# Unintentional Drowning Deaths in Thailand : 2000-2009

# การจมน้ำตายในประเทศไทยปี พ.ศ. 2543-2552

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## ABSTRACT

Our study describes the pattern of unintentional drowning deaths and identifies the factors associated with drowning deaths in Thailand from 2000 to 2009. Reported death data were obtained from the Bureau of Health Policy and Strategy, Thai Ministry of Public Health. Drowning death rates separated by year, Public Health Area (PHA), gender, and age group were calculated. Poisson regression models were used to identify the factors associated with drowning deaths. During the period from 2000-2009, 40,604 deaths were reported. Of these, 30,610 (75%) were males. The overall drowning death rate per 100,000 population was 6.3. The highest death rate was in aged 0-4 years. Drowning death rates peaked in 2006. Gender, age group, Public Health Area (PHA), and year were associated with the drowning death rate.

## บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษารูปแบบการเสียชีวิตจากอุบัติเหตุจมน้ำและปัจจัยที่มีความสัมพันธ์กับการจมน้ำในช่วงปี พ.ศ. 2543-2552 ข้อมูลการจมน้ำตายจำแนกตาม ปี เขตสาธารณสุข เพศ และกลุ่มอายุ ได้รับจากสำนักนโยบายและยุทธศาสตร์ กระทรวงสาธารณสุข โดยใช้แบบจำลองการถดถอยปัวส์ซองในการระบุปัจจัยที่มีความสัมพันธ์กับการจมน้ำตาย ผลการศึกษาพบว่า การจมน้ำตายในช่วงเวลาดังกล่าว จำนวน 40,604 คน พบว่าผู้เสียชีวิตเป็นเพศชาย 30,610 คน (75 %) อัตราการจมน้ำตายโดยรวมต่อประชากร 100,000 คน เท่ากับ 6.3 กลุ่มอายุ 0-4 ปี มีอัตราการจมน้ำตายสูงสุด อัตราการจมน้ำตายพบสูงสุดในปี พ.ศ. 2549 เพศ กลุ่มอายุ เขตสาธารณสุข และปีมีความสัมพันธ์กับอัตราการจมน้ำตาย

**Key Words:** Drowning, Public Health Area, Thailand

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## Introduction

Drowning is a common cause of unintentional injury death. In 2004, an estimated 388,000 people died from drowning with 6.2 per 100,000 population, accounting for 7% of all injury related deaths (WHO, 2010a). Most drowning deaths (about 97%) occur in low- and middle-income countries, especially in the African, Western Pacific, and Southeast Asia regions (International Life Saving Federation, 2007). Drowning affects all age groups but globally more than half of all deaths occur among children aged less than 15 years (Peden et al, 2002; Fang et al, 2007a; Rahman et al, 2009).

A study of drowning deaths in 69 countries reported that Thailand is among the first five leading countries in drowning death rates (Lu et al, 2010). Drowning was the fifth leading cause of deaths from injuries for all age groups (Bureau of Non Communicable Disease, 2008). In 2009, 4,090 reported drowning deaths accounted for 6.4 deaths per 100,000 population (Bureau of Policy and Strategy, 2009). Two-thirds of drowning deaths occurred in ages less than 15 years old (Plitponkarnpim et al, 1999a). Drowning deaths in Thailand mostly occur in natural water bodies such as rivers, ponds, ditches, and lakes (Laosee et al, 2007a).

Previous studies (Fang et al, 2007b; Laosee et al, 2007b; Ma et al, 2010) have focused on drowning among children aged less than 15 years due to this group having the highest risk of drowning death. However, there are few studies in Thailand that have considered drowning deaths in all age groups. The study of drowning deaths in all age groups may provide more significant information of drowning deaths. The findings of this study will assist in better understanding of drowning trends and provide useful information for health planning to reduce drowning deaths in Thailand. The aim of this paper was to analyze the patterns of drowning death rates in Thailand and identify the factors associated with drowning deaths in 2000-2009 in Thailand.

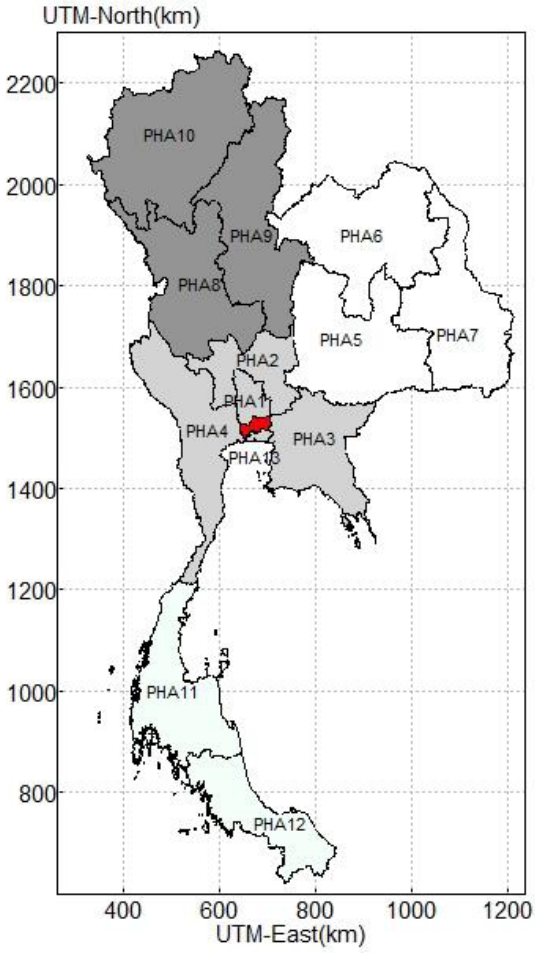


**Figure 1** Public Health Area (PHA) map of Thailand.

## Materials and methods

### Data sources

Drowning deaths based on death certificates in the years 2000-2009 were obtained from the Bureau of Health Policy and Strategy, Thai Ministry of Public Health. Only accidental drowning and submersion with codes W65-W74 using the ICD-10 were selected.

Projected populations at risk by gender, age group, year and province were obtained from the Institute of Population Studies at Mahidol University.

The determinants of this study are year, Public Health Area (PHA), gender, and age group. In Thailand, PHA was classified into 13 areas. Each PHA consists of approximately five to seven provinces except PHA13 (Bangkok) as shown in Figure 1. PHA 1-4 are in Central, PHA 5-7 are in Northeast, PHA 8-10 are in North, PHA 11-12 are in South regions and PHA 13 is Bangkok. Age was divided into six groups: 0-4, 5-14, 15-29, 30-44, 45-49, and 60 and older. The outcome is the drowning death rate (deaths per 100,000 population).

**Statistical model**

The number of deaths ($\lambda_{ijt}$) per 100,000 population ($P_{ijt}$) by PHA (i) (i=1, 2, 3,…, 13), gender-age group (j) (j=11,…, 16, 21,…, 26) and year (t) (t=2000, 2001, 2002,…, 2009) were modeled using the Poisson generalized linear model. This gave the following model as shown in Eq. 1.

$$\lambda_{ijt} = P_{ijt} \exp(\alpha_i + \beta_j + \gamma_t)$$

Where $\alpha_i$ is the PHA specific parameter, $\beta_j$ is the gender-age group parameter, and $\gamma_t$ is the year parameter. Sum contrasts (Venables and Ripley, 2002; Tongkumchum and McNeil, 2009) were used to provide 95% confidence intervals for each level of each factor enabling comparison with the overall mean. The 95% confidence interval of drowning death rates was produced based on the model results. (Odton et al, 2010). All statistical modeling and graphical displays were performed using R statistical software (R Development Core Team, 2010).

**Table 1** Unintentional drowning deaths 2000-2009: distributes by age group, gender, PHA, and year.

| Factors | Cases | % of deaths | Rate/100,000 population |
|---|---|---|---|
| Age group | | | |
| 0-4 | 5,181 | 12.8 | 10.9 |
| 5-14 | 8,655 | 21.3 | 8.6 |
| 15-29 | 6,159 | 15.2 | 3.8 |
| 30-44 | 8,586 | 21.1 | 5.3 |
| 45-59 | 6,517 | 16.1 | 6.0 |
| 60+ | 5,506 | 13.6 | 8.2 |
| Gender | | | |
| Male | 30,610 | 75.4 | 9.6 |
| Female | 9,994 | 24.6 | 3.0 |
| PHA | | | |
| PHA1 | 2,394 | 5.9 | 6.1 |
| PHA2 | 2,724 | 6.7 | 8.8 |
| PHA3 | 3,345 | 8.2 | 8.2 |
| PHA4 | 2,792 | 6.9 | 6.7 |
| PHA5 | 5,768 | 14.2 | 7.3 |
| PHA6 | 4,526 | 11.1 | 6.0 |
| PHA7 | 4,419 | 10.9 | 6.6 |
| PHA8 | 2,657 | 6.5 | 8.1 |
| PHA9 | 2,997 | 7.4 | 7.7 |
| PHA10 | 2,944 | 7.3 | 6.2 |
| PHA11 | 2,023 | 5.0 | 4.9 |
| PHA12 | 1,827 | 4.5 | 3.9 |
| PHA13 | 2,188 | 5.4 | 3.3 |
| Year | | | |
| 2000 | 3,749 | 9.2 | 6.0 |
| 2001 | 3,806 | 9.4 | 6.1 |
| 2002 | 3,975 | 9.8 | 6.3 |
| 2003 | 3,888 | 9.6 | 6.1 |
| 2004 | 3,881 | 9.6 | 6.0 |
| 2005 | 4,416 | 10.9 | 6.8 |
| 2006 | 4,635 | 11.4 | 7.1 |
| 2007 | 4,097 | 10.1 | 6.2 |
| 2008 | 4,064 | 10.0 | 6.1 |
| 2009 | 4,093 | 10.1 | 6.1 |

## Results

During the study period, the total number of reported drowning deaths was 40,604. Of these, 30,610 (75.4%) were males and 9,994 (24.6%) were females. The overall death rate per 100,000 population was 6.3. Males had a drowning death rate three times higher than in females. The age group 0-4 years had the highest drowning death rate. The highest drowning death rate was found in PHA2, followed by PHA3 and PHA8, respectively. The drowning death rate had a peak in the year 2006 (Table 1).

Figure 2 shows the trend of drowning death rates by age group in Thailand. Drowning death rates in males were consistently higher than those in females across all age groups. Thailand had a peak of drowning deaths in aged 0-4 years. A decreasing trend from age 0-4 to 15-29 years was found in both sexes and a slightly increasing trend for both sexes occurred until aged 60 years and over.

Figure 3 shows drowning death rates by year and gender. Males had slightly increased trend of drowning death rate with a peak in year 2006 whereas a slightly decreasing trend appeared in females. Males had drowning death three times higher than females.

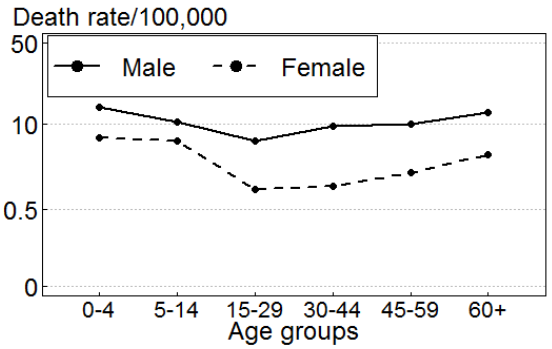


**Figure 2** Trends in drowning death rates in Thailand (per 100,000 population) by age group.

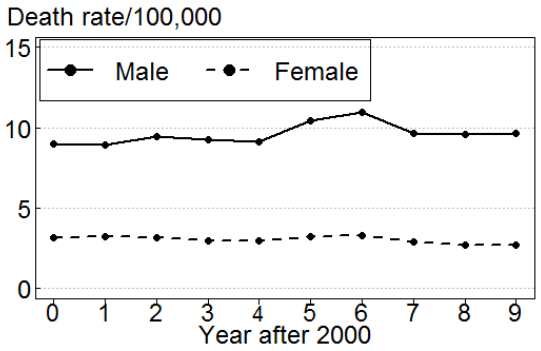


**Figure 3** Annual drowning death rates (per 100,000 population) by age group

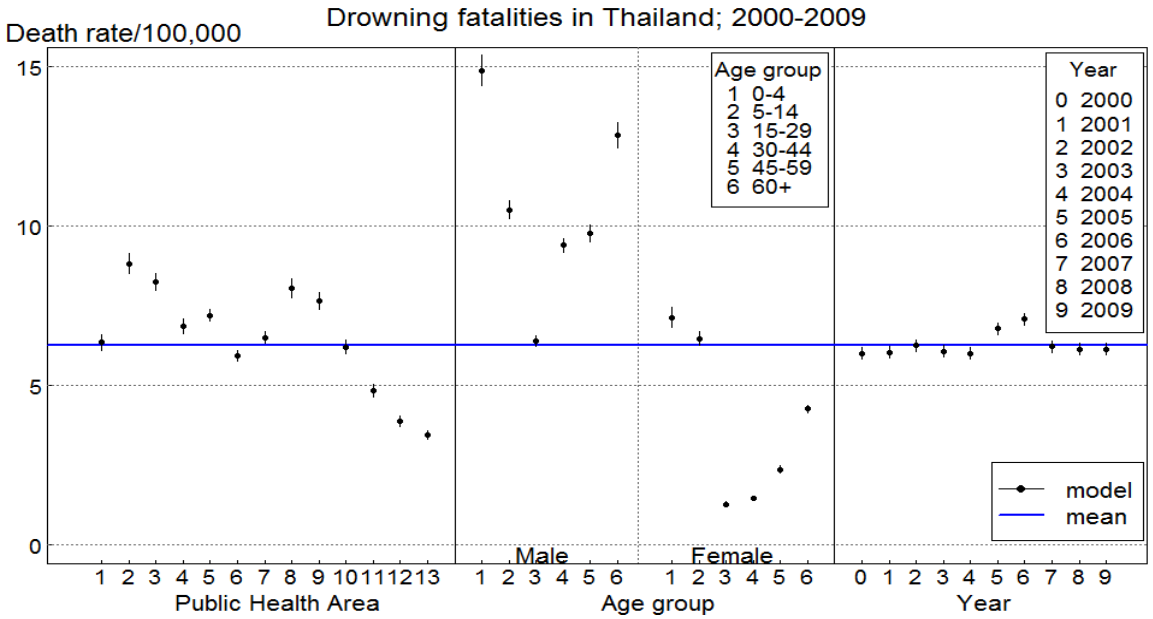


**Figure 4** 95% Confidence intervals plot of drowning death rate per 100,000 population during the period 2000-2009.

Figure 4 shows the confidence intervals of drowning death rates from log linear model based on the Poisson distribution. The results showed that the average drowning death rate per 100,000 population was 6.3. Gender-age group, PHA, and year were associated with drowning death. Males aged 0-4 years (rate=14.9, 95%CI=14.4-15.4) had the highest drowning death rate while females aged 15-29 years (rate=1.3, 95%CI=1.2-1.4) had lowest drowning death rate. Males in age groups 0-4 (rate=14.9, 95%CI=14.4-15.4), 5-14 (rate=10.5, 95%CI=10.2-10.8), 30-44 (rate=9.4, 95%CI=9.2-9.6), 45-59 (rate=9.8, 95%CI= 9.5-10.0), and 60+ (rate=12.8, 95%CI= 12.4-13.2) years, and females in age group 0-4 years (rate=7.1, 95%CI=6.8-7.5), had higher drowning death rates than average rate whereas females aged 15+ had lower death rate than average rate.

Drowning death rate in PHA13 (rate=3.3, 95%CI=3.3-3.6) was lower than other PHAs. Death rates in PHA2 (rate=8.8, 95%CI=8.5-9.2), PHA3 (rate=8.2, 95%CI=8.0-8.5), PHA4 (rate=6.9, 95%CI=6.6-7.1), PHA5 (rate=7.2, 95%CI=7.0-7.4), PHA8 (rate=8.1, 95%CI=7.8-8.4), and PHA9 (rate=7.7, 95%CI=7.4-7.9) were higher than average death rate whereas death rates in PHA6 (rate=5.9, 95%CI=5.8-6.1), PHA11 (rate=4.8, 95%CI=4.6-5.0), PHA12 (rate=3.9, 95%CI=3.7-4.1), and PHA13 were lower than average. Drowning death rates in year 2005 (rate=6.8, 95%CI=6.6-7.0) and 2006 (rate=7.1, 95%CI=6.9-7.3) were higher than average.

## Discussion

In the present study, 75.4% of all drowning deaths were males. The overall drowning death rate in Thailand was 6.3. This rate is similar to an estimated global drowning death rate in 2004 of 6.2 (WHO, 2010b). In developed countries, drowning death rate has declined (Lunetta et al, 2004; Nasrullah and Muazzam, 2011) whereas the rate has still increased in developing countries (Ahmed et al, 1999; Laosee et al, 2007; Meel, 2008). An increasing trend in drowning deaths in Thailand was evident in 1987-1996 (Plitponkarnpim et al, 1999). However in this study, the increasing trend was observed only in males.

Males have previously been found to have higher drowning death rates than females in all age groups (Peden and McGee, 2003). Drowning rate was highest in ages less than five years, which is consistent with drowning data from most areas of the world (Ahmed et al, 1999; Nakahara et al, 2004; Yang et al, 2005). Previous studies on drowning deaths in Thailand mainly focused on specific areas (Plitponkarnpim et al, 1999b; Laosee et al, 2007c). Although there are a few studies of drowning deaths for the whole country, they did not analyze the data by PHA (Gerdmongkolgan et al, 2009). In this study, the majority of drowning deaths occurred in the Central (PHA1-PHA4) and North regions (PHA8-PHA10) with above average drowning death rates. The limitation of this study was our use of secondary drowning death data from death certificate, which lacks information about locations of drowning as recorded for less than 1% of the deaths. Thus this factor was not included in the analysis.

## Conclusions

Based on death certificates, drowning accounted for more than 40,000 of all deaths in Thailand from 2000 to 2009. The total number of drowning deaths was more than 3,500 per year and was higher in the Central and the Northern regions of Thailand. Drowning fatality rates were associated with

region, gender and age. A prevention policy for drowning mortality should be targeted at children aged 0-4 years. Drowning prevention programs in the form of active prevention such as water safety guidance for parents, water safety education and swimming lessons for children, and placing warning signs in unsafe zones, should be used to reduce drowning death rates in Thailand.

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