



Obstetric transition in the World Health Organization Multicountry Survey on Maternal and Newborn Health: exploring pathways for maternal mortality reduction

Solange da Cruz Chaves,¹ José Guilherme Cecatti,¹ Guillermo Carroli,² Pisake Lumbiganon,³ Carol J. Hogue,⁴ Rintaro Mori,⁵ Jun Zhang,⁶ Kapila Jayaratne,⁷ Ganchimeg Togoobaatar,⁵ Cynthia Pileggi-Castro,⁸ Meghan Bohren,⁹ Joshua Peter Vogel,¹⁰ Özge Tunçalp,¹⁰ Olufemi Taiwo Oladapo,¹⁰ Ahmet Metin Gülmezoglu,¹⁰ Marleen Temmerman,¹⁰ and João Paulo Souza⁸

Suggested citation

Chaves SC, Cecatti JG, Carroli G, Lumbiganon P, Hogue CJ, Mori R, et al. Obstetric transition in the World Health Organization Multicountry Survey on Maternal and Newborn Health: exploring pathways for maternal mortality reduction. *Rev Panam Salud Publica*. 2015;37(4/5):203–10.

ABSTRACT

Objective. To test whether the proposed features of the Obstetric Transition Model—a theoretical framework that may explain gradual changes that countries experience as they eliminate avoidable maternal mortality—are observed in a large, multicountry, maternal and perinatal health database; and to discuss the dynamic process of maternal mortality reduction using this model as a theoretical framework.

Methods. This was a secondary analysis of a cross-sectional study by the World Health Organization that collected information on more than 300 000 women who delivered in 359 health facilities in 29 countries in Africa, Asia, Latin America, and the Middle East, during a 2–4-month period in 2010–2011. The ratios of Potentially Life-Threatening Conditions, Severe Maternal Outcomes, Maternal Near Miss, and Maternal Death were estimated and stratified by stages of obstetric transition. The characteristics of each stage are defined.

Results. Data from 314 623 women showed that female fertility, indirectly estimated by parity, was higher in countries at a lower obstetric transition stage, ranging from a mean of 3 children in Stage II to 1.8 children in Stage IV. Medicalization increased with obstetric transition stage. In Stage IV, women had 2.4 times the cesarean deliveries (15.3% in Stage II and 36.7% in Stage IV) and 2.6 times the labor inductions (7.1% in Stage II and 18.8% in Stage IV) as women in Stage II. The mean age of primiparous women also increased with stage. The occurrence of uterine rupture had a decreasing trend, dropping by 5.2 times, from 178 to 34 cases per 100 000 live births, as a country transitioned from Stage II to IV.

Conclusions. This analysis supports the concept of obstetric transition using multicountry data. The Obstetric Transition Model could provide justification for customizing strategies for reducing maternal mortality according to a country's stage in the obstetric transition.

Key words

Women's health; maternal mortality, trends; obstetrics labor complications; maternal welfare, global health; World Health Organization.

¹ Department of Obstetrics and Gynecology, School of Medical Sciences, University of Campinas, Campinas, São Paulo, Brazil.

² Centro Rosarino de Estudios Perinatales, Rosario, Argentina.

³ Department of Obstetrics and Gynecology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.

⁴ Emory University, Atlanta, Georgia, United States of America.

⁵ Department of Health Policy, National Center for Child Health and Development, Tokyo, Japan.

⁶ Ministry of Education, Shanghai Key Laboratory of Children's Environmental Health, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China.

⁷ Family Health Bureau, Ministry of Health, Colombo, Sri Lanka.

⁸ Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, São Paulo, Brazil. Send

correspondence to João Paulo Souza, email: jpsouza@fmrp.usp.br

⁹ Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, United States of America.

¹⁰ United Nations Development Program/United Nations Population Fund/United Nations Children's Fund/World Health Organization/World Bank Special Programme of Research, Development and Research Training in Human Reproduction, Department of Reproductive Health and Research, WHO, Geneva, Switzerland.

The year 2015 marks the end of the first global cycle of coordinated actions to promote human and social development in the new millennium. This cycle began with the Millennium Declaration in 2000 (1), and since then, the governments of signatory countries, the United Nations and its specialized agencies, civil society, and many partners around the world have set in motion an unprecedented effort to achieve eight broad goals aimed at combatting extreme poverty and promoting human development (2). The Millennium Development Goals (MDG) initiative uses the year 1990 as a baseline, and priorities include improvements in maternal and reproductive health. The fifth goal is to reduce the global maternal mortality ratio (MMR) by 75% from levels observed in 1990, as well as to provide universal access to reproductive health care (2). MMR is a strong social indicator because it can reflect the living conditions of women, the level of population development, and the quality and level of the health system organization (3).

The global MMR showed a significant decline recently, dropping from 380 in 1990 to 210 in 2013, a reduction of approximately 45% (4). Nevertheless, this reduction is still below the original goal. There is a wide disparity among Regions, with MMR ranging from more than 1 000 maternal deaths per 100 000 live births (LB) in some developing countries, to less than 10 per 100 000 LB in others. The estimated risk of a woman dying from causes associated with the pregnancy-postpartum cycle in high-income countries is 1 in 3 400, compared to 1 in 52 in lower-income countries (4).

Despite all the global efforts, 2013 still recorded an estimated 289 000 maternal deaths, an alarming number (4). If this number of deaths were to occur in a single episode, this would easily be recognized as major tragedy. However, since maternal deaths are dispersed and occur mostly in poor and remote settings, often among ethnic minorities, they often go unnoticed by the public and the media. These fatalities have widespread magnitude, directly affecting families, resulting in a loss of structure and stability, and causing a great impact on the community. Sadly enough, the vast majority of maternal deaths could be avoided (3–5).

A secular, worldwide trend towards social development and maternal mor-

talidity reduction has been observed. The trend is more or less visible, depending on the country evaluated. Evolutionary changes in the pattern of MMR reduction, which can occur at a faster or slower pace, are known to be related to the amount and efficiency of government and societal efforts to implement public policies that promote social development and health improvement. This broad pattern includes a shift from maternal deaths predominantly due to direct obstetric causes to deaths due to indirect causes; from deaths due to communicable diseases to deaths caused by non-communicable diseases; from a younger maternal population to an older one; and a decrease in MMR, along with an increase in institutionalized maternity care, and eventually over-medicalization. We have called this phenomenon of gradual changes that countries experience in their pathway towards elimination of avoidable maternal mortality, the “obstetric transition” (6, 7). The proposed stages of obstetric transition are shown in Box 1.

The main objective of this paper was to test whether the proposed features of the Obstetric Transition Model are observed in a large, multicountry, maternal and perinatal health database (8, 9). Secondly, this study aimed to discuss the

dynamic process of maternal mortality reduction using the Obstetric Transition Model as a theoretical framework.

MATERIALS AND METHODS

This was a secondary analysis of the World Health Organization Multicountry Survey on Maternal and Newborn Health 2010–2012 (WHO MCS); the methodology and details of the primary study are published elsewhere (8, 9). Briefly, the WHO MCS was a cross-sectional study, collecting data from health facilities in 29 countries in Africa, Asia, Latin America, and the Middle East, from May 2010–December 2011.

Participating facilities and individuals

The majority of facilities in this analysis had participated in the previous WHO Global Survey on Maternal and Perinatal Health (10) and were included through a multistage random selection process. In each hospital, data collection took place during a 2–4-month period, depending on the number of annual deliveries in the health facility or group of health facilities selected in each country.

Three groups of women were eligible to participate in the WHO MCS: all those

BOX 1. Stages of the Obstetric Transition

- Stage I (Maternal Mortality Ratio > 1 000 maternal deaths/100 000 live births): the majority of women experiences a situation close to the natural history of pregnancy and childbirth. Stage I is characterized by a very high maternal mortality ratio, with elevated fertility and the predominance of direct causes of maternal mortality, along with a large proportion of deaths attributable to communicable diseases, such as malaria. The majority of women do not receive professional obstetric care or do not have access to health facilities.
- Stage II (Maternal Mortality Ratio: 999 - 300 maternal deaths/100 000 live births): Mortality and fertility remain very high, with a pattern of causes similar to Stage I. However, a greater proportion of women start to seek and receive care in health units.
- Stage III (Maternal Mortality Ratio: 299 - 50 maternal death/100 000 live births): Fertility is variable and direct causes of mortality still predominate. This is a complex stage, because access continues to be an issue for a large part of the population. However, since a high proportion of pregnant women arrive at health services, quality of care is one of the main determinants of health outcomes, particularly related to overburdened health services. Primary prevention, as well as secondary and tertiary prevention, is fundamental to improve maternal health outcomes in this stage. In other words, the quality of care, skilled childbirth care and adequate management of complications are essential for the reduction in maternal mortality.
- Stage IV (MMR < 50 maternal deaths/100 000 live births): maternal mortality is low. There is a low fertility rate and indirect causes of maternal mortality, in particular chronic-degenerative diseases gain increasing importance. An aspect that emerges in this phase is the increasing role of medicalization as a threat to the quality and improvement of health outcomes.
- Stage V (all avoidable maternal deaths are actually prevented; maternal mortality ratio < 5 maternal deaths/100 000 live births). Maternal mortality is very low, the fertility rate is low or very low, and indirect obstetric causes associated with chronic-degenerative disorders are the main causes of maternal mortality. The main challenges in this stage are the consolidation of advances against structural violence (for example, gender inequalities), effective management of vulnerable populations (for example, immigrants, refugees and displaced people in their own country) and sustainability of excellence in quality of care.

Source: References 6 and 7.

admitted for childbirth at one of the selected health units during data collection period; all women with severe maternal outcomes (SMO) classified as cases of maternal near-miss (MNM) associated with childbirth or abortion; and all maternal deaths.

Data collection

The medical charts of all eligible women were reviewed until hospital discharge or until either the 7th day postpartum, abortion, or death, whichever occurred first. WHO criteria (11) were used to identify potentially life-threatening conditions (PLTC) and MNM. Trained data collectors reviewed each chart on daily visits to each health unit facility, recording individual data on pregnancy outcome, severe complications, and clinical management. The paper form used for data collection had been previously pilot-tested. Data was coded and entered into an electronic data management system. Internal consistency and random checks were performed, comparing collected data, hospital records, and electronic data.

Data analysis

The demographic and obstetrics characteristics of all women were described using simple frequencies and percentages. WHO estimates of MMR were used to stratify participating countries into obstetric transition stages. Stage I was not used because none of the participating countries had MMR greater than 1 000 deaths/ 100 000 LB. Stage V was also not used because it was considered a stage where MMR remained uncertain, idealized, and still theoretical (7). The frequency of women with PLTC (i.e., conditions that may lead to a maternal death) and SMO (i.e., MNM and maternal deaths) was calculated according to the stages of obstetric transition.

Due to lack of direct information, some characteristics of obstetric transition were evaluated through proxies. Considering the role of each characteristic in defining the obstetric transition concept, these proxies were selected *a priori*. Parity served as a fertility proxy. The rate of cesarean delivery and labor induction served as proxies for medicalization of care. The frequency and ratio of uterine rupture were used as a proxy for avoidable causes of morbidity and mortality,

since its occurrence is highly preventable by quality intrapartum monitoring and care. Simple frequencies were used to determine the prevalence of conditions selected. The mortality index—the number of maternal deaths divided by the number of women with severe maternal outcomes—was used as an overall indicator of quality of care (6). Subjects with missing data were not excluded and the total number available for each analysis is shown in tables. Statistical analysis was performed using SPSS software, version 21 (SPSS Inc., an IBM company, Chicago, Illinois, United States).

Ethics approval

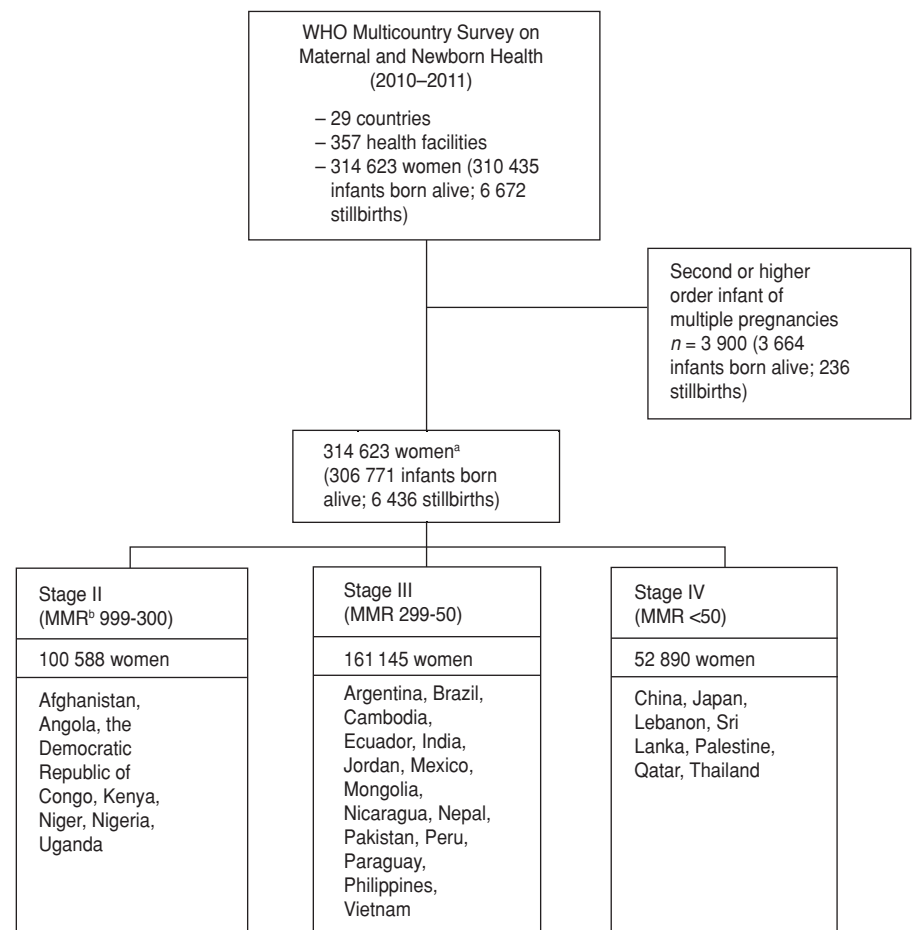
The UNDP/UNFPA/UNICEF/WHO/World Bank Special Program of Research, Development and Research Training in Human Reproduction (HRP) Special-

ist Panel on Epidemiological Research reviewed and approved the protocol of the WHO MCS for technical content. The WHO MCS was approved by the WHO Ethical Review Committee and the relevant ethical clearance mechanisms in all countries (protocol ID: A65661; date of approval: 27 October 2009). Formal authorization for study implementation was obtained from the Ministry of Health of each country, as well as from each participating facility.

RESULTS

Data from 314 623 women admitted for childbirth by 359 health institutions in 29 countries were analyzed. After excluding the second or more newborns from multiple births, there were 306 771 live births and 6 436 still births. Figure 1 presents the analysis flow diagram.

FIGURE 1. The Obstetric Transition Model in the World Health Organization Multicountry Survey (2010–2011): Analysis flow diagram



^a Sum of live births and stillbirths does not equal the number of women because some women had abortions or did not have a delivery.
^b Maternal mortality ratio.

Table 1 presents the demographic and obstetric characteristics of all the study participants. Most of the women (81%) were 20–35 years of age; almost 90% were living with a partner; 57% had 9 years or more of schooling; 88% had never undergone a cesarean section; 77% had a spontaneous labor; 71% had a vaginal delivery; and 42% had no children, while 41% had 1–2 children.

Table 2 presents the frequency of women according to maternal outcome and obstetric transition stage. It was observed that as the obstetric transition stage improved, there was a gradual increase in PLTC (ranging from 70.1/1 000 LB in Stage II to 101.8 in Stage IV), and marked reductions in MNM (ranging from 13.1/1 000 LB in Stage II to 4.2

cases in Stage IV) and maternal death (ranging from 315 deaths/100 000 LB in Stage II to 13 in Stage IV). The mortality index in Stage II was 17.6% (268 deaths/1 525 women with severe maternal outcomes); 16.5% in Stage III (211 deaths/1 278 women); and 3.2% (3 deaths/221 women) in Stage IV.

In the current database, most countries in Stage II are located in Africa, while most in Stage IV are in Asia. All Latin American countries in this database were classified as Stage III, along with other Asian and Eastern Mediterranean countries.

Female fertility, indirectly estimated by parity, was higher in countries at a lower obstetric transition stage, ranging from a mean of 3 children in Stage

II to 1.8 children in Stage IV. The level of medicalization in health facilities in participating countries, defined by the number of cesarean deliveries and number of labor inductions, tended to increase as the stages of obstetric transition increased. In Stage IV, women had 2.4 times more cesarean deliveries (15.3%–36.7%) and 2.6 times more labor inductions (7.1%–18.8%) than women in Stage II. As the stages of obstetric transition increased, the mean age of primiparous women also increased. The occurrence of uterine rupture had a decreasing trend for higher obstetric transition stages. Uterine rupture decreased by 5.2 times and its rate dropped from 178 to 34 cases per 100 000 LB between Stages II and IV (Table 3).

TABLE 1. Demographic and obstetric characteristics of women in the World Health Organization Multicountry Survey on Maternal and Newborn Health (2010–2011) by stages of Obstetric Transition (OT)

Characteristic	All women		OT Stage II		OT Stage III		OT Stage IV	
	No.	%	No.	%	No.	%	No.	%
All women	314 623	100	100 588	32.0	161 145	51.2	52 890	16.8
Age ^a (years)								
< 20	32 328	10.3	11 122	11.1	18 102	11.2	3 104	5.9
20–35	254 307	81.1	79 354	79.4	131 268	81.6	43 685	82.6
> 35	27 054	8.6	9 407	9.4	11 548	7.2	6 099	11.5
Subtotal	313 689	100.0	99 883	100.0	160 918	100.0	52 888	100.0
Marital status ^a								
Without partner	31 693	10.2	11 778	12.0	19 134	11.9	781	1.5
With partner	279 241	89.8	86 366	88.0	141 506	88.1	51 369	98.5
Subtotal	310 934	100.0	98 144	100.0	160 640	100.0	52 150	100.0
Schooling ^a (years)								
< 5	58 630	20.3	35 118	39.8	21 858	14.1	1 654	3.6
5–8	65 718	22.8	22 091	25.0	36 593	23.6	7 034	15.4
9–11	73 611	25.5	9 584	10.9	48 904	31.6	15 123	33.1
>11	90 816	31.4	21 415	24.3	47 590	30.7	21 811	47.8
Subtotal	288 775	100.0	88 208	100.0	154 945	100.0	45 622	100.0
Number of previous births ^a								
0	132 672	42.3	31 412	31.4	75 510	46.9	25 750	48.7
1–2	130 245	41.5	37 384	37.3	69 324	43.1	23 537	44.5
> 2	51 052	16.3	31 336	31.3	16 117	10.0	3 599	6.8
Subtotal	313 969	100.0	100 132	100.0	160 951	100.0	52 886	100.0
Number of previous cesarean sections ^a								
0	272 302	87.7	90 676	92.8	135 744	85.0	45 882	86.8
1	29 307	9.4	5 282	5.4	18 387	11.5	5 638	10.7
>1	8 746	2.8	1 804	1.8	5 611	3.5	1 331	2.5
Subtotal	310 355	100.0	97 762	100.0	159 742	100.0	52 851	100.0
Onset of labor ^a								
Spontaneous	241 724	77.3	86 797	87.2	123 228	76.9	31 699	60.0
Induced	32 784	10.5	7 088	7.1	15 757	9.8	9 939	18.8
No labor (cesarean section)	38 073	12.2	5 609	5.6	21 257	13.3	11 207	21.2
Subtotal	312 581	100.0	99 494	100.0	160 242	100.0	52 845	100.0
Mode of delivery ^a								
Vaginal	223 145	71.4	84 050	84.5	105 690	65.9	33 405	63.2
Cesarean section	89 515	28.6	15 421	15.5	54 661	34.1	19 433	36.8
Subtotal	312 660	100.0	99 471	100.0	160 351	100.0	52 838	100.0

^a Pearson Chi-Square test: $P < 0.000$.

TABLE 2. Frequency of women according to maternal outcome with potentially life-threatening conditions and severe maternal outcomes (maternal near miss and maternal deaths) and according to obstetric transition stage, World Health Organization Multicountry Survey on Maternal and Newborn Health (2010–2011)

Country	Obstetric Transition										
	Hospitals	All women	Live births	Potentially life-threatening conditions ^a		Severe maternal outcomes ^a		Maternal near miss cases ^a		Maternal deaths	
	No.	No.	No.	No.	%	No.	%	No.	%	No.	IHMRR ^b
Stage II											
Afghanistan	8	26 148	25 227	923	36.6	440	17.4	421	16.7	19	75
Angola	20	10 450	9 966	587	58.9	92	9.2	57	5.7	35	351
DR Congo	21	8 756	8 395	501	59.7	115	13.7	88	10.5	27	322
Kenya	20	20 354	19 658	1 511	76.9	132	6.7	77	3.9	55	280
Niger	11	11 116	10 714	516	48.2	223	20.8	196	18.3	27	252
Nigeria	21	12 841	11 775	1 701	144.5	371	31.5	298	25.3	73	620
Uganda	21	10 923	10 467	691	66.0	152	14.5	120	11.5	32	306
<i>Subtotal</i>	<i>122</i>	<i>100 588</i>	<i>96 202</i>	<i>6 430</i>	<i>70.1</i>	<i>1 525</i>	<i>16.2</i>	<i>1 257</i>	<i>13.1</i>	<i>268</i>	<i>315</i>
Stage III											
Argentina	14	9 807	9 729	768	78.9	60	6.2	51	5.2	9	93
Brazil	7	7 058	7 019	505	71.9	18	2.6	17	2.4	1	14
Cambodia	5	4 725	4 635	288	62.1	64	13.8	59	12.7	5	108
Ecuador	18	10 245	10 108	1 429	141.4	39	3.9	30	3.0	9	89
Philippines	13	10 783	10 609	830	78.2	41	3.9	29	2.7	12	113
India	21	31 318	30 094	2 214	73.6	283	9.4	174	5.8	109	362
Jordan	1	1 167	1 158	119	102.8	5	4.3	5	4.3	0	0
Mexico	14	13 309	13 167	1 052	79.9	157	11.9	153	11.6	4	30
Mongolia	5	7 365	7 303	823	112.7	62	8.5	61	8.4	1	14
Nepal	8	11 290	10 999	363	33.0	73	6.6	65	5.9	8	73
Nicaragua	8	6 571	6 426	1 707	265.6	125	19.5	119	18.5	6	93
Pakistan	16	13 175	12 729	1 158	91.0	132	10.4	94	7.4	38	299
Peru	16	15 285	15 021	1 116	74.3	175	11.7	169	11.3	6	40
Paraguay	6	3 610	3 595	106	29.5	11	3.1	8	2.2	3	83
Viet Nam	15	15 437	15 411	138	9.0	33	2.1	33	2.1	0	0
<i>Subtotal</i>	<i>167</i>	<i>161 145</i>	<i>158 003</i>	<i>12 616</i>	<i>86.9</i>	<i>1 278</i>	<i>7.8</i>	<i>1 067</i>	<i>6.9</i>	<i>211</i>	<i>94</i>
Stage IV											
China	21	13 277	13 242	927	70.0	34	2.6	34	2.6	0	0
Japan	10	3 537	3 527	655	185.7	21	6.0	21	6.0	0	0
Lebanon	9	4 044	4 008	210	52.4	20	5.0	18	4.5	2	50
Sri Lanka	14	18 129	17 988	862	47.9	76	4.2	73	4.1	3	17
OPT ^c	1	980	975	150	153.8	3	3.1	3	3.1	0	0
Qatar	1	3 950	3 932	509	129.5	14	3.6	14	3.6	0	0
Thailand	12	8 973	8 894	656	73.8	53	6.0	51	5.7	2	22
<i>Subtotal</i>	<i>68</i>	<i>52 890</i>	<i>52 566</i>	<i>3 969</i>	<i>101.8</i>	<i>221</i>	<i>4.3</i>	<i>214</i>	<i>4.2</i>	<i>7</i>	<i>13</i>
Overall	357	314 623	306 771	23 015	86.2	3 024	7.3	2 538	8.0	486	140

^a The prevalence of women with potentially life-threatening conditions, women with severe maternal outcomes and maternal near miss cases are calculated per 1 000 live births.

^b IHMMR: intra-hospital maternal mortality ratio, limited to the first week following pregnancy termination and calculated per 100 000 live births.

^c OPT: Occupied Palestinian Territory.

DISCUSSION

This study applied the obstetric transition concept to examine a large, multi-country database of women who gave birth in health facilities. After country stratification by obstetric transition stage based on country-level MMR estimates (4), we found that as the stages of obstetric transition increased, women tended to have fewer children, have the first child at an older age, and experience increased medicalization of childbirth. The frequency of uterine rupture, used as a proxy for avoidable morbidity and mor-

tality, decreased as the obstetric transition stage increased. The frequency of severe maternal outcomes (both near-miss and mortality) decreased in the study facilities as obstetric transition stage increased.

The Obstetric Transition Model was proposed as a theoretical framework that could provide a particular perspective for examining the dynamic process of maternal mortality reduction. This model allows identification of a country's current obstetric stage, which in turn can indicate which strategies should be used to make further improvements. Because

this model considers specific features of the maternal population (such as fertility, medicalization of pregnancy and childbirth, age of maternal population, and causes of maternal morbidity and mortality), it moves beyond human development index classifications and previous transition models. The features of this model can provide guidance to public health decisionmakers on implementation of appropriate, dynamic, and efficient programs at the global, regional, and national levels (5).

Although the study findings corroborate the hypothesis of an ongoing ob-

TABLE 3. Obstetric transition stages and their characteristics in the World Health Organization Multicountry Survey on Maternal and Newborn Health (2010–2011)

Characteristic	Stage II	Stage III	Stage IV	Overall
All women	100 588	161 145	52 890	314 623
Live births (LB)	96 202	158 003	52 566	306 771
Maternal mortality ^a				
Intra-hospital maternal deaths /100 000 LB	279	134	13	158
Number of maternal deaths	268	211	7	486
Fertility (proxy) ^a				
Parity (± Standard Deviation [SD])	3.0 (±2.2)	2.0 (± 1.3)	1.8 (± 1.1)	2.3 (±1.7)
Medicalization (proxy) ^b				
Cesarean section rate (Number of cesarean sections)	15.3% (15 421)	33.9% (54 661)	36.7% (19 433)	28.5% (89 515)
Inductions of labor rate (Number of inductions of labor)	7.1% (7 095)	9.8% (15 761)	18.8% (9 941)	10.4% (32 797)
Age of maternal population (proxy) ^a				
Age of nulliparous in years (± SD)	22.3 (± 4.7)	23.4 (± 5.0)	25.8 (± 5.3)	23.6 (±5.1)
Avoidable morbidity & mortality (proxy) ^b				
Ruptured uterus per 100 000 LB	178	80	34	86
Number of ruptured uterus	171	127	18	316

^a $P < 0.000$ (Pearson Chi-Square test).

^b $P < 0.000$ (ANOVA).

stetric transition, some aspects deserve further exploration. At first glance, the higher prevalence of potentially life-threatening conditions observed in the more advanced stages of obstetric transition seem counterintuitive. However, this higher prevalence may actually suggest more thorough surveillance and a greater capacity to diagnose pregnancy complications, such as pre-eclampsia, postpartum hemorrhage, and indirect complications. Deaths caused by pre-eclampsia and postpartum hemorrhage are largely preventable, but early diagnosis may be challenging in under-resourced settings. For example, if birth assistants are overwhelmed with patients and lack conditions and resources to offer appropriate care, some cases of mild pre-eclampsia or postpartum hemorrhage may not be detected, leading to a false low PLTC prevalence. In part, this is why we used uterine rupture as a proxy for avoidable causes of maternal deaths: this complication is clearly preventable and rarely overlooked. Although more related to intrapartum care and the ability to detect and manage obstructed labor, we considered uterine rupture a more stable indicator for studying the relationship between obstetric transition stages and the occurrence of preventable causes of maternal mortality. Mortality among cases presenting with severe maternal

outcomes (i.e., the SMO mortality index) could also provide some understanding of the role of quality of care in the obstetric transition (11). Our findings suggest that poor quality of care and difficulties in managing severe complications are a relevant issue at early stages of the obstetric transition.

One of the challenges of maternal mortality reduction is that sustainable and impactful solutions are needed beyond the health sector, and often require an intersectoral approach for health and social development (3, 12–14). In part, this is the reason why the MMR was selected as a development indicator as part of the MDG. Most maternal deaths take place in low-income countries. Reduction requires effective public policies that transcend the health sector. Intersectoral actions, such as health, social, economic, cultural, and environmental policies are needed to induce social development, and result in a global maternal mortality reduction (3, 5, 12–14).

In the health sector, several strategies may be used concurrently to reduce preventable maternal mortality. These include adequate emergency obstetric care; functioning referral systems; available blood transfusion; effective medicines and obstetric surgery; family planning; contraception; high-quality, humane care during pregnancy, child-

birth, and the postpartum period; access to safe abortion; adequate equipment and skilled personnel; and health information and surveillance systems with the appropriate registration of maternal death and near-miss cases and the study of their causes (5).

Although all countries participating in the WHO MCS showed a downward MMR trend in 1990–2013, the highly significant difference in rates between countries highlights the underlying social inequity in the world (4, 9; see [Supplementary material](#) that chart MMR trends by obstetric transition stage). These inequities also occur within countries, where vulnerable populations (i.e., the economically-disadvantaged, those with few years of education, racial and ethnic minorities, refugees, indigenous people) suffer most. These groups and communities suffer the effects of structural violence (e.g., institutionalized racism or sexism that prevent certain people from meeting their basic needs and/or achieving their potential) that can culminate in avoidable death or morbidity (3, 12–14).

We also observed some variation in the obstetric transition status according to the country's geographic location, emphasizing the need to customize strategies. Thus, while in most African countries great emphasis should be di-

rected to strengthening basic social and health infrastructure, in Asia and Latin America further reductions in maternal mortality may be largely dependent on improvements in quality of care. It is important to note that this analysis was conducted at a high level with a lens on certain aspects, however, all aspects remain important and should not be overlooked.

Limitations

This analysis presents both strengths and limitations of note. The size and breadth of the database allowed the obstetric transition concept to be explored on a global scale for the first time. However, the study's cross-sectional design, the source of data (routine medical records), and the ecological approach limited the level of evidence that could be generated. Other limitations include the use of proxies to study some characteristics of the obstetric transition. Also, one must consider that the obstetric transition is the product of complex in-

teractions of social, economic, cultural, biological, and health forces, among others, and that these interactions have implications that go far beyond the health sector.

Conclusions

This analysis supports the theory of obstetric transition using multicountry data. The study findings demonstrated that the Obstetric Transition Model can be used to justify customizing solutions for maternal mortality reduction by aligning with a country's stage in the obstetric transition. Promoting social development and equity, together with health system strengthening and improvements in quality of care, are necessary actions for avoiding maternal deaths that may be more effectively and efficiently applied when a country's stage in the transition is known. Future research could explore population-based data (e.g., demographic health surveys) to further understand the obstetric transition concept.

Acknowledgements. The authors wish to thank all members of the WHO Multicountry Survey on Maternal and Newborn Health Research Network, including Regional and country coordinators, data collection coordinators, facility coordinators, data collectors, and all the staff at participating facilities who made the survey possible.

Funding. The WHO MCS study was financially supported by the UNDP/UNFPA/UNICEF/WHO/World Bank Special Programme of Research, Development and Research Training in Human Reproduction (HRP); the World Health Organization; United States Agency for International Development; Ministry of Health, Labor and Welfare of Japan; and Gynuity Health Projects.

Disclosure. The sponsors had no role in data collection, analysis, or interpretation of the data, and any views and opinions are solely those of the authors.

Conflicts of interest. None.

REFERENCES

1. United Nations Millennium Declaration. New York: UN; 2000. Available from: www.un.org/millennium/declaration/ares552e.htm Accessed on 23 April 2015.
2. United Nations. Millennium Development Goals (MDG). New York: UN; 2014. Available from: www.un.org/millenniumgoals/ Accessed on 12 June 2014.
3. United Nations Population Fund. Rich mother, poor mother: the social determinants of maternal death and disability. New York: UNFPA; 2012. Available from: www.unfpa.org/webdav/site/global/shared/factsheets/srh/EN-SRH%20fact%20sheet-Poormother.pdf Accessed on 12 June 2014.
4. World Health Organization. Trends in maternal mortality: 1990 to 2013: estimates by WHO, UNICEF, UNFPA, the World Bank, and the United Nations Population Division: executive summary, 2014. Available from: http://apps.who.int/iris/bitstream/10665/112697/1/WHO_RHR_14.13_eng.pdf?ua=1 Accessed on 9 April 2015.
5. World Health Organization. Strategies toward ending preventable maternal mortality. Geneva: WHO; 2015. Available from: http://apps.who.int/iris/bitstream/10665/153544/1/9789241508483_eng.pdf?ua=1 Accessed on 24 April 2015.
6. Souza JP. Mortalidade materna e desenvolvimento: a transição obstétrica no Brasil; Maternal mortality and development: the obstetric transition in Brazil. *Rev Bras Ginecol Obstet.* 2013;35(12):533-5.
7. Souza JP, Tunçalp Ö, Vogel JP, Bohren M, Widme M, Oladapo OT, et al. Obstetric transition: the pathway towards ending preventable maternal deaths. *BJOG.* 2014;121(s1):1-4.
8. Souza JP, Gulmezoglu AM, Carroli G, Lumbiganon P, Qureshi Z, WHOMCS Research Group. The World Health Organization multicountry survey on maternal and newborn health: study protocol. *BMC Health Serv Res.* 2011;11:286.
9. Souza JP, Gulmezoglu AM, Vogel J, Carroli G, Lumbiganon P, Qureshi Z, et al. Moving beyond essential interventions for reduction of maternal mortality (the WHO Multicountry Survey on Maternal and Newborn Health): a cross-sectional study. *Lancet.* 2013;381:1747-55.
10. Shah A, Faundes A, Machoki M, Bataglia V, Amokrane F, Donner A, et al. Methodological considerations in implementing the WHO Global Survey for Monitoring Maternal and Perinatal Health. *Bull World Health Organ.* 2008;86:126-31.
11. Say L, Souza JP, Pattinson RC, WHO working group on Maternal Mortality and Morbidity classifications. Maternal near miss towards a standard tool for monitoring quality of maternal health care. *Best Pract Res Clin Obstet Gynaecol.* 2009;23(3):287-96.
12. United Nations Population Fund. The social determinants of maternal death and disabilities. Available from: www.unfpa.org/webdav/site/global/shared/factsheets/srh/EN-SRH%20fact%20sheet-Poormother.pdf Accessed on 12 June 2012.
13. United Nations Development Program. A social determinants approach to maternal health. Available from: www.undp.org/content/dam/undp/library/Democratic%20Governance/Discussion%20Paper%20MaternalHealth.pdf Accessed on 12 June 2014.
14. Tunçalp Ö, Souza JP, Hindin MJ, Santos CA, Oliveira TH, Vogel JP, et al. on behalf of the WHO Multicountry Survey on Maternal and Newborn Health Research Network. Education and severe maternal outcomes in developing countries: a multicountry cross-sectional survey. *BJOG.* 2014;121(Suppl. 1):57-65.

Manuscript received on 17 August 2015. Revised version accepted for publication on 31 March 2015.

RESUMEN

Transición obstétrica en la Encuesta Global de la Organización Mundial de la Salud sobre Salud Materna y Neonatal: exploración de las vías de reducción de la mortalidad materna

Objetivo. Evaluar si las características propuestas del Modelo de Transición Obstétrica, un marco teórico que puede explicar los cambios graduales que experimentan los países a medida que eliminan la mortalidad materna evitable, se pueden observar en una amplia base de datos de salud materna y perinatal de varios países; y tratar sobre el proceso dinámico de reducción de la mortalidad materna utilizando este modelo como marco teórico.

Métodos. Este estudio consistió en un análisis secundario de un estudio transversal realizado por la Organización Mundial de la Salud que recopiló información sobre más de 300 000 mujeres que dieron a luz en 359 establecimientos de salud de 29 países de África, Asia, América Latina y Oriente Medio, durante un período de 2 a 4 meses en el 2010 y el 2011. Se calcularon los índices de afecciones potencialmente mortales, resultados maternos graves, morbilidad materna extremadamente grave, y muerte materna, y se estratificaron según las etapas de transición obstétrica. Se definen las características de cada etapa.

Resultados. Los datos de 314 623 mujeres indicaron que la fecundidad femenina, calculada indirectamente por el número de partos, fue mayor en los países que se hallaban en las primeras etapas de la transición obstétrica, desde un promedio de 3 hijos en el estadio II a 1,8 en el estadio IV. El nivel de medicalización de los establecimientos de salud de los países participantes, definido por el número de partos por cesárea y el número de partos inducidos, tuvo tendencia a aumentar según avanzaba la etapa de transición obstétrica. En el estadio IV, las mujeres tuvieron 2,4 veces más partos por cesárea (15,3% en el estadio II y 36,7% en el estadio IV) y 2,6 veces más inducciones de parto (7,1% en el estadio II y 18,8% en el estadio IV) que las mujeres en el estadio II. A medida que avanzaban las etapas de transición obstétrica, también se incrementaba la media de edad de las mujeres primíparas. La ocurrencia de rotura uterina mostraba una tendencia descendente, y se reducía 5,2 veces, de 178 a 34 casos por 100 000 nacidos vivos, a medida que un país efectuaba la transición del estadio II al IV.

Conclusiones. Este análisis apoya el concepto de transición obstétrica utilizando datos de varios países. El Modelo de Transición Obstétrica podría justificar la adaptación de las estrategias para reducir la mortalidad materna según la etapa de transición obstétrica en que se halla un país.

Palabras clave

Salud de la mujer; mortalidad materna, tendencias; complicaciones del trabajo de parto; bienestar materno; salud global; Organización Mundial de la Salud.