

## RESEARCH ARTICLE

# Differences in Cancer Incidence among Predominantly Muslim and Buddhist Subpopulations in Songkhla

Hutcha Sriplung<sup>1</sup>, Surichai Bilheem<sup>1</sup>, Tirada Kuntipundee<sup>1</sup>, Sarayut Lucian Geater<sup>2</sup>

### Abstract

**Background:** The population of Songkhla, a province in Southern Thailand, can be divided into a predominantly Muslim subpopulation (PMSP, approximately 70% Muslim) and a predominantly Buddhist subpopulation (PBSP, around 14% Muslim). **Objectives:** This study was conducted to 1) describe the incidence of various cancers in both PMSP and PBSP, and 2) compare the incidence of various cancers between the two subpopulations. **Materials and Methods:** Cancer cases diagnosed between 1990 and 2010 were drawn from the database of Songkhla Cancer Registry. Population denominators were estimated from the 3 population censuses surveyed by the National Statistical Office of Thailand in 1990, 2000, and 2010. **Results:** The age-standardized incidence rates (ASR) of the 5 commonest male cancers among both subpopulations were calculated. In females, a lower incidence of cancers of the cervix and breast in PMSP compared to PBSP, with odds ratios of 0.54 (95% CI: 0.45-0.64) and 0.51 (95% CI: 0.43-0.60) respectively, was observed. In males, the incidence of cancers of the lung, liver, colon-rectum, and some other cancers were significantly different between the two populations in the past, but only prostate cancer showed a lower incidence among males in PMSP in recent years. Independent of sex and year of diagnosis, the incidence of lung, liver, NHL, and colorectal cancers was lower in MPSP compared to BPSP, with odds ratios of 0.75 (95% CI: 0.65-0.85), 0.74 (95% CI: 0.62-0.88), 0.74 (95% CI: 0.60-0.91), and 0.67 (95% CI: 0.56-0.78) respectively. **Conclusions:** The differences in incidence of some cancers and religion-related culture between the two subpopulations need 2 sets of cancer-control plans and goals to fit the unique population context in deep Southern Thailand. This plan can be used in the 3 southernmost provinces of Thailand where the percentage of Muslims is over 85%.

**Keywords:** Cancer incidence - Songkhla Thailand - Muslim subpopulation - Buddhist subpopulation - comparison

*Asian Pac J Cancer Prev*, 15 (22), 9979-9983

### Introduction

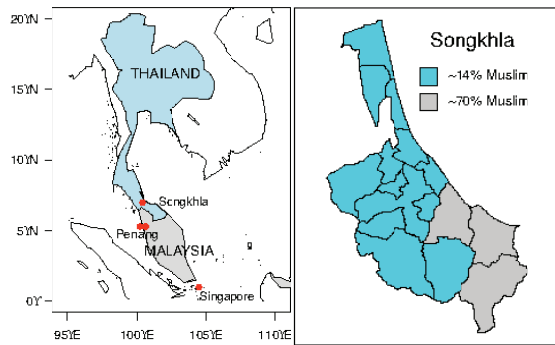
Songkhla is a unique province in Southern Thailand, where approximately 25% of its population is Muslim (National Statistical Office, 2012). The proportion of Muslims in its three southeast districts, namely Chana, Thepha, and Saba Yoi, is around 70%, while it is approximately 14% in the remaining 13 districts of Songkhla (Figure 1).

In countries and areas inhabited by a mixture of Muslims and people of other religious beliefs, Muslim people usually live in clusters composed of members of their own community and have their own life style, i.e., their dietary and cultural practices are different from those of nearby religious communities. Such differences in practice, e.g., the kind and amount of spices in food originating in the Middle East and abstention from alcoholic beverage, may be related to differences in health status, especially cancer incidence, in their population. Such phenomenon is also true in Thailand; however, the

Muslim communities there are not isolated. Close contact among Buddhist and Muslim communities is a fact in the Southern provinces of Thailand. A few studies on the effect of religion on disease prevalence and healthcare system conducted in Southern Thailand have focused on differences in some diseases and health conditions, but, to date, there has been no study on cancer (Golomb, 1985; Baelum et al., 2003; Sengupta et al., 2006; Liabsuetrakul et al., 2009).

To avoid conflict between different ethnic groups in Thailand, the Thai government promoted the idea of a unified Thai nationality and devalued the sense of race and ethnic differences (Chuah, 2010; Laungaramsri 2014). This policy has caused both national unification and conflict at the same time. Even though the majority of Thai Muslims in this area have been able to cope well with the cultural differences between them and the non-Muslim populations, some have failed to. Their resistance has caused difficulties in healthcare services offered to this category of people. This phenomenon is more pronounced

<sup>1</sup>Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Thailand, <sup>2</sup>Department of International Medicine, Faculty of Medicine Prince of Songkla University, Thailand \*For correspondence: [hutcha.s@gmail.com](mailto:hutcha.s@gmail.com), [hutcha.s@psu.ac.th](mailto:hutcha.s@psu.ac.th)



**Figure 1. Maps Showing Location of Cancer Registries of Songkhla, Penang and Singapore**

in the three southernmost provinces of Thailand: Pattani, Yala, and Narathiwat, but less in the three districts of Songkhla, which is close to these three provinces. Thus, access to the healthcare system in Songkhla is good, while it is less so in the three southernmost provinces.

Since no cancer registry exists in the three southernmost provinces of Thailand on the eastern coast of Peninsular Thailand, where the percentage of Muslim population is around 85%, and also Satun, a province on the West (Andaman) Coast with a proportion of Muslims of around 68%, the incidence of cancers in the three districts in Songkhla may provide some clues regarding cancer burden to justify a cancer-control plan for the Muslim-predominated provinces in Southern Thailand. The objectives of this study were to 1) describe the incidence of various cancers in predominantly Muslim subpopulation (PMSP), which comprises the residents of Chana, Thepha, and Saba Yoi districts, and 2) compare their incidence between PMSP and the predominantly Buddhist subpopulation (PBSP), who reside primarily in the remaining districts of Songkhla Province.

**Materials and Methods**

*Recruitment of cancer cases*

Cancer cases diagnosed between 1990 and 2010 were drawn from the database of Songkhla Cancer Registry. The population-based cancer registry of Songkhla is kept at the Faculty of Medicine, Prince of Songkla University. It involved both passive and active case finding from 23 sources of data consisting of 3 hospitals with over 400 beds, community hospitals, private hospitals, special hospitals, the Provincial Health Office, and the Population Registration Office of the province. The completeness of death registrations was acceptable. However, the number of undiagnosed and unregistered cancer cases was difficult to estimate, but was one among registries with expected completeness greater than 95% by capture-recapture method (Suwanrungruang, et al., 2011). A few Muslims from the remote areas of Southeastern Songkhla visited large hospitals in the two nearby provinces, and some of them, especially the elderly, used traditional herbal medicines and never accessed the governmental healthcare system. The situation has been continuously improving since the healthcare reform started in 2002 under the universal coverage scheme of the National Health Security Office, which has led to a much better organized patient registration system and ensured the coverage of essential

cancer treatment. The cancer statistics of the Songkhla Cancer Registry meet international standards and have been regularly published in the series ‘Cancer in Thailand’ by the Thai National Cancer Institute (Vatanasapt et al., 1993; Deerassamee, et al., 1999; Sriplung et al., 2003; Khuhaprema et al., 2007; 2010; 2012; 2013), and ‘Cancer Incidence in Five Continents’ published by the International Agency for Research on Cancer (Parkin et al., 1997; 2002; Curado et al., 2007).

*Population denominators*

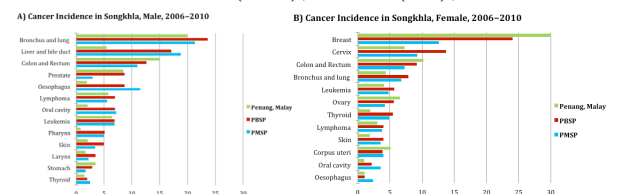
The population denominators used in the calculation of incidence rates were estimated from the 3 population censuses conducted by the Thai National Statistical Office in 1990, 2000, and 2010 (National Statistical Office, 1992; 2002; 2012). The population denominators by both sexes for all districts were readily present in the censuses. Intercensus populations were estimated using the log-linear function between two consecutive censuses.

*Statistical analysis*

Cases and populations were stratified into PMSP and PBSP by district of residence as mentioned above, and the age-standardized incidence rates (ASR) per 10<sup>5</sup> population (Boyle et al., 1991) of various cancers were calculated for the two groups. The population denominators in each calendar year from 1990 to 2010 were estimated from population censuses of 1990, 2000, and 2010 using the log-linear equation for 5-year age group strata. Annual ASRs were analyzed by subpopulation, sex, and year of diagnosis by means of simple linear and Poisson regression models using the R statistical software version 3.0.2 (R Core Team, 2013). The annual ASRs for each particular major cancer in PMSP and PBSP were shown as graphs of cancer trends. ASRs of leading cancers in the last 5-year period, from 2006 to 2010, were calculated and shown via horizontal bar charts for a clear comparison of the incidence in the two subpopulations. The standardized incidence ratio (SIR) and its variance were calculated according to the formula documented by Boyle and Parkin (Boyle et al., 1991).

**Results**

The 5 commonest male cancers among PMSP in the last 5-year period (2006-2010) were cancers of the lung (ASR = 21.3 per 10<sup>5</sup> population), liver (18.8), esophagus (11.5), colon-rectum (11.0), oral cavity (7.2), while those in PBSP were: cancers of the lung (23.6), liver (17.1), colon-rectum (12.6), esophagus (8.7), and prostate (8.7) [Figure 2A]. The top 5 cancers in females in PMSP were those of the breast (12.6), cervix (9.3), colon-rectum



**Figure 2. Age-Standardized Incidence Rates of Common Cancers in PMSP and PBSP with Comparison to that of Penang Malay Population (2004-2007)**

(7.3), lung (6.8), and thyroid (4.9), while, in PBSP, the rank was: breast (24.1), cervix (13.7), colon-rectum (9.2), lung (7.9), and leukemia (5.7) [Figure 2B]. In Figure 2, the incidence rates of cancers in the Penang Malay population (2004-2007) [World Health Organization, 2013], the nearest registry in Malaysia reported in Cancer Incidence in Five Continents volume X, are also given for comparison. Penang is about 200 km south of Songkhla. Muslims constitute 43.6% of the Penang population, while other ethnicities are Chinese (45.6%), Indian (10.4%), and others (0.4%). The Penang Malay population has a large proportion of Muslims, and the incidence of some cancers, such as male liver and oral cancers and female breast, cervical, lung, and thyroid cancers was obviously lower than those of our PMSP and PBSP, while the incidence of colorectal cancer in both sexes was somewhat higher but without statistical significance.

The Poisson regression models revealed a significantly lower incidence of cancers of the cervix and breast in PMSP compared to PBSP with odds ratios of 0.54 (95% CI: 0.45-0.64) and 0.51 (95% CI: 0.43-0.60) respectively, while the incidences of some other cancers were also significantly different as shown in Figure 3. Among males, the incidences of cancers of the lung, liver, colon-rectum, and other cancers, as shown in Figure 3A, were significantly different between the two populations. Independent of sex and year of diagnosis, the incidence

of lung, liver, NHL, and colorectal cancers was lower in PMSP compared to BPSP, with odds ratios of 0.75 (95% CI: 0.65-0.85), 0.74 (95% CI: 0.62-0.88), 0.74 (95% CI: 0.60-0.91), and 0.67 (95% CI: 0.56-0.78), respectively. However, the rate of cancer incidence increase, e.g., that of the liver, in PMSP was higher than that in BPSP and it reached the same rate in the last 5-year period.

In the comparison of rates using the SIR method, we used the incidence in Songkhla (2004-2007) reported in the 'Cancer Incidence in Five Continents Vol. X' as the standard (reference) incidence. The expected rates for PMSP and PBSP in Songkhla, the whole Thailand, Penang Malay, and Singapore Malay populations were plotted for those cancers that showed some difference among the five populations, i.e., cancers of the liver and bile duct (female), lung, prostate, oral (male), breast, cervix and thyroid (female) [Figure 4]. Other cancers without significant difference among the populations of interest were not plotted.

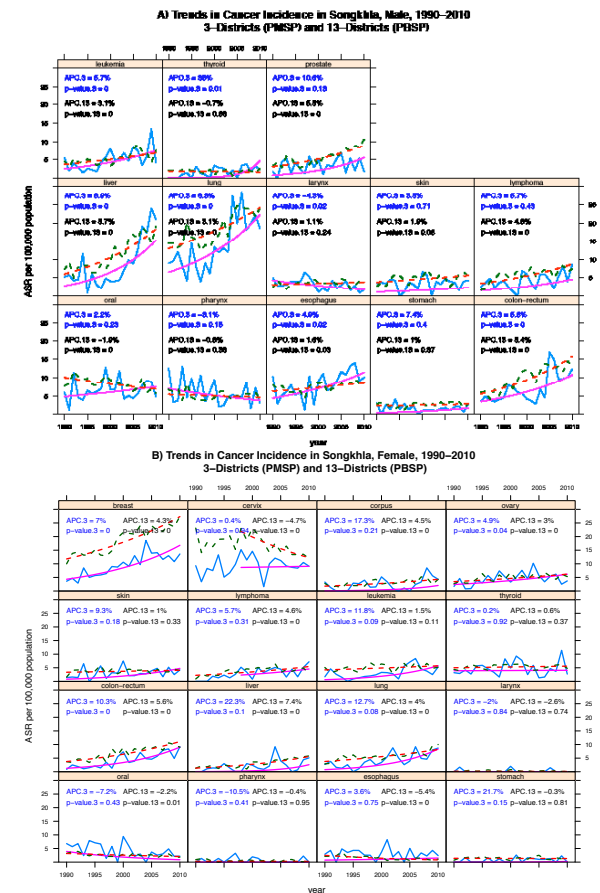


Figure 3. Trends in Age-Standardized Incidence Rates (ASR) of Cancers in Songkhla Among Males (A) and Females (B): Trends of ARS Among PMSP Presented in Solid Lines, Dotted Lines Represent PBSP, and Jagged Lines Represent Actual ASR

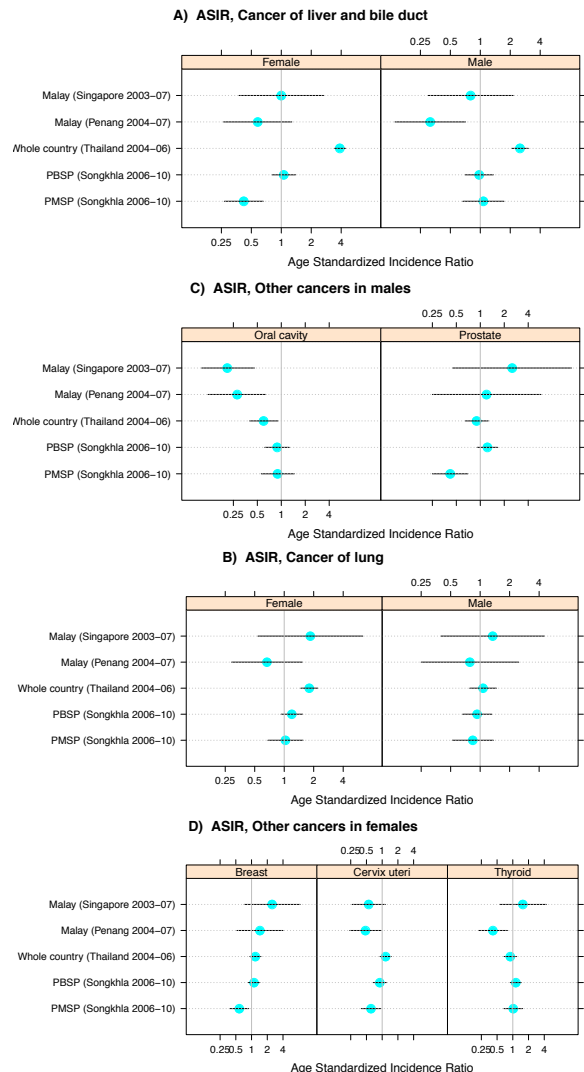


Figure 4. Standardized Incidence Ratios (SIR) and Confidence Intervals of A) Liver and Bile Duct Cancer, B) Lung Cancer, C) other Important Cancers in Males, and D) other Important Cancers in Females. The Reference is the Incidence in Songkhla (2004-2007) Reported in the 'Cancer Incidence in Five Continents Vol. X'

## Discussion

It was found that, in the past, the incidence rates of some cancers in both males and females among PMSP were significantly lower than those of PBSP, but the rate of incidence increase for some cancers was higher in PMSP and caused the ASRs of both populations in the last 5-year period to be similar (Figure 3). The underlying reasons need to be identified. One among the possible explanations may be under-registration among MPSP in the first decade of the registration period. After the 2002 healthcare reform in Thailand, the improvement of healthcare facilities, settlement of the patient referral system, and establishment of the country-wide patient database have led to a better registration of cancer patients in PMSP. Due to the possibility of the improved patient catchment as a result of the registry, the feature of cancers in the last 5-year period, as shown in Figure 2, better explains the true incidence of cancer among PMSP.

Though the time period of cancer incidence among the Penang Malay population is almost 5 years earlier than that of this report, it is the latest official publication available in CI5 vol. X. The higher incidence of cancers of the colon-rectum, stomach, breast, ovary and corpus uteri among the Penang Malay population than that of both MPSP and BPSP points to the trends towards the urbanization of Penang, which is a highly developed province in Malaysia. The lower incidence of tobacco-related cancers in the Penang Malay population such as that of the oral cavity, pharynx, esophagus, and larynx is rather interesting, since a recent report from Malaysia indicated a smoking prevalence of 55.9% among Malay ethnics aged 18 or above (Lim, et al., 2013). However, WHO states that the lowest smoking prevalence in Malaysia is among urban Penang and Sarawak populations (WHO-WEPRO, 2014). A correlation between those cancers and smoking prevalence in the past decades is needed to confirm such an association. The incidence of lung cancer among Singapore Malays was slightly higher than that among PMSP and PBSP in Songkhla (Figure 4), but without statistical significance. The smoking prevalence among Southern Thai males aged 15 years or above in 2008 was reported at 48.2% (National Health Examination Survey, 2009). Unfortunately, data on smoking prevalence in Songkhla in the previous few decades are not available.

Liver cancer was much lower in incidence among the Penang Malay population than our study population. These findings are worth comparing and studying in detail in order to find the underlying reasons for the difference. The reasons behind the lower incidence of female liver cancer among PMSP than that of PBSP are not clear. It should be noted that cholangiocarcinoma (CCA), not hepatocellular carcinoma (HCC), was the major histologic type of female liver cancer in Songkhla. At present, the incidence of CCA outnumbers that of HCC in both sexes and both subpopulations in Songkhla, and the decrease in HCC incidence among young people is evident (unpublished analysis).

The Poisson regression modelling (Figure 3) and SIR (Figure 4) methods resulted in the same conclusion regarding the difference in rates for cancers of the cervix

and female breast among both subpopulations, but the results were different in other cancers. One of the reasons for these differences in sensitivity is the use of long-term data in the regression models, where the SIR method used only a single 5-year period point to compare. Another reason is the convergence of trends in those cancers in the last 5-year period among the two populations, as can be obviously seen in Figure 3A. Thus, the evidence seems to demonstrate that only cervix and female breast cancers were statistically different among PMSP and PBSP, while the incidences of other cancers was different in the far past but converging in the recent years.

It should be noted that oral cancer incidence was high in both subpopulations compared to the Penang and Singapore Malay populations (Figure 4). It is not easy to explain this phenomenon. Malay ethnics and Islam do not seem to be the good explanations. The risk factor(s) for male oral cancer in Songkhla should affect both Buddhists and Muslims at the same degree. The lower incidence of prostate cancer among PMSP than PBSP seemed to be related to the distance to the urban centers of Songkhla, namely Hat Yai Municipality and Songkhla City. Among females, PMSP had lower cancer incidences than PBSP. The phenomenon might be related to the lower degree of awareness and accessibility to screening facilities, which are more prevalent in the urban areas of Hat Yai and Songkhla cities. However, the incidence of cervical cancer was as low as 10 per 10<sup>5</sup> population among Muslim women, i.e., lower than among Buddhist women. Nevertheless, its rate is continuously decreasing due to better awareness and utilization of cervical cancer screening facilities. Thus, the incidence of cervical cancer in both populations will most likely be at the same level in the near future.

In conclusion, in Songkhla, the incidence of some cancers is generally lower among Muslims than Buddhists. The difference in cancer incidence as well as in religion-related culture between the two subpopulations suffices consideration of a specific surveillance and monitoring system and two sets of cancer control plans and goals, especially for cervical cancer, in order for them to fit the unique population context of the deep Southern Thailand.

## Acknowledgements

The authors deeply appreciate the effort of all registrars of the Songkhla Cancer Registry led by Paradee Prechawitayakul and Cheamchit Tassanapitak in maintaining the quality of data collection throughout its operation. Hutcha Sriplung acknowledges the financial support of the National Science and Technology Development Agency (P-10-10307).

## References

- Baelum V, Pisuthanakan S, Teanpaisan R, et al (2003). Periodontal conditions among adults in Southern Thailand. *J Periodontal Res*, **38**, 156-63.
- Boyle P, Parkin DM. (1991) Statistical Methods for Registries. In: Jensen OM, Parkin DM, McLennan R, Moor CS, Skeet RG, eds. Cancer Registration: Principles and Methods. IARC Scientific Publication No 95. Lyon, France, IACR

- Press. pp. 126-158.
- Chuah OA. (2010) Conflicts and Peace Initiatives between Minority Muslims and Thai Buddhists in the Southern Thailand. *J Religion Conflict Peace*. 3(2). [cited 2014 July 16]. Available from: <http://www.religionconflictpeace.org/volume-3-issue-2-spring-2010/conflicts-and-peace-initiatives-between-minority-muslims-and-thai>
- Curado MP, Edwards B, Shin HR, et al, eds. (2007) *Cancer Incidence in Five Continents Vol. IX*. IARC Scientific Publications No 160, Lyon, France. IARC Press.
- Deerassamee S, Martin N, Sontipong S, et al, eds. (1999) *Cancer in Thailand vol. II, 1992-1994*. IARC Technical Report No 34, Lyon, France. IARC Press.
- Forman D, Bray F, Brewster DH, et al, eds. (2014) *Cancer Incidence in Five Continents Vol. X*. IARC Scientific Publications No 164, Lyon, France. IARC Press.
- Golomb L. (1985) Curing and sociocultural separatism in South Thailand. *Soc Sci Med*. 21(4): 463-468.
- Khuhaprema T, Attasara P, Sriplung H, Wiangnon S, Sangrajrang S, eds. (2013) *Cancer in Thailand Vol. VII, 2007-2009*. Bangkok, Thailand: National Cancer Institute.
- Khuhaprema T, Attasara P, Sriplung H, Wiangnon S, Sumitsawan Y, Sangrajrang S, eds. (2012) *Cancer in Thailand Vol. VI, 2004-2006*. Bangkok, Thailand: National Cancer Institute.
- Khuhaprema T, Srivatanakul P, Attasara P, Sriplung H, Wiangnon S, Sumitsawan Y, eds. (2010) *Cancer in Thailand Vol. V, 2001-2003*. Bangkok, Thailand: National Cancer Institute.
- Khuhaprema T, Srivatanakul P, Sriplung H, Wiangnon S, Sumitsawan Y, Attasara P, eds. (2007) *Cancer in Thailand vol. IV, 1998-2000*. Bangkok Medical Publisher, Bangkok.
- Liabsuetrakul T, and Southern Soil-Transmitted Helminthes and Maternal Health. (2009) Epidemiology and the effect of treatment of soil-transmitted helminthiasis in pregnant women in southern Thailand. *Southeast Asian J Trop Med Public Health*, 40, 211-222.
- Lim HK, Ghazali SM, Kee CC, et al. (2013) Epidemiology of smoking among Malaysian adult males: prevalence and associated factors. *BMC Public Health*. 13:8.
- Laungaramsri P. (2014) Contested Citizenship: Cards, Colors, and the Culture of Identification. in: Marston JA, ed. *Ethnicity, Borders, and the Grassroots Interface with the State: Studies on Southeast Asia in Honor of Charles F. Keyes* (Google eBook), Chiang Mai, Thailand. Silkworm Books. pp. 1983-1991. [cited 2014 July 16]. Available at: <http://books.google.co.th/books?id=BiQDBAAAQBAJ>
- National Health Examination Survey, 4th 2008-9. (2009) Bangkok, Thailand, National Health Examination Survey Office.
- National Statistical Office. (1992) *Advance Report: 1990 Population and Housing Census*. Bangkok, Thailand, National Statistical Office.
- National Statistical Office. (2002) *2000 Population and Housing Census*. Bangkok, Thailand, National Statistical Office.
- National Statistical Office. (2012) *2010 Population and Housing Census*. Bangkok, Thailand, National Statistical Office. [cited 2014 July 16]. Available from: [http://songkhla.old.nso.go.th/nso/project/table/files/songkhla/C-pop/2553/000/songkhla\\_C-pop\\_2553\\_000\\_01000300.xls](http://songkhla.old.nso.go.th/nso/project/table/files/songkhla/C-pop/2553/000/songkhla_C-pop_2553_000_01000300.xls)
- Parkin DM, Whelan SL, Ferlay J, Raymond L, Young J, eds. (1997) *Cancer Incidence in Five Continents Vol. VII*. IARC Scientific Publications No 143, Lyon, France. IARC Press.
- Parkin, DM, Whelan SL, Ferlay J, Teppo L, Thomas DB, eds. (2002) *Cancer Incidence in Five Continents Vol. VIII*. IARC Scientific Publications No 155, Lyon, France. IARC Press.
- R Core Team. (2013) *R: A language and environment for statistical computing* [Internet]. Vienna: R Foundation for Statistical Computing; [cited 2014 January 10]. Available from: <http://www.R-project.org/>
- Sengupta S, Punggrassami P, Balthip Q, Strauss R, Kasetjaroen Y, Chongsuivatwong V, Van Rie A. (2006) Social impact of tuberculosis in southern Thailand: views from patients, care providers and the community. *Int J Tuberc Lung Dis*, 10, 1008-12.
- Sriplung H, Sontipong S, Martin N, et al, eds. (2003) *Cancer in Thailand vol. III, 1995-1997*. Bangkok, Thailand, Bangkok Medical Publisher.
- Suwanrungruang K, Sriplung H, Attasara P, et al. (2011) Quality of case ascertainment in cancer registries: A proposal for a virtual three-source capture-recapture technique. *Asian Pac J Cancer Prev*, 12, 173-8.
- Vatanasapt V, Martin N, Sriplung H, et al, eds. (1993) *Cancer in Thailand 1988-1991*. IARC Technical Report No 16, Lyon, France. IARC Press.
- WHO. (2013) *Cancer Incidence in Five Continents. Volume X: Malaysia, Penang; Malay (2004-2007)*. Lyon, France. IARC Press. [cited 2013 January 10]. Available from: <http://ci5.iarc.fr/CI5-X/PDF/Asia/44580227.pdf>
- WHO-Western Pacific Region. (2014) *Smoking Statistics*. [cited 2014 January 10]. Available from: [http://www.wpro.who.int/mediacentre/factsheets/fs\\_20020528/en/](http://www.wpro.who.int/mediacentre/factsheets/fs_20020528/en/)