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Professional assistance during birth and maternal mortality in two Indonesian districts
C Ronsmans, S Scott, SN Qomariyah, E Achadi, D Braunholtz, T Marshall, E Pambudi, KH Witten & WJ Graham

Introduction
The fifth Millennium Development Goal (MDG 5) is to reduce the maternal mortality ratio worldwide by 75% between 1990 and 2015. An essential strategy for achieving MDG 5 is to ensure that all births are managed by skilled health professionals. This strategy requires high population coverage and an enabling environment, including 24-hour access to effective emergency obstetric care.

Ecological studies have shown an inverse correlation between the number of health professionals per unit of population and the proportion of births attended by a health professional on the one hand, and maternal mortality on the other. However, causal inferences cannot be robustly drawn. Few studies have assessed whether the percentage of births assisted by a health professional within a population correlates with maternal mortality, and even fewer studies have checked for a correlation between an individual woman's use of a health professional at birth and her risk of maternal death. Thus, the size of the effect that a given strategy to promote skilled birth attendance could have on maternal mortality is unclear.

Indonesia is one of the few countries that have implemented initiatives to provide midwifery care in the community. In 1989, the Indonesian Government launched a safe motherhood programme that aimed to assign a midwife to every village. Within seven years, more than 54 000 midwives had been posted, and the proportion of births managed by a midwife or other health professional had nearly doubled (from 35% in the late 1980s to 69% in 2000).

In response to the economic crisis in 1997, the government introduced a social safety net programme that exempts the poor from paying health service fees. In 2005, a new health insurance scheme called ASKESKIN (asuransi kesehatan untuk keluarga miskin or health insurance for the poor) made the poorest families eligible for fee exemption for routine and emergency care. Under ASKESKIN, midwives are paid to manage deliveries, either in their own home or in the pregnant woman's home.

In this paper we evaluate Indonesia's safe motherhood programme by examining whether differences in the availability and use of midwives and other health professionals at birth can explain differences in the risk of maternal mortality in two districts in West Java.

Methods
Safe motherhood programme and study population
As part of an international research initiative known as the Initiative for Maternal Mortality Programme Assessment (Immpact), we measured maternal mortality, assessed the provision of midwifery care, and determined the levels of uptake of professional delivery care in the Serang and Pandeglang districts of Banten Province, Java, Indonesia. Serang is 72 km

Objective
To examine determinants of maternal mortality and assess the effect of programmes aimed at increasing the number of births attended by health professionals in two districts in West Java, Indonesia.

Methods
We used informant networks to characterize all maternal deaths, and a capture-recapture method to estimate the total number of maternal deaths. Through a survey of recent births we counted all midwives practising in the two study districts. We used case–control analysis to examine determinants of maternal mortality, and cohort analysis to estimate overall maternal mortality ratios.

Findings
The overall maternal mortality ratio was 435 per 100 000 live births (95% confidence interval, CI: 376–498). Only 33% of women gave birth with assistance from a health professional, and among them, mortality was extremely high for those in the lowest wealth quartile range (2303 per 100 000) and remained very high for those in the lower middle and upper middle quartile ranges (1218 and 778 per 100 000, respectively). This is perhaps because the women, especially poor ones, may have sought help only once a serious complication had arisen.

Conclusion
Achieving equitable coverage of all births by health professionals is still a distant goal in Indonesia, but even among women who receive professional care, maternal mortality ratios remain surprisingly high. This may reflect the limitations of home-based care. Phased introduction of fee exemption and transport incentives to enable all women to access skilled delivery care in health centres and emergency care in hospitals may be a feasible, sustainable way to reduce Indonesia's maternal mortality ratio.

Une traduction en français de ce résumé figure à la fin de l'article. Al final del artículo se facilita una traducción al español.
from Jakarta, the capital of Indonesia, and moderately urbanised, with three hospitals and 36 health centres for its 1.8 million people. Pandeglang, more remote, has one district hospital and 30 health centres for its 1.1 million people. Serang and Pandeglang districts have 55 and 23 urban villages and 318 and 312 rural villages, respectively. In these two districts, the uptake of professional care at birth is lower than the national average.15

Data sources

Informant-based identification of maternal deaths

A double informant-based approach based on Maternal Deaths from Informants (MADE-IN) and Maternal Death Follow-on Review (MADE-FOR)17 was used to identify all maternal deaths that occurred in the two study districts between January 2004 and December 2005. MADE-IN uses existing village administrative systems to collect information about women’s deaths. Village informants held “listing meetings” during which they listed the details of deaths in village women 15 to 49 years of age that occurred over the previous 2 years. The informants were health post volunteers (kaders) and unpaid village officials (rakun tetangga or RT heads), both of which were used in all urban villages and in a random sample of 78 rural villages. In the remaining 552 rural villages, only kaders were used. A maternal death was defined as any death during pregnancy or within 42 days after pregnancy, regardless of the cause. Once all maternal deaths were identified, the MADE-FOR team visited the family of each deceased woman to collect information about the circumstances of her death, and her use of health services during pregnancy and near the time of death. The team also collected information on the household’s assets, the woman’s education and the source of payment for medical care.

Population-based survey

We conducted a stratified cluster random sample survey in the two districts between April and June 2006.15 Villages were stratified as urban, rural or rural-remote. Remote villages exist only in Pandeglang and are defined as those that lie further than 33.3 km (the median distance to non-urban villages in this district) from the nearest government hospital in the study area. Although some villages in Serang are further than 33.3 km from a government hospital, they are not classified as remote because they lie close to neighbouring suburban or industrial areas and are well served by transport and service infrastructure. A total of 150 villages were sampled with probability proportional to size and with replacement. Within each sampled village, a randomly-selected administrative unit provided a list of the members of all households by which to identify all women with a live birth or stillbirth between April 2004 and March 2006. Eight births per village were then randomly selected, and information was collected from the families on the same background variables as for maternal deaths.

Midwife census

In September 2005, each midwife in the two districts completed a questionnaire that included questions on personal and professional characteristics, including age, parity, training, type of employment contract and workload. Each was also asked if she had been assigned responsibility to particular villages for pregnancy, delivery and post-partum care.16

Data analysis

Determinants of maternal mortality

We performed a case–control analysis to examine the determinants of maternal mortality. Cases were all maternal deaths between January 2004 and December 2005; unmatched controls were all women who reported a birth between April 2004 and March 2006 in the population-based survey previously described. By means of logistic regression, with allowance for village clustering and stratification, we examined the associations between maternal death and asset ownership, maternal education, type of health insurance, district, urban or rural residence, local midwife density (number of midwives per 10 000 population) and the presence of a health professional during birth or near the time of death. We calculated crude and adjusted odds ratios (ORs) with their 95% confidence intervals (CI) and repeated the analysis after excluding women who died during pregnancy.

Health professionals were defined as midwives (community or health centre midwives) or physicians. Wealth was ascertained by an asset index derived using principal component analyses.18 To construct an asset score for the cases, the values assigned to each asset from the principal component analysis of the controls were applied to the assets of each case. The wealth quintile ranges were derived from the first principal component based on recent births only. For insurance, the categories were none, insurance for the poor (ASKESKIN) and other insurance (private or employer-based). All recent births from the survey were linked with the village where the mother lived to obtain information on the local midwife density.

Maternal mortality ratios

For a random sample of villages, linked data on deaths from the two different informant networks (kaders and RT heads) enabled us to use a capture–recapture method19 to gauge misreporting, estimate the proportion of maternal deaths identified and estimate the true total number of maternal deaths for the two districts. Thus, capture–recapture methods allowed an assessment of the completeness of reporting of the two informant networks. For example, if only half of the cases identified by the kaders were identified by the RT heads, the completeness of the kader reporting was estimated as approximately 50%. These techniques are becoming more widely used in public health.20 The expected number of births in each of five geographical strata (urban and rural in each district and rural-remote area in Pandeglang) were estimated from the population in each village (based on the 2004 national census), and stratified crude birth rates were estimated from the population-based survey.

To estimate maternal mortality ratios (maternal deaths per 100 000 live births) by women’s characteristics, the birth data from the population-based survey were used to estimate the number of births with the desired characteristic (within strata), on the assumption of a binomial distribution. Analyses were performed using WinBUGS.21
Results

Most births (83%) in the two districts took place at home, and only one-third of births (32.8%) were attended by a health professional (90.4% by a midwife, 7.0% by both a midwife and doctor, and 2.7% by a doctor). Few births took place in a health centre, clinic or hospital (5.8%); 11.2% of births took place in a midwife’s home. There were 474 maternal deaths, for an overall maternal mortality ratio of 435 per 100 000 (95% CI: 376–498). Nearly half (47.6%) of the women who died had been managed by a health professional before death. Of the 355 women who died during labour, delivery or the postpartum period, 43.4% had been managed by a health professional during the birth. Of the 107 women who died during pregnancy, 61.7% had been attended by a health professional during the illness leading to death (data were missing for 12 women). The odds of having a health professional present during delivery or around the time of death was 1.9 times higher (95% CI: 1.4–2.5) among women who died than among women who survived (Table 1). Excluding deaths during pregnancy reduced the OR slightly, to 1.53 (95% CI: 1.1–2.1).

Among women in the poorest quartile range, only 10.3% gave birth with assistance from a health professional, and the maternal mortality ratio was 706 per 100 000 (Table 1). The women in the highest quartile range gave birth with assistance from a health professional 71.1% of the time, and the maternal mortality ratio was 232 per 100 000 (Table 1).
had lower maternal mortality, although the ratio remained surprisingly high (232 per 100 000) given the high coverage of professional care at birth (71.1%) (Table 1, Fig. 1). Most births with a health professional in this group took place outside the woman’s home (44.6% in the midwife’s home, 7.2% in a health centre and 13.5% in hospital). Insurance for the poor had been accessed by 10% of the study population, and mortality in this group was very high (641 per 100 000) (Table 1). Only 21% had given birth with a health professional. Conversely, birth with a health professional was substantially higher in those with private or employment insurance, 23% of whom gave birth in hospital, but maternal mortality in this group remained high (260 per 100 000). Professional attendance at birth was higher in villages with four or more midwives per 10 000 population, but patterns of maternal mortality were inconsistent (Table 1).

Adjusting the analysis for all variables attenuated the ORs, and only the wealth quartile range remained significantly associated with maternal mortality: the adjusted OR for women in the poorest quartile range was 2.28 (95% CI: 1.3–4.0) when compared with women in the wealthiest quartile range. In all groups except the highest wealth quartile range, a health professional was much more likely to have been present for women who died than for those who survived (Fig. 2). The interaction between wealth quartile range and the presence of a health professional at birth was of borderline statistical significance ($P = 0.058$). Mortality was extremely high among the poorest women who gave birth with a health professional (2303 per 100 000), and it remained very high for women in the two middle wealth quartile ranges who gave birth with a health professional (2318 per 100 000), and it remained very high for women in the two middle wealth quartile ranges who gave birth with a health professional (2303 per 100 000), and it remained very high for women in the two middle wealth quartile ranges who gave birth with a health professional ($P < 0.001$). Mortality was extremely low for the lowest three wealth quartile ranges (0.6%); the wealthiest quartile range had a rate of 3.1% ($P = 0.003$ compared with the other three quartile ranges). Those who accessed insurance for the poor had higher Caesarean rates than those who did not (3.1% versus 0.4%, $P < 0.001$). Caesareans were more common among those with private or employment insurance (8.9%, $P < 0.001$) compared to those without health insurance. Women who died during or after delivery were 6.2 times more likely to have had a Caesarean than women who survived (95% CI: 3.1–12.5; adjusted OR: 8.7; 95% CI: 3.4–22.3).

**Discussion**

The maternal mortality ratios reported here are considerably higher than Indonesia’s overall ratio of 307 per 100 000. Among the poorest women, a mere 10% gave birth with a health professional, and their mortality reached a staggering 2303 per 100 000, a level 13 times higher than that found in the wealthiest women. Similar patterns were seen in Nepal, where only 8% of births were managed by a health professional. Nonetheless, in our study mortality was twice as high among those who gave birth with a health professional (mostly midwives) than among those who did not.

The high levels of mortality among those receiving professional care is perhaps not surprising in light of the fact that only one-third of all births were managed by a health professional. When uptake of professional birth attendance is low, women only seek professional care when they are ill, perhaps too late for a midwife or doctor to be able to save their lives. This is particularly the case when timely access to emergency obstetric care is limited. As coverage improves, women at lower risk of complications are more likely to seek care, so that average mortality in those seeking care will decrease. In this study,
maternal mortality only fell substantially when nearly three-quarters of the population sought professional delivery care, a rate seen among the wealthiest women. The maternal mortality ratio for the wealthy (232 per 10 000) remained surprisingly high, however, given the high coverage of professional care at birth.

Why has the uptake of professional delivery care remained so low in the two districts? The overall midwifery density of 2.2 per 10 000 population is similar to that in Malaysia and Sri Lanka, neighbouring countries that have achieved nearly universal professional attendance, with midwife densities of 3.4 and 1.6 per 10 000 population, respectively.23 In the two districts examined in this study, midwifery density was much lower in rural and remote villages than in urban areas,14 but the uptake of professional care remained relatively low even in urban areas. The strong attachment of women to birth traditions is often cited as the main reason for low use of professional care.14 However, the wealthiest women and those with access to health insurance clearly received more professional care than the poorest women, which suggests that economic barriers are the key deterrents. The direct costs to households for a delivery with a midwife are high, whether in the woman’s home (43 United States dollars, US$) or the midwife’s home (US$ 55).24 The costs of a Caesarean are even higher,25 so that only the wealthy can afford one without catastrophic consequences to the family.11

The Indonesian Government’s efforts to exempt the poor from paying user fees have not yet improved access or reduced their burden of maternal death. Mortality was three times greater among the poorest women than among the wealthiest, and the same gap between rich and poor has been found using Demographic and Health Survey (DHS) data.26 Many families were unaware of the insurance scheme, some midwives only had a partial understanding of it, and families reported delays in receiving care owing to the need to gather various documents. Eliminating user fees for pregnant women or offering cash incentives or vouchers to selected groups can increase service uptake, but it is unknown whether these strategies reduce the burden of maternal mortality or inequalities in the maternal mortality ratio.27–29 Our results suggest that increasing the uptake of skilled care at delivery is a necessity, if not sufficient, condition for achieving lower levels of maternal mortality, but the word to emphasize here is “skilled”. The persistently high levels of maternal mortality among wealthier women who give birth with a health professional are worrying. Some of these women will have sought care too late for the midwife or doctor to be able to prevent death. However, midwives may not be skilled enough at managing complications, even when women seek help early.30,31

Most midwives perform many tasks (including providing nutrition advice and immunizations) and attend

<table>
<thead>
<tr>
<th>Wealth quartile range</th>
<th>Delivery with health professional</th>
<th>Maternal deaths a (95% CI)</th>
<th>Case–control study</th>
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<td>Adjusted OR (95% CI) b</td>
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<td>Poorest</td>
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<td>6.67 (2.8–15.8)</td>
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<tr>
<td></td>
<td>No</td>
<td>1.43 (0.7–2.9)</td>
<td>2.04 (0.9–4.5)</td>
</tr>
</tbody>
</table>

CI, confidence interval; OR, odds ratio.

a Based on enumeration of all deaths and expected number of births in each village.

b Per 100 000 live births.

Adjusted for all other variables shown in Table 1.
This study has some limitations. First, women’s reports of the health professionals attending delivery may be inaccurate. However, this limitation is less relevant in the Indonesian context, where birth attendants are usually midwives or doctors, than in countries where traditional birth attendants are common. Second, estimates of maternal deaths produced by the capture–recapture method are likely to be less biased than the crude death count based on two informant networks, but there may still have been some bias. In particular, the informants may have missed some maternal deaths in early pregnancy or due to sensitive causes. Finally, this study’s asset-based classification of the population into wealth quartiles may not overlap with the method the government uses to determine who receives insurance for the poor. The usefulness of asset-based approaches for determining relative wealth in specific cultural contexts has also been questioned; such doubts would also apply to our findings.

Midwifery provision in Indonesia has focused on increasing the number of midwives, rather than on creating a supporting environment. This close-to-client focus promotes care in the woman’s or midwife’s home, but evidence from Bangladesh suggests that conditions in these locations can be basic. However, this strategy for intrapartum care is inefficient in terms of the midwife’s time and does not help her to cope with emergencies. While Indonesia has trained and posted a remarkable number of midwives, it is unclear whether universal coverage will be possible with a continued community focus. Midwives prefer to serve the population in the urban and more accessible areas. Data from Bangladesh also indicate that midwives deployed in the community provide few outreach services. Midwives working in health facilities can clearly assist more births because they can provide care to more than one woman in a given period and because they work in teams. A shift from home births to health centre births is possible even in settings with strong attachment to home births, and such a strategy may ultimately be efficient, effective and sustainable in reaching out to women.

The Indonesian Government has already recognized the potential of health centres to increase the number of births attended by health professionals. An intrapartum care strategy focused on health centres could represent the next phase in Indonesia’s progress towards universal skilled attendance. The phased introduction of fee exemption and transport incentives, with initial targeting of underserved areas, to enable all women to access skilled delivery care in health centres and emergency care in hospitals may be one feasible and sustainable option to enable the Indonesian Government to make further progress towards achieving MDG 5.

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Competing interests: None declared.
Résumé

Assistance professionnelle pendant la naissance et mortalité maternelle dans deux districts indonésiens

Objectif Étudier les déterminants de la mortalité maternelle et évaluer l’effet de programmes visant à accroître le nombre de naissances assistées par des professionnels de santé dans deux districts de l’Ouest de Java, en Indonésie.

Méthodes Nous avons utilisé des réseaux informateurs pour caractériser l’ensemble des décès maternels et une méthode de capture-recapture pour estimer le nombre total de ces décès. Par le biais d’une enquête sur les naissances récentes, nous avons recensé toutes les sages-femmes exerçant dans les deux districts étudiés. Nous avons fait appel à une étude cas-témoins pour examiner les déterminants de la mortalité maternelle et à une étude de cohorte pour estimer le taux global de mortalité maternelle.

Résultats Le taux global de mortalité maternelle était de 435 pour 100 000 naissances vivantes (intervalle de confiance à 95 %, IC : 376-498). N’ont bénéficié de l’assistance d’un professionnel de santé pendant l’accouchement que 33 % des femmes, et parmi ce groupe, la mortalité était extrêmement élevée chez les mères appartenant au quintile de richesse le plus bas (2303 pour 100 000) et restait très forte dans les quintiles moyen-inferieur et moyen-supérieur (1218 et 778 pour 100 000 naissances vivantes, respectivement). La raison de cette mortalité excessive est peut être que les femmes, notamment les plus pauvres, ne sollicitent pas l’aide qu’après l’apparition d’une complication grave.

Conclusion L’obtention d’une couverture équitable de la totalité des naissances par des professionnels de santé est encore un objectif lointain en Indonésie, mais même chez les femmes bénéficiant de soins professionnels, les taux de mortalité maternelle restent étonnamment élevés. Cette situation reflète peut être les limites des soins à domicile. La mise en place par étapes d’une exemption de paiement des actes et de mesures incitatives en matière de transport pour permettre à toutes les femmes d’accéder à des soins obstétricaux qualifiés dans un centre de santé ou à des soins d’urgence dans un hôpital pourrait être un moyen praticable et durable de réduire le taux de mortalité maternelle en Indonésie.

Resumen

Atención profesional en el parto y mortalidad materna en dos distritos de Indonesia

Objetivo Analizar los factores determinantes de la mortalidad materna y evaluar el efecto de los programas encaminados a aumentar el número de partos atendidos por profesionales de la salud en dos distritos de Java occidental, Indonesia.

Métodos Nos servimos de redes de informantes para caracterizar todas las defunciones maternas, y empleamos un método de captura-recaptura para estimar el número total de tales defunciones. A través de una encuesta sobre nacimientos recientes, contabilizamos el número de parteras que ejercían en los dos distritos estudiados. Realizamos un análisis de casos y controles para examinar los determinantes de la mortalidad materna, y un análisis de cohortes para estimar las razones de mortalidad materna globales.

Resultados La razón de mortalidad materna global fue de 435 por 100 000 nacidos vivos (intervalo de confianza del 95%: 376-498). Sólo un 33% de las mujeres dieron a luz con la asistencia de un profesional sanitario, y entre ellas la mortalidad fue muy alta en las situadas en el intervalo intercuartílico inferior de riqueza (2303 por 100 000), pero también bastante alta en las situadas en los intervalos intercuartílicos medio-bajo y medio-alto (1218 y 778 por 100 000, respectivamente). Ello se debe quizá a que las mujeres, especialmente las de las capas más pobres de la población, pueden haber buscado ayuda sólo después de haber sufrido una complicación grave.

Conclusión El logro de una cobertura equitativa de todos los nacimientos por profesionales sanitarios sigue siendo una meta lejana en Indonesia, pero, incluso entre las mujeres que reciben atención profesional, las razones de mortalidad maternas se mantienen sorprendentemente altas, debido quizá a las limitaciones de la asistencia domiciliaria. La introducción escalonada de medidas de exención del pago de honorarios y de incentivos al transporte para permitir a todas las mujeres acceder a atención obstétrica especializada en los centros de salud y a los servicios de urgencias en los hospitales podría ser una alternativa factible y sostenible para reducir la razón de mortalidad materna en Indonesia.

ملخص

الماعدة المهنية خلال الولادة ووفيات الأمهات في مقاطعتين في إندونيسيا

الهدف: دراسة محددات وفيات الأمهات وتقييم أثر البرامج التي تهدف إلى زيادة عدد الولادات التي يحصل فيها مهنئون صحيون في مقاطعتين غرب جاوه في إندونيسيا.

الطريقة: استخدم الباحثين شبكات المعلومات للتعروف على صفات جميع وفيات الأمهات وتقدير إجمالي عدد وفيات الأمهات وأسباب إعادة فحص مصادر البيانات. ومن خلال مسح ولادات حديثة، قام الباحثين أيضاً بإحصاء جميع الحالات، ومن خلال القابات الثلاثة لتقدير المعدلات تقدمت الباحثون إلى دراسة وتفقد الاضياع، والمساهمة في مساهمة، مما يجعل السباق المتوقع، الملاحظ على أنه، وليست المساعدة إلا بعد حدوث المعقدات الخطيرة.
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