

## Original Articles

# Maternal Health Care Services in Zhejiang Province, China: From 1998 to 2010

CJ ZOU, XF WANG, ZH YE

### Abstract

**Objective:** To investigate the utilisation levels of maternal health care services and its changes in Zhejiang province, China during the period from 1998 to 2010. **Methods:** Data were drawn from the *Zhejiang Maternal and Child Health Statistics* conducted under the supervision of the Health Bureau of Zhejiang province. **Results:** The rates of medical card establishment, systematic management, examination, and early examination increased significantly ( $p < 0.001$ , respectively) during this period, and these rates were higher in urban than in rural areas. However, the high-risk pregnancy rate increased dramatically from 21.59% to 42.56% with an odds ratio (OR) of 1.227, and it was higher in urban than in rural areas. The maternal mortality decreased from 25.48 to 7.50 per 100 000 with an OR of 0.294, with a higher rate in rural areas ( $p < 0.001$ ). It was negatively correlated with the rates of medical card establishment, systematic management, examination and early examination, with a highest coefficient for systematic management rate ( $r = -0.555$ ,  $p < 0.001$ ). Postpartum haemorrhage and pregnancy-induced hypertension were two major causes of maternal death in the 1990s with a decreasing tendency. The hospital delivery rate was high during the study period and the overall difference between urban and rural areas was substantially narrowed. The stillbirth rate decreased from 5.39% in 1998 to 3.88% in 2010 with an OR of 0.717. **Conclusion:** These data suggest that the maternal health care services in Zhejiang province were improved during 1998 to 2010. However, potential factors (e.g. health awareness, medical technology, etc.) that may affect the maternal health care utilisation need to be improved.

**Key words** Children; China; Health care; Maternal; Mortality

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### Introduction

The level of maternal health care services, similar to the child health care services, is regarded as an important indicator for health care and social development. The low level of maternal health care services and high maternal and paediatric mortality reflect one of the shameful failures in human development. The global estimates of maternal mortality indicate that 342 900 women died due to pregnancy related causes in 2008.<sup>1</sup> Approximately 80% of the maternal deaths globally occur due to haemorrhage, sepsis, hypertensive disorder of pregnancy, unsafe induced abortion, and obstructed labour,<sup>2,3</sup> which can be avoided with key health interventions. In addition, the risk of

maternal death was not uniformly distributed, with a large proportion of the maternal deaths occurring in developing countries.<sup>4,5</sup> The gap in the risk of maternal deaths between developed and developing countries is considered the "greatest health divide in the world". The United Nations Millennium Development Goals (MDGs) call for a 75% reduction in maternal mortality between 1990 and 2015.<sup>6</sup>

China, a developing country, has a dramatic development in society and economy since the reforms in 1980s. The government was actively involved in the MDGs project,<sup>5</sup> and has made effort to reduce the mortality of mothers, neonates and children less than 5 years. A series of laws and regulations aiming to improve maternal and child health have been legislated, including the *Maternal and Infant Health Care Law of the PRC* in 1994,<sup>7</sup> and *Guidelines for Chinese Women's Development* in 1995, 2000 and 2011,<sup>8,9</sup> respectively. Zhejiang province, one of the affluent provinces in the eastern coast of China, comprise Hangzhou, Ningbo, Wenzhou, Jiaxing, Huzhou, Shaoxing, Jinhua, Quzhou, Zhoushan, Taizhou, and Lishui 11 administrative regions (Figure 1). Since the early 1990s, a network covering the whole province to monitor the maternal healthcare services has been established. However, there has been no report about the utilisation of the maternal health care services in Zhejiang Province. Herein, we aimed to investigate the utilisation levels of maternal health care services in Zhejiang during the period from 1998 to 2010.

## Subjects and Methods

### Data Collection

Data about maternal health care services in Zhejiang province were drawn from the *Zhejiang Maternal and Child Health Statistics* conducted under the supervision of the Health Bureau of Zhejiang province. It covered the whole Zhejiang province, involving both urban and rural populations. Data from cities and counties are reported to the centers of the 11 administrative regions aforementioned, and then aggregated to the Department of Maternal and Child Health Care in the Health Bureau of Zhejiang province.

This study was approved by the Ethical Committee of the Sir Run Run Shaw Hospital of Zhejiang University School of Medicine.

### Indicators and Definition

The indicators of prenatal care included the expected population, medical card establishment rate (proportion of pregnancies with medical card established after at least one visit), systematic management rate (proportion of pregnancies finishing all monitoring examinations from prenatal to postnatal care), early examination rate (proportion of first prenatal visits within 12 weeks of gestation), examination rate (proportion of prenatal care visit frequency meeting the Chinese National Ministry of Health standards: at least 5 prenatal visits in rural areas and 8 visits in urban areas), high-risk pregnancy (with at least one factor which may harm the maternal or newborn health), and systematic management rate for high-risk pregnancy.

The indicators of delivery care included hospital delivery rate, and hospital delivery rate for high-risk pregnancy. Also, the maternal mortality, cause of maternal death, and stillbirths were analysed.

### Statistical Analysis

Statistical analyses were conducted using SPSS software (version 15.0). The Pearson Chi-square test was used to measure enumeration data among groups. The odds ratio (OR) and 95% confidence interval (CI) were all weighted. Correlations between the mortality and the indicators of prenatal care were analysed. Significant differences were regarded if a P value <0.05.



**Figure 1** The location of Zhejiang province and 11 administrative regions of Zhejiang province.

## Results

The annual expected maternal population ranged from 354 140 to 408 704 during the period from 1998 to 2010. The medical card establishment rate was 96.31% even in the year 1998, and reached 98.98% in 2010, with a slightly higher rate observed in urban areas than in rural areas each year ( $p < 0.001$ , respectively). The systematic management rate increased to 96.02% in 2010 from 84.09% in 1998, with significant difference ( $\chi^2 = 30670$ ,  $p < 0.001$ ). The mean

systematic management rate was significantly higher in urban areas than in rural areas (90.26% vs. 88.55%,  $\chi^2 = 4600$ ,  $p < 0.001$ ), as shown in Table 1.

The examination rate was also increased from 96.28% in 1998 to 99.17% in 2010 with significant difference among these 13 years ( $\chi^2 = 15090$ ,  $p < 0.001$ ). It was slightly higher in urban areas than in rural areas in each year ( $p < 0.001$ , respectively). The early examination rate was only 86.15% in 1998 and increased to 96.58% in 2010, with a significant difference among these 13 years

**Table 1** The population with medical card establishment and those receiving systematic management

Year	Expected population			Card establishment population (%)					Systematic management population (%)				
	Total	Urban	Rural	Total	Urban	Rural	t	P value	Total	Urban	Rural	t	P value
Total	4930919	3178740	1752179	4814039 (97.62)	3119606 (98.14)	1689519 (96.42)	13800	<0.001	4422556 (89.69)	2873393 (90.26)	1549887 (88.55)	4600	<0.001
1998	384622	235955	148667	370434 (96.31)	228451 (96.82)	141983 (95.50)	444.4	<0.001	323429 (84.09)	197808 (83.83)	125621 (84.50)	30.175	<0.001
1999	370260	228020	142240	357690 (96.61)	221052 (96.94)	136638 (96.06)	208.0	<0.001	317575 (85.77)	195003 (85.52)	122572 (86.17)	30.562	<0.001
2000	386857	240638	146219	375401 (97.04)	234677 (97.52)	140724 (96.24)	519.3	<0.001	337300 (87.19)	209423 (87.02)	127877 (87.46)	14.887	<0.001
2001	370664	238644	132020	366173 (97.79)	233821 (97.98)	127438 (96.53)	722.3	<0.001	307557 (82.97)	202558 (84.88)	105723 (80.08)	1398.0	<0.001
2002	359928	232735	127193	351227 (97.58)	228483 (98.17)	122744 (96.50)	973.3	<0.001	304668 (84.65)	200144 (86.00)	104524 (82.18)	923.0	<0.001
2003	354140	231034	123106	346216 (97.76)	227671 (98.54)	118545 (96.30)	1858	<0.001	323869 (91.45)	211652 (91.61)	112217 (91.15)	21.361	<0.001
2004	386384	252176	134208	374135 (96.83)	247803 (98.27)	126332 (94.13)	4877	<0.001	344915 (89.27)	230629 (91.46)	114286 (85.16)	3628.0	<0.001
2005	408704	264204	144500	396570 (97.03)	259806 (98.34)	136764 (94.65)	4413	<0.001	368505 (90.16)	242913 (91.94)	125592 (86.91)	2661.0	<0.001
2006	377173	243279	133894	367041 (97.31)	238223 (97.92)	128818 (96.21)	969.2	<0.001	343149 (90.98)	222726 (91.55)	120423 (89.94)	273.7	<0.001
2007	381939	249820	132119	375065 (98.20)	246155 (98.53)	128910 (97.57)	452.3	<0.001	356848 (93.43)	233857 (93.61)	122991 (93.09)	37.942	<0.001
2008	378400	251088	127312	371668 (98.22)	247119 (98.42)	124549 (97.83)	168.0	<0.001	356270 (94.15)	236806 (94.32)	119464 (93.84)	34.811	<0.001
2009	385221	254849	130372	379747 (98.58)	251984 (98.88)	127763 (98.00)	437.6	<0.001	367241 (95.33)	242942 (95.33)	124299 (95.34)	0.038	0.846
2010	386627	256298	130329	382672 (98.98)	254361 (99.24)	128311 (98.45)	536.1	<0.001	371230 (96.02)	246932 (96.35)	124298 (95.37)	214.0	<0.001
F				12030	7710	7559			5834	61460	38610		
P value				<0.001	<0.001	<0.001			<0.001	<0.001	<0.001		

( $\chi^2=54110$ ,  $p<0.001$ ). Similarly, it was also higher in urban areas than in rural areas in each year ( $p<0.05$ , respectively) except for that in 1998 and 1999 ( $p=0.262$  and  $p=0.248$ , respectively). The mean early examination rate was significantly lower than the examination rate (91.64% vs. 97.65%,  $\chi^2=169700$ ,  $p<0.001$ ), as shown in Table 2.

The number of high-risk pregnancies increased in both urban and rural areas. The annual proportion of high-risk pregnancies increased dramatically from 21.59% in 1998

to 42.56% in 2010 ( $\chi^2=10320$ ,  $p<0.001$ ) with an OR of 1.227 and a 95% CI of 1.222-1.231. Moreover, it was higher in urban areas than in rural areas in each year of the period we investigated ( $p<0.001$ , respectively). The mean delivery high-risk pregnancy was high (99.96%). It was noted that the rate were increased among these 13 years ( $F=329.2$ ,  $p<0.001$ ) and the mean rate in urban area was higher than that in rural area ( $F=170.5$ ,  $p<0.001$ ;  $F=217.2$ ,  $p<0.001$ ), as shown in Table 3.

**Table 2** The population receiving standard examination and those receiving early examination

Year	Examination population (%)					Early examination population (%)				
	Total	Urban	Rural	t	P value	Total	Urban	Rural	t	P value
Total	4814733 (97.64)	3120495 (98.15)	1694238 (96.73)	10670	<0.001	4525119 (91.77)	2936909 (92.30)	1588210 (90.75)	4582	<0.001
1998	370298 (96.28)	228332 (96.77)	141966 (95.49)	414.6	<0.001	331371 (86.15)	203170 (86.11)	128201 (86.23)	1.258	0.262
1999	357605 (96.58)	221020 (96.93)	136585 (96.02)	217.7	<0.001	326153 (88.09)	200968 (88.14)	125185 (88.01)	1.334	0.248
2000	375310 (97.02)	234623 (97.50)	140687 (96.22)	517.6	<0.001	345883 (89.41)	215623 (89.60)	130260 (89.09)	25.888	<0.001
2001	361173 (97.44)	233754 (97.95)	127419 (96.51)	702.5	<0.001	335658 (90.56)	216482 (90.71)	119176 (90.27)	10.412	0.001
2002	351182 (97.57)	228467 (98.17)	122715 (96.48)	987.2	<0.001	328813 (91.36)	213258 (91.63)	115555 (90.85)	63.543	<0.001
2003	345991 (97.70)	227527 (98.48)	118464 (96.23)	1813	<0.001	325935 (92.04)	214698 (92.93)	111237 (90.36)	723.9	<0.001
2004	374322 (96.88)	247903 (98.31)	126419 (94.20)	4891	<0.001	350209 (90.64)	233704 (92.67)	116505 (86.81)	3551	<0.001
2005	397740 (97.32)	259865 (98.36)	137875 (95.42)	3098	<0.001	373359 (91.35)	245774 (93.02)	127585 (88.29)	2646	<0.001
2006	368675 (97.75)	238610 (98.08)	130065 (97.14)	346.9	<0.001	347305 (92.08)	225184 (92.56)	122121 (91.21)	217.4	<0.001
2007	375935 (98.43)	246232 (98.56)	129703 (98.17)	86.007	<0.001	360570 (94.41)	236406 (94.63)	124164 (93.98)	69.471	<0.001
2008	372472 (98.43)	247352 (98.51)	125120 (98.28)	29.953	<0.001	358657 (94.78)	238494 (94.98)	120163 (94.38)	61.409	<0.001
2009	380603 (98.80)	252244 (98.98)	128359 (98.46)	198.3	<0.001	367805 (95.48)	244732 (96.03)	123073 (94.40)	5.301	<0.001
2010	383427 (99.17)	254566 (99.32)	128861 (98.87)	213.7	<0.001	373401 (96.58)	248416 (96.92)	124985 (95.90)	274.8	<0.001
F	15090	8601	9634			54110	39710	18600		
P value	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001		

The annual number of live births was about 380 000 (ranging from 361 000 to 410 000) with slight internal fluctuation. It had an increasing tendency in urban areas with 236 355 in 1998 and 258 240 in 2010, while it showed a decreasing tendency in rural areas with 148 863 in 1998 and 131 293 in 2010. The hospital delivery rate was higher during the study period. It was 97.94% in 1998, and increased to 99.99% in 2010. Moreover, the change of the rate varied with the socio-economic status of different areas.

The hospital delivery rate increased slightly from 99.23% to 99.99% in urban areas while it increased from 95.91% to 99.95% in rural areas. The overall difference between rural and urban areas was substantially narrowed, but with statistical differences in each year over the period ( $p < 0.001$ , respectively), as shown in Table 4.

The stillbirths rate decreased from 5.39% in 1998 to 3.88% in 2010 ( $\chi^2 = 97.420$ ,  $p < 0.001$ ) with an OR of 0.717 and a 95%CI of 0.671-0.776. The mean stillbirths rates were

**Table 3** The high-risk pregnancy and hospital delivery rate for high-risk pregnancy

Year	High-risk pregnancy (%)					Hospital delivery for high-risk pregnancy (%)				
	Total	Urban	Rural	t	P value	Total	Urban	Rural	t	P value
Total	1666803 (33.80)	1125580 (35.22)	541223 (31.15)	10320	<0.001	1666211 (99.96)	1125336 (99.98)	540875 (99.93)	187.0	<0.001
1998	83059 (21.59)	54528 (23.11)	28531 (19.19)	827.0	<0.001	82989 (99.92)	54506 (99.96)	28483 (99.83)	36.382	<0.001
1999	89184 (24.09)	57955 (25.42)	31229 (21.96)	574.0	<0.001	89111 (99.92)	57925 (99.95)	31186 (99.86)	18.321	<0.001
2000	103388 (26.73)	68889 (28.63)	34499 (23.59)	1177	<0.001	103335 (99.95)	68871 (99.97)	34464 (99.90)	25.454	<0.001
2001	110705 (29.87)	75846 (31.78)	34859 (26.40)	1174	<0.001	110657 (99.96)	75833 (99.98)	34824 (99.90)	38.204	<0.001
2002	119373 (33.17)	80770 (34.70)	38603 (30.35)	703.6	<0.001	119333 (99.97)	80758 (99.99)	38575 (99.93)	25.939	<0.001
2003	119960 (33.87)	83194 (36.01)	36766 (29.87)	1354	<0.001	119911 (99.96)	83178 (99.98)	36733 (99.91)	31.060	<0.001
2004	133263 (34.49)	91893 (36.44)	41370 (30.83)	1222	<0.001	133191 (99.95)	91869 (99.97)	41322 (99.88)	42.705	<0.001
2005	143996 (35.23)	98620 (37.33)	45376 (31.40)	1437	<0.001	143904 (99.94)	98570 (99.95)	45334 (99.91)	8.529	0.003
2006	135737 (35.99)	90688 (37.28)	45049 (33.65)	4946	<0.001	135676 (99.96)	90644 (99.95)	45032 (99.96)	0.779	0.337
2007	146282 (38.30)	98466 (39.41)	47816 (36.19)	379.9	<0.001	146272 (99.99)	98460 (99.99)	47812 (99.99)	0.243	0.622
2008	155846 (41.19)	105189 (41.89)	50657 (39.79)	154.3	<0.001	155837 (99.99)	105184 (99.99)	50653 (99.99)	0.585	0.444
2009	161473 (41.92)	108465 (42.56)	53008 (40.66)	128.1	<0.001	161465 (100.00)	108463 (100.00)	53002 (99.99)	6.453	0.011
2010	164537 (42.56)	111077 (43.34)	53460 (41.02)	190.2	<0.001	164530 (100.00)	111075 (100.00)	53455 (99.99)	4.839	0.028
F	91030	51890	7102			329.2	170.5	217.2		
P value	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001		

4.55% and 4.50% in urban and rural areas respectively with a slight significant difference ( $\chi^2=6.539$ ,  $p=0.011$ ,  $OR=1.153$ ,  $95\% CI=1.034-1.287$ ), although the differences of annual stillbirths rates between the urban and rural area were not significant in most years of this period, as shown in Table 4.

The maternal mortality decreased dramatically during the study period, dropping from 25.48/100 000 in 1998 to 7.50/100 000 in 2010 ( $\chi^2=37.854$ ,  $p<0.001$ ) with an OR of 0.294 and a 95% CI of 0.194-0.445. It was notable that the

annual maternal mortality in rural areas was always higher than that in the urban areas, with a mean mortality of 16.66/100 000 and 12.74/100 000 in rural and urban areas respectively, with a significant difference ( $\chi^2=14.999$ ,  $p<0.001$ ,  $OR=1.344$ ,  $95\% CI=1.156-1.561$ ). It was noted that annual maternal mortality in rural areas was higher than that in the urban areas in 1998 ( $t=11.185$ ,  $p<0.001$ ), but without difference in the following years ( $p>0.05$ , respectively), as shown in Table 5.

Correlations between the mortality and the indicators of

**Table 4** The live births and stillbirths

Year	Live birth			Hospital delivery rate of live birth (%)					Stillbirths (%)				
	Total	Urban	Rural	Total	Urban	Rural	t	P value	Total	Urban	Rural	t	P value
Total	4953056	3194269	1758787	4914220 (99.22)	3179458 (99.53)	1734762 (98.68)	11870	<0.001	22549 (4.54)	14572 (4.55)	7977 (4.50)	6.539	0.011
1998	385218	236355	148863	377299 (97.94)	234528 (99.23)	142771 (95.91)	4998	<0.001	2087 (5.39)	1255 (5.28)	832 (5.56)	0.175	0.676
1999	370992	228493	142499	365044 (98.40)	227156 (99.41)	137888 (96.77)	3909	<0.001	1894 (5.08)	1146 (4.99)	748 (5.22)	1.322	0.250
2000	388001	241365	146636	382959 (98.70)	240046 (99.45)	142913 (97.46)	2823	<0.001	1899 (4.87)	1212 (5.00)	687 (4.66)	0.944	0.331
2001	371803	239434	132369	368328 (99.07)	238264 (99.51)	130064 (98.26)	1445	<0.001	1634 (4.40)	1093 (4.54)	541 (4.07)	2.119	0.145
2002	361073	233587	127486	358504 (99.29)	232495 (99.53)	126009 (98.84)	557.6	<0.001	1707 (4.71)	1041 (4.44)	666 (5.20)	4.449	0.035
2003	355349	231856	123493	353005 (99.34)	230864 (99.57)	122141 (98.91)	547.0	<0.001	1589 (4.45)	1022 (4.39)	567 (4.39)	10.326	0.001
2004	387853	253190	134663	385418 (99.37)	252049 (99.55)	133369 (99.04)	366.9	<0.001	1773 (4.55)	1167 (4.59)	606 (4.48)	0.609	0.435
2005	410322	265310	145012	407969 (99.43)	264110 (99.55)	143859 (99.20)	193.3	<0.001	1808 (4.39)	1144 (4.29)	664 (4.56)	0.230	0.632
2006	378909	244469	134440	376643 (99.40)	243174 (99.47)	133469 (99.28)	54.09	<0.001	1675 (4.40)	1075 (4.38)	600 (4.44)	1.524	0.217
2007	385686	252992	132694	381701 (98.97)	249748 (98.72)	131953 (99.44)	446.0	<0.001	1762 (4.55)	1163 (4.58)	599 (4.49)	0.085	0.771
2008	380522	252448	128074	380284 (99.94)	252330 (99.95)	127954 (99.91)	29.968	<0.001	1653 (4.33)	1135 (4.48)	518 (4.03)	0.131	0.717
2009	387795	256530	131265	387630 (99.96)	256483 (99.98)	131147 (99.91)	104.6	<0.001	1552 (3.99)	1067 (4.14)	485 (3.68)	4.004	0.045
2010	389533	258240	131293	389436 (99.99)	258211 (99.99)	131225 (99.95)	57.525	<0.001	1516 (3.88)	1052 (4.06)	464 (3.52)	4.701	0.030
F				21740	7505	200304			174.2	80.721	129.6		
P value				<0.001	<0.001	<0.001			<0.001	<0.001	<0.001		

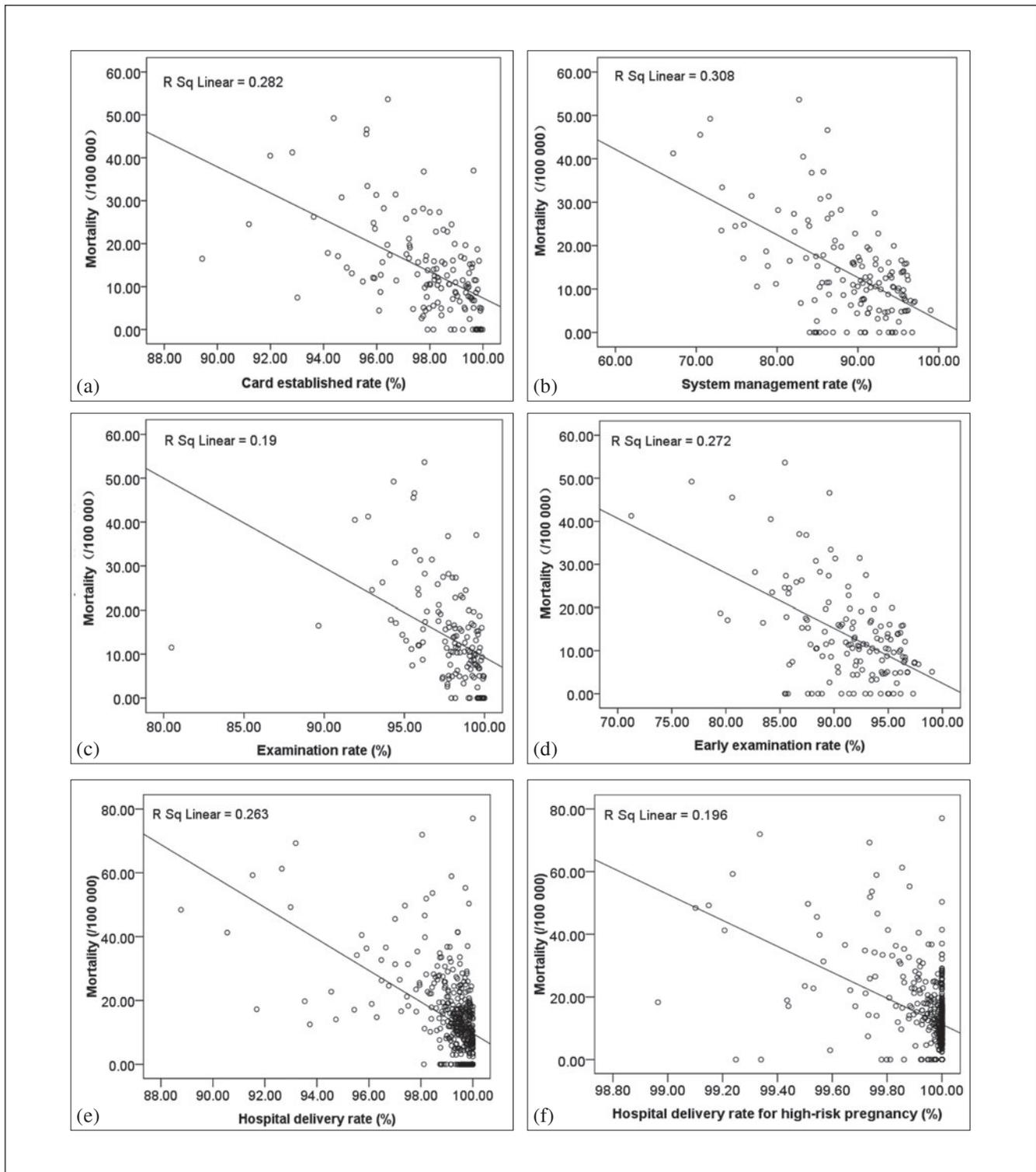
prenatal care were analysed. We found that the mortality was negatively correlated with the medical card establishment rate, systematic management rate, the examination rate and early examination rate ( $r=-0.531$ ,  $p<0.001$ ;  $r=-0.555$ ,  $p<0.001$ ;  $r=-0.436$ ,  $p<0.001$ ;  $r=-0.521$ ,  $p<0.001$ ; respectively) with a highest coefficient for systematic management rate (Figures 2a-2d). Correlations between the mortality and the indicators of prenatal care were analysed. We found that the mortality was negatively

correlated with the hospital delivery rate for live birth and high-risk pregnancy ( $r=-0.443$ ,  $p<0.001$ ;  $r=-0.511$ ,  $p<0.001$ , respectively), as shown in Figures 2e-2f. The main causes of maternal death included postpartum haemorrhage in 181 cases, pregnancy-induced hypertension in 65, infection in 4, medical illness in 309, and other reasons in 139. The number and proportion of maternal death caused by postpartum haemorrhage decreased from 1998 to 2010 (Table 5).

**Table 5** The maternal mortality and the major causes of death

Year	Mortality (/100 000)					Cause of death (%)				
	Total	Urban	Rural	t	P value	PPH	PIH	Infection	Medical illness	Other
Total	698 (14.16)	401 (12.74)	297 (16.66)	14.999	<0.001	181 (22.95)	65 (8.68)	4 (0.47)	309 (47.16)	139 (20.74)
1998	98 (25.48)	44 (18.65)	54 (36.33)	11.185	<0.001	37 (37.76)	9 (9.18)	2 (2.04)	36 (36.73)	14 (14.29)
1999	82 (22.15)	47 (20.61)	35 (24.61)	0.631	0.427	26 (31.71)	8 (9.76)	0	35 (42.68)	13 (15.85)
2000	75 (19.39)	44 (18.28)	31 (21.20)	0.399	0.528	25 (33.33)	10 (13.33)	0	23 (30.67)	17 (22.67)
2001	72 (19.42)	42 (17.60)	30 (22.72)	1.149	0.284	18 (25.00)	5 (6.94)	1 (1.39)	32 (44.44)	16 (22.22)
2002	46 (12.78)	26 (11.17)	20 (15.72)	1.334	0.248	10 (21.74)	3 (6.52)	0	26 (56.52)	7 (15.22)
2003	53 (14.97)	31 (13.42)	22 (17.87)	1.064	0.302	12 (22.64)	9 (16.98)	0	18 (33.96)	14 (26.42)
2004	56 (14.49)	33 (13.09)	23 (17.14)	0.992	0.319	15 (26.79)	9 (16.07)	0	24 (42.86)	8 (14.29)
2005	55 (13.46)	33 (12.49)	22 (15.22)	0.519	0.471	15 (27.27)	3 (5.45)	0	26 (47.27)	11 (20.00)
2006	39 (10.34)	23 (9.45)	16 (11.95)	0.520	0.471	5 (12.82)	1 (2.56)	0	23 (58.97)	10 (25.64)
2007	31 (8.12)	19 (7.61)	12 (9.08)	0.232	0.630	10 (32.26)	2 (6.45)	0	18 (58.06)	1 (3.23)
2008	25 (6.61)	16 (6.37)	9 (7.07)	0.062	0.803	3 (12.00)	2 (8.00)	0	16 (64.00)	4 (16.00)
2009	37 (9.60)	26 (10.20)	11 (8.44)	0.280	0.597	3 (8.11)	3 (8.11)	1 (2.70)	18 (48.65)	12 (32.43)
2010	29 (7.50)	17 (6.63)	12 (9.20)	0.764	0.382	2 (6.90)	1 (3.45)	0	14 (48.28)	12 (41.38)
F	113.8	52.856	66.749							
P value	<0.001	<0.001	<0.001							

PPH, postpartum hemorrhage; PIH, pregnancy-induced hypertension.



**Figure 2** Correlations between the material mortality and indicators of prenatal care and delivery care. (a) Correlation between mortality and medical card establishment rate. (b) Correlation between mortality and systematic management rate. (c) Correlation between mortality and the examination rate. (d) Correlation between mortality and early examination rate. (e) Correlation between mortality and the hospital delivery rate. (f) Correlation between mortality and the hospital delivery rate for high-risk pregnancy.

## Discussion

With rapid socioeconomic development, more effort has been made to improve the maternal and child health services in China, especially to cut down the mortality of mothers and children younger than 5 years. Since the early 1990s, the maternal and child health care services network has been established in Zhejiang province. It covers over 99% of the resident population, even including part of the floating population (not shown here), which is higher than the mean level in the whole country of China,<sup>10-12</sup> also higher than that in some developed and developing countries.<sup>13,14</sup> Moreover, the HIV, syphilis, TORCH, antenatal screening and diagnosis, and anaemia programs have been established since 2008 (not shown here), as indicated by WHO.<sup>15</sup>

Over the periods from 1998 to 2010, there was significant improvement in maternal care utilisation, including prenatal care and delivery care, which was similar with postnatal care reported by Zhang et al.<sup>16</sup> The card establishment rate and examination rate had only 2% to 3% increment as they were high (>96%) at the beginning year of this study. The systematic management rate increased by 12% to 96.02% from 84.09%. Likewise, the early examination rate made an increment by over 12% (from 86.12% to 96.58%) although there were internal fluctuation and variations. These improvement may be attributed to not only the general socioeconomic development, including the increases in income, living standards, and educational levels, and elevated women's social position,<sup>4,13,17,18</sup> but also the effort of the government.<sup>11,12</sup>

It was notable that the cards establishment rate, systematic management rate, examination rate and early examination rate were lower in the rural areas than in the urban areas over the study periods, although the difference was slight. It was similar to reports from other developing countries and from other areas of China,<sup>14,18,19</sup> and may be associated with the difference in geographical distance, economic level, education level, health awareness and women's social position.<sup>14,20</sup>

It is noteworthy that the high-risk pregnancies increased dramatically during the study periods both in urban and rural areas. In 2010, the high-risk pregnancy rate was about twice of that in 1998, which may be associated with several facts. First, fertility decreased because of various factors associated with the excessive emphasis on economic development, including changes of the environment, diet, living habits, and work stress. Second, medical technology development and health awareness were enhanced owing to the economic and education advancement, especially in

urban areas. Some risk factors, which were used to be ignored, were stressed. Meanwhile, we found the high-risk pregnancy rate was higher in urban than in rural areas, which is likely to be associated with more work stress, less activity habits, and more health awareness of the mothers and better medical technology in the urban areas.

Although the number of annual live births was relatively stable during the 13 years of study, live births showed an increasing trend in urban areas while a decreasing trend in rural areas. This is probably associated with the increasing number of childbearing-age women in urban areas, caused by the urbanisation throughout China since the reforms in 1980s, as similarly happening in some other developing countries.<sup>14</sup>

As for the hospital delivery rate, we noted the rates for both high risk pregnancy and live births approached 99% throughout the study period. However, we noted that the difference of hospital delivery rate between rural and urban areas were significant during first 8 years, while the differences were reduced in recent years. Also, the hospital delivery rate for live birth rose significantly in rural areas (about 5%) while it rose about 0.7% in urban areas. Besides, the stillbirth rate decreased even below the urban levels during the period from 2008 to 2010. This suggested that the effort of the government to improve the health care service and the rural New Co-operative Medical System in Chinese rural areas established since 2003 have shown good results in recent years.<sup>11</sup>

The maternal mortality made an exceptional progress in that it decreased by over 2/3 from 25.48/100 000 in 1998 to 7.50/100 000 in 2010. Moreover, the improvement in rural areas was significantly faster, as it decreased by about 3/4 (from 36.33/100 000 to 9.20/100 000). The maternal mortality was lower than in most developing countries,<sup>1,21</sup> but still slightly higher than that in some developed countries,<sup>1</sup> and required the support of the whole society and the family members, including the husband.<sup>22-24</sup> Despite the faster progress, the mortality in rural areas was still slight higher than that in urban areas at the end of this study. The difference may be attributed to the poor health awareness and medical technology in rural areas,<sup>14,19,25</sup> and suggested that the health service in rural areas requires more social attention.

In addition, the mortality is closely associated with the medical card establishment rate, the examination rate, early examination rate, hospital delivery rate for live birth and high-risk pregnancy, especially the systematic management rate. This suggests that the systematic management and hospital delivery may reveal the risk factors and be helpful

for reducing the morality by early intervention.

By analysing the main causes of maternal death, we noted that postpartum haemorrhage and pregnancy-induced hypertension were the main causes in 1990s, which accounted for 37.76% and 9.18% of the deaths respectively in the year 1998, similar to several reports from developing countries.<sup>2,3</sup> After 13 years of effort, the maternal death due to postpartum haemorrhage and pregnancy-induced hypertension was reduced dramatically. In 2010, most deaths were due to pre-existing medical disease, and only 2 (6.90%) and one (3.45%) deaths were caused by postpartum haemorrhage and pregnancy-induced hypertension in the whole province. Hence, more attention should be paid to pre-existing medical disease in pregnant women in the future.

In summary, our data suggest that the maternal health care services in Zhejiang province were improved during 1998 to 2010. However, potential factors (e.g. health awareness, medical technology, etc.) that may affect the maternal health care utilisation need to be improved.

## Conflict of Interest

There are no competing interests.

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