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Causes of Non-maternal Mortality in Taiwan

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This study identifies the major causes of non-maternal mortality in Taiwan. The study findings may enhance current information regarding non-maternal mortality and have important implications for future legislation.

Key words: Taiwan; non-maternal death; pregnancy-related mortality; information

Introduction

Pregnancy-related deaths include both maternal and non-maternal deaths. Maternal mortality is the result of causes directly related to pregnancy. A non-maternal death, non-obstetric or unrelated death is defined as a death which occurs during pregnancy or within 42 days following the termination of pregnancy but is considered to be unrelated to pregnancy (e.g., due to injury, suicide, homicide, or malignancy) or its management (Syverson et al. 1991:603-608; Public Health Reports 1988:464-471; Rochat 1981:2-13; Koonin, Atrash and Rochat 1988:91-97). No epidemiological or clinical evidence is yet available of an increased risk of non-maternal mortality among pregnant women (Rochat et al. 1988:91-97; Walters 1989:615-616). In this study, the term "non-maternal death" is used instead of "non-obstetric death", "non-related", or "unrelated death".

Non-maternal deaths are not classified in the ninth revision of the International Classification of Disease (ICD-9) (DHHS 1989). Therefore, they are not reported through official vital statistics system or published with a nation's mortality data (Rochat 1981:2-13). Pregnancy-related mortality from "accidental and incidental" causes has historically been excluded from the definition of maternal mortality. That is, the definition of maternal death excludes accidental and incidental causes, while pregnancy-related death includes them. These definitions remain unchanged from the ICD-9 (DHHS 1989; Fortney 1990: 246-248). In addition, most maternal mortality studies do not include non-maternal deaths. However, as Rochat and associates (Rochat et al. 1981) suggest, maternal mortality studies should compare mortality from maternal with that from non-maternal causes whenever possible. This study identifies the major causes and examines the socio-demographic correlates of non-maternal mortality in Taiwan during the study period.

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Methods

The study determined which Taiwan women aged 10 to 49 had died in the study period regardless of the causes of death entered on the death certificate. Hence, we made copies of the death certificate of all females aged 10 to 49 who died in Taiwan during 1984-88. Family members of those deceased women were interviewed by public health nurses and midwives of local health stations, who received

pre-interview training to ensure the reliability, consistency, and stability of the interviews. Data collection began annually in July to accumulate the data from the previous year.

A questionnaire protocol including the death certificate was used by the interviewers. Completed questionnaires were examined by the head public-health nurses of local health stations before being sent to the up-level county or city health bureaus in which nursing supervisors were responsible for the second evaluation of the questionnaires. The researchers screened all the questionnaires of female deaths accumulated from county and city health bureaus. The screened pregnancy-related deaths were then reviewed and evaluated by senior obstetricians-gynecologists using a clinically oriented classification scheme, ICD-9-CM (Clinical Modification) (DHHS 1989). In the absence of interview-based or other additional information, the cause of death was taken from the death certificate.

SAS USAGE software was used for data analysis. The Chi-square analysis (the χ^2-test) was employed to examine the socio-demographic correlates of non-maternal mortality.

Results

There were 27,171 deaths in women aged 10-49 years during 1984-88 in Taiwan. Successful interviews were obtained from family members of 22,121 cases. Interviews on 5,050 deaths were not completed due to the family members' migration, rejection or failure to be contacted after three attempts. The average five-year interview rate was 81.4 percent. Of the 22,121 cases whose family members were interviewed, 520 were known to have died during pregnancy or within 42 days postpartum during the study period.

From the screened 520 pregnancy-related deaths, 274 were clinically reviewed and classified by the obstetricians-gynecologists as due to maternal causes and the other 246 as non-maternally related.

Causes of Death by ICD Codes

Table 1 lists the five-year distribution of the causes of non-maternal mortality. All deaths were attributed to one of the causes listed. The causes of non-maternal mortality were taken from the death certificates' original classifications based on the ICD-9. To simplify the presentation and ensure adequate numbers in each cell of Chi-square analysis, some categories were grouped together. Of the 246 non-maternal deaths identified by this study, 95 deaths (38.6 percent) were classified as ICD 001-799 and E960-E989 (diseases and others), 63 (25.6 percent) as ICD E810-E825 (motor vehicle accidents), 42 (17.1 percent) as ICD E858-E949 (other accidents), and 46 (18.7 percent) as ICD E950-E959 (suicide and self-inflicted injury).

Table 1 *Distribution of Causes of Non-maternal Deaths Based on Death Certificates (N=246)*

ICD-9 Code	Cause of Death	No.	PMR*
001-799 E960-E989	**Diseases and Others**	**95**	**38.6**
001-139	Infectious diseases	7	2.8
140-239	Neoplasms	17	6.9
240-289	Endocrine, nutritional and metabolic diseases, and immunity disorders	4	1.6
320-389	Inflammatory diseases of the central nervous system	8	3.3
390-459	Diseases of the circulatory system	17	6.9
460-519	Diseases of the respiratory system	7	2.8
520-579	Diseases of the digestive system	12	4.9
580-629	Diseases of the genitourinary system	5	2.0
710-719	Arthropathies and related disorders	1	0.4
798-799	Sudden death, other ill-defined and unknown causes	13	5.3
E960-E989	Homicide and injury purposely inflicted by other persons	4	1.6
E810-E825	**Motor Vehicle Accidents**	**63**	**25.6**
E812	Other motor vehicle traffic accidents involving collision with another motor vehicle	10	4.1
E815	Other motor vehicle traffic accidents involving collision on the highway	1	0.4
E817	Non-collision motor vehicle traffic accidents while boarding or alighting	2	0.8
E818	Other non-collision motor vehicle traffic accidents	1	0.4
E819	Motor vehicle traffic accidents of unspecified nature	47	19.1
E823	Other motor vehicle non-traffic accidents involving collision with stationary object	2	0.8
E858-E949	**Other Accidents**	**42**	**17.1**
E858-E869	Accidental poisoning by other drugs, alcohol, gas, agricultural and horticultural chemical and pharmaceutical preparations	15	6.1
E880-E899	Accidents by falls and fire	7	2.8
E910-E949	Accidental drowning and submersion; other accidents	20	8.1
E950-E959	**Suicide and Self-inflicted Injury**	**46**	**18.7**
E950	Suicide and self-inflicted poisoning by solid or liquid substances	39	15.9
E951	Suicide and self-inflicted poisoning by gases in domestic use	1	0.4
E953	Suicide and self-inflicted injury by hanging, strangulation and suffocation	6	2.4

PMR Proportionate mortality rate (percentage)*

Diseases and others **(ICD 001-799, E960-E989)**
Of the 95 deaths associated with diseases and others, the four chief causes were neoplasms (ICD 140-239), diseases of the circulatory and digestive systems (ICD 390-459 and ICD 520-579), and sudden deaths, and unknown causes (ICD 798-799). Neoplasms (all malignant) and circulatory diseases were the major causes of death from diseases, each accounting for 17 deaths, and each representing 6.9 percent of the total 246 non-maternal deaths. Sudden deaths and unknown causes accounted for 13 deaths and digestive diseases accounted for 12 deaths, representing 5.3 percent and 4.9 percent of the total 246 non-maternal deaths, respectively.

Motor vehicle accidents **(ICD E810-E825)**
Of the 63 deaths associated with motor vehicle accidents, motor vehicle traffic accidents of unspecific nature (ICD E819) were the most frequent cause of non-maternal deaths among pregnant women investigated, accounting for 47 deaths, representing 19.1 percent of the total 246 non-maternal deaths. Collision with another motor vehicle (ICD E812) accounted for 10 deaths, representing 4.1 percent of all the non-maternal deaths.

Other accidents **(ICD E858-E949)**
Of the 42 deaths associated with other accidents, accidental drowning and submersion (ICD E910-E949) accounted for 20 deaths, representing 8.1 percent of all non-maternal deaths; accidental poisoning (ICD E858-E869) accounted for another 15 deaths, representing 6.1 percent of all non-maternal deaths; and accidents by falls and fire (ICD E880-E899) accounted for another 7 deaths, representing 2.8 percent of the total non-maternal deaths.

Suicide and self-inflicted injury **(ICD E950-E959)**
Suicide by taking a poisoned substance (ICD E950) was the second most significant cause of non-maternal mortality in this study, accounting for 39 deaths and representing 15.9 percent of the total 246 non-maternal deaths.

Suicide by hanging, strangulation and suffocation (ICD E953) accounted for another 6 deaths, representing 2.4 percent of all non-maternal deaths.

Leading Causes and Cause-Specific Mortality Rates
Most of the 246 non-maternal deaths, excluding unrelated diseases, were attributed to unintentional and intentional injuries. Most of the unintentional injuries were due to automotive accidents and other accidents. The other injuries were intentional; most were due to suicide.

Table 2 lists the leading causes and their cause-specific mortality rates of non-maternal deaths. In this study, motor vehicle accidents, suicides, and other accidents were the three most frequently specified causes of non-maternal mortality related to injuries. These three injury-related causes accounted for 61.4 percent of all non-maternal deaths. The remaining cases of non-maternal deaths were attributed to a variety of diseases, unknown causes, and homicides. No significant trends were found in the leading causes of non-maternal mortality in Taiwan during the five-year study period.

As Table 2 illustrates, the five-year cause-specific mortality rate per 100,000 live births was 3.76 for motor accidents; 2.75 for suicides; 2.51 for other accidents; and 5.68 for diseases and others.

Table 2 *Leading Causes and Cause-specific Mortality Rates of Non-maternal Deaths*

Year[n.s]		Motor Accidents	Other Accidents	Suicides	Disease/others	Total
1984	Deaths (%)	11(17.5)	6(14.3)	14(30.4)	25(26.3)	56(22.8)
	CSMR*	2.98	1.63	3.80	6.78	15.18
1985	Deaths (%)	13(20.6)	8(19.1)	9(19.6)	13(13.7)	43(17.5)
	CSMR*	3.79	2.33	2.62	3.79	12.54
1986	Deaths (%)	15(23.8)	8(19.1)	12(26.1)	20(21.1)	55(22.4)
	CSMR*	4.90	2.61	3.92	6.53	17.95
1987	Deaths (%)	11(17.5)	11(26.2)	6(13.0)	21(22.1)	49(19.9)
	CSMR*	3.51	3.51	1.92	6.70	15.64
1988	Deaths (%)	13(20.6)	9(21.4)	5(10.9)	16(16.8)	43(17.5)
	CSMR*	3.80	2.63	1.46	4.68	12.56
Total Deaths (%)		**63(25.6)**	**42(17.1)**	**46(18.7)**	**95(38.6)**	**246(100.0)**
	CSMR*	**3.76**	**2.51**	**2.75**	**5.68**	**14.70**

[n.s]*Non-significant*
**Cause-specific mortality rate per 100,000 live births; Total live births for 1984-88 = 1,673,608 (statistics adopted from DHEY 1994)*

Table 3 *Leading Causes of Non-maternal Mortality by Socio-demographic Characteristics*

Socio-demographic Characteristics	Motor Accidents Deaths (%)	Other Accidents Deaths (%)	Suicides Deaths (%)	Disease/Others Deaths (%)	Total Deaths (%)
Urbanization $^{n.s}$	**63**	**42**	**46**	**95**	**246**
Municipal City	8 (12.7)	6 (14.3)	2 (4.4)	13 (13.7)	29 (11.8)
County/City	11 (17.5)	6 (14.3)	8 (17.4)	26 (27.4)	51 (20.7)
Urban Township	16 (25.4)	9 (21.4)	9 (19.6)	15 (15.8)	49 (19.9)
Rural Township	28 (44.4)	21 (50.0)	27 (58.7)	41 (43.2)	117 (47.6)
Age***	**63**	**42**	**46**	**95**	**246**
Under 20	4 (6.4)	2 (4.8)	8 (17.4)	1 (1.1)	15 (6.1)
20-24	23 (36.5)	23 (54.8)	19 (41.3)	25 (26.3)	90 (36.6)
25-29	27 (42.9)	12 (28.6)	16 (34.8)	44 (46.3)	99 (40.2)
30 and Older	9 (14.3)	5 (11.9)	3 (6.5)	25 (26.3)	42 (17.1)
Marital Status$^{n.s}$	**63**	**42**	**46**	**95**	**246**
Married	56 (88.9)	36 (85.7)	37 (80.4)	83 (87.4)	212 (86.2)
Non-married	7 (11.1)	6 (14.3)	9 (19.6)	12 (12.6)	34 (13.8)
Marriage Age*	**58**	**33**	**37**	**83**	**211**
Under 20	14 (24.1)	8 (24.2)	15 (40.5)	10 (12.1)	47 (22.3)
20-24	33 (56.9)	19 (57.6)	16 (43.2)	46 (55.4)	114 (54.0)
25 and Older	11 (19.0)	6 (18.2)	6 (16.2)	27 (32.5)	50 (23.7)
Occupation$^{n.s}$	**63**	**42**	**46**	**95**	**246**
Unemployed	32 (50.8)	26 (61.9)	29 (63.0)	54 (56.8)	141 (57.3)
Employed	31 (49.2)	16 (38.1)	17 (37.0)	41 (43.2)	105 (42.7)
Years of Education*	**63**	**42**	**46**	**95**	**246**
0-6	20 (31.8)	10 (23.8)	21 (45.7)	34 (35.8)	85 (34.6)
7-9	27 (42.9)	15 (35.7)	18 (39.1)	26 (27.4)	86 (35.0)
10 and More	16 (25.4)	17 (40.5)	7 (15.2)	35 (36.8)	75 (30.5)
Place of Death*	**63**	**42**	**45**	**94**	**244**
Government Hospital	7 (11.1)	5 (11.9)	3 (6.7)	19 (20.2)	34 (13.9)
Private Hospital/Clinic	25 (39.7)	14 (33.3)	12 (26.7)	38 (40.4)	89 (36.5)
Home/Others	31 (49.2)	23 (54.8)	30 (66.7)	37 (39.4)	121 (49.6)

$^{*}p<0.05\ (\chi^2)$; $^{***}p<0.001\ (\chi^2)$; $^{n.s}$Non-significant

This study examines the indicators among socio-demographic characteristics and places of death to determine their association with the leading causes of non-maternal mortality. Table 3 lists the leading causes of non-maternal mortality during the study period by socio-demographic characteristics and place of death. Women at the lowest level of urbanization (rural townships) had a somewhat (but not significantly) higher percentage of deaths from suicide than those at other levels of urbanization. Suicides were significantly higher in percentage among young women and women who married young (under 20), and those with low level of education.

The percentage of suicides was slightly higher among nonmarried women (including unmarried, single, divorced, separated, and widowed women); however, the difference was insignificant. Women who died of diseases and other causes were more likely to have hospitals or clinics as places of death (more than 60 percent), whereas most (half or more than half) of the other three leading causes occurred at home or other places.

Discussion

1. Distinction between Maternal and Non-maternal Deaths

The distinction between maternal deaths and non-maternal deaths is difficult to make with certainty. Some deaths from external causes may actually be attributable to the pregnancy itself. An example in the study by Fortney and associates (Fortney et al. 1986:134-138) illustrates the case of a young, unmarried woman who was murdered by her family, who preferred this drastic measure to the shame of a premarital pregnancy. It is likely that many homicides, and probably most suicides of pregnant or recently-pregnant women are in some way related to the pregnancy.

Accidents might also be considered in this light (Fortney 1990:246-248). Other situations proposed by Dorfman (Dorfman 1990:317-323) also demonstrate the increasing difficulty in distinguishing maternal from non-maternal deaths.

> "What if homicide cases were perpetrated by jealous lovers, or a drug-crazed thief looking for an easy hit? What if a bathtub electrocution occurred because advanced pregnancy threw the woman off her balance?
>
> What if postpartum depression pushed the suicidal woman over the brink?
>
> Are these pregnancy-related deaths?"

In some cases, the study had difficulty in defining a death as maternal or non-maternal either because of lack of available information, or because of an uncertainty in the pathogenesis of the factors leading to the maternal deaths. In these uncertain cases, this study adopted the position of favoring non-maternal cause of mortality over maternal cause in order not to favorably affect the maternal mortality. Restated, when there was either more than one possible cause of death or insufficient evidence on the basis of available information, priority was given to non-maternal causes.

2. Intentional and Unintentional Injuries

Deaths from injury accounted for most of the non-maternal deaths. In the United States, intentional and unintentional injuries are a leading cause of death among reproductive-age women (Rochat et al. 1988:91-97; Centers for Disease Control 1986:118; Koonin, Atrash and Lawson 1991; Sachs et al. 1987:667-672; Varner 1989:555-562).

The findings of this study correspond with the reports that motor vehicle accidents, other accidents and suicides were the leading causes of non-maternal deaths (Table 1). Deaths from injury considered in this study accounted for more than 60 percent of all the 246 non-maternal deaths (Table 2).

Trauma remains a persistent cause of preventable non-maternal deaths in Taiwan which reveals the necessity of continued public education as well as legislation for mandatory safety restraints on automobiles. This also suggests that considerable room for improvement exists in the field of education of patients, and of health care professionals who routinely care for patients with complicated obstetric problems (Varner 1989:555-562).

3. Suicides

Overall, approximately one-fifth of the total 246 non-maternal deaths were attributed to suicides: these were reported and classified on the death certificates as non-maternal deaths during the five-year study period (Table 2). We believe that non-maternal deaths from suicides were substantially under-reported. Based on the results of the interviews, at least 9 additional suicide cases were misclassified according to the original ICD codes: 7 deaths as "other accidents" and 2 deaths as "diseases or others". That is, at least 55 (22.4 percent) women died from suicide rather than the official 46 (18.7 percent) during the five-year study period. Thus, the study estimates that the official reports by death certificates detected no more than 80 percent of the deaths {[1-(9/46)]*100 percent} of pregnant women dying from suicide. This is based only on confirmed cases and is probably a minimal estimate. We also suspect that pregnancy status may be determined for women dying from suicide but the information is not shared in official reports.

Suicide is alarmingly the second most common traumatic cause of non-maternal deaths. In addition to the physical stress, the emotional, social and financial pressures of pregnancy, particularly an unplanned or unwanted one, must always be acknowledged (Varner 1989:555-562; Alauddin 1986:13-21).

Some of the suicides were considered preventable because health care providers had failed to appreciate significant preceding psychiatric disorders.

4. Other Accidents

Injuries from other accidents were the third leading cause of the non-maternal deaths among pregnant women investigated during the five-year study period (Table 2). The study suspects that non-maternal deaths under this classification were considerably overreported. Quite surprising was the frequency of deaths among pregnant women from "accidents" such as falls, drowning

(submersion), and poisoning. Many social, cultural, religious, emotional or practical reasons account for not classifying deaths as suicides. Women who commit suicide may often have their deaths classified as "accidents" to avoid embarrassing the surviving family or for other traditional Chinese reasons. The extent of this type of underreporting can be considerable.

5. Motor Vehicle Accidents

Injuries from motor vehicle accidents were the most frequent cause of non-maternal mortality among pregnant women investigated (Table 2). This certainly allows re-emphasis of the often heard prescriptions against driving without seatbelts and driving when intoxicated. In addition, the three-point harness allows for dissipation of crash energy over the chest wall and pelvis (Kemmerer 1987:574-575). All motor-vehicle occupants, especially pregnant women, should always wear three-point restraints.

Based on the study by Varner (1989:555-562), the documented number of motor vehicle accident deaths during the study period represents only a small fraction of the actual total, because in Taiwan motor vehicle accident deaths are the most common cause of deaths among women of reproductive age (DHEY 1994).

6. Diseases and Others

Of the approximately two-fifths of non-maternal deaths resulting from diseases and others, the major cause was malignant neoplasms which are thought to be related only temporarily to pregnancy.

Specific malignant diseases represent many of those commonly found in women of reproductive age (DHEY 1994). The remaining deaths resulted from diseases of the circulatory and digestive systems, and various other diseases or disorders (Table 1).

7. The Role of Care Providers

Obstetric care providers have a unique responsibility and opportunity to prevent deaths resulting from personal, social and behavioral factors through counseling and health education. Simple measures such as recommending seatbelts for pregnant women have been reported to have reduced maternal injuries and deaths from vehicle accidents. Detection of battering during pregnancy and early counseling of those women who are battered may also contribute to prevention of deaths from such causes (Rochat et al. 1988:91-97).

In conclusion, the approach of systematically identifying cases of non-maternal mortality adapted in this study is the first of its kind in the health history of Taiwan. Its findings and suggestions may have important implications for future legislation in Taiwan.

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