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Original Article

Changes in the number and causes of maternal deaths after the introduction of pregnancy checkbox on the death certificate in Taiwan

Ching-Yi Lin ^a, Pei-Yin Tsai ^b, Liang-Yi Wang ^c, Ginden Chen ^a, Pao-Lin Kuo ^b, Meng-Chih Lee ^a, Tsung-Hueh Lu ^{c,*}^a Institute of Medicine, Chung-Shan Medical University, Taichung, Taiwan^b Department of Gynecology and Obstetrics, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan^c NCKU Research Center for Health Data and Department of Public Health, College of Medicine, National Cheng Kung University, Tainan, Taiwan

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ABSTRACT

Objective: To examine changes in the number and causes of maternal deaths after the introduction of pregnancy checkbox on the death certificate in January 2014 in Taiwan.**Materials and methods:** We first used the cause-of-death (COD) mortality data for years 2010 through 2017 to examine the number of deaths by item of pregnancy checkbox. We then compared the distribution of the causes of maternal deaths before and after the introduction of pregnancy checkbox.**Results:** Between 2014 and 2017, 111 women died, for whom the certifiers indicated the following in the pregnancy checkbox items: 2 (pregnant at the time of death; $n = 10$), 3 (died within 42 days after the termination of pregnancy; $n = 64$), and 4 (died between 43 days and 1 year after the termination of pregnancy; $n = 37$). However, in only 61 of the 111 deaths, the certifiers reported pregnancy or delivery-related diagnosis in the COD section of the death certificate—5 each for items 2 and 4 and 51 for item 3. The number of maternal deaths was 55 in 2010–2013; this number increased to 82 in 2014–2017. A decline in the percentage of maternal deaths from obstetric hemorrhage was noted from 38% (21/55) in 2010–2013 to 21% (17/82) in 2014–2017.**Conclusion:** The number of maternal deaths increased, and the distribution of causes of maternal deaths changed after the introduction of pregnancy checkbox. Additional studies are required to examine the possible misclassification of pregnancy-associated deaths indicated in the pregnancy checkbox.© 2019 Taiwan Association of Obstetrics & Gynecology. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Underreporting of maternal deaths in government mortality statistics has been a major problem in many countries [1]. According to two record linkage studies in Taiwan, the underreporting of maternal deaths was 65% in 2000–2009 and 57% in 2004–2011 [2,3]. The addition of a pregnancy checkbox on the death certificate has been proposed to solve this problem. The solution was approved by the 43rd World Health Assembly in 1990 and was incorporated into the International Classification of Diseases, Tenth Revision (ICD-10) [4,5]. The pregnancy checkbox has been implemented in more than 30 countries. However, the item wordings vary between countries and between regions within one country

(Fig. 1) [5]. The pregnancy checkbox was added on the death certificate in January 2014 in Taiwan with five items as follows (Fig. 2):

1. Not pregnant within the past year
2. Pregnant at the time of death
3. Died within 42 days after the stop or termination of pregnancy
4. Died between 43 days and 1 year after the stop or termination of pregnancy
5. Unknown if pregnant within the past year

Several studies in the United States have reported the drastic increase in the number of maternal deaths in the states that have adopted the pregnancy checkbox [6–10]. However, no such study has been conducted in other countries. We aimed in this study to examine changes in the number of maternal deaths and distribution of causes of maternal deaths after the introduction of pregnancy checkbox on the death certificate in Taiwan.

* Corresponding author. Department of Public Health, College of Medicine, National Cheng Kung University, No. 1, Dah Hsueh Road, Tainan City, 701, Taiwan.

E-mail address: robertlu@mail.ncku.edu.tw (T.-H. Lu).

(A)

► For women, was the deceased pregnant?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown
<input type="checkbox"/> At time of death	<input type="checkbox"/> Within 42 days before the death		
<input type="checkbox"/> Between 43 days up to 1 year before death	<input type="checkbox"/> Unknown		
Did the pregnancy contribute to the death?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown

(B)

36. IF FEMALE: <input type="checkbox"/> Not pregnant within past year <input type="checkbox"/> Pregnant at time of death <input type="checkbox"/> Not pregnant, but pregnant within 42 days of death <input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death <input type="checkbox"/> Unknown if pregnant within the past year

(C)

38. If a woman has died as a result of complications of pregnancy, indicate if death occurred: <input type="checkbox"/> During pregnancy <input type="checkbox"/> Within 43 days following termination of pregnancy <input type="checkbox"/> Between 43 days and 1 year following termination of pregnancy
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(D)

If deceased was a female, did the death occur: <input type="checkbox"/> during pregnancy (including abortion and ectopic pregnancy) <input type="checkbox"/> within 42 days thereafter <input type="checkbox"/> between 43 days and 1 year thereafter

(E)

13. If a woman, did death occur either during a pregnancy or within 90 days following termination of pregnancy?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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Fig. 1. Different item wordings in the pregnancy checkbox in between countries or between regions within one country: (A) the World Health Organization; (B) the United States; (C) New Nauveau Brunswick, Canada; (D) Ontario, Canada; (E) Alberta, Canada.

Materials and methods

The cause-of-death (COD) mortality data for 2010–2017 were obtained from the Department of Statistics, Ministry of Health and Welfare of Taiwan. We first examined the number of deaths by the pregnancy checkbox items and by whether the certifiers reported

pregnancy or delivery-related diagnosis (such as obstetric embolism or hemorrhage) in the COD section of the death certificate. In some circumstances, the certifier might indicate item 3 (died within 42 days after the stop or termination of pregnancy) but might not mention any pregnancy or delivery-related diagnosis in COD section (Fig. 2).

(十) 懷孕情形(如死者為女性)	<input type="checkbox"/> 於過去一年未懷孕 <input type="checkbox"/> 懷孕中死亡 <input checked="" type="checkbox"/> 懷孕終止或結束之 42 天內死亡 <input type="checkbox"/> 懷孕終止或結束後 43 天至 1 年內死亡 <input type="checkbox"/> 不清楚過去一年是否懷孕		
(十一) 死亡原因：(儘量不要填寫症狀或死亡當時之身體狀況：如心臟衰竭、身體衰弱)		發病至死亡概略時間	
1. 直接引起死亡之疾病或傷害：			
甲、敗血症 Sepsis			2·days
先行原因：(若有引起上述死因之疾病或傷害)			
乙、(甲之原因) 肺炎 Pneumonia			1·week
丙、(乙之原因) 肺腺癌 Adenocarcinoma-of-lung			1·year
丁、(丙之原因)			
2. 其他對於死亡有影響之疾病或身體狀況 (但與引起死亡之疾病或傷害無直接關係者)			

Fig. 2. Example of a recorded pregnancy checkbox and the cause-of-death section of the death certificate in Taiwan.

In the second part of the analysis, we confined to maternal deaths alone. The World Health Organization defines maternal death as “the death of a woman while pregnant or within 42 days after the termination of gestation, irrespective of the duration and site of pregnancy” with ICD-10 codes O00–O95 and O98–O99 [4]. We compared the distribution of causes of maternal deaths before (2010–2013) and after (2014–2017) the introduction of pregnancy checkbox on the death certificate. The causes of maternal deaths were grouped as hypertensive disorder (ICD-10 codes O11–O16), obstetric embolism (ICD-10 codes O88), obstetric hemorrhage (ICD-10 codes O20, O43–O46, O67, O71, and O72), and others according to ICD-10-Maternal Mortality [5]. A chi-square test was used to examine significant difference in the distribution of causes of maternal deaths between 2010–2013 and 2014–2017.

Results

Between 2014 and 2017, 111 women died for whom the certifiers indicated the following in the pregnancy checkbox items: 2 (pregnancy at the time of death; $n = 10$), 3 (died within 42 days after the stop or termination of pregnancy; $n = 64$), and 4 (died between 43 days and 1 year after the stop or termination of pregnancy; $n = 37$). However, in only 61 out of 111 deaths, the certifiers reported pregnancy or delivery-related diagnosis in the COD section of the death certificate—5 each for items 2 and 4 and 51 for item 3. For 50 deaths in which the certifiers did not report pregnancy or delivery-related diagnosis, the two main underlying COD were cancer ($n = 22$) and circulatory diseases ($n = 12$).

We noted 4 and 32 deaths indicated in the pregnancy checkbox as items 1 (no pregnancy within past year) and 5 (unknown if pregnant within the past year), respectively; nevertheless, the

certifiers reported pregnancy or delivery-related diagnosis in the COD section of the death certificate (Table 1).

The number of maternal deaths was 55 in 2010–2013 and it increased to 82 in 2014–2017. A decline in the percentage of maternal deaths from obstetric hemorrhage was noted from 38% (21/55) in 2010–2013 to 21% (17/81) in 2014–2017 (Table 2). An increase in the percentage of other causes from 7% (4/55) to 20% (16/82) was observed. The number of diagnosis coded as ICD-10 O26.9 (pregnancy-related condition, unspecified) was 1 in 2010–2013 and increased to 6 in 2014–2017.

Discussion

The findings of this study indicate that the number of maternal deaths increased, and the distribution of causes of maternal deaths changed after the introduction of pregnancy checkbox in 2014 in Taiwan. However, we also found some incompatibilities between information indicated in the pregnancy checkbox and that in the COD section of the death certificate.

The primary aim to add the pregnancy checkbox was to solve the problem of underreporting of maternal deaths, which used

Table 2
Causes of maternal deaths in Taiwan, 2010–2013 versus 2014–2017.

Causes of maternal deaths	2010–2013		2014–2017		Total	
	No.	%	No.	%	No.	%
Hypertensive disorder	5	9.1	9	11.0	14	10.2
Obstetric embolism	25	45.5	40	48.8	65	47.4
Obstetric hemorrhage	21	38.2	17	20.7	38	27.7
Other causes	4	7.3	16	19.5	20	14.6
Total	55	100.0	82	100.0	137	100.0

Table 1
Causes of death reported by certifiers by the item of pregnancy checkbox in Taiwan, 2014–2017.

Item	Reporting pregnancy or delivery related diagnosis in cause-of-death section		
	Yes	No	Total
1 Not pregnant within past year	4		4
2 Pregnant at time of death	5	5	10
3 Died within 42 days after stop or termination of pregnancy	51	13	64
4 Died between 43 days to one year after stop or termination of pregnancy	5	32	37
5 Unknown if pregnant within the past year	32		32
Total	97	50	147

items 1–3 to remind the certifiers to indicate if the death was maternal or not. The secondary aim (item 4) was to assist the identification of pregnancy-associated death, which was defined by the Centers for Disease Control and Prevention, in collaboration with the Maternal Mortality Special Interest Group of the American College of Obstetricians and Gynecologists (CDC/ACOG) as “a death from any cause during pregnancy or within 1 calendar year of delivery or pregnancy termination, regardless of the duration or anatomical site of the pregnancy” [11,12].

According to information based on the pregnancy checkbox (items 2, 3, and 4) only, we could identify 111 pregnancy-associated deaths between 2014 and 2017. However, if we added the information recorded in the COD section of the death certificate, we could further identify 36 pregnancy-associated deaths (total = 147). However, only 82 of 147 pregnancy-associated deaths agreed with the definition of maternal deaths. Of 65 nonmaternal deaths, 4 were (late maternal deaths), which were defined as “the death of a woman from direct or indirect obstetric causes more than 42 days but less than 1 year after the termination of pregnancy” with the ICD-10 code O96 [4,7]. Of 65 nonmaternal deaths, 61 were dead from nonobstetric-related causes, such as cancer, circulatory diseases, systematic lupus erythematosus, or external causes (motor vehicle crashes or suicide). Many of these deaths were preventable, and some preventive programs should be designed.

The findings of this study also indicate some incompatibilities between information indicated in the pregnancy checkbox and those in the COD section: 4 and 32 deaths were indicated in the pregnancy checkbox as items 1 (no pregnancy within the past year) and 5 (unknown if pregnant within the past year), respectively; nevertheless, the certifiers still reported specific pregnancy or delivery-related diagnosis in the COD section of the death certificate. We asked the officers of the Department of Statistics of Ministry of Health and Welfare and told that two electronic death registration systems were operated in Taiwan: one for natural deaths occurring in medical settings and one for unnatural deaths (i.e., accidents, suicide, homicide, or intent undetermined) or suspect unnatural deaths maintained by the Ministry of Justice, which were examined by prosecutors and medical examiners (or coroners). The pregnancy checkbox questions were not added in the electronic registration system in the Ministry of Justice. All deaths submitted from the Ministry of Justice system to the Ministry of Health and Welfare were automatically been classified as item 5 in the final combined registration system. We suggested abolishing this default programing function and leaving the item blank to avoid this incompatibility problem.

MacDorman and Declercq reminded that the number of maternal deaths was over-reported in some states adopting the pregnancy checkbox [13]. The authors cited a report from maternal mortality review committees in four states and found that 15% (97/650) of reported maternal deaths were not maternal deaths at all [14]. They further pointed out that the United States coding rules code every death with the pregnancy or postpartum checkbox checked to maternal causes, regardless of what is written in the COD section [13]. In Taiwan, if no pregnancy or delivery-related diagnosis was recorded in the COD section of the death certificate, the death was not to be defined as maternal death. However, according to the ICD-10 special instructions on maternal mortality (Step M4): “if pregnancy, childbirth, or puerperium is reported anywhere on the certificate but is not clearly stated that pregnancy, childbirth, or puerperium contributed to the death, first contact the certifier and ask for additional information” [4, p107]. We recommend that the Department of Statistics, Ministry of Health and Welfare of Taiwan should query 50 deaths where the certifiers indicated items 2, 3, and 4 in the pregnancy checkbox yet did not report pregnancy or delivery-related diagnosis in the COD section of the death certificate to clarify the role of pregnancy contributing to death.

This study has several limitations. First, we did not link to other gold standard datasets such as hospital medical records; therefore, we could not determine if the misclassification of maternal deaths was based on the information indicated in the pregnancy checkbox. Second, the increase in the number of maternal deaths in 2014–2017 are not completely attribute to the addition of pregnancy checkbox because a birth-related no fault compensation program was introduced in 2012 and onward, which might also have some effects on the reporting of maternal deaths [15].

In conclusion, the number of maternal deaths increased, and the distribution of the causes of maternal deaths changed after the introduction of pregnancy checkbox. The government should query the certifiers to clarify the contribution of pregnancy to death. Additional studies examining the possible misclassification of pregnancy-associated deaths indicated in the pregnancy checkbox are required.

Conflicts of interest

The authors have no conflicts of interest to disclose.

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