Midwives and Maternal Mortality:
How Effective Has Indonesia’s Village Midwife Program Been?

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Abstract

Objective: To assess the effect of Indonesia’s Village Midwife Program on Maternal Mortality Rates

Methods: Use data from the Demographic and Health Surveys (years) to construct a time series (1985-2002) of estimates of Maternal Mortality Rates-separately for rural and urban areas- using the Sisterhood method. Use data from the Indonesian Family Life Survey (years) to construct estimates of village midwife availability, and also a time series of both the Crude Birth Rate and the Teenage Birth Rates-separately for rural versus urban areas. Use regression analysis to identify the effect of village midwives after controlling for other correlates such as maternal education, and maternal age at pregnancy.

Findings: Between the time in 1993 when the deployment of midwives began in earnest and 2000, the majority of the trained midwives were deployed to rural areas, and resulted in a large reduction in the rural-urban gap in MMRates over this period. We also find a reduction in the rural-urban difference in Crude Birth Rates and Teenage Birth Rates. Together these results suggest that village midwives may have impacted maternal mortality rates by improving access to family planning methods, and by reducing unsafe abortion practices. The results are robust to the consideration of other factors such as changes in mother characteristics and access to other sources of maternal care.

Key Words: maternal mortality, Indonesia, village midwife

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I. Introduction

Perhaps the most difficult-to-achieve of the Millenium Development Goals (MDG) to which the nations of the world are committed is that to reduce maternal mortality by three quarters between 1990 and 2015 (MDG5). Since recent research (Lorentzen et al; 2008) has shown that the incentive effects on capital formation are larger for mortality reductions among adults than for those among children, and since young children of deceased mothers have a much larger chance of dying than those of living mothers (Anderson et al 2007, Crampin et al 2002), this MDG5 goal may be very important for long-run development. Given the constraints on both the public health budgets of poor countries and the household budgets of the poor in those countries, quite clearly success in achieving this goal requires programs that are both cost-effective and accessible.

There are several causes of maternal death in Indonesia, but two of the most important are perhaps death due to obstructed labor, and unsafe abortion practices. The latter is thought to cause about 15 percent of the overall maternal deaths in Indonesia. For each such cause, a somewhat different strategy may be required. On the one hand, preventing deaths due to obstructed labor requires emergency obstetric care. On the other, unsafe abortion calls for better family planning practices.

With a Maternal Mortality Ratio (MMR) of over 400 per 100,000 live births, (i.e., well above the world median), Indonesia launched a large scale Village Midwife Program (VMP) in 1989 (Government of Indonesia 1989). Since VMPs are frequently recommended as a low cost means of reducing maternal mortality (and perhaps infant mortality as well) (e.g., World Bank 2003, Campbell et al 2006, Ronsmans et al 2006), and are featured in current attempts to reduce MMRs in two countries with the highest such rates at present (Malawi and Nigeria), Indonesia offers a useful context for examining the effects of a VMP. Indonesia’s VMP called for a full year of training of about 50,000 midwives to be deployed to those of its villages deemed underserved by health professionals.

Numerous shortcomings of VMP have been noted. In particular, Hatt et al (2007) show that the program did not reduce the urban-rural gap in life-saving emergency care such as delivery by caesarian section. Makowiecka et al (2008) show that, despite the VMP’s targeting of less well served rural areas, in practice access to VMW emergency services became less equitable between both rural and urban areas. Numerous studies (World Bank 1999; Hull 1998) note that the aggregate MMR had not fallen appreciably between the initiation of the program in 1989 and 1994.
Advocacy of VMPs in Indonesia as well as other developing countries has undoubtedly been motivated by historical evidence linking the reductions in MMRs achieved in Sri Lanka and Malaysia in the mid-20th Century (Seneviratne and Rajapaksa, 2000; Liljestrand and Pathmanathan, 2004) to the rather massive spreading of midwives in the preceding period. For example, between 1940 and 1950 Sri Lanka’s MMR fell from 1607 to 577 while attendance at birth by midwives and other health professionals doubled. Similarly, between 1949 and 1961, Malaysia’s MMR fell from 520 to 200 while birth attendance by midwives and other trained professionals doubled. Notably, however, other conditions that were undoubtedly also changing over time, such as access to hospitals, and doctors (especially in Malaysia), and disease (especially malaria in Sri Lanka), were not controlled for in these case studies. As a result, the effects of these midwife programs may have been overestimated. Indeed, in the Sri Lankan case, while its MMR was falling sharply and its midwives increasing rapidly, not only was its malaria rate falling sharply but also the proportion of women delivering at hospitals or clinics was doubling, and the usage of sulfa drugs, and blood transfusions were also expanding rapidly (Paxton et al, 2004; Jayachandran and Lleras-Muney, 2009).

Two of the most widely used methods to measure maternal health are the Maternal Mortality Ratio (MMR), and the Maternal Mortality Rate (MMRate). The MMR is defined as the number of maternal deaths/number of live births, while the MMRate is the number of maternal deaths divided by the number of reproductive age women. By definition, the MMR is not sensitive to changes in maternal deaths due to unsafe abortion practices, while the MMRate may be more sensitive to changes in maternal deaths due to both obstructed labor and unsafe abortion. Therefore, in this paper, we use the MMRate as our main outcome variable to estimate the effect of Indonesia’s VMP program on maternal health.

II. Methods

Data Sources and Study Population

Data on our main dependent variable- the Maternal Mortality Rate- come from the Demographic and Health Surveys of Indonesia (1994, 1997, 2002-3, and 2007). The samples included 33,738 households in 1994, 34,255 in 1997, 33,088 in 2002-3, and 40,701 in 2007. The numbers of ever-married women 15-49 in these samples were 28,168, 28,810, 29,483, and 32,895, respectively. The second primary source of data is the first four rounds of the Indonesian Family Life Survey (IFLS 1993, 1997, 2000, and 2007) with samples of 7224, 7698, 10,574, and 13,535 households, respectively. The households were sampled from about 310 enumeration
areas in 13 provinces, representing about 83 percent of the Indonesian population. This source provides data on access to village midwives (VMWs) and other sources of maternity care. Critically for our purposes, both surveys provide identifiers for several geographic levels (urban and rural, and province) and allow us to construct annual time series on these levels for both MMRates and VMWs from at least 1980 to 2006. However, in our preferred specification we only include data from 1982-2002. We test the robustness of this restriction on our findings by including the full sample in alternate specifications of our model.

**Variables**

The main dependent variable is the MMRate defined as the number of maternal deaths per 100,000 women of reproductive age (15-49) based on the aforementioned DHS. In the absence of actual data on the number of maternal deaths, we use the sisterhood method—promoted by the World Health Organization—to calculate the MMRate. We construct this time series for the period 1980-2006. We also construct the VMW availability measure—the fraction of districts with a village mid-wife. At the national level, we do this for the country as a whole and for its urban and rural areas separately. In addition, we also create variables that may also be correlated with MMRates such as maternal education, and age.

**Statistical Analysis**

We assess annual trends in both the fraction of village midwives, and the MMRate for the period 1980-2006 and plot these trends separately for urban and rural areas. Then we use the variation in the growth of village midwives in the urban and rural areas to estimate the effect of the program on the MMRate and the fraction of districts with village midwives (Midwife) using regression equations of the following forms:

\[
\text{MMRate}_{jt} = \alpha_0 + \alpha_1 (t) + \alpha_2 (VMP_t) + \alpha_3 (VMP_t \times Rural) + \alpha_4 (Rural) + \alpha_5 X + \epsilon_{jt} \quad (1)
\]

\[
\text{Midwife}_{jt} = \beta_0 + \beta_1 (t) + \beta_2 (VMP_t) + \beta_3 (VMP_t \times Rural) + \beta_4 (Rural) + \beta_5 X + \epsilon_{jt} \quad (2)
\]

where:  
- \(t = 1982,1983,\ldots,2002\).  
- \(j = \text{rural, urban}\)

The variable \(VMP\) is coded as 1 if the program was in effect, and 0 if not in effect. Although the program officially began in 1990, it was not until 1993 that the trained midwives actually began to be placed in the villages. Thus, we define \(VMP = 1\) if year is greater than or equal to 1993. \(Rural\) is a dummy variable representing a rural area while \(u\) and \(e\) denote error terms. The vector \(X\) includes variables that may affect maternal mortality such as the fraction of districts (within rural-urban-year cells) with a village midwife (Midwife), mean education level of the mother, and mean age of the mother at pregnancy.
The coefficient $\alpha_3$ represents the difference in the effect (on maternal mortality) of the VMP in rural and urban areas, and $\beta_3$ represents the difference in the effect of the VMP on village midwife availability in rural and urban areas. More specifically, $\alpha_3$ and $\beta_3$ represent the “difference-in-difference”- since they compare the rural-urban difference between pre- and post-program years. To the extent that unmeasured factors that affect maternal mortality rates stay “fixed” in the pre-and post-program periods, the coefficients may also be treated as representing the causal effect of the village midwife program on MMRates.

In several regression models, we also control for the effects of other factors that can affect maternal mortality such as maternal education, and the number of community health centers in each rural-urban-year cell. In all regressions, the observations are weighted by the number of women contributing data toward the estimation of the rate.

III. Results

In Figure 1, we plot the trends in the fraction of districts with VMWs-separately for rural and urban areas. The difference is quite striking: there was a much quicker growth in the village midwife availability in rural areas. In 1991-92, virtually no district in the rural areas had any village midwife, but by 1997 almost all districts in the rural areas had at least one village midwife. There was growth in village midwife availability in urban areas as well- but this was at a much less spectacular rate than in rural regions. In Figure 2, we plot -separately for rural and urban areas- trends in MMRates, while in panels A and B of Figure 3, we plot the trends the Crude Birth Rate (CBR) and Teenage Birth Rate (TBR), respectively. The overall pattern is quite clear: the rural-urban difference in the birth rates and MMRates rapidly narrowed in the 1990s-especially after 1993. In each case the narrowing roughly coincided with the preferential deployment of VMWs to rural areas.

Panels A-C of Figure 4 plot trends in maternal education, maternal age at pregnancy and # of health centers within 5 kilometers of the village center separately for rural and urban areas. They reveal that rural-urban differences in these potential correlates of maternal mortality have not changed appreciably over time. Thus, it would seem unlikely that the narrowing of rural-urban differences in MMRates was caused due to these factors. This conjecture is further verified in results presented in Table 1.

Table 1 presents results for estimated coefficients from regressions (1) and (2) in which we treat the program year(s) as 1993-2002. The estimates in column 1 suggest that after 1993
there was a 48 percentage point increase in midwives in rural areas relative to the urban areas. The rural dummy variable is essentially estimated as a zero reflecting the fact that before 1993, there was no difference in village midwife presence in rural versus urban areas. In column 2, the results suggest that there were roughly 2350 fewer births (per 100,000 reproductive age women) in rural areas relative to urban areas post-program than there were in the pre-1993 period. Combined with about 2200 more births in rural areas prior to 1993, the results from Table 1 suggest that the rural-urban difference in crude birth rates was virtually eliminated by 2002—mirroring the pattern observed in Figure 3.

The last three columns of Table 1 show the corresponding trends in MMRates. The results in column 3 suggest that there were about 12 fewer maternal deaths (per 100,000 reproductive aged women) in rural areas vis-a-vis urban areas in the post-program (1993 and beyond) period than in the pre-program period. Combined with about 16 more deaths (per 100,000 reproductive aged women) in rural areas vis-a-vis urban areas before the program, these results also mirror the declining rural-urban difference in MMRates that were revealed in Figure 2. In column 4 of Table 1, we control for both maternal education, and the number of health centers in close proximity to the village center. These variables do not appear to affect the rural-urban difference in MMRates in the post-program relative to the pre-program period. The results in column 5 of Table 1 show that almost all of the reduction in rates post-program (1993-2002) can be explained by the presence of village midwives. In particular, once we control for the presence of village midwives, we find that there is virtually no additional convergence of MMRates in the 1993-2002 period.

In Table 1, we make an assumption that maternal mortality can be modeled as a linear function of midwives. In order to gauge the sensitivity of our estimates to this rather strong assumption, we tried estimating alternate specifications of equation 1. First, in the results shown in column 1 of Table 2 are those in which we use the natural logarithm of MMRate as the dependent variable. The results in column 1 reveal that there was a roughly 30 percent reduction in the rural-urban difference in MMRates between the pre- and post-program periods. This difference is virtually eliminated in column 2 when we also control for the presence of village midwives in the specification. Indeed, once we adjust for the presence of village midwives, it appears that in the post-program period, the MMRate was higher in the rural areas (coefficient = +0.34), but the estimate is not statistically significant at the 95% level of significance. Second, in columns 3 and 4, we use the MMRate as the dependent variable, but now include in our analysis all the years for which data on MMRates could be obtained (i.e., 1980-2006). The results show,
once again, the pivotal role of village midwives in narrowing the rural-urban gap in maternal mortality rates. The entire analysis is performed using STATA/SE version 11.0.

IV. Discussion

By 2003, approximately halfway between 1990 and 2015 (the target year for fulfillment of MDG5 for maternal mortality), the results presented above suggest that Indonesia made some progress in narrowing rural-urban differences in maternal mortality rates over two decades (1982-2002). We demonstrate that this narrowing may have been driven by the influx of over 50,000 village midwives over that period. Indeed, we confirm that rural-urban differences in other potential determinants of maternal mortality such as maternal age and maternal education did not change appreciably over the period 1985-2005.

Earlier studies have suggested that contemporaneous with the introduction of the VMP, the rural-urban disparity in emergency obstetric care also widened (Makowiecka et al, 2008). While that may be true, our analysis suggests that the reduction in the MMRate may have been brought about by a narrowing of the rural-urban disparities in the birth rates (CBR and TBR). Thus, we infer that the village midwives affected maternal mortality in part by lowering the number of unwanted pregnancies and also possibly by supervising safer abortion practices.

However, since even by 2003 the VMP was virtually fully deployed, the provision of midwives by itself would seem unlikely to contribute much more to MMRate reduction than it had by then. Hence, clearly other measures intended to overcome some of the shortcomings in the program noted above. These might include (1) various means of improving access of women with troubled pregnancies to hospitals with emergency care, and (2) encouraging commitment to a comprehensive MMRate reduction such as the one which has been deemed successful in Mongolia (Yadamsuren et al, 2010).

This paper is subject to several limitations. First, due to the absence of vital registration data on maternal deaths, we resort to the sisterhood method to calculate MMRates. Although the method is not generally applied to estimating trends, we show that by combining multiple waves of DHS data, we are able to overcome the small sample size problem, and obtain fairly precisely estimated rates- at least in the case of rural Indonesia. Indeed, Figure 5 shows that the confidence intervals on the MMRates are sufficiently narrow for us to see that a reduction in the rate was statistically significant. Second, because of the limited sample size, we were forced to use a more parsimoniously specified model than would be desired. Third, it is plausible that the introduction
of the village midwives had “spillover” effects on other parts of the health care system. In particular, the increase in competition faced due to the influx of over 50,000 midwives might have led to an overall improvement in the quality of both family planning and maternal care. Finally, and perhaps most importantly, the study makes the assumption that sisters’ of the female respondent in the DHS also lived in the same area (rural or urban) as the respondent. Although we cannot directly test the validity of this assumption, we can (and do) examine the rural vs. urban differences in birth rates. Using data from the IFLS, we find that over 80 percent of the siblings stay in the same province- bolstering confidence in the validity of the aforementioned assumption.

These limitations notwithstanding, we believe that the paper has been able to show that the effects of the VMP on MMRates to have been quite substantial. These findings may be encouraging to proponents of Indonesia’s VMP in the wake of recent relatively widespread criticism that the program has failed to meet its objectives. In particular, it highlights the possibility that restricting attention to changes in the Maternal Mortality Ratio may not fully capture the effects of programs aimed at reducing the number of maternal deaths. In poor countries where emergency obstetric health care services may be hard to access, programs such as Indonesia’s VMP- where the midwives are rigorously trained in family planning methods and in ensuring safe abortion practices- could play a crucial role in lowering the MMRate.

Finally, it should be pointed out that the benefits of the VMP program may go well beyond the benefits in terms of maternal mortality for which it was designed. Indeed, studies by Frankenberg and Thomas (2001), Frankenberg, Suriastini and Thomas (2005) show that village midwives have had other important effects, such as improving the infant birth outcomes and child health, and in increasing the spacing between children. Thus, indirect benefits of maternal mortality reductions might accrue. Hence, even if it should be determined that the costs of the VMP should appear high relative to the benefits realized in reducing maternal mortality alone, because of these many other benefits of the VMP, the overall benefits could well exceed the costs.
Figure 1: Trends in village midwives (VMWs)

![Graph showing trends in village midwives]

Notes: Data come from the Indonesia Family Life Survey

Figure 2: Trends in Maternal Mortality Rates (MMRates), Rural (r) and Urban (u)

![Graph showing trends in maternal mortality rates]

Notes: Data come from the Demographic and Health Surveys in Indonesia.
Figure 3: Trends in Birth Rates: Urban vs. Rural

Panel A: Crude Birth Rate

Panel B: Teenage Birth Rate
Figure 4: Trends in Health Centers, Mother’s Education, and Maternal Age, Rural and Urban

Panel A: Mothers’ age at first pregnancy

Panel B: Mothers’s Years of Education

Panel C: Number of health centers within 5 kilometers of village center
Figure 5: Rural MMRates with 95% Confidence Intervals

![Diagram showing rural MMRates with 95% confidence intervals from 1985 to 2005. The y-axis represents MMRate ranging from 0 to 0.0006, and the x-axis represents years from 1985 to 2005. The graph shows a decreasing trend in MMRate over the years, with 95% confidence intervals indicated by error bars.]
Table 1: Trends in Village Midwives, Crude Birth Rate, and Maternal Mortality Rates: Rural vs. Urban

<table>
<thead>
<tr>
<th></th>
<th>Midwives (1)</th>
<th>Crude Birth Rate (per 100,000 reproductive age women) (2)</th>
<th>Maternal Mortality Rate (per 100,000 reproductive age women) (3)</th>
<th>Maternal Mortality Rate (per 100,000 reproductive age women) (4)</th>
<th>Maternal Mortality Rate (per 100,000 reproductive age women) (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Year&gt;=1993) x Rural</td>
<td>0.48***</td>
<td>-2349***</td>
<td>-12.3***</td>
<td>-9.0***</td>
<td>2</td>
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<tr>
<td></td>
<td>(0.41-0.55)</td>
<td>(-3141; -1555)</td>
<td>(-20; -5)</td>
<td>(-15; -3)</td>
<td>(-13; 17)</td>
</tr>
<tr>
<td>Rural</td>
<td>0</td>
<td>2191***</td>
<td>16.3***</td>
<td>6</td>
<td>16***</td>
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<tr>
<td></td>
<td>(-0.03- 0.03)</td>
<td>(1712;2670)</td>
<td>(12;20)</td>
<td>(-28;39)</td>
<td>(12;20)</td>
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<tr>
<td>Year&gt;=1993</td>
<td>0.17***</td>
<td>-170</td>
<td>-3.3</td>
<td>-2</td>
<td>1.77</td>
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<tr>
<td></td>
<td>(0.08-0.26)</td>
<td>(-792; 452)</td>
<td>(-10; -3)</td>
<td>(-9;5)</td>
<td>(-5.5;9)</td>
</tr>
<tr>
<td>Time</td>
<td>0.01***</td>
<td>-446 ***</td>
<td>0.06</td>
<td>0.5</td>
<td>0.15</td>
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<tr>
<td></td>
<td>(0-0.02)</td>
<td>(-503; -390)</td>
<td>(-0.4;0.55)</td>
<td>(-0.9;1.9)</td>
<td>(-0.2-1.2)</td>
</tr>
<tr>
<td>Fraction of districts with village midwives</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>-29**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-57;-2)</td>
</tr>
<tr>
<td>Maternal Education</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Constant</td>
<td>0.22***</td>
<td>6373***</td>
<td>16.2***</td>
<td>50</td>
<td>54</td>
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<tr>
<td></td>
<td>(0.16-0.27)</td>
<td>(5846;6898)</td>
<td>(10.7;21.8)</td>
<td>(-22;130)</td>
<td>(-24;132)</td>
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<td>R-squared</td>
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<td>0.97</td>
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<td>0.68</td>
<td>0.71</td>
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<td>42</td>
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</table>

Notes: 95% confidence intervals (bootstrapped with 500 replications) are in parenthesis
N denotes (Not included), Y denotes Included
Table 2: Robustness of Findings to Empirical Specification

<table>
<thead>
<tr>
<th></th>
<th>Log(MMRate)</th>
<th>Log(MMRate)</th>
<th>MMRate</th>
<th>MMRate</th>
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<tr>
<td>(Year&gt;=1993) x Rural</td>
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<td>0.34</td>
<td>-8.0**</td>
<td>5.6</td>
</tr>
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<td></td>
<td>(-0.7;0.12)</td>
<td>(-0.15;0.84)</td>
<td>(-14.7;-1.4)</td>
<td>(4.8)</td>
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<td>Rural</td>
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<td>0.78***</td>
<td>14.90***</td>
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<td></td>
<td>(0.5;1.0)</td>
<td>(0.55;1.03)</td>
<td>(9.6;20.1)</td>
<td>(11;20)</td>
</tr>
<tr>
<td>Year&gt;=1993</td>
<td>0.06</td>
<td>0.17</td>
<td>0.68</td>
<td>5.82*</td>
</tr>
<tr>
<td></td>
<td>(-0.47;0.35)</td>
<td>(-0.27;0.49)</td>
<td>(-6.7;8.1)</td>
<td>(-0.8;12.4)</td>
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<td>Fraction of districts with village midwives</td>
<td>N</td>
<td>-1.76***</td>
<td>N</td>
<td>-37***</td>
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<td>(-2.8;-0.6)</td>
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<td>(-57;-17)</td>
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<tr>
<td>Time trend</td>
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<td>Y</td>
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<tr>
<td>Sample Size</td>
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<td>42</td>
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</table>

Notes: 95 percent confidence intervals (bootstrapped with 500 replications) are in parenthesis. N denotes (Not included), Y denotes Included
References


