The relationship between attendance at birth and maternal mortality rates: an exploration of United Nations' data sets including the ratios of physicians and nurses to population, GNP per capita and female literacy

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The relationship between attendance at birth and maternal mortality rates: an exploration of United Nations' data sets including the ratios of physicians and nurses to population, GNP per capita and female literacy

Background. This is the third and final paper drawing on data taken from United Nations (UN) data sets. The first paper examined the global distribution of health professionals (as measured by ratios of physicians and nurses to population), and its relationship to gross national product per capita (GNP) (Wharrad & Robinson 1999). The second paper explored the relationships between the global distribution of physicians and nurses, GNP, female literacy and the health outcome indicators of infant and under five mortality rates (IMR and u5MR) (Robinson & Wharrad 2000). In the present paper, the global distribution of health professionals is explored in relation to maternal mortality rates (MMRs). The proportion of births attended by medical and nonmedical staff defined as 'attendance at birth by trained personnel' (physicians, nurses, midwives or primary health care workers trained in midwifery skills), is included as an additional independent variable in the regression analyses, together with the ratio of physicians and nurses to population, female literacy and GNP.

Aim. To extend our earlier analyses by considering the relationships between the global distribution of health professionals (ratios of physicians and nurses to population, and the proportion of births attended by trained health personnel), GNP, female literacy and MMR.

Design. Using a database on 155 countries, regression analyses were performed using numbers of physicians, and numbers of nurses, per 1000 population, the proportion of births attended by trained health personnel, GNP per capita and female literacy as independent variables and MMRs as the dependent variable.

Results. Linear regression analyses show positive associations for MMRs and the ratios of physicians to population (73%, $n = 136$), ratios of nurses to population (56%, $n = 137$), and the proportion of births attended by trained health personnel

(83%, $n = 118$). Multiple regression analyses reveal a more complex picture, with nurses disappearing altogether when regressed with physicians, GNP, female literacy and MMR. The three variables, attendance at birth by trained personnel, GNP and physicians per 1000 population explained 87% of the variation in MMR ($n = 112$) when included in the multiple regression analysis.

Conclusions. As in the previous papers, caution is required regarding the validity and reliability of the UN data sources used in these analyses. Maternal mortality rates are particularly susceptible to inaccuracies. Nevertheless, the strength of the positive correlations suggests that real relationships are identified between the independent variables and the dependent variable of MMR. The strength of the linear and multiple correlations between births attended by trained personnel and lower MMRs indicates that maternal deaths are substantially reduced when a high proportion of births are attended by health professionals, including primary health care workers trained in midwifery skills, with the maintenance of an aseptic environment, the identification of maternal and foetal complications, and the opportunity when necessary to transfer parturient mothers to centres with higher level skills and facilities.

Keywords: births attended, female literacy, gross national product per capita, health economics, health outcomes research, health policy, international comparisons, maternal mortality rates, nurses, midwives, physicians, regression analyses, United Nations data

Introduction

Every minute of every day a woman dies as a result of pregnancy or childbirth somewhere in the world. She may be a teenage bride, physically not yet sufficiently developed for childbirth, struggling to give birth to a first baby, far from professional help. She may be a woman who has delivered in hospital who dies for want of blood or drugs that are in short supply. Or she may be an older woman already struggling to feed a large family who tries secretly and in desperation to terminate an unwanted pregnancy (Petros-Barvazian 1991, p. vii).

This paper presents findings from the analysis of a global data set on 155 countries derived from United Nations (UN) sources, to determine relationships between the ratios of health services personnel to population and maternal mortality rates (MMRs). The study represents the final part of a series of three analyses on the global distribution of health personnel. Earlier papers reported on the global distribution of physicians and nurses and its relationship to gross national product per capita (GNP) (Wharrad & Robinson 1999), and on the relationship between the global distribution of physicians and nurses, GNP, female literacy and the health outcomes indicators of infant and under five mortality rates (IMR and u5MR) (Robinson & Wharrad 2000).

The established relationships between income, female literacy and health, as measured by the outcome indicators of IMR and u5MR are discussed in Robinson and Wharrad (2000). The present paper extends this previous study to the relationship of health personnel to MMRs. Gross national product per capita and percentage female literacy were included in the correlations to take into account socio-economic variables that are known to be correlated positively with MMR (see, for example, The World Bank 1990, 1993, United Nations Children's Fund (UNICEF) 1992, 1994, World Health Organization (WHO) 1995, 1996, United Nations Development Programme (UNDP) 1995, 1997).

It is acknowledged that factors not considered in this paper are also implicated in MMRs, for example, access to clean water and sanitation services; adequate and appropriate nutrition; and fertility rates, with birth spacing an important variable in women's health. Hertz *et al.* (1994) in an international comparison study of data from UN sources on 35 countries found that MMRs were significantly correlated with the percentage of houses without water, total calories consumed, and total fat residual. Statistics on physicians per 10 000 population and hospital bed availability for 1980 included in the Hertz *et al.* (1994) model were derived from the World Health Statistics Quarterly (1980).

It was beyond the scope of this study, which was primarily concerned with the contribution of health professionals to health outcomes, to incorporate the range of variables that Hertz *et al*. included. However, our data also includes in addition to physicians per 1000 population, data on nurses per 1000 (which in UN data include midwives) and attendance at birth by nonmedical staff, including primary health care workers trained in midwifery skills. The latter categories of health personnel are likely to be highly relevant in many developing countries where a physician may only rarely attend parturient women. See note below on the problems of definitions.

The study

Materials and methods

Adding to the original data from UN sources for physicians (1990–1995) and nurses (1988–1992) per 1000 population, and GNP per capita ($US 1995) or GDP ($US 1994) for missing variables (see Wharrad & Robinson 1999, p. 111 for original data sources), the following variables were introduced to establish a new, combined data base (see Appendix 1):

- Percentage female literacy (1995) from the UNICEF (1997, Tables 4, 116 countries);
- Maternal mortality rate, the number of deaths to women during pregnancy and childbirth per 100 000 live births in the same year (1990) from the *Revised Estimates of Maternal Mortality* (WHO & UNICEF 1996), missing data from The World Bank (1997, Table A6) total 145 countries;
- Percentage of births attended by physicians, nurses, midwives, or primary health care workers trained in midwifery skills (1990–1996) from UNICEF (1997, Tables 7, 119 countries).

Note: Attendance at birth by trained medical and nonmedical health care workers is the only UN category of health personnel in relation to care of the parturient woman. The above definition includes a range from the most highly qualified obstetrician, to registered/graduate nurses and midwives, to traditional birth attendants who have been taught basic hygiene. It should be noted also that UN definitions of categories of health workers are not standard (Robinson & Wharrad 2000). The definition of a nurse is particularly problematic. Not only does it fail to distinguish between nurses and midwives, but also there is no global standard definition of a 'registered' nurse (International Labour Organization 1997). Primary health care workers trained in midwifery skills (UNICEF 1997, p. 102) may include a range of traditional health workers with varied amounts of training.

The total number of countries entered into each of the regressions varied between 112 and 144, depending on the availability of full sets of country data. The UNICEF, the WHO and The World Bank granted copyright permission for the use of the above data.

Data analysis

Statistical methods were used to analyse the relationships between the dependent and independent variables. Prior to all the regression analyses, exploratory analysis was carried out to determine the linearity of the relationship between the variables. Nonlinearity was addressed by log transforming the data for the variables GNP, physicians per 1000 population and nurses per 1000 population (Bland & Altman 1996). In addition the 'attendance at birth' and female literacy percentage data was arcsin transformed. The application of the arcsin transformation before a traditional regression analysis has its origins in the theory that such regression analysis requires all observations to have the same underlying variance. When the percentages are scattered around 50% their distribution is more or less normal (Gaussian). Problems arise at the ends of the scale. Percentages lie in the range of 0–100% but it is assumed in the normal distribution that the tails of the curve extend to infinity on either side of the mean. The consequence of this is that, if a sample has a mean of say 90%, it will tend to have a smaller standard deviation (SD) than a sample with a mean of 50% simply because the observations >90% cannot be >100%. The nearer the mean lies to 100% the more pronounced this effect becomes. The same thing happens at the other end of the scale. Thus the data will not conform to the normal distribution. The actual transformation for percentage data is

$$\text{Arcsin}[(\text{percentage value} - 50)/50]$$

The subtraction of 50% from everything allows low percentages to be handled similarly to high ones. The division by 50 linearly transforms the data to the range –1 to +1 so that the inverse sin transformation is valid for all data points.

The purpose of the multiple linear regression analysis was to determine how much of the variation in the dependent variables could be explained by the variation in the independent variables (this is indicated by the R^2 value) and also to identify outlying countries. The sample estimate of R^2 tends to be an overestimate of the population parameter. The R^2 values presented are the adjusted R^2 that compensates for the optimistic bias of R^2. This figure takes account of the number of variables in the model and the sample size.

Results

Maternal mortality rates vary from 1700 to a reported zero deaths of women during pregnancy and childbirth per 100 000 live births in the same year.

The size of the positive correlation coefficient for MMRs against the number of physicians per 1000 population is 0·73 and 0·56 for MMR against number of nurses per 1000 population. These are highly significant ($P < 0·001$) showing that countries having high MMRs also have low numbers of physicians and nurses (Figures 1 and 2). The strongest positive correlation coefficient (0·83) is, however, between the percentage of births attended by trained personnel and MMR (Figure 3) although, as a result of an absence of data for some countries, the sample is reduced to 118 countries for this analysis. Table 1 provides a summary of the linear regression analyses for GNP per capita, female literacy, births attended by trained personnel, and physicians, and nurses per 1000 population against MMRs.

Multiple regression analyses of the five independent variables (GNP per capita, female literacy, births attended by trained personnel, and physicians and nurses per 1000 population) with the dependent variable MMR shows yet a further pattern of relationships. The percentage of births attended is associated with 79% of the variation in MMR. A further 6% is associated with GNP per capita, and physicians per 1000 population a further 2% (Table 2).

When standardized residuals from the regression analyses in Table 2 are plotted against each other, the distribution of MMRs between countries can be seen as predicted by the percentage of births attended and GNP (Figure 4). Countries in the top left hand segment of Figure 4 have high MMRs and low births attended, as predicted by GNP (for example, Angola, Bhutan, Guinea, India, Lebanon, Papua New Guinea and Peru). Countries in the bottom right hand segment have low MMRs and high births attended as predicted by GNP (Albania, Belarus, Lithuania, Mongolia, Syria and Vietnam).

Discussion

This paper has presented evidence of positive relationships between the ratios of physicians and nurses to population,

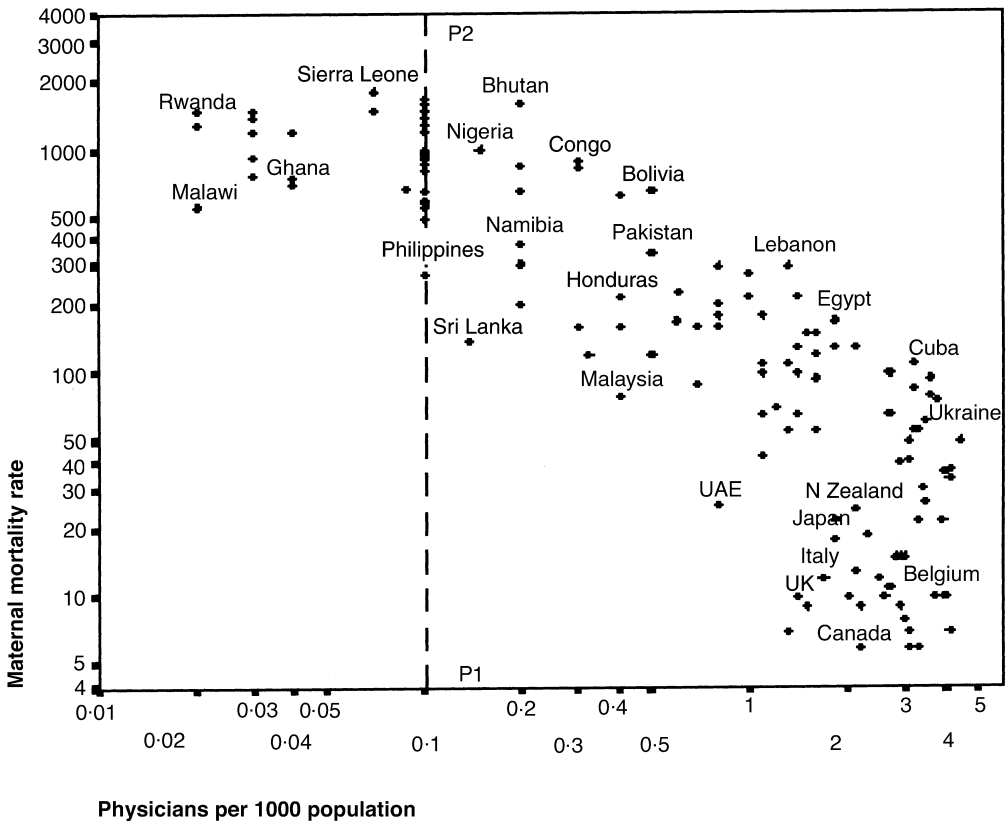

Figure 1 Scatterplot of physicians per 1000 population and MMRs. The dashed line (P1–P2) shows The World Bank minimum recommendations for the number of physicians per 1000 population. Data are plotted on logarithmic scales. Countries labelled are either examples used in the text or examples of outliers.

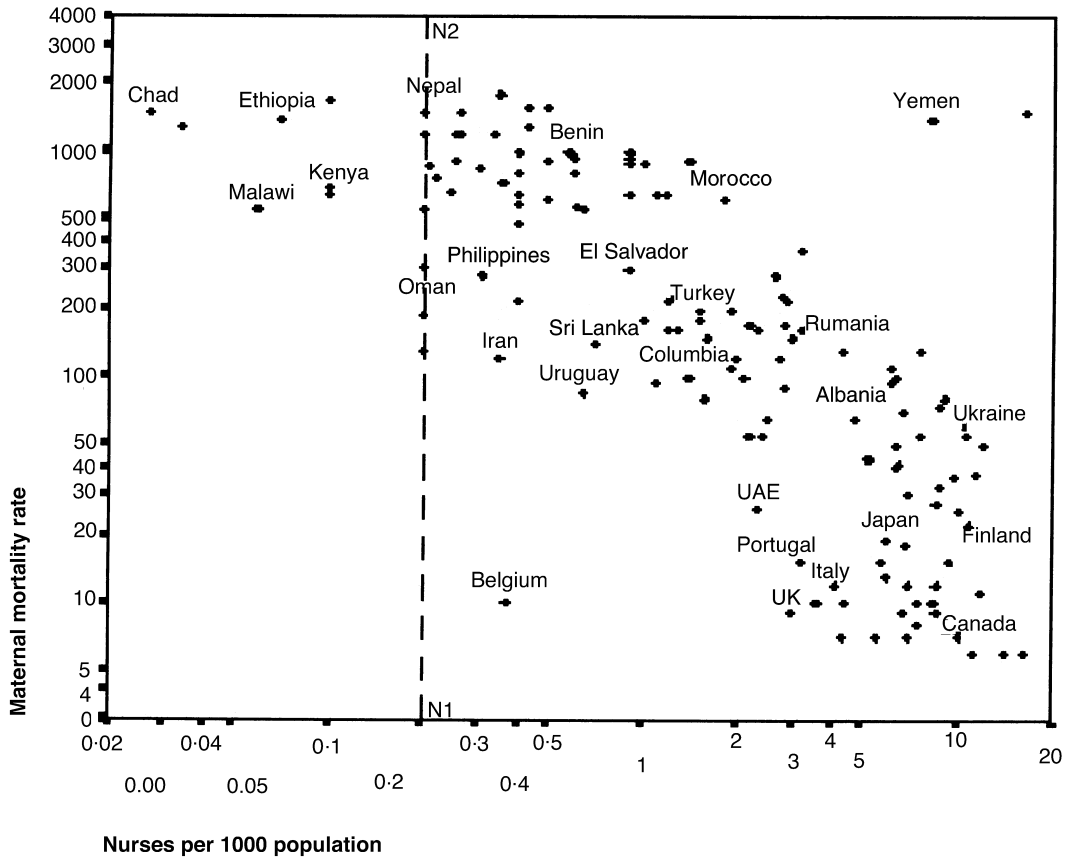

Figure 2 Scatterplot of nurses per 1000 population and MMRs. The dashed line (N1–N2) shows The World Bank minimum recommendations for the number of nurses per 1000 population. Data are plotted on logarithmic scales. Countries labelled are either examples used in the text or examples of outliers.

births attended by trained personnel, socio-economic indicators and MMR. In the linear regression analyses, 73% of the variation in MMRs is associated with the distribution of physicians, and 56% with the distribution of nurses. However, 83% of the variation in MMRs is associated with the percentage of births attended by trained personnel.

Multiple regression analyses show a more complicated picture. Seventy-nine per cent of the variation in MMRs is associated with the percentage of births attended, and a further 6% associated with GNP per capita.

It has been suggested above that a majority of births attended in many developing countries probably involve midwives, nurse–midwives, and trained primary health care personnel, rather than physicians, although it is emphasized that there is no hard evidence for this statement in the data sources used for this paper. Nevertheless nurses (including midwives), as a separate independent variable, disappear altogether when regressed with the other independent variables for MMR. This finding replicates that found when nurses per 1000 population was regressed with the two dependent mortality rates of IMR and u5MR (Robinson & Wharrad 2000).

Study limitations: reliability and validity

All the UN sources used for data identification emphasize the variable reliability of the data sets provided. All emphasize that caution should be exercised in their interpretation. *The Revised 1990 Estimates of Maternal Mortality* (WHO and UNICEF 1996), the data source used for MMRs in this paper, emphasizes that:

> It is extremely difficult to assess levels of maternal mortality at the national level. Doing so requires knowledge about deaths of women of reproductive age (15–49 years), the cause of death and also whether or not the woman was pregnant at the time of death or had recently been so. Yet few countries count births and deaths; even fewer register the cause of death; and fewer still note pregnancy status on the death form (pp. 2 and 3).

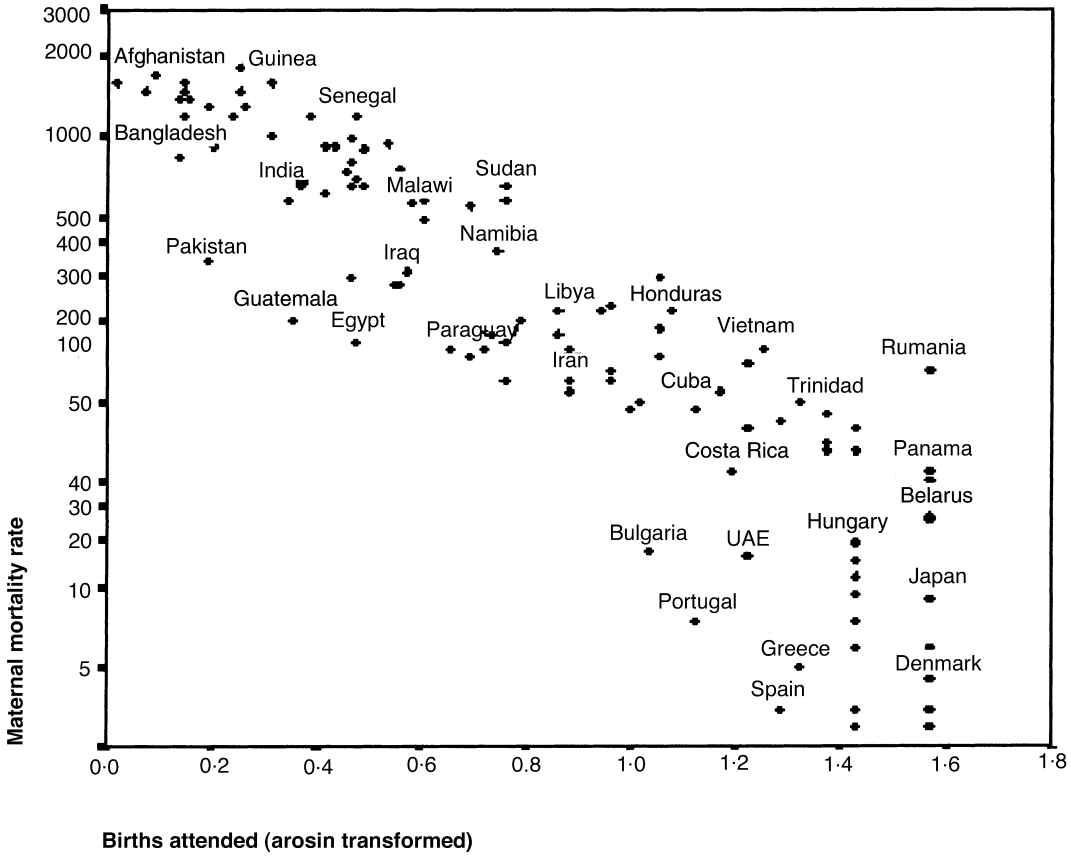

Figure 3 Scatterplot of births attended by trained personnel and MMRs. In order to minimize errors caused by using percentage data in parametric statistical analyses such as linear and multiple linear regression, the births attended percentages were arcsin transformed (see text for details). Countries labelled are either examples used in the text or examples of outliers.

Table 1 Linear regression analyses for GNP, physicians per 1000 population, nurses per 1000 population (all log transformed), female literacy and births attended by trained personnel (both arcsin transformed) against MMRs

Dependent variable	Independent variable	Number of countries	R^2 (SEM)	Constant (SEM)	Coefficient (SEM)	ANOVA
GNP	MMR	143	0·70 (0·41)	4·956 (0·157)	−0·887 (0·048)	$F = 340$, $P < 0·001$
Female literacy	MMR	115	0·62 (0·40)	2·625 (0·044)	−0·757 (0·055)	$F = 190$, $P < 0·001$
Physicians/1000	MMR	136	0·73 (0·39)	1·918 (0·035)	−0·921 (0·049)	$F = 360$, $P < 0·001$
Nurses/1000	MMR	137	0·56 (0·50)	2·304 (0·044)	−0·870 (0·066)	$F = 176$, $P < 0·001$
Births attended	MMR	118	0·83 (0·31)	3·395 (0·058)	−1·371 (0·057)	$F = 570$, $P < 0·001$

The Revised 1990 Estimates of Maternal Mortality describes the ways in which the new estimates were derived and states that they 'should be taken as orders of magnitude rather than precise estimates and are not necessarily what governments consider most appropriate (p. 7). *The Revised Estimates* also point out that because the standard errors associated with the predicted MMRs are very large, they cannot be used to monitor trends on a year by year basis, but may be used to monitor changes over the decade.

Robinson and Wharrad (2000) also describe the limitations of the other indicators used in this paper. The findings presented here should, therefore, be taken only as indicative of possible relationships between the independent and dependent variables. Nevertheless, we would contend that exercises such as we have carried out in this series of three papers are an essential preliminary to more detailed studies based first on more reliable global data sets and, second, on individual case studies carried out by individual countries in order to confirm or refute the findings that we have presented.

Table 2 Step-wise multiple linear regression analyses for GNP, births attended and physicians per 1000 population on MMRs, nurses per 1000 population, female literacy

Dependent variable	Independent variable	R^2 (SEM)	Constant (SEM)	Coefficient (SEM)	ANOVA
MMR*	Births attended†	79% (29)	3·343 (0·061)	−1·231 (0·068)	$F = 330$, $P < 0·001$
MMR*	Births attended†	85% (24)	4·252 (0·154)	−0·845 (0·084)	$F = 256$, $P < 0·001$
	GNP*			−0·406 (0·065)	
MMR*	Births attended†	87% (22)	3·677 (0·205)	−0·660 (0·091)	$F = 203$, $P < 0·001$
	GNP*			−0·297 (0·066)	
	Physicians/1000*			−0·241 (0·062)	

*Data log transformed; †data arcsin transformed.

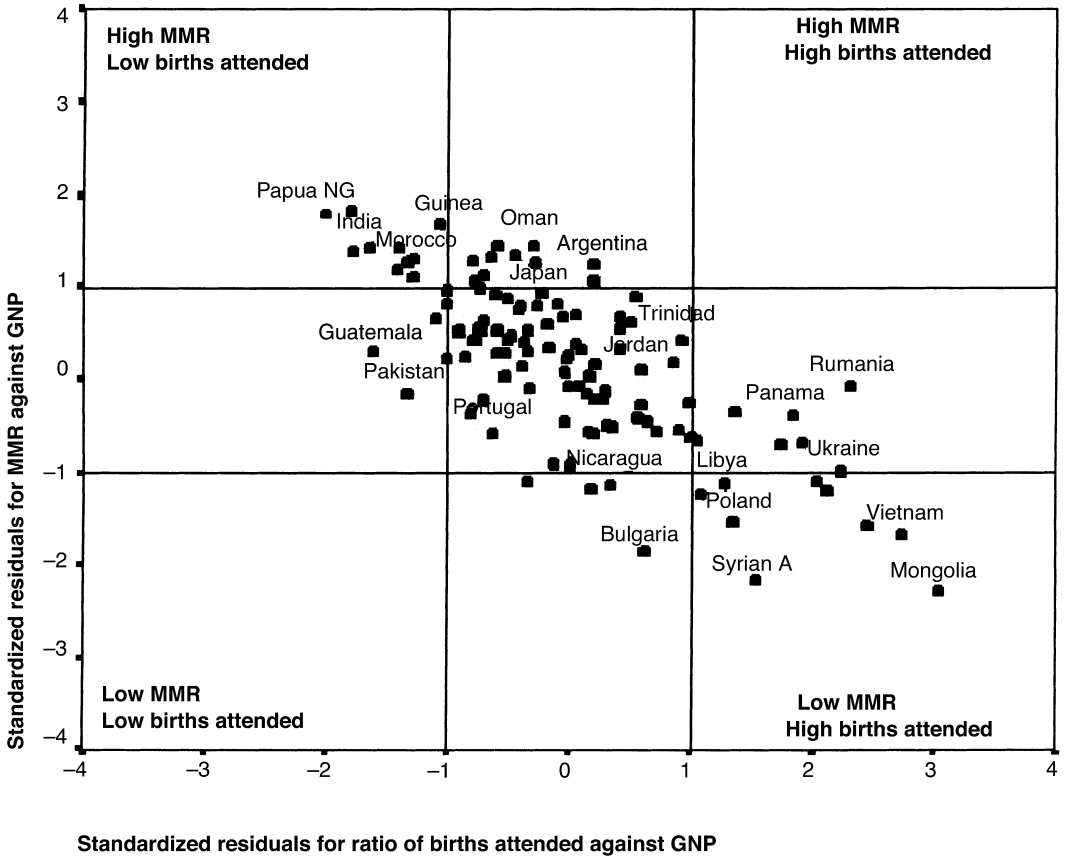

Figure 4 Scatterplot of the standardized residuals for the regression of births attended on GNP (per capita $) against the standardized residuals for the regression of MMRs on GNP (per capita $). Countries labelled are either examples used in the text or examples of outliers. The figure is divided into nine quadrants determined by SDs from the regression lines. The central quadrant shows countries within 1 SD from the respective regression lines for the ratios of births attended on GNP and MMRs on GNP. The outlying quadrants show variations between 1 and 4 SDs.

Conclusion

The continuing burden of maternal mortality is identified in the analyses presented in this paper. Strong positive associations have been shown to exist between ratios of physicians and nurses to population, and the proportion of trained health personnel in attendance at birth, and MMRs. The caution needed in the interpretation of the data has been emphasized. Nevertheless, high numbers of health personnel correlate with low maternal mortality and vice versa. Needed now, in addition to timely and accurate global data sets, are case studies of individual countries' respective situations in order to establish the reliability of the findings, and to determine where their best efforts should be directed in order to address unacceptable variations in maternal mortality. The need to include a range of

contributing independent variables in future maternal mortality research is also confirmed.

Nurses per 1000 population (the definition of which includes midwives in UN data) add nothing further to the outcomes for this multiple regression once births attended by trained personnel, GNP and physicians per 1000 population are entered. This finding, which replicates that for IMR and u5MR as reported in Robinson and Wharrad (2000) is more explicable for MMR as it is very probable that the majority of 'births attended' in many countries involve not a physician, but a midwife, nurse–midwife, nurse, or trained primary health care worker. The management by this cadre of workers of the aseptic aspects of intra and postpartum care, plus the ability to recognize, to act and to refer appropriately in the case of an obstetric emergency, would almost certainly have contributed to the strength of the positive correlation between the percentage of births attended and the lower rates of MMR.

There is a danger that the 'invisibility' of nursing and midwifery in the multiple regression analyses found for maternal mortality (and for infant and under five mortality) adds to the perceived dominance of medicine in the social construction of health services worldwide. In Robinson and Wharrad (2000), examples of why the quality of the global data on nursing and midwifery is poor were outlined, including ambiguities about the definition of a 'registered nurse' and inaccuracies in the recording of data on the number of nurses working single-handedly in the community particularly in developing countries. Its weakness as an independent variable in the multiple regression analyses, appears to result in nursing and midwifery's independent contribution to health care being lost in its subservience, as a variable, to the ratios of physicians to population. In the context of maternal mortality this is a wholly unacceptable situation. National and international agencies must now take steps to improve the data and, thereby, the quality of future researches on the contribution of health personnel to reductions in maternal mortality.

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Appendix 1

Country	Physicians per 1000 population	Nurses per 1000 population	GNP ($)	MMR (per 100 000)	Births attended by trained personnel (%)	Female literacy (%)
Afghanistan	0·1	0·1	280	1700	9	15
Albania	1·4	4·7	670	65	99	*
Algeria	0·8	3·2	1600	160	77	49
Angola	0·07	16·4	700	1500	15	29
Antigua	0·9	4·8	6770	*	*	*
Argentina	2·7	2·1	8030	100	97	96
Armenia	3·1	6·4	730	50	*	98
Australia	2·2	8·5	18 720	9	100	*
Austria	2·6	8·4	26 890	10	100	*
Azerbaijhan	3·9	10·8	480	22	*	96
Bahamas	1·4	6·4	11 940	100	*	*
Bangladesh	0·2	0·3	240	850	14	26
Barbados	1·1	5·2	6560	43	*	*
Belarus	4·1	11·4	2070	37	100	97
Belgium	3·7	0·37	24 710	10	100	*
Belize	0·5	1·3	5590	*	*	*
Benin	0·1	0·58	370	990	45	26
Bhutan	0·2	0·5	420	1600	15	28
Bolivia	0·5	0·9	800	650	47	76
Bosnia	0·5	1·8	725	*	*	*
Brazil	1·4	0·4	3640	220	81	83
Bulgaria	3·5	8·5	1330	27	86	97
Burkina	0·03	0·25	230	930	42	9
Burundi	0·1	0·43	160	1300	19	23
Cambodia	0·1	1	270	900	47	22
Cameroon	0·1	0·64	650	550	64	52
Canada	2·2	11·2	19 380	6	99	*
Central Africa	0·04	0·1	340	700	46	52
Chad	0·03	0·027	180	1500	15	35
Chile	1·1	2·5	4160	65	98	95
China	1·6	1·1	620	95	84	73
Columbia	1·1	1·4	1910	100	85	91
Comoros	0·1	0·6	470	950	*	*
Congo	0·3	0·9	680	890	*	67
Costa Rica	1·3	2·2	2610	55	93	95
Cote d'Ivoire	0·1	0·4	660	810	45	30
Croatia	2	4·4	3250	10	*	95
Cuba	3·6	6·1	1170	95	90	95
Czech Rep.	3	9·4	3870	15	*	*
Denmark	2·9	6·7	29 890	9	100	*
Dominica	0·5	0·35	2990	*	*	*
Dominican Rep.	1·1	0·8	1460	110	92	82
Ecuador	1·5	1·6	1390	150	64	88
Egypt	1·8	2·2	790	170	46	39
El Salvador	0·8	0·9	1610	300	87	70
Equat. Guinea	0·3	0·6	380	820	*	*
Ethiopia	0·03	0·07	100	1400	14	25
Finland	2·7	12	20 580	11	100	*
France	2·8	5·7	24 990	15	99	*
Georgia	4·1	8·7	440	33	*	98
Germany	3·3	5·6	27 510	22	99	*
Ghana	0·04	0·36	390	740	44	54
Greece	4	3·6	8210	10	97	93
Guatamala	0·8	1·5	1340	200	35	49

Appendix 1 (Continued)

Country	Physicians per 1000 population	Nurses per 1000 population	GNP ($)	MMR (per 100 000)	Births attended by trained personnel (%)	Female literacy (%)
Guinea	0·1	0·43	550	1600	31	22
Hiaiti	0·1	0·4	250	1000	21	42
Honduras	0·4	1·2	600	220	88	73
Hong Kong	1·3	5·5	22 990	7	100	88
Hungary	3·4	7	4120	30	99	98
Iceland	3	7·1	24 950	0	*	*
India	*	*	1348	570	34	38
Indonesia	0·2	1·1	980	650	36	78
Iran	0·32	0·35	1033	120	77	59
Iraq	0·2	0·2	1036	310	54	45
Ireland	2	7·5	14 710	10	*	*
Israel	*	7	15 920	7	99	89
Italy	1·7	4·1	19 020	12	*	96
Jamaica	0·5	2	1510	120	82	89
Japan	1·8	6·8	39 640	18	100	*
Jordan	1·6	3	1510	150	87	79
Kazakhstan	3·6	9	1330	80	99	96
Kenya	*	0·1	280	650	45	70
Korean Rep.	1·2	6·7	9700	70	98	97
Kuwait	*	*	17 390	29	99	75
Kyrgyzstan	3·2	6·1	700	110	*	96
LaoPDR	0·2	1·18	350	650	*	*
Latvia	2·9	6·4	2270	40	*	99
Lebanon	1·3	*	2660	300	45	90
Lehsotho	0	0·5	770	610	40	62
Libya	1	2·9	269	220	76	63
Lithuania	4	9·7	1900	36	100	98
Madagasca	0·1	0·4	230	490	57	73
Malaysia	0·4	1·56	3890	80	94	78
Malawi	0·02	0·06	170	560	55	42
Mali	0·1	0·25	250	1200	24	23
Malta	2·5	11·8	6021	0	*	*
Mauritania	0·1	0·5	460	930	40	26
Mexico	1·3	1·9	3320	110	77	87
Moldova	3·5	10·4	870	60	*	94
Mongolia	2·7	*	310	65	99	77
Morocco	0·4	1·8	1110	610	40	31
Mozambique	0·02	0·26	80	1500	25	23
Mynamar	0·1	0·4	220	580	57	78
Namibia	0·2	3·2	2000	370	68	*
Nepal	0·1	0·2	200	1500	7	14
Netherlands	2·5	8·5	24 000	12	100	*
Nicaragua	0·7	1·2	380	160	61	67
Niger	0·03	0·2	220	1200	15	7
Nigeria	0·15	0·9	260	1000	31	47
Norway	3·3	16·4	31 250	6	100	*
Oman	*	0·2	4820	190	87	46
Pakistan	0·5	*	460	340	19	24
Panama	1·6	2·4	2750	55	100	90
Papua New Guin.	0·1	1·4	1160	930	20	63
Paraguay	0·3	1·3	1690	160	66	91
Peru	1	2·6	2310	280	52	83
Philippines	0·1	0·31	1050	280	53	94
Poland	2·3	5·9	2790	19	99	98

Appendix 1 (Continued)

Country	Physicians per 1000 population	Nurses per 1000 population	GNP ($)	MMR (per 100 000)	Births attended by trained personnel (%)	Female literacy (%)
Portugal	2·9	3·2	9740	15	90	81
Rumania	1·8	4·3	1480	130	100	95
Russian Fed.	3·8	8·7	2240	75	*	98
Rwanda	0·02	0·034	180	1300	26	52
South Africa	0·61	2·75	3160	230	82	82
Saudi Arabia	1·4	0·2	6180	130	82	50
Senegal	0·1	0·26	600	1200	46	23
Sierra Leone	0·07	0·35	180	1800	25	18
Singapore	1·4	3·5	26 730	10	100	86
Somalia	*	*	120	1600	2	14
Spain	4·1	4·3	13 580	7	96	93
Sri Lanka	0·14	0·71	700	140	94	87
St Lucia	0·5	2·8	3370	*	*	*
St Kits	0·9	6·5	5170	*	*	*
St Vincent	0·5	3·1	2280	*	*	*
Slovakia	3	7·5	8200	8	*	*
Slovenia	2·1	5·9	2950	13	*	*
Sudan	0·09	0·24	480	660	69	35
Surinam	0·8	3·1	880	*	*	*
Swaziland	0·1	0·2	1170	560	*	*
Sweden	3·1	10·1	23 750	7	100	*
Switzerland	3·1	14	40 630	6	99	*
Syrian A.	0·8	1	112	180	67	56
Taiwan	1·3	2·6	12 790	*	*	*
Tajikistan	2·1	7·6	340	130	*	97
Tanzania	0·03	0·22	120	770	53	57
Thailand	0·2	1·9	2740	200	71	92
Togo	0·1	0·4	310	640	54	37
Trinidad	0·7	2·8	3770	90	98	97
Tunisia	0·6	2·8	1820	170	69	55
Turkey	1·1	1·5	2780	180	76	72
Turkmenistan	3·2	7·7	920	55	*	97
Uganda	0·04	0·34	240	1200	38	50
Ukraine	4·4	12·2	1630	50	100	97
UK	1·5	3	18 700	9	100	*
Uruguay	3·2	0·64	5170	85	96	98
USA	2·5	7	26 980	12	99	*
Uzbekistan	3·3	10·6	970	55	*	96
Venzuela	1·6	2·7	3020	120	69	90
Vietnam	0·4	2·3	219	160	95	91
Yemen	0·1	8·2	260	1400	16	26
Zaire	0·1	0·21	120	870	*	68
Zambia	0·1	0·9	400	940	51	71
Zimbabwe	0·1	0·61	540	570	69	80

*Missing data. For data sources and dates see text.