9

STUDYING THE THAI HEALTH-RISK TRANSITION

ADRIAN SLEIGH AND SAM-ANG SEUBSMAN

Abstract

Since Thailand's first census 100 years ago, its patterns of illness, mortality and fertility have been transformed. Mortality and fertility fell very rapidly in the first 70 years as infectious diseases receded. Healthy childhood and safe motherhood were key benefits. Successive cohorts grew taller, and previously rare chronic diseases became common as families became smaller, incomes rose, people urbanised and the population aged.

Dengue and tuberculosis remain major problems, and in recent decades, HIV/AIDS has become an important cause of mortality among young adults. Traffic injury has become a major threat, and unfamiliar problems such as obesity, anxiety and depression are becoming widespread in Thailand.

These changes have been the focus of a large multidisciplinary study of the Thai health-risk transition funded by the Wellcome Trust and the NH&MRC since 2004, with strong support from senior Thai government officials. The study focuses on the transition of both health risks and outcomes in the Thai population. Guided by conceptual advances in Professor Tony McMichael's approach to population health, it looks beyond the proximate, searching for multilevel drivers of changes under way and the sequences and mediators of transitions. Here, we outline the overall study design – with retrospective and prospective components – including an ongoing cohort study of nearly 90,000 adults already followed for eight years. Progress is summarised and future prospects reviewed.

Introduction

In this chapter, we introduce our longitudinal multidisciplinary international study of the health-risk transition under way in Thailand. The project received critical administrative and intellectual support from Professor Tony McMichael – as Director of the National Centre for Epidemiology and Population Health (NCEPH), as one of the initial Chief Investigators, as advocate for multilevel epidemiology and as a leader of multidisciplinary regional public health research. The legacy of health transition theory established at NCEPH in the 1990s by Professor Jack Caldwell, The Australian National University's (ANU) celebrated demographer, also helped to inspire the work. Another seminal influence arose from the doctoral research experience of the project leaders, as both Adrian Sleigh and Sam-ang Seubsman were engaged in cohort studies at that early stage of their careers. Over the past 10 years, the project has been directed in Australia from ANU (by Sleigh at NCEPH) and in Thailand from the Sukhothai Thammathirat Open University (STOU) (by Seubsman in Bangkok).

The research tackles a significant regional population health issue in middle-income Thailand – transition to modern health risks and the concomitant emergence of chronic disease and injury. The aim is long-term multidisciplinary research that improves understanding of health and its determinants in Thailand while boosting regional health research capacity and collaboration. The questions to be addressed include the progression of the Thai health-risk transition over the past 50 years, its distribution and determinants and potential interventions. Accordingly, we conducted an historical study looking back 50–100 years and also established a large prospective Thai Cohort Study. Regional population health research capacity was also a focus, with a substantial commitment to PhD training in Australia and Master training in Thailand.

We focused on Thailand as an influential country in the region at the geographical head of the Association of Southeast Asian Nations (ASEAN) and bordering more ASEAN neighbours than any other country. It is grappling with unfamiliar health risks and new disease patterns as health-risk transitions unfold. Its responses will be informative to Southeast Asia. To stay relevant, given these changes and mindful of the potential for long-term involvement, we directed capacity-building research to the health-risk transition itself, examining both determinants (risks) and outcomes (health).

We were aware that a demographic transition from high to low fertility and mortality was well advanced in Thailand (Figure 9.1). The country has also experienced an epidemiological transition from infectious to chronic diseases and a health transition from traditional beliefs and practices to science-based health behaviour and services. In addition, Thailand is experiencing a nutrition

transition from traditional to 'modern' food, urbanisation and transitions in formal occupation, communication, transport, sexual behaviour, health service access and health service utilisation.

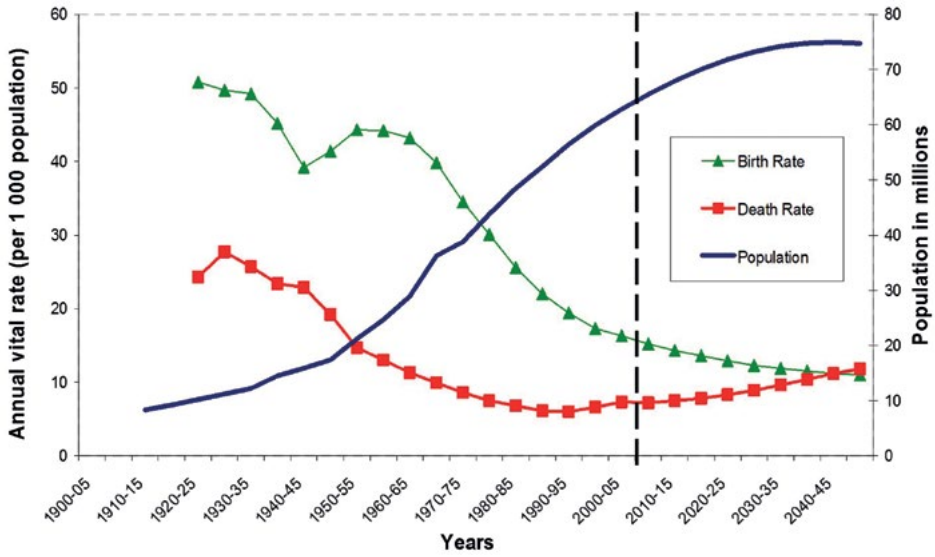

Figure 9.1 The demographic transition in Thailand.

Multiple sources, from Sleigh et al., 2008 (with permission). Population before 1940: Hirshman (1994); birth and death rates before 1950 adapted from estimates of crude birth rate and crude death rate for each year (1920–50) from the Economic and Social Commission for Asia and the Pacific (1976); from 1960: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2003).

The study began in 2004 and was funded competitively for the first five years under the International Collaborative Research Grants Scheme, a once-only opportunity created by the combined efforts of the Wellcome Trust (UK) and the Australian National Health and Medical Research Council (NH&MRC). These funders created an unusual opportunity to form an international research team to investigate a regional public health problem that neither threatened Australia directly nor promised bioscience patents of direct benefit to the Australian economy. In 2009, the NH&MRC launched its new competitive global health project grant funding, enabling our project to win support for five more years.

The research involves a Thai–Australian partnership including STOU, the Thai National Economic and Social Development Board reporting to the Thai Prime Minister and Cabinet, the Thai Ministry of Public Health, Chiang Mai University and several Australian partners (see acknowledgements).

Health-Risk Transitions

In recent years, understanding of the dynamics and determinants of population health transitions has been enhanced by diverse international syntheses on social, demographic and health trends (Caldwell, 1993; Harper et al., 1994; World Health Report, 2002). This has involved insights from sociologists, historians, demographers, nutritionists and ecologists. Newly characterised upstream health determinants have been identified as drivers of population health transitions, either under way or completed in many regions – for survival and longevity (Caldwell and Caldwell, 1993), for diet and nutrition (Drewnowski and Popkin, 1997) and for epidemiologic patterns, environmental risks and human ecology (McMichael, 2001).

This knowledge is complemented by the growing insights of social epidemiology, showing how sociocultural and economic factors also act as upstream drivers of many health outcomes (Berkman and Kawachi, 2000). Also important was the realisation that the distribution of risk factors within populations was the best target for many interventions (Rose, 1992; Laaser et al., 2001). Every population should understand the local dynamics of the distributions and upstream determinants of its own health risks before devising national intervention strategies.

The economic causes and consequences of the interrelated demographic, epidemiological and nutritional transitions have become a central concern for health and development planners and financiers (Jamison et al., 1993; World Bank, 1993). Economic debate on whether health is an 'input' or 'output' of 'development' has culminated in the recognition that health is both, and the international health economics agenda for the new millennium opened with the World Health Organization's *Report of the Commission on Macroeconomics and Health* (Commission on Macroeconomics and Health, 2001). This comprehensive and persuasive dossier shows that health has been a key determinant of the economic development and wealth of nations over the past 200 years. For example, it showed that in low-income countries, an additional investment of US$34 per head in health would prevent about eight million deaths per year, around one-fifth of the annual toll worldwide. This would boost life expectancy at birth (LEB), and for every 10 per cent improvement of LEB, after controlling for other factors, the economy of a country would grow 0.3–0.4 percentage points. The report lays out compelling economic arguments for investing in population health and has exerted considerable influence over the past decade. Notwithstanding these considerations, there are also growing concerns about the long-term consequences of continuous economic growth, with implications for public health, as considered below.

Preventive thinking has moved beyond old debates over the relative contributions of material advances, social modernisation or deliberate public health interventions. Well-governed societies distribute health knowledge and technology via responsive and fair health systems within supportive civil institutions and cultural norms (Warren, 1997), and invest in health to boost wealth creation and development. Experiences in Japan, Korea and Singapore show that population health patterns can change over just two to four decades, from high to low mortality and fertility, with increased longevity, control of infectious diseases and large reduction of maternal–child mortality. Transitions that took Western countries 150 years can be telescoped into shorter periods, if all goes well. But, economic progress may consume ecological (i.e. natural) capital, leaving overly large 'environmental footprints', or induce health-impairing consumer behaviours, thus jeopardising population health (McMichael, 2001c).

The foregoing considerations are highly relevant to Thailand, now undergoing its own rapid risk and health transition, with years of high economic growth but limited societal capacity to detect and contain health-endangering environmental, economic and social changes. Some countries recently achieved risk and health transitions with lower per capita gross domestic product (GDP) than previously (Wilson, 2001). Over the decades, 1976–96, Thais experienced a remarkable 11-year rise in LEB (from 59 to 70 years for males and from 64 to 75 years for females) and equally dramatic falls in infant mortality and fertility. The Thai population is now nearly 65 million, and its growth rate has slowed. Mean per capita income has passed US$3,000 per year, and 36 per cent of the export-oriented economy's GDP now derives from manufacturing, while only 12 per cent is from agricultural production (National Statistical Office of Thailand, 2003; World Bank, 2013).

Other transitions are visible in Thailand. Chronic disease and injury are emerging as unfamiliar sources of most of the years of healthy life now being lost. The twin epidemics of obesity and (Type 2) diabetes loom. By 2000, diabetes incidence was rising 10 per cent per year, reaching 13.2 new cases reported per 100,000 (Bureau of Health Policy and Planning, 2002), and obesity now affects around one-third of the adult population (Aekplakorn et al., 2007). Fatal injury has also appeared as a major problem over the past two decades, with rates among males about four times those for females, mostly associated with motorcycles (Wilbulpolprasert, 2008).

The transitions in Thai health and risk were not automatic; they co-evolved with and reflected social attitudes and other aspects that were conducive. National identity remains strong, religious freedom is entrenched, there is no male child preference and female autonomy is evident. So, Thai men and women are free to embrace changes in family dynamics, lifestyle and even in core values. To some extent, this freedom has affected national governance and integration

into the world economy. For example, over the past two decades parliamentary democracy initially strengthened, Thailand joined the World Trade Organization in 1995 and the country adopted its first popular democratic constitution in 1997. Governments changed peacefully several times, but consensus broke down in the last decade and was replaced by civil disturbances and conflict between political factions, yet to be resolved.

Economic changes have also been important influences on health and risks. Forty years of rapid national economic growth ceased in 1997, completing the low-wage phase of industrialisation. Now, the Thai economy is growing again, but with increasing need for a skilled workforce and an economic strategy to take the country forward towards a higher-wage future. Population health status will be both an input and an output of future skill development and the expanding Thai economy.

Bearing in mind the complex forces, as discussed above, that determine population health status in Thailand, we adopted a multilevel eco-social model to guide our ongoing study of the health-risk transition under way (Figure 9.2).

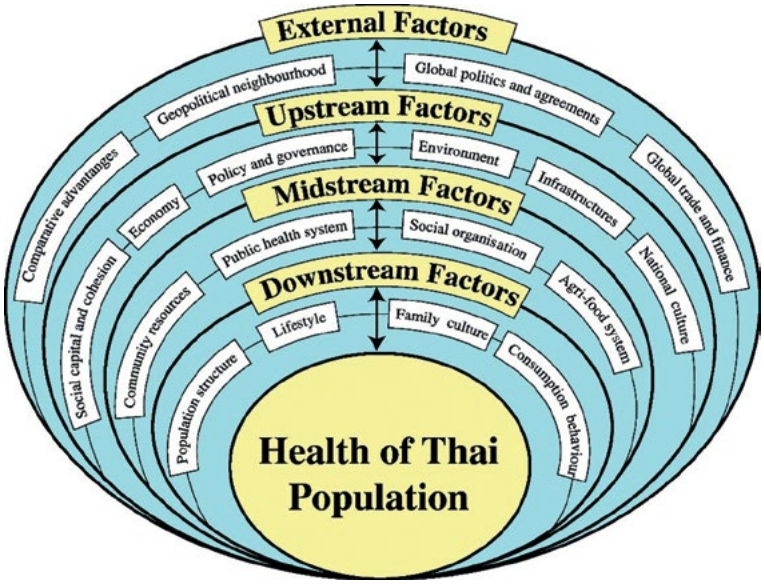

Figure 9.2 Multilevel eco-social health model.

Source: Sleigh et al., 2008 (open access).

Rationale for a National Cohort Study in Thailand

Our research is generating novel Thai data on population risk and health transitions. The country is moving on from its 'old agenda' of high maternal and infant mortality and poverty-related environmental and microbial risks, but needs new knowledge to reduce its emerging health problems – chronic disease and injury. As Thailand modernises, its population is adapting to Western medical services. In addition, dietary habits are changing, urbanisation and associated environmental pollution proceed, oncoming population segments are reaching higher education and scientific capacity is growing. To design appropriate prevention programmes, Thais need comprehensive information on the trends and determinants of current risk and health transitions.

Prospective cohort studies follow individuals into the future, periodically monitoring their health and other potential risk factors over time. This research design enables the investigation of multiple risk factors as well as the multiple health effects of given risks, such as smoking, specific diets, exercise levels, residential conditions and occupational exposures, including climate change and heat stress. All-cause mortality and major morbidity are estimable and can be characterised further for specific health outcomes. Distributions of risk exposures are measurable, and their upstream socioecological determinants can also be investigated within the cohort study – with implications for national interventions. For common morbid outcomes (such as transport or occupational injury, or effects of air pollution), detection of incident cases enables case-control analysis and socioecological research on upstream causal webs.

Some general population cohort studies, in other parts of the world, have lasted many decades and have provided much valuable information for public health policy. Taking peer-reviewed research publications as one indication of overall scientific productivity, we note that the Nurses' Health Study in the USA (n = 121,900) has produced nearly 1,000 original articles since 1976 (Figure 9.3). It has also trained many national and international leaders in public health (www.channing.harvard.edu/nhs/).

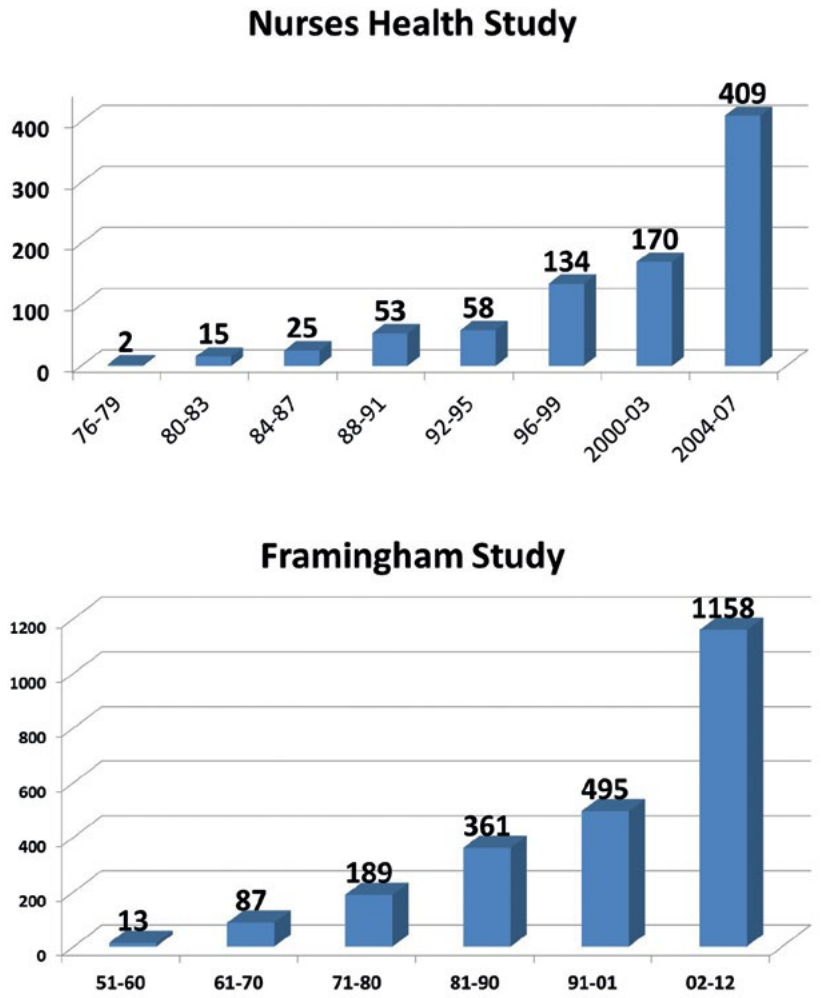

Figure 9.3 Publications over time for two seminal cohort studies. Data not cumulative.

Source: Nurses and Framingham cohort project websites.[1] Not previously published.

Another famous community cohort study continues in Framingham, Massachusetts, USA. It began in 1948 with 5,200 men and women and has lasted for 53 years. Problems arising from the small size of the original cohort were tackled by creating second- and third-generation cohorts, children and grandchildren of the original group. This study is a powerhouse of new health knowledge, with publications now appearing at the rate of 100 per year, totalling over 2,000 since inception (Figure 9.3). Framingham's cohorts now enable studies

1 www.channing.harvard.edu/nhs, accessed 10 April 2015; www.framinghamheartstudy.org, accessed 10 April 2015.

of many outcomes, beyond the initial focus on heart disease, including stroke, dementia, osteoporosis, arthritis, nutrition, diabetes, eye diseases, hearing disorders, lung diseases and genetic disorders.

There have been many other useful cohort studies, large and small, over the past 40 years. But no such general cohort studies have been conducted in the developing world, owing to the unequal distribution of global resources for such research. Our project, developing a large national cohort study in Thailand, helps to fill that significant research gap. Our Thai Cohort Study is of special value because that country is undergoing a rapid health and risk transition and is a public health leader for the ASEAN region, especially Indochina.

This is the first prospective cohort study addressing the health-risk transition, a set of emerging health problems centred around chronic disease and injury and arising with socio-economic development. It is the first nationwide cohort study to be conducted in Thailand and therefore is a landmark in the development of epidemiology in the region. These data reveal trends in population health in Thailand bearing on an emerging public health issue in the Asia-Pacific – transition from traditional patterns of risk, infection and maternal–child health problems, to the dominance of chronic disease and injury with concomitant implications for prevention and health services.

Overview of Thai Cohort Study Design

We developed our Thai Cohort Study by recruiting cohort members nationally, collaborating with STOU, Thailand's largest established distance learning open university (Sleigh et al., 2008). Its 200,000 students are an accessible group of emerging educated Thais, who aspire to an educated world view and are those most likely to be affected by the health-risk transitions under way. The open university status of STOU means there are no course fees; hence, students need not be socially or economically advantaged, and may live all over Thailand. This student population thus represents Thai adults well for age, sex, occupation, geographic residence and socio-economic status (Seubsman et al., 2012). Furthermore, these adult students are uniquely accessible by mail and are adept at filling in optically scanned sheets, because such forms are in use for multiple-choice examinations in the STOU system.

We recruited 87,134 students at baseline in 2005, with ages ranging from 15 to 87 years (median 29 years) and with 54 per cent females. Among them, we could determine distributions and rates of change for multiple proximal and upstream risk factors, many of which were generalisable to the wider Thai population (Ponsonby et al., 1996). The first follow-up in 2009 reached over 60,000 (more than 70 per cent) of the baseline cohort. These data are yielding

valuable information on relative risk trends, transitions and upstream drivers, and comparative data on the effect of risk exposures – knowledge needed to plan multilevel population interventions (Table 9.1).

Table 9.1 Risk hierarchy – three levels of analysis for five risk factors.

Risk factors	Levels of analysis		
	Proximal (downstream) Level 1	Structural (upstream) Level 2	Systemic (distal) Level 3
Diet – cardiovascular disease	Intake of fat, sugar, protein, fruit, carbohydrate, vegetables, alcohol	Social class, income, food costs, household management, transport	Culinary culture, risk perceptions, market–regulation, socioecology
Energy expenditure – obesity and diabetes	Housework, shopping, work, recreation, travel to work	Social class, income, transport cost–availability, ease of exercise	Knowledge–perceptions, marketing, built environment, ecology
Motor cycle use – traffic injury	Motorcycle–alcohol, size–quality, helmet, driver–pillion	Social class, income, transport cost, peers, time–weather, work	Laws, marketing, risk perceptions, roads–vehicles–alcohol
Social integration – mental illness, violence and suicide	Social network, friends, family, positive community, upbringing	Marital status, education, income, employment, health services	Temperament, culture, social capital, urban–rural location
Tobacco – cardiopulmonary disease	Smoking duration and frequency, addiction, environmental smoke	Social class, income, family size, social cluster effects, work stress	Anti-smoking laws, taxes, marketing, perceptions, knowledge

Source: Thai cohort study team (2004-15).

Topics covered for the cohort study include social demography, socio-economic status, health service use and finance, contraceptive use, vision, hearing and dental health and occupation and associated hazards. Further, using questions based on standards indicated in parentheses (with the sources given when they are used), we measured overall health (SF8),[2] psychological distress (Kessler),[3] personal well-being (Cummins),[4] happiness (Yiengprugsawan et al., 2012a) and social capital (Putnam)[5]. We also collected self-reported data on the lifetime record of injury and of 25 important medical conditions including depression, diabetes, hypertension, stroke and common varieties of cancer. In addition, participants provided information on smoking and alcohol consumption, transport and related safety behaviour, family health history, body size at birth, current height and weight and food purchasing and consumption habits.

2 www.sf-36.org/tools/sf8.shtml, accessed 10 April 2015.
3 www.beyondblue.org.au/the-facts/depression/signs-and-symptoms/anxiety-and-depression-checklist-k10.
4 tinyurl.com/potge6s, accessed 10 April 2015.
5 bowlingalone.com/, accessed 10 April 2015.

Information generated from the cohort baseline in 2005 (including embedded retrospective components) has been substantial. The cohort productivity in terms of new knowledge about population health trends in middle-income transitional Thailand will continue to increase as person-time accumulates. Our current analyses (in 2013) are concentrated on the first four years of longitudinal data (2005–09). The first eight years (2005–2009–2013) will be available in 2015, a rich source of new longitudinal information.

In the following sections, we summarise Phase I (2004–09) of our Thai health-risk transition research, as well as the first part of Phase II (2010–15), in regard to both the research findings and capacity building.

Key Research Findings

Analyses of 2005 baseline data from the large national (STOU) cohort led to a number of key findings. For example, injury was more frequent than expected. Its risk factors included being male, having poor vision, having low income and being young (for traffic injury) or old (for falls) (Stephan et al., 2010). Social capital influenced self-assessed health, psychological health and personal well-being (Yiengprugsawan et al., 2011a). In transitional Thailand, we found that mental health and well-being were affected adversely by psychosocially or physically hazardous jobs, a pattern similar to that found in affluent countries (Yiengprugsawan et al., 2013). Self-reported health also mirrors patterns found in developed countries, with females reporting more frequent 'poor' or 'very poor' health (odds ratio (OR) = 1.35) (Seubsman et al., 2011). Also, emulating patterns in affluent settings are some unfortunate consequences of improved nutrition and smaller families. Taller women had an increased risk of breast cancer (OR = 2.3), as did women with non-insulin-dependent diabetes mellitus (OR = 8.4). Women with older siblings had a reduced risk of breast cancer compared to those firstborn (OR = 0.3) (Jordan et al., 2009).

By Asian standards of self-reported height and weight, 16 per cent of the cohort was obese (body mass index (BMI) >25) and 15 per cent overweight (BMI >23–24.9). Obesity was associated with urban residence, inactivity and with spending more than four hours a day watching television or using computers. We found a 33 per cent reduction in obesity risk for cohort members reporting daily housework/gardening (Banwell et al., 2009). Further longitudinal analyses have also revealed the strong relationship between short sleep hours and weight gain in the cohort (Yiengprugsawan et al., 2012b). A most interesting finding was the association of obesity with sex and socio-economic status in our cohort. The relationship was direct for males (i.e. higher status linked to

more obesity) but strongly inverse for females, suggesting that educated Thai women had already developed a rich-country pattern of an inverse relationship between social class and obesity. The OR for obesity associated with higher income was 1.54 for males and 0.68 for females (Seubsman et al., 2010).

Another transition-related finding was the strong relationship between life-course urbanisation status and health outcomes. The rural–urban group (those who moved to cities after age 12 years) constituted almost one-third of the cohort members and were significantly different from other groups in many ways (e.g. more one-person or couple-with-no-children households). Health and other social outcomes of urbanisers were closer to those in the urban–urban group and were worse than the rural–rural group, with lower self-assessed health and a higher prevalence of hypertension, depression and obesity (Lim et al., 2009; Seubsman et al., 2010, 2011; Thawornchaisit et al., 2013).

Another important finding to date relates to the progressive increase in the attained height of young adult Thais over the past 50 years. We studied this in 34,000 20-year-old military recruits measured in Bangkok from 1972 to 2006, finding a five-centimetre increase to 169 centimetres over that period. The best explanation was that poor children around Bangkok became progressively better nourished and healthier from 1952 to 1986 (Seubsman and Sleigh, 2009). Biological nationwide evidence of such an historical health-risk transition was also obtained among age cohorts born from the 1940s to the 1990s. Such data for both sexes were available from STOU students who were members of the Thai Cohort Study (Jordan et al., 2012) (Figure 9.4). This analysis supported the military recruit data and showed that urban Thais became taller than rural counterparts, reflecting healthier childhoods on average, with the gap growing wider over this 50-year period. However, rural Thais also grew taller, but at a slower rate, suggesting increased inequality. Both males and females had similar trends (female data not shown). This growing divergence reflects, and possibly underpins, much of the rural-urban tension still evident in Thailand.

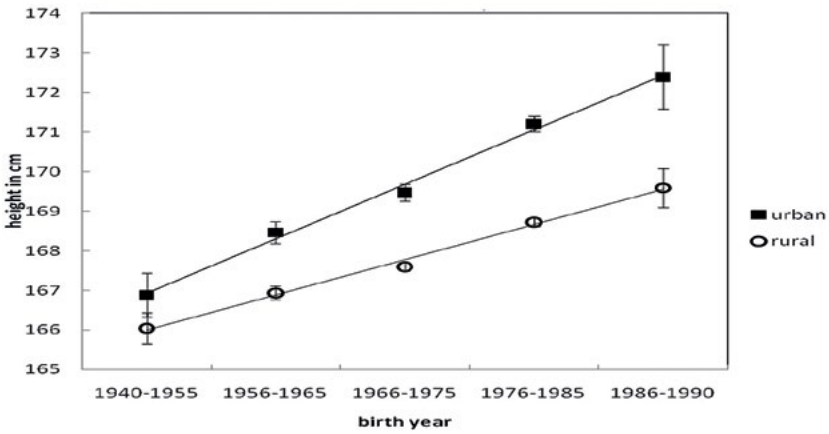

Figure 9.4 Mean heights (95 per cent CIs) among Thai men classified by their location (whether rural or urban) at age 10–12.

Source: Thai Cohort Study analysis, with permission (Jordan et al., 2012).

An important issue for future population health in Thailand concerns the effects of heat stress, particularly in the workplace (Kjellstrom et al., 2009). At baseline in 2005, around 20 per cent of working cohort members reported experiencing uncomfortably high temperatures at work, and in 2009, around 30 per cent reported being bothered by high temperatures when either sleeping, doing housework, working, exercising or daily travelling. Our study has revealed such heat stress in Thailand is associated with kidney disease (Tawatsupa et al., 2012a), poorer overall well-being (Tawatsupa et al., 2012b) and increased risk of occupational injury (Tawatsupa et al., 2013). These associations will be of particular concern if global temperatures increase under climate change. Mortality in Thailand may be expected to increase 5–13 per cent if predicted temperature increases of 4°C by 2100 are realised (Tawatsupa et al., 2012c).

As the Thai population ages and chronic disease and disability become more prevalent, the need for caring support will also increase. In the absence of sufficient state-supported social security measures, this caring burden falls largely to family members, as it would traditionally. However, in the past, aged people were less prevalent and larger families were normal. Around one-third of our Thai cohort reported currently being a carer for a sick or disabled individual. Caring had significant impacts on cohort members, with carers reporting more prevalent lower back pain, psychological distress and, among females, worse self-rated overall health than their non-carer counterparts (Yiengprugsawan et al., 2012c). However, caregiving was also associated with higher levels of self-esteem and contentment with life, particularly where caregivers retained social contacts with those outside the household, indicating the importance of social support for those in caregiving roles (Yiengprugsawan et al., 2012d).

The effects of increased longevity, as well as changes in lifestyles, are being revealed in other aspects of our study. Oral health is one example where age is important, with older cohort members having a much higher prevalence of poor oral health, which is then associated with poor quality of life (Yiengprugsawan et al., 2011b, 2011c). Around 8.5 per cent of cohort members had trouble with their hearing (Yiengprugsawan et al., 2012e), and one-third of the cohort had vision impairment (Yiengprugsawan et al., 2012f). Both of these problems were strongly associated with poor self-rated health and psychological distress.

Building Regional Population Health Capacity

We have developed a productive international research partnership involving senior policymakers and academics in Thailand and specialists in epidemiology, international health, demography, sociology, economics and development in Australia. Further, we have boosted public health research capacity through doctoral and Masters training. By May 2014, directly associated with the project, there were eight completed or current Master's graduates in Thailand; in addition, six Thais and two Australians had completed PhDs in Australia and three more were under way. Among these 19 young public health scholars, 16 are Thai and three are Australasian.

By May 2014, the research has generated a substantial output on risk trends, transitions and health outcomes, with 80 published or in press papers, seven books or book chapters, and eight submitted papers. Of the 21 first authors for these 80 published papers, eight were Thai and 12 authors were PhD students or project postdoctoral researchers.

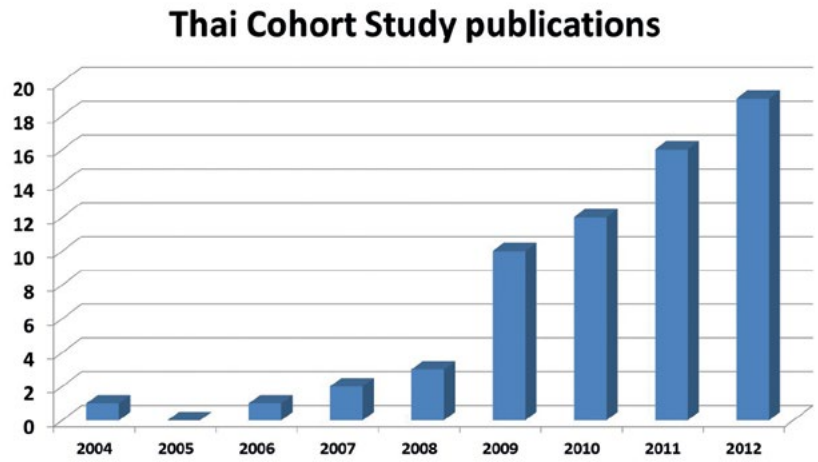

Figure 9.5. Publications arising from the Thai Cohort Study each year.
Source: Authors' work.

Conclusions

The mean height trends suggest that Thai modernisation is about half completed, but that rural disadvantage is growing. Public health campaigns are urgently needed to reduce traffic injury. We also recognise a new public health focus is needed on urban health, social capital and healthy cities. There are serious emerging problems of stress and psychological distress at work and at home, and an urgent need exists for dietary education and regulation of the food environment, decreasing exposure to calorie-dense processed foods. As well, there is a need to encourage physical activity and a permissive built environment, especially for Thai children. There also appears to be an emerging problem of underweight young Thai females, particularly noticeable in the cohort.

Other project data (not discussed above) also indicate the great importance of maintaining the successful anti-smoking campaigns, especially for females, whose non-smoking behaviour is set culturally and is enormously beneficial (Pachanee et al., 2011). It is also important to monitor the Universal Coverage Scheme of health insurance, especially for the poor (Yiengprugsawan et al., 2009), and to provide new sexual health services for Thai adolescents (Tangmunkongvorakul et al., 2010). Continued improvement in occupational health and safety is needed as the Thai workforce formalises (Yiengprugsawan et al., 2009; Kelly et al., 2010; Tangmunkongvorakul et al., 2010; Berecki-Gisolf et al., 2013).

Our results are available to assist health policy development in Thailand, and we already have two senior policymakers as Chief Investigators. We have also succeeded in linking our cohort data (which includes Citizen ID numbers) with the existing national databases for deaths (Ministry of Interior, Ministry of Public Health). We continue to seek links to Thai cancer registries and health-service databases (civil servant and universal health insurance) to improve our analytic capacity.

The Thai–Australian partnership has worked productively in terms of capacity building, regional collaboration and research. Professor McMichael was both inspirational and supportive, especially at the start, as we were finding our way. He was also an excellent host on many social occasions, and this helped to motivate the team.

Acknowledgements

Phase I of the project (2004–10) was supported by the International Collaborative Research Grants Scheme, with joint grants from the Wellcome Trust UK (GR071587MA) and the Australian NH&MRC (268055). Phase II (2010–14) was supported by the Australian NH&MRC (585426). We thank the staff at Sukhothai Thammathirat Open University who assisted with student contact, and STOU students who are participating in the cohort study. We thank our research collaborators at Monash University, The University of Queensland and the Queensland Institute of Medical Research in Australia.

Finally, we thank the members of the Thai cohort study team, who worked together over many years to make this project happen. The team members are listed here. Thailand: Jaruwan Chokhanapitak, Chaiyun Churewong, Suttanit Hounthasarn, Suwanee Khamman, Daoruang Pandee, Suttinan Pangsap, Tippawan Prapamontol, Janya Puengson, Yodyiam Sangrattanakul, Boonchai Somboonsook, Nintita Sripaiboonkij, Sam-ang Seubsman, Pathumvadee Somsamai, Benjawan Tawatsupa, Arunrat Tangmunkongvorakul, Duangkae Vilainerun, Wanee Wimonwattanaphan. Australia: Chris Bain, Emily Banks, Cathy Banwell, Janneke Berecki-Gisolf, Bruce Caldwell, Gordon Carmichael, Tarie Dellora, Jane Dixon, Sharon Friel, David Harley, Susan Jordan, Matthew Kelly, Tord Kjellstrom, Lynette Lim, Roderick McClure, Anthony McMichael, Tanya Mark, Adrian Sleigh, Lyndall Strazdins, Tam Tran, Vasoontara Yiengprugsawan, Jiaying Zhao.

References

Aekplakorn, W., Hogan, M.C., Chongsuvivatwong, V., Tatsanavivat, P., Chariyalertsak, S., Boonthum, A., et al. 2007. Trends in obesity and associations with education and urban or rural residence in Thailand. *Obesity* 15, 3113–21.

Banwell, C., Lim, L.L.Y., Seubsman, S., Bain, C., Dixon, J. & Sleigh, A.C. 2009. Body mass index and health-related behaviours in a national cohort of 87 134 Thai open university students. *Journal of Epidemiology and Community Health* 63, 366–72.

Berecki-Gisolf, J., Tawatsupa, B., McClure, R., Seubsman, S, Sleigh, A. & the Thai Cohort Study Team 2013. Determinants of workplace injury among Thai Cohort Study participants. *BMJ Open*, pii:e003079, doi:10.1136/bmjopen-2013-003079.

Berkman, L.F. & Kawachi, I. (eds) 2000. *Social Epidemiology*. Oxford University Press, Oxford, UK, and New York, USA.

Bureau of Health Policy and Planning 2002. *Annual Morbidity Statistics*. Ministry of Public Health, Thailand.

Caldwell, J.C. 1993. Health transition: the cultural, social and behavioural determinants of health in the Third World. *Social Science & Medicine* 36, 125–35.

Caldwell, J.C. & Caldwell, P. 1993. The South African fertility decline. *Population and Development Review* 19, 225–62.

Commission on Macroeconomics and Health 2001. *Macroeconomics and Health: Investing in Health for Economic Development*. Report of the Commission on Macroeconomics and Health. World Health Organization, Geneva, Switzerland.

Drewnowski, A. & Popkin, B.M. 1997. The nutrition transition: new trends in the global diet. *Nutrition Reviews* 55, 31–4.

Harper, A.C., Holman, C.D.J. & Dawes, V.P. 1994. *The Health of Populations*. Churchill Livingston, South Melbourne, Victoria, Australia.

Hirshman, C. 1994. Population and society in twentieth-century Southeast Asia. *Journal of Southeast Asian Studies* 25, 381–416.

Jamison, D.T., Mosley, W.H., Measham, A.R. & Bobadilla, J.L. (eds) 1993. *Disease Control Priorities of the Developing World*. Oxford University Press, New York, USA.

Jordan, S., Lim, L.L.Y., Vilainerun, D., Banks, E., Sripaiboonkij, N., Seubsman, S., et al. 2009. Breast cancer in the Thai Cohort Study: an exploratory case-control analysis. *The Breast* 18, 299–303.

Jordan, S., Lim, L.L.Y., Seubsman, S., Bain, C., Sleigh, A.C. & the Thai Cohort Study Team 2012. Secular changes and predictors of adult height for 86105 male and female members of the Thai Cohort Study born between 1940 and 1990. *Journal of Epidemiology and Community Health* 66, 75–80.

Kelly, M., Strazdins, L., Dellora, T., Khamman, S., Seubsman, S. & Sleigh, A.C. 2010. Thailand's work and health transition. *International Labour Review* 149, 373–86.

Kjellstrom, T., Homer, I. & Lemke, B. 2009. Workplace heat stress, health and productivity – an increasing challenge for low- and middle-income countries during climate change. *Global Health Action* 2, 10.3402/gha.v2i0.2047.

Laaser, U., Breckenkamp, J., Ullrich, A. & Hoffmann, B. 2001. Can a decline in the population means of cardiovascular risk factors reduce the number of people at risk. *Journal of Epidemiology and Community Health* 55, 179–84.

Lim, L.L.Y., Kjellstrom, T., Sleigh, A.C., Khamman, S., Seubsman, S., Dixon, J., et al. 2009. Associations between urbanisation and components of the health-risk transition in Thailand. A descriptive study of 87,000 Thai adults. *Global Health Action* 2, doi:10.3402/gha.v52i0.1914.

McMichael, A.J. 2001. *Human Frontiers, Environments and Disease: Past Patterns, Uncertain Futures*. Cambridge University Press, Cambridge, UK.

National Statistical Office of Thailand 2003. Core Economic Indicators of Thailand, and Key Statistics of Thailand, 2001. Available at: www.nso.go.th/, accessed 20 October 2010.

Pachanee, C., Lim, L.L.Y., Bain, C., Wibulpolprasert, S., Seubsman, S. & Sleigh, A.C. 2011. Smoking behavior among 84 315 open-university students in Thailand. *Asia Pacific Journal of Public Health* 23, 544–54.

Ponsonby, A.-L., Dwyer, T. & Couper, D. 1996. Is this finding relevant? Generalisation and epidemiology. *Australian and New Zealand Journal of Public Health* 20, 54–6.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat 2003. World Population Prospects: The 2004 Revision and World Urbanization Prospects: The 2003 Revision. Now available at: www.un.org/en/development/desa/population/publications/pdf/trends/population-projections.pdf, accessed March 2015.

Rose, G. 1992. *The Strategy of Preventive Medicine*. Oxford University Press, Oxford, UK, and New York, USA.

Seubsman, S. & Sleigh, A.C. 2009. Change in mean height of Thai military recruits from 1972 through 2006. *Journal of Epidemiology* 19, 196–201.

Seubsman, S., Lim, L.L.Y., Banwell, C., Sripaiboonkit, N., Kelly, M., Bain, C., et al. 2010. Socioeconomic status, sex and obesity in a large national cohort of 15–87 year old open university students in Thailand. *Journal of Epidemiology* 20, 13–20.

Seubsman, S., Kelly, M.J., Yiengprugsawan, V. & Sleigh, A.C. 2011. Thai Cohort Study Team. Gender, socioeconomic status, and self-rated health in a transitional middle-income setting: evidence from Thailand. *Asia Pacific Journal of Public Health* 23, 754–65.

Seubsman, S., Yiengprugsawan, V., Sleigh, A.C. & the Thai Cohort Study Team 2012. A large national Thai cohort study of the health-risk transition based on Sukhothai Thammathirat Open University students. *ASEAN Journal of Open Distance Learning* 4, 58–69.

Sleigh, A.C., Seubsman, S., Bain, C. & the Thai Cohort Study Team 2008. Cohort profile: the Thai cohort of 87,134 open university students. *International Journal of Epidemiology* 37, 266–72.

Stephan, K., McClure, R., Seubsman, S., Kelly, M., Yiengprugsawan, V., Bain, C., et al. 2010. Review of injuries over a one year period among 87,134 adults studying at an open university in Thailand. *Southeast Asian Journal of Tropical Medicine and Public Health* 41, 1220–30.

Tangmunkongvorakul, A., Carmichael, G., Banwell, C., Seubsman, S. & Sleigh, A.C. 2010. Intimate relationships amongst adolescents in different social groups in Northern Thailand. *Southeast Asian Journal of Tropical Medicine and Public Health* 41, 1475–93.

Tawatsupa, B., Lim, L.L.Y., Kjellstrom, T., Seubsman, S., Sleigh, A.C. & the Thai Cohort Study Team 2012a. The association between occupational heat stress and kidney disease among 17 402 males and 20 414 females in the Thai Cohort Study (TCS). *Journal of Epidemiology* 22, 251–60.

Tawatsupa, B., Yiengprugsawan, V., Kjellstrom, T., Seubsman, S., Sleigh, A.C. & the Thai Cohort Study Team 2012b. Heat stress, health, and wellbeing: findings from a large national cohort of Thai adults. *BMJ Open* 2, e001396, doi:10.1136/bmjopen-2012-001396.

Tawatsupa, B., Dear, K., Kjellstrom, T. & Sleigh, A.C. 2012c. The association between temperature and mortality in middle income Thailand from 1999 to 2008. *International Journal of Biometerology*, doi:10.1007/s00484-012-0597-8.

Tawatsupa, B., Yiengprugsawan, V., Kjellstrom, T., Berecki-Gisolf, J., Seusbman, S. & Sleigh, A.C. 2013. Association between heat stress and occupational injury among Thai workers: findings of the Thai Cohort Study. *Industrial Health* 51, 34–46.

Thawornchaisit, P., de Looze, F., Reid, C.M., Seubsman, S. & Sleigh, A.C. 2013. Thai Cohort Study Team. Health risk factors and the incidence of hypertension: 4-year prospective findings from a national cohort of 60569 Thai Open University students. *BMJ Open* 3, doi:10.1136/bmjopen-2013-002826.

Warren, K.S. 1997. Rationalising health care in a changing world: the need to know. *Health Transition Review* 7, 61–71.

Wilbulpolprasert, S. (ed.) 2008. *Thailand Health Profile 2005–2007*. Ministry of Public Health, Bangkok, Thailand.

Wilson, C. 2001. On the scale of global demographic convergence 1950–2000. *Population and Development Review* 27, 155–71.

World Bank 1993. *Investing in Health. World Development Report 1993*. Oxford University Press, Oxford, UK.

World Bank 2013. World Data Bank: World Development Indicators. Online database. Available at: databank.worldbank.org/ddp/home.do?Step=3&id=4, accessed 8 March 2013.

World Health Report 2002. *Reducing Risks, Promoting Healthy Life*. World Health Organization, Geneva, Switzerland.

Yiengprugsawan, V., Lim, L.L.Y., Carmichael, G. & Sleigh, A.C. 2009. Tracking and decomposing health and disease inequality in Thailand. *Annals of Epidemiology* 19, 800–7.

Yiengprugsawan, V., Khamman, S., Seubsman, S., Lim, L.L.Y. & Sleigh, A.C. 2011a. Social capital and health in a national cohort of 82,482 Open University adults in Thailand. *Journal of Health Psychology* 16, 632–42.

Yiengprugsawan, V., Somkotra, T., Seubsman, S., Kelly, M., Sleigh, A.C. & the Thai Cohort Study Team 2011b. Factors associated with self-reported number of teeth in a large national cohort of Thai adults. *BMC Oral Health* 11, 31, doi:10.1186/1472-6831-11-31.

Yiengprugsawan, V., Somkotra, T., Seubsman, S., Sleigh, A.C. & the Thai Cohort Study Team 2011c. Oral health-related quality of life among a large national cohort of 87,134 Thai adults. *Health and Quality of Life Outcomes* 9, 42, doi:10.1186/1477-7525-9-42.

Yiengprugsawan, V., Somboonsook, B., Seubsman, S. & Sleigh, A.C., 2012a. Happiness, mental health, and socio-demographic associations among a national cohort of Thai adults. *Journal of Happiness Studies* 13, 1019–29.

Yiengprugsawan, V., Banwell, C., Seubsman, S. & Sleigh, A.C. 2012b. Short sleep and obesity in a large national cohort of Thai adults. *BMJ Open*, doi:10.1136/bmjopen-2011-000561.

Yiengprugsawan, V., Harley, D., Seubsman, S., Sleigh, A.C. & the Thai Cohort Study Team 2012c. Physical and mental health among caregivers: findings from a cross-sectional study of Open University students in Thailand. *BMC Public Health* 12, 1111, doi:10.1186/1471-2458-12-1111.

Yiengprugsawan, V., Seubsman, S. & Sleigh, A.C. 2012d. Psychological distress and mental health of Thai caregivers. *Psychology of Well-Being: Theory, Research and Practice* 2, doi:10.1186/2211-1522-2-4.

Yiengprugsawan, V., Hogan, A., Harley, D., Seubsman, S., Sleigh, A.C. & the Thai Cohort Study Team 2012e. Epidemiological associations of hearing impairment and health among a national cohort of 87 134 Adults in Thailand. *Asia Pacific Journal of Public Health* 24, 1013–22.

Yiengprugsawan, V., Seubsman, S. & Sleigh, A.C. 2012f. Associations of vision impairment and health among a national cohort of 87,134 Thai Adults. *Asia Pacific Journal of Public Health*, doi:10.1177/1010539511433049.

Yiengprugsawan, V., Strazdins, L., Lim, L.L.Y., Kelly, M., Seubsman, S., Sleigh, A.C., et al. 2013. Physically and psychologically hazardous jobs and mental health in Thailand. *Health Promotion International*, doi:10.1093/heapro/dat080.

This text is taken from *Health of People, Places And Planet: Reflections based on Tony McMichael's four decades of contribution to epidemiological understanding*, edited by Colin D. Butler, Jane Dixon and Anthony G. Capon, published 2015 by ANU Press, The Australian National University, Canberra, Australia.