01***	0.04***	0.01**
	(0.01)	(0.01)	(0.01)	(0.01)
Muslim	-0.02	-0.00	-0.03	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)
Christian	0.01	-0.01**	0.01	-0.02**
	(0.01)	(0.01)	(0.02)	(0.01)
Other Religion	-0.04**	-0.00	-0.04*	-0.00
	(0.02)	(0.01)	(0.02)	(0.01)

Scheduled Caste	-0.01	-0.01	-0.00	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)
Scheduled Tribe	0.00	0.01	0.00	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
Other Backward Class	0.01	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Birth Order Number	-0.01***	-0.00	-0.01*	-0.00
	(0.01)	(0.00)	(0.01)	(0.00)
Mother's Years of Schooling	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	6,537	17,255	6,046	16,199

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robust Standard Errors Clustered at Mother Level

Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's Age at Birth^2

In the estimation sample, 40% of the low SES category and 25% of the high SES category have reported domestic violence. As expected, the results highlight differences in the effect of violence by SES. Families in the Low SES categories have a higher likelihood of child death when faced with the presence of domestic violence in both models. A low SES status results in a 7 percentage point increase in the likelihood of mortality in the neonatal model and a 6 percentage point increase in the likelihood of mortality in the infant model. A χ^2 test of statistical difference in the estimated parameters for low SES versus high SES households results in a p value of 0.00 in the neonatal model and the infant model. As in the previous split sample test based on the location of the household, mother's height is a significant predictor only in the low SES groups in both models.

6. Conclusion

This study constitutes a significant first step towards establishing a causal link between domestic violence and infant mortality. We find a significant positive relationship between domestic violence and both neonatal and infant mortality. Importantly, we avoided the problem of endogeneity by using the real price of gold as a source of exogenous variation in domestic violence. The results remained consistent through alternative measures of domestic violence and through several robustness tests. The magnitude of the IV results, relative to the OLS, provides compelling evidence of an attenuation bias in OLS estimation caused by underreporting of domestic violence.

This research could be enhanced by more extensive data on the timing of violence and the cash values of various kinds of dowries. Given the prevalence of both domestic violence and dowry practices in India, there is an inherent need for this data. However, the illegality of dowry and domestic violence – and subsequent underreporting of each – could make further accurate data collection difficult and must be addressed methodologically for precision in future analysis, for example by changing key survey parameters to overcome underreporting and systematic measurement errors.

Concerted policy initiatives directed at the identification and eradication of domestic violence can effectively reduce neonatal and infant mortality levels in India. This could set helpful examples for developing countries where public health funding dedicated to the lowering of child mortality is frequently limited. Public policy addressing key aspects of improving absolute levels of gender equality tend to be relatively inexpensive and, if incorporating

mechanics aimed at the reduction of domestic violence, should induce a reduction in child mortality.

Appendix

Column 1 and Column 3 in Table 1 present the linear probability estimates excluding all controls for neonatal and infant mortality models respectively. The estimates are positive and significant in both models. Conditioning on all controls maintains the direction of the association but leads to a reduction in statistical significance.

Table 1 - Linear Probability Estimation

VARIABLES	(1) Neonatal Mortality	(2) Neonatal Mortality	(3) Infant Mortality	(4) Infant Mortality
Domestic Violence	0.003***	0.000	0.006***	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Female Child		-0.011***		-0.012***
		(0.002)		(0.003)
Income Category: Poor		0.003		-0.0005
		(0.006)		(0.008)
Income Category: Middle		-0.005		-0.012*
		(0.006)		(0.007)
Income Category: Richer		-0.010*		-0.028***
		(0.006)		(0.007)
Income Category: Richest		-0.013**		-0.025***
		(0.006)		(0.008)
Mother's Age at Birth		-0.021*		-0.027**
		(0.012)		(0.013)
Mother's Age at Birth^2		0.001		0.001*
		(0.000)		(0.001)
Mother's Height		-0.010***		-0.010***
		(0.002)		(0.003)
Household located in Rural Area		0.010***		0.009***
		(0.003)		(0.003)
Muslim		0.0003		-0.002
		(0.004)		(0.005)
Christian		-0.002		-0.005
		(0.005)		(0.006)
Other Religion		-0.008*		-0.006
		(0.005)		(0.007)
Scheduled Caste		0.007*		0.006
		(0.004)		(0.005)
Scheduled Tribe		0.003		0.010*
		(0.005)		(0.006)
Other Backward Class		0.006**		0.008**
		(0.003)		(0.004)
Birth Order Number		-0.003*		-0.002
		(0.002)		(0.002)
Mother's Years of Schooling		-0.000		-0.001**
		(0.000)		(0.000)
Observations		23,792		22,245

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Robust Standard Errors Clustered at Mother Level
Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth^3

Table 2 and table 3 present the first and the second stage IV results of both models with the inclusion of year fixed effects. The coefficients continue to maintain a positive relationship with domestic violence. However, there is a loss of identification of the instrument as measured by Stock & Yogo's minimum eigenvalue statistic. The test of strength of the instrument drops to 10.14 in the first stage. Since the instrument itself relies on variation by year of marriage (fixed in state across all observations), the year fixed effects leads to a loss in precision of the estimator.

Table 2 - IV First Stage Conditioning on Fixed Effects for the Year of Birth

VARIABLES	**Domestic Violence**
Price of Gold at Marriage	0.01***
	(0.01)
Price of Gold at Marriage^2	-0.00***
	(0.00)
Female Child	0.01
	(0.02)
Income Category: Poor	0.00
	(0.04)
Income Category: Middle	-0.10
	(0.06)
Income Category: Richer	-0.06***
	(0.06)
Income Category: Richest	-0.15***
	(0.07)
Mother's Age at Birth	-0.03**
	(0.02)
Mother's Age at Birth^2	0.01*
	(0.00)
Mother's Height	-0.04
	(0.03)
Household located in Rural Area	-0.04***
	(0.03)
Muslim	0.04**
	(0.05)
Christian	0.01
	(0.06)
Other Religion	0.05
	(0.07)
Scheduled Caste	0.06***
	(0.05)
Scheduled Tribe	-0.02
	(0.06)
Other Backward Class	0.03
	(0.04)
Birth Order Number	0.09***
	(0.02)
Mother's Years of Schooling	-0.03***
	(0.00)
Observations	23,882
Durbin-Wu-Hausman (p value)	**0.04**

Sargans test of overidentifying restrictions (p value)	**0.45**
F Statistic	**10.14**

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Robust Standard Errors Clustered at Mother Level
Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth[3]

Table 3 - Instrumental Variable conditioning on fixed effects for the year of birth

VARIABLES	(1) Neonatal Mortality	(2) Infant Mortality
Domestic Violence	0.05	0.06*
	(0.03)	(0.04)
Female Child	-0.01***	-0.01***
	(0.00)	(0.00)
Income Category: Poor	0.00	-0.00
	(0.01)	(0.01)
Income Category: Middle	0.00	-0.01
	(0.01)	(0.01)
Income Category: Richer	-0.00	-0.01
	(0.01)	(0.01)
Income Category: Richest	0.01	-0.00
	(0.01)	(0.02)
Mother's Age at Birth	-0.01	-0.02
	(0.01)	(0.02)
Mother's Age at Birth^2	0.00	0.00
	(0.00)	(0.00)
Mother's Height	-0.01***	-0.01**
	(0.00)	(0.00)
Household located in Rural Area	0.02***	0.02***
	(0.01)	(0.01)
Muslim	-0.01	-0.01
	(0.01)	(0.01)
Christian	-0.00	-0.01
	(0.01)	(0.01)
Other Religion	-0.01*	-0.01
	(0.01)	(0.01)
Scheduled Caste	-0.01	-0.01
	(0.01)	(0.01)
Scheduled Tribe	0.01	0.01*
	(0.01)	(0.01)
Other Backward Class	0.01	0.01
	(0.00)	(0.01)
Birth Order Number	-0.01**	-0.01*
	(0.00)	(0.00)
Mother's Years of Schooling	0.001	0.00
	(0.00)	(0.00)
Observations	23,792	22,245

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Robust Standard Errors Clustered at Mother Level
Additional Controls: State fixed effects, Month of birth fixed effects, Year of birth trend, State Fixed time trends & Mother's age at birth[3]

Table 4 – Proportion of sample with the presence of domestic violence by state

State	Mean	Standard Deviation
Jammu and Kashmir	0.08	0.27
Himachal Pradesh	0.05	0.21
Punjab	0.25	0.43
Uttaranchal	0.3	0.46
Haryana	0.31	0.46
Bihar	0.57	0.5
Sikkim	0.11	0.31
Arunachal Pradesh	0.36	0.48
Nagaland	0.16	0.37
Manipur	0.4	0.49
Mizoram	0.24	0.43
Tripura	0.45	0.5
Meghalaya	0.12	0.33
Assam	0.3	0.46
West Bengal	0.29	0.45
Jharkhand	0.33	0.47
Orissa	0.35	0.48
Chhatisgarh	0.27	0.44
Madhya Pradesh	0.44	0.5
Gujarat	0.27	0.45
Maharashtra	0.27	0.44
Andhra Pradesh	0.35	0.48
Karnataka	0.16	0.37
Goa	0.17	0.37
Kerala	0.12	0.32
Tamil Nadu	0.48	0.5
Total	**0.29**	**0.45**

Table 5 - Proportion observations with the presence of domestic violence by year of marriage

Year of Marriage	Mean	Standard Deviation
1992	0.28	0.45
1993	0.31	0.46
1994	0.34	0.47
1995	0.33	0.47
1996	0.31	0.46
1997	0.31	0.46
1998	0.29	0.46
1999	0.28	0.45
2000	0.28	0.45
2001	0.27	0.44
2002	0.24	0.42
2003	0.19	0.39
2004	0.2	0.4
2005	0.17	0.38
Total	**0.29**	**0.45**

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