



Non-Fatal Injury in Thailand From 2005 to 2013: Incidence Trends and Links to Alcohol Consumption Patterns in the Thai Cohort Study

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ABSTRACT

Background: We analyzed population-based injury trends and the association between injury and alcohol consumption patterns in Thailand, a middle-income country undergoing rapid social change.

Methods: A nationwide cohort of 42 785 Thai adult Open University students, who were aged 15 to 87 years at enrolment, participated in cross-sectional assessments at baseline (2005) and 8 years later (2013). Incident non-fatal traffic and non-traffic injuries were recorded. Alcohol consumption patterns were categorized as follows: non-drinkers, occasional light drinkers, occasional heavy drinkers, regular drinkers, and ex-drinkers. Logistic regression was used to assess associations in 2005 and 2013 between injuries and alcohol consumption. We adjusted odds ratios (ORs) for socio-demographic factors, stress, health behaviors, and risk-taking behaviors.

Results: Incidence estimates in 2013 were standardized to the age structure of 2005: the standardized rates were 10% (95% confidence interval [CI], 9.32–9.89) for participants with at least one non-traffic injury and 5% (95% CI, 4.86–5.29) for those with at least one traffic injury. Both standardized incidences for non-traffic and traffic injuries were significantly lower than corresponding rates in 2005 (20% and 6%, respectively). Alcohol consumption was significantly associated with non-traffic injury in 2005, but the association disappeared in 2013. For example, non-traffic injury was associated with regular drinking (adjusted OR 1.17; 95% CI, 1.01–1.40) in 2005, but not in 2013 (adjusted OR 0.89; 95% CI, 0.73–1.10). In both survey years, traffic injury was not associated with occasional heavy drinking when adjusted for health and risk-taking behavior.

Conclusions: We examined non-fatal injury and the health-risk transition in Thailand in 2005 and 2013. Our data revealed decreases in alcohol consumption and non-fatal injury in the Thai Cohort between 2005 and 2013. Alcohol-related injury in Thailand today could be amenable to preventive intervention.

Key words: Thailand; injury; alcohol; health transition; socio-economic status

INTRODUCTION

Injury in developing countries is a public health problem. In middle-income countries of Southeast Asia, including

Thailand, road injury is one of the top 10 causes of death.^{1,2} In addition, alcohol consumption is broadly associated with the risk of injury. Alcohol was the number one cause of burden in disability-adjusted life years (DALYs) among men in Thailand

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in 2009.³ A major barrier to addressing the problem in low- to middle-income countries is the lack of information about injuries and related demographic, psychosocial, and personal risk-taking factors.

Alcohol consumption in Southeast Asia in 2008 was highest in Thailand, with an average annual intake per capita equivalent to 7.08 liters of pure alcohol, which was higher than the world average of 6.65 liter per capita.⁴ Unlike Western countries, few women drink in Thailand.⁵ Thai alcohol consumption steadily increased from 1990 to the early 2000s,⁵ partly due to de-restriction of alcohol sales in 1997.⁶ In 2001, the Thai Health Promotion Foundation, funded by new alcohol and tobacco taxes, began to promote smoking cessation and alcohol control.⁶ The government has responded by introducing more alcohol taxes and new restrictions on sales, increasing the drinking age to 20 years, and performing drunk-driving campaigns.^{6,7} At present, alcohol use in Thailand is declining, with a decreasing trend in new female drinkers.⁶

In developed countries, the association between acute alcohol consumption and injury has been well established.⁸⁻¹¹ Alcohol use is a strong risk factor for all causes of injuries, including traffic incidents,¹² violence,¹³ suicide,¹⁴ and other non-traffic injuries.¹⁵⁻¹⁷ At the population level, risk of injury increases incrementally with increasing average daily volume of alcohol intake.¹⁸

Here, we report our cohort study of injury trends in middle-income Thailand during a period of rapid social change. Given the relatively high alcohol consumption in Thailand and its importance to DALYs lost, we focused on connections between alcohol and injury across socio-geographic groups, noting and interpreting the changes occurring over an 8-year period. Such local data help clarify and anticipate the impact of alcohol use on injury in the Thai population.

METHODS

Generating the study population

We studied 42 785 members of a Thai Cohort examined in 2005 and 2013. The original Thai Cohort Study (TCS) members were recruited in 2005 from 200 000 Sukhothai Thammathirat Open University (STOU) students, community-embedded adult distance learners residing throughout Thailand. STOU is a national Open University at which any adult can enroll, qualifying with high school graduation or substantial life experience, paying low fees while taking up to 12 years to complete their degree. In 2005, a 20-page baseline questionnaire was mailed to all STOU students who had completed at least their first semester, with 87 151 (44%) responding. Details of data-processing procedures can be found elsewhere.¹⁹ Respondents at the 2005 baseline were similar to other STOU students in age distribution, sex ratio, marital and socio-economic status, and field of study.²⁰ Also, compared to the general Thai adult population in 2005,

TCS members were more educated but otherwise similar in terms of socio-economic level, national geo-demographic distribution, and religious and ethnic mix.²⁰

Overall, 42 785 TCS members answered both baseline (2005) and 8-year follow-up (2013) questionnaires. For this report, we excluded those with missing responses for alcohol or injury questions (826 in 2005 and 1981 in 2013); 39 978 cohort members remained after exclusions. Proportions missing co-variable data in 2005 or 2013 were low, ranging from 0.2% and 0.5% for education to 10.8% and 9.2% for occupation in the baseline and follow-up questionnaires, respectively.

Study design

We analyzed alcohol drinking habit and injury in the cohort at the beginning and at the end of the 8-year period of longitudinal observation, noting associations and secular trends after adjusting for potential effects of an array of socio-demographic and personal factors. We recorded injuries recalled for the year before the assessments in 2005 and 2013. This 12-month period was chosen as it was closest in time and thus subject to the least recall error.

Measures

Incidence of non-fatal injuries

In 2005, participants were asked the following questions: "In the last 12 months, how many injuries have you had that were serious enough to interfere with daily activities and/or required medical treatment ('None', 'one', 'two', 'three', 'four or more')?", and "Was this serious injury related to road traffic? ('Yes', 'No')". In 2013, participants were asked two independent questions: "In the last 12 months how many times did you get injured in a traffic crash ('None', 'once', 'twice', 'three times', 'four times or more')?" and "In the last 12 months how many times did you have a non-traffic injury?". Additional questions about injury severity ("When you experienced your most serious traffic or non-traffic injury, did you receive medical care and/or limit your normal activities for 1 day or more?") in 2013 enabled us to harmonize our findings with the questionnaire in 2005. The recalled incidence of traffic injury was 2242 (6%) in 2005 and 2423 (6%) in 2013; recalled incidence of non-traffic injury was 7896 (20%) and 4866 (12%).

Alcohol consumption in 2005

Alcohol consumption patterns in 2005 were assessed using the following two questions: "Have you ever drunk alcohol ('No, never', 'Occasional social drinker', 'Current regular drinker', 'Used to drink before, now stopped')?", and "How many drinks of alcohol do/did you have in one sitting when you are/were drinking ('less than 2 drinks', '2-3 drinks', '4-5 drinks', '6 drinks or more')?". These two questions replicated those used in a 2004 Thai survey of cigarette smoking and alcohol drinking and measure typical use (not available in English). Participants who answered "No, never" in the first question

were classified as a “non-drinkers” ($n = 11\,299$), and those who answered “Used to drink before, now stopped” were classified as “ex-drinkers” ($n = 3411$). Current drinkers were categorized into three categories: occasional drinkers who reported drinking ≥ 4 drinks per occasion (occasional heavy drinkers, $n = 10\,531$); occasional light drinkers who drank < 4 drinks per occasion ($n = 12\,733$); and regular drinkers ($n = 2004$). We separated occasional drinkers by whether or not they drank ≥ 4 drinks on a single occasion, because this corresponds to drinking to intoxication in a Thai person²¹ and corresponds approximately to international definitions of binge drinking.²²

Alcohol consumption in 2013

Alcohol consumption patterns in 2013 were assessed using the following item: “Please describe your current alcohol drinking (choose one answer and indicate amount for choices 3 and 4), with responses of (1 ‘Don’t drink’, 2 ‘Used to drink but quit’, 3 ‘Drink in social situation, about ___ glasses/week’, 4 ‘Current regular drinker of about ___ glasses/day’). Participants who answered they ‘Drink in a social situation’ were sub-divided into occasional light (≤ 3 glasses/week) and occasional heavy drinkers (> 3 glasses/week). There were five categories of alcohol consumption in total: “non-drinker” ($n = 18\,167$), “occasional light drinker” ($n = 7610$), “occasional heavy drinker” ($n = 7314$), “regular drinker” ($n = 1666$), and “ex-drinker” ($n = 5221$).

Demographic, mental and behavioral factors

TCS questionnaires covered an array of factors that could affect alcohol drinking or injury.^{23,24} These included demographic variables (age, sex, urban residence, income, education, occupation, and marital status) and health behavior (smoking and exercise). Life-course migration was based on participants’ current residence and residence at age 10–12 years (urban-urban, urban-country, country-urban, country-country). Urban residence in 2005 and 2013 was based on participants’ current residence. Mental distress was scored 0–12 (0 is indicating no distress) using the three anxiety-oriented items from Kessler scale (K6).²⁵ Social support was scored 0–16 (0 is indicating no social support) using four questions from the Irish Social Science Data questionnaire on social capital.²⁶ Risk-taking behaviors were measured by self-reported drunk-driving and usage of seatbelts and helmets.

Statistical analysis

All analyses were performed with SAS 9.3 software (SAS Institute, Cary, NC, USA). The 2005 and 2013 incidences of injury were cross tabulated with socio-demographic, health behavior, social capital, and psychosocial stress variables, with trends for proportions and means evaluated. Since we performed cross-sectional analyses in 2005 and 2013, we used separate multivariable logistic regression models to calculate odds ratios (ORs) and 95% confidence intervals (CIs) of traffic and non-traffic injury for each drinking category relative to non-drinkers. The results were adjusted

for demographic variables, health behavior, and risk-taking behavior variables. All tests were two-sided, and significance was set at $P < 0.05$. When incidence rates were directly compared, the estimates for 2013 were standardized to the age structure for 2005.

Ethical approval

The study was approved by the Sukhothai Thammathirat Open University Research and Development Institute (protocol 0522/10) and the Australian National University Human Research Ethics Committee (protocol 2004344, 2009/570). Informed written consent was provided by all participants.

RESULTS

Distribution of alcohol consumption patterns in 2005 and 2013

In 2005, men frequently reported occasional heavy (45%) and regular drinking (11%). Non-drinking was much more common among women (42%) than men (11%). Drunk-driving was much more frequent among men (48%) than women (8%). By 2013, drinking among cohort members had declined; 66% of women were now non-drinkers, fewer men reported occasional heavy (34%) or regular drinking (9%), and drunk-driving had declined for both men (35%) and women (5%) (Table 1).

Distribution of other potential risk factors in 2005 and 2013

In 2005, the female:male ratio was 55:45, and mean age for women (31 years) was younger than men (34 years). More than half of the men and women had high school diplomas or less education in 2005. In 2013, women had more university or higher degrees (82% vs 77%) and more professional or managerial jobs (43% vs 38%) than men, while men had higher incomes than women ($> 20\,000$ Baht/month; 48% vs 34%). By 2013, most men (76%) and women (65%) were married (compared to 56% and 41%, respectively, in 2005). In 2005 and 2013, more than half of the participants had an urban residence, with slightly higher proportions in women. About one third of cohort members had urbanized since age 12; proportions were similar between sexes and in survey years (Table 1).

In 2013, both sexes had less psychological stress than in 2005. In addition, participants in 2013 engaged in more non-vigorous exercise (both walking and moderate levels) but less vigorous exercise, such as running. Rates of smoking and other risk-taking behaviors, such as non-usage of backseat seatbelts or helmets, continued. Non-usage of frontseat seatbelts remained at a low level ($< 5\%$) in 2005 and 2013; however, non-usage of backseat seatbelts increased in both sexes (31% of men and 43% of women in 2005 vs 40% of men and 51% of women in 2013) (Table 1).

Table 1. Characteristics of Thai Cohort members (n = 39 978) in 2005 and 2013

		Male (n = 17 902)		Female (n = 22 076)	
		2005	2013 ^h	2005	2013 ^h
Mean (SD) age, years		34.2 (8.8)	42.2 (8.8)	30.9 (7.7)	38.8 (7.7)
Education	High school or lower	8915 (50)	2803 (16)	8401 (38)	2427 (11)
	Post-high school diploma	4029 (23)	1139 (6)	6702 (30)	1461 (7)
	University or higher	4927 (28)	13 868 (77)	6916 (31)	18 087 (82)
Income (Baht/month) ^a	≤7000	5082 (28)	1517 (8)	9010 (41)	2222 (10)
	7001–20 000	9621 (54)	7628 (43)	10 488 (48)	12 164 (55)
	≥20 000	2930 (16)	8603 (48)	2105 (10)	7456 (34)
Marital status	Not married	7537 (42)	4030 (23)	12 617 (57)	7498 (34)
	Married	9972 (56)	13 588 (76)	8971 (41)	14 250 (65)
Location	Bangkok	2487 (14)	2428 (14)	4031 (18)	3867 (18)
	Central/East	4995 (28)	5184 (29)	6795 (31)	7051 (32)
	North	3819 (21)	3820 (21)	4196 (19)	4214 (19)
	Northeast	4386 (25)	4346 (24)	4024 (18)	3999 (18)
	South	2105 (12)	2124 (12)	2923 (13)	2945 (13)
Urban residence Life-course migration ^b	Rural & Rural	8772 (49)	9579 (54)	11 167 (51)	12 349 (56)
	Rural & City	8153 (46)	7315 (42)	9791 (44)	8622 (40)
	Rural & City	5351 (30)	6086 (35)	6148 (28)	7190 (33)
	City & Rural	793 (4)	752 (4)	931 (4)	840 (4)
	City & City	3383 (19)	3402 (19)	4983 (23)	5044 (23)
Job	Professional/manager	5231 (29)	6823 (38)	6283 (28)	9484 (43)
	Skilled worker/manual labor	4214 (24)	3023 (17)	3468 (16)	2675 (12)
	Office assistance	4481 (25)	5243 (29)	7219 (33)	6971 (32)
Mean (SD) social support score ^c		6.7 (2.3)	7.0 (2.6)	6.8 (2.2)	7.2 (2.5)
Mean (SD) psychological distress score ^d		5.5 (2.1)	3.9 (2.2)	5.7 (2.1)	3.9 (2.2)
Exercise ^e	Mean (SD) walking, times/week	2.5 (3.4)	6.7 (9)	1.2 (2.5)	5.9 (8.2)
	Mean (SD) moderate, times/week	2.3 (3.3)	3.4 (5.1)	1.3 (2.7)	2.1 (3.7)
	Mean (SD) vigorous, times/week	4.9 (5.9)	4.4 (6.1)	4.9 (5.7)	3.8 (5.2)
Alcohol	Non-drinker	1944 (11)	3575 (20)	9355 (42)	14 592 (66)
	Occasional light drinker ^f	4204 (23)	3746 (21)	8529 (39)	3864 (18)
	Occasional heavy drinker ^g	7987 (45)	6012 (34)	2544 (12)	1302 (6)
	Regular drinker	1884 (11)	1585 (9)	120 (1)	81 (0)
	Ex-drinker	1883 (11)	2984 (17)	1528 (7)	2237 (10)
Smoking	Non-smoker	8455 (47)	14 964 (84)	20 670 (94)	21 935 (99)
	Current smoker	3081 (17)	2863 (15)	153 (1)	128 (1)
Drunk-driving	No	6587 (37)	9859 (55)	8947 (41)	17 439 (79)
	Yes	8512 (48)	6351 (35)	1687 (8)	1184 (5)
Frontseat seatbelt	Always	12 856 (72)	13 907 (78)	14 425 (65)	16 219 (73)
	Sometimes	3871 (22)	3321 (19)	5776 (26)	4585 (21)
	Never use	450 (3)	277 (2)	952 (4)	421 (2)
	Vehicle does not have one	250 (1)	310 (2)	277 (1)	761 (3)
Backseat seatbelt	Always	1725 (10)	1867 (10)	1181 (5)	1345 (6)
	Sometimes	3765 (21)	4583 (26)	3829 (17)	5010 (23)
	Never use	5619 (31)	7071 (40)	9552 (43)	11 169 (51)
	Vehicle does not have one	5501 (31)	4146 (23)	6281 (28)	4369 (20)
Helmet (motor cycle)	Always	11 304 (63)	9810 (55)	12 216 (55)	10 989 (50)
	Sometimes	3650 (20)	4371 (24)	4996 (23)	5739 (26)
	Rarely or never use	855 (5)	955 (5)	1957 (9)	1738 (8)

SD, standard deviation.

Values are reported as n (%), unless otherwise noted.

^aUS \$1 = 42 Baht in 2005, US \$1 = 34 Baht in 2013.

^bBased on residence aged 12 years and in 2005 or 2013.

^cMean of summed scores for four social capital questions (4 point scale, 0 to 3): lowest score (0) vs highest score (12).

^dMean of summed scores for three of the standard Kessler questions related to anxiety (5 point scale, 0 to 4): healthiest score (0) vs worst score (12).

^eMean frequency (times/week) for each exercise level (walking, moderate, or vigorous).

^fOccasional light drinker = less than 4 glasses per time in 2005; less than 4 glasses per week in 2013.

^gOccasional heavy drinker = 4 or more glasses per time in 2005; 4 or more glasses per week in 2013.

^hExcept for location, the distribution of all these factors was significantly different between 2005 to 2013. For location, *P*-value was 0.39 for men and 0.09 for women.

Non-fatal injury in 2005 and 2013

In 2013, 12% of participants had at least one non-traffic injury, and 7% of them had at least one traffic injury. Incidence rate estimates for 2013, age-standardized to the 2005 age structure, were 10% (95% CI, 9.32–9.89%) for non-traffic injuries and 5% (95% CI, 4.86–5.29%) for traffic injuries. Both estimates fell substantially and significantly ($P < 0.001$) from those of 2005 (20% non-traffic, 6% traffic). Men were over-represented for traffic injuries in 2005 (54%) but were under-represented in 2013 (42%). For non-traffic injuries, men were again over-represented in 2005 (52%) and less so in 2013 (49%).

Risk factors for traffic injury in 2005 and 2013

Increasing education was linked to traffic injury (Table 2). Traffic injury rates for women fell as education rose in both survey years. People who had high incomes had less traffic injury in both years. Psychological distress in the cohort had fallen substantially for men and women by 2013; this difference was significant ($P < 0.001$). In all traffic injury analyses (for men and women, and for 2005 and 2013), injured persons had considerably more psychological stress than people who had not been injured.

Health behavior was also connected to traffic injury, as well as to the passage of time. For example, for the cohort in 2013, non-vigorous exercise (walking and moderate exercise) had increased from 2005 levels. Women walked 1.2 times/week in 2005, and they walked 6.5 times/week in 2013. For both sexes, people who had traffic injuries in 2013 did more exercise than in 2005. Additionally, regular drinkers of both sexes had higher traffic injury frequency than other drinking categories in both survey years ($P < 0.05$). Further, in 2005 and 2013, helmet users had more traffic injuries than people who did not use helmets.

Risk factors for non-traffic injury in 2005 and 2013

Geographic location had little influence on 2013 incidence of non-traffic injury for either sex (Table 3). Life-course migration between cities and rural areas had little influence for women in either year. However, for men who migrated from a city to a rural area, incidence of non-traffic injury in 2005 was considerably higher (28%) than for other categories (21% to 23%). This difference was not observed in 2013. Skilled or manual workers of both sexes had higher rates of non-traffic injury in both years compared to other job categories.

Kessler-scored psychological distress among participants with non-traffic injuries was worse for both sexes in 2005 than in 2013. Exercise varied between 2005 and 2013: cohort members with non-traffic injuries reported more walking and moderate exercise but less vigorous exercise. In contrast, drinking categories had little influence on non-traffic injury incidence in either year. Among men, smoking was linked to increases in non-traffic injury incidence of 20% in 2005 and 16% in 2013. Trends in women were uninterpretable because few smoked and even fewer were injured. Cohort members

with non-traffic injuries were assessed for risk behaviors using variables directly relevant for traffic-injury analysis. These analyses showed that, from 2005 to 2013, drunk-driving, non-usage of seatbelts, and non-usage of helmets all fell.

Association between alcohol consumption pattern and injury in 2005 and 2013

At baseline, all categories of drinkers had significantly higher odds of at least one traffic injury compared to non-drinkers, even after adjustment for socio-demographic factors. However, the significance of the association was lost when the analysis was also adjusted for health and behaviors. Thus, regular drinking had a strong and significant association with traffic injury (crude OR 2.14; 95% CI, 1.78–2.98), but this was not significant (adjusted OR 1.20; 95% CI, 0.93–1.55) in the fully adjusted model (Table 4, Model 3).

In the 2013 assessment, crude analysis showed that all drinking categories were significantly associated with traffic injury (Table 4, Model 1). However, in the fully adjusted model (Model 3), only ex-drinkers had a marginally significant OR for traffic injury (adjusted OR 1.19; 95% CI, 1.02–1.40).

In 2005, the fully adjusted model showed that all drinking categories were significantly associated with non-traffic injury. For example, non-traffic injury reported in 2005 was associated with regular drinking (adjusted OR 1.16; 95% CI, 1.00–1.35). In 2013, regular drinking was no longer associated with non-traffic injury (adjusted OR 0.89; 95% CI, 0.73–1.10). Only ex-drinkers had a significant adjusted association with non-traffic injury in 2013, but the strength of this association was marginal (adjusted OR 1.22; 95% CI, 1.09–1.36).

All drinking categories were significantly associated with overall injury in the fully adjusted model in 2005. For example, regular drinking was associated with overall injury in 2005 (adjusted OR 1.17; 95% CI, 1.00–1.36). In 2013, regular drinking was no longer associated with overall injury (adjusted OR 1.01; 95% CI, 0.84–1.20). Only ex-drinkers had a significant association with overall injury in 2013, but the strength of this association was smaller than in 2005 (adjusted OR 1.18; 95% CI, 1.07–1.31).

DISCUSSION

Our nationwide Thai cohort displayed a downward secular trend in injury occurrence and alcohol consumption over the 8-year period of study. From 2005 to 2013, annual age-standardized incidence of traffic injury fell from an average of 6 to 5 events per person per year, and age-standardized incidence of non-traffic injury fell from an average of 20 to 10 events per person per year. For traffic injury, the downward cohort trend was consistent with national Thai data showing traffic injury rates falling (152/100 000 in 2004 and 98/100 000 in 2009).²⁷ Our cohort also displayed a secular trend of falling rates for non-traffic injury over the 2005 to 2013 period. National non-traffic injury data for that period were not

Table 2. Risk factor comparisons for traffic injury in Thai Cohort between 2005 and 2013

		Injured cases: cumulative incidence (%) ^a or mean (SD)						
		Men			Women			
		2005	2013	P-value	2005	2013	P-value	
Overall incidence		7	8		4	5		
Socio-demographic factors								
Mean (SD) age, years		33.0 (8.6)	41.3 (8.7)	<0.0001	29.2 (7.5)	38.2 (7.8)	<0.0001	
Education	High school or lower	7	10	<0.0001	5	7	<0.0001	
	Post-high school	7	12		5	7		
	University or higher	5	7		4	5		
Income, Baht ^b	≤7000	8	9	<0.0001	6	7	<0.0001	
	7001–20 000	7	9		4	6		
	≥20 000	4	6		3	3		
Marital status	Not married	8	8	<0.0001	5	5	<0.0001	
	Married	6	7		4	5		
Location	Bangkok	6	8	0.27	4	4	0.03	
	Central/East	7	8		5	5		
	North	6	7		4	5		
	Northeast	8	8		6	5		
	South	5	7		5	6		
Residence	Rural	7	7	0.0003	5	5	0.01	
	Urban	7	7		4	5		
Life-course migration ^c	Rural & Rural	7	7	0.002	5	5	0.14	
	Rural & City	7	7		5	5		
	City & Rural	9	8		5	5		
	City & City	6	8		4	5		
Job	Professional/manager	6	6	<0.0001	4	4	<0.0001	
	Skilled worker/manual labor	8	9		5	7		
	Office assistance	6	9		5	5		
Mean (SD) social support score ^d		6.7 (2.3)	6.6 (2.6)	0.628	6.8 (2.2)	6.9 (2.6)	0.007	
Health and behavior								
Mean (SD) psychological distress score ^e		6.0 (2.0)	4.5 (2.2)	<0.0001	5.7 (2.1)	4.6 (2.3)	<0.0001	
Exercise ^f	Mean (SD) walking, times/week	2.7 (3.4)	7.3 (10.9)	<0.0001	1.2 (2.5)	6.5 (10.6)	<0.0001	
	Mean (SD) moderate, times/week	2.7 (3.5)	3.9 (6.0)	<0.0001	1.3 (2.7)	2.6 (4.5)	<0.0001	
	Mean (SD) vigorous, times/week	5.2 (6.6)	4.8 (6.9)	0.16	4.9 (5.7)	4.6 (8.8)	0.03	
Alcohol	Non-drinker	4	5	<0.0001	4	5	<0.0001	
	Occasional light drinker ^g	6	6		5	6		
	Occasional heavy drinker ^h	7	8		5	6		
	Regular drinker	8	10		10	10		
	Ex-drinker	7	8		5	6		
Smoking	Non-smoker	5	7	<0.0001	5	5	<0.0001	
	Current smoker	8	11		9	7		
Drunk-driving	No	6	7	<0.0001	5	6	<0.0001	
	Yes	9	8		7	6		
Frontseat seatbelt	Always	6	7	0.002	5	5	<0.0001	
	Sometimes	8	9		5	6		
	Never use	9	8		4	7		
	Vehicle does not have one	8	10		3	9		
Backseat seatbelt	Always	8	6	<0.0001	5	6	<0.0001	
	Sometimes	7	7		5	5		
	Never use	7	8		4	5		
	Vehicle does not have one	7	7		5	5		
Helmet (motor cycle)	Always	8	8	<0.0001	5	6	0.61	
	Sometimes	7	8		4	5		
	Rarely or never use	4	5		3	4		

SD, standard deviation.

^aCumulative incidence based on 1-year recall (injured cases/number of participants).

^bUS \$1 = 42 Baht in 2005, US \$1 = 34 Baht in 2013.

^cBased on residence aged 12 years and in 2005 or 2013.

^dMean of summed scores for four social capital questions (4 point scale, 0 to 3); lowest score (0) vs highest score (12).

^eMean of summed scores for three of the standard Kessler questions related to anxiety (5 point scale, 0 to 4); healthiest score (0) vs worst score (12).

^fMean frequency (times/week) for each level (walking, moderate, or vigorous).

^gOccasional light drinker = less than 4 glasses per time in 2005; less than 4 glasses per week in 2013.

^hOccasional heavy drinker = 4 or more glasses per time in 2005; 4 or more glasses per week in 2013.

Table 3. Risk factor comparisons for non-traffic injury in Thai cohort between 2005 and 2013

		Injured cases - cumulative incidence (%) ^a or mean (SD)					
		Men			Women		
		2005	2013	<i>P</i> -value	2005	2013	<i>P</i> -value
Overall incidence		23	13		17	11	
Socio-demographic factors							
Mean (SD) age, years		33.7 (8.8)	42.0 (9.0)	<0.0001	30.6 (8)	39.6 (8.3)	<0.0001
Education	High school or lower	24	16	<0.0001	18	13	<0.0001
	Post-high school	24	15		18	13	
	University or higher	19	13		16	11	
Income, Baht ^b	≤7000	26	18	<0.0001	20	15	<0.0001
	7001–20 000	23	14		16	11	
	≥20 000	18	12		14	10	
Marital status	Not married	24	14	<0.0001	18	12	<0.0001
	Married	22	13		16	11	
Location	Bangkok	21	13	0.15	18	12	0.07
	Central/East	23	13		17	11	
	North	23	14		15	11	
	Northeast	24	13		18	10	
	South	21	15		18	13	
Residence	Rural	23	14	0.04	17	11	<0.0001
	Urban	22	13		18	11	
Life-course migration ^c	Rural & Rural	23	14	0.06	17	11	0.0008
	Rural & City	22	13		18	10	
	City & Rural	28	14		19	11	
	City & City	22	13		17	13	
Job	Professional/manager	23	12	<0.0001	17	11	<0.0001
	Skilled worker/manual labor	26	16		20	14	
	Office assistance	20	13		16	11	
Mean (SD) social support score ^d		6.6 (2.3)	6.8 (2.6)	0.12	6.6 (2.2)	6.7 (2.6)	0.003
Health and behavior							
Mean (SD) psychological distress score ^e		5.9 (2.1)	4.3 (2.2)	<0.0001	6.1 (2.1)	4.4 (2.2)	<0.0001
Exercise ^f	Mean (SD) walking, times/week	2.8 (3.8)	6.8 (9.1)	<0.0001	1.4 (2.9)	6.4 (9.4)	<0.0001
	Mean (SD) moderate, times/week	2.6 (3.7)	3.6 (5.0)	<0.0001	1.6 (3.2)	2.4 (5.0)	<0.0001
	Mean (SD) vigorous, times/week	5.2 (6.4)	4.6 (5.6)	<0.0001	5.3 (6.4)	4.4 (6.1)	<0.0001
Alcohol	Non-drinker	19	13	<0.0001	15	11	<0.0001
	Occasional light drinker ^g	23	13		19	12	
	Occasional heavy drinker ^h	23	14		19	12	
	Regular drinker	23	13		20	13	
	Ex-drinker	25	15		21	14	
Smoking	Non-smoker	20	13	<0.0001	17	11	<0.0001
	Current smoker	24	15		24	15	
Drunk-driving	No	22	13	<0.0001	20	12	<0.0001
	Yes	25	14		21	13	
Frontseat seatbelt	Always	22	13	<0.0001	17	11	<0.0001
	Sometimes	24	15		17	12	
	Never use	26	17		18	11	
	Vehicle does not have one	27	15		15	15	
Backseat seatbelt	Always	24	13	<0.0001	18	12	<0.0001
	Sometimes	23	13		18	11	
	Never use	23	14		17	11	
	Vehicle does not have one	22	13		17	11	
Helmet (motor cycle)	Always	24	14	<0.0001	18	11	<0.0001
	Sometimes	23	15		17	11	
	Rarely or never use	23	14		17	12	

SD, standard deviation.

^aCumulative incidence based on 1-year recall (injured cases/number of participants).^bUS \$1 = 42 Baht in 2005, US \$1 = 34 Baht in 2013.^cBased on residence aged 12 years and in 2005 or 2013.^dMean of summed scores for four social capital questions (4 point scale, 0 to 3); lowest score (0) vs highest score (12).^eMean of summed scores for three of the standard Kessler questions related to anxiety (5 point scale, 0 to 4); healthiest score (0) vs worst score (12).^fMean frequency (times/week) for each level (walking, moderate, or vigorous).^gOccasional light drinker = less than 4 glasses per time in 2005; less than 4 glasses per week in 2013.^hOccasional heavy drinker = 4 or more glasses per time in 2005; 4 or more glasses per week in 2013.

Table 4. Association between alcohol consumption and incidence of non-fatal injury in 2005 and 2013

	2005						2013					
	Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 1 ^a		Model 2 ^b		Model 3 ^c	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Traffic injury												
Alcohol												
Non-drinker	ref		ref		ref		ref		ref		ref	
Occasional light drinker ^d	1.34	(1.19–1.51)	1.32	(1.16–1.49)	1.24	(1.08–1.42)	1.27	(1.13–1.43)	1.20	(1.05–1.37)	1.04	(0.90–1.20)
Occasional heavy drinker ^e	1.77	(1.57–2.00)	1.58	(1.37–1.81)	1.16	(0.98–1.38)	1.76	(1.58–1.96)	1.55	(1.35–1.78)	1.15	(0.97–1.37)
Regular drinker	2.14	(1.78–2.57)	1.98	(1.62–2.43)	1.20	(0.93–1.54)	2.29	(1.93–2.72)	2.01	(1.64–2.47)	1.29	(1.00–1.66)
Ex-drinker	1.43	(1.20–1.70)	1.34	(1.12–1.61)	1.24	(1.01–1.52)	1.41	(1.24–1.6)	1.29	(1.11–1.50)	1.19	(1.02–1.40)
Non-traffic injury												
Alcohol												
Non-drinker	ref		ref		ref		ref		ref		ref	
Occasional light drinker ^d	1.36	(1.27–1.45)	1.35	(1.26–1.45)	1.32	(1.22–1.42)	1.13	(1.04–1.22)	1.13	(1.03–1.24)	1.07	(0.97–1.18)
Occasional heavy drinker ^e	1.56	(1.46–1.67)	1.42	(1.31–1.54)	1.27	(1.15–1.41)	1.22	(1.12–1.32)	1.23	(1.11–1.36)	1.05	(0.92–1.19)
Regular drinker	1.58	(1.41–1.78)	1.40	(1.24–1.59)	1.17	(1.01–1.37)	1.17	(1.01–1.36)	1.05	(0.88–1.25)	0.89	(0.73–1.10)
Ex-drinker	1.59	(1.44–1.74)	1.46	(1.32–1.61)	1.47	(1.32–1.64)	1.30	(1.18–1.42)	1.25	(1.12–1.39)	1.22	(1.09–1.36)
Overall injury^f												
Alcohol												
Non-drinker	ref		ref		ref		ref		ref		ref	
Occasional light drinker ^d	1.36	(1.27–1.45)	1.35	(1.26–1.44)	1.32	(1.22–1.43)	1.16	(1.08–1.25)	1.15	(1.06–1.24)	1.07	(0.98–1.17)
Occasional heavy drinker ^e	1.56	(1.46–1.67)	1.42	(1.31–1.53)	1.27	(1.15–1.40)	1.37	(1.28–1.47)	1.32	(1.20–1.44)	1.09	(0.97–1.22)
Regular drinker	1.59	(1.41–1.78)	1.40	(1.24–1.59)	1.17	(1.00–1.36)	1.45	(1.28–1.65)	1.30	(1.12–1.51)	1.01	(0.84–1.20)
Ex-drinker	1.59	(1.44–1.74)	1.47	(1.33–1.62)	1.46	(1.31–1.63)	1.29	(1.19–1.40)	1.24	(1.13–1.37)	1.18	(1.07–1.31)

^aLogistic regression injury odds ratio estimates for alcohol consumption categories (Not-adjusted).

^bAdjusted for socio-demographic factors (age in years, sex, education, income, job, marital status, region, rural/urban residence, life course urbanization, social support).

^cFurther adjusted for mental health, health behaviors, and risk-taking behavior: psychological distress (Kessler score), health behavior (exercise level, smoking), and risk-taking behaviors (drunk-driving, non-use of front or back seatbelts or helmets).

^dOccasional light drinker = less than 4 glasses per time in 2005; less than 4 glasses per week in 2013.

^eOccasional heavy drinker = 4 or more glasses per time in 2005; 4 or more glasses per week in 2013.

^fOverall injury means incidence of either traffic or non-traffic injury.

aggregated, but the categories reported from 2005 and 2010 showed minimal change, as follows: accidental falls (16% in 2005 and 17% in 2010), assaults (10% in 2005 and 9% in 2010), and intentional self-harm (4% in 2005 and 2010).²⁷

In our cohort, drinking declined, and the proportion of non-drinkers increased in both sexes from 2005 to 2013. This trend was similar to Thai national data: since 2001, the number of regular alcohol drinkers in Thailand fell from 16.2 million to 14.9 million. The rate of new female drinkers fell from 5.6% in 2003 to 1.8% in 2009, and there was a 16 000 million baht reduction in expenditure on alcohol between 2008 and 2011.⁶

Compared to 2005, the cohort was better off in 2013 for many health indicators. They walked and engaged in moderate exercise more frequently, drank less alcohol, smoked less, had less psychological stress, and did less drunk-driving. These results suggest that, over the 8 years, cohort members had developed greater health consciousness than in 2005, which could have contributed to reduction in the incidence of injury in 2013.

The association between alcohol consumption and both traffic and non-traffic injury weakened from 2005 to 2013. Accordingly, the association of overall injury and alcohol had a similar trend, generally weakening and losing statistical significance from 2005 to 2013. However, ex-drinkers in 2013 still had significantly higher odds of injury, even after

adjusting for other factors, than other consumers of alcohol or non-drinkers. This may be an example of reverse causation, whereby people stop consuming alcohol after they are injured, but we are not able to determine cause and effect.

Individuals whose socio-economic status (SES) improved between 2005 and 2013 had less injury than those who saw a decline, especially men. A study in the United States showed that individuals with lower SES had higher injury mortality than those with higher SES,²⁸ perhaps because of health-compromising behaviors (eg, smoking and drinking), a rationale that was also suggested in a longitudinal study of increased injury mortality in young Finns.²⁹ We expect that national economic development improves population working or living conditions and contributes to falling rates of injury overall.

Traffic injury interacts with modernization. At first, unregulated motorization, urbanization, and industrialization converge to increase dangerous use of motor vehicles and risk of traffic injury.³⁰ However, as economic development proceeds, the risk environment improves. This is what we found in our Thai cohort 8 years after baseline. At the endpoint in 2013, traffic injury incidence had fallen, and fewer people reported drunk-driving. However, there was little change in the proportion reporting lack of backseat seatbelts or who never choose to wear them.

Alcohol is a known determinant of transport risk,^{31–33} and, in Thailand, it is implicated in 40%–50% of traffic injuries.³⁴ Since 1994, Thailand has legally set the blood alcohol limit for driving at 0.05 g/100 mL or “0.05%”, but enforcement has been hindered by lack of testing equipment, as well as political and logistical issues.³⁵ Since 2008, Thailand has enforced the drunk-driving law and has instituted other preventive programs directed at alcohol use and road safety.³⁶ However, there is more to be done to enhance traffic safety, and the national toll remains high.

We found that non-fatal injury in the cohort fell from 2005 to 2013. This is a good result, as our cohort is dominated by younger adults (with a median age of 30 years in 2005). Non-traffic injury deaths, such as suicide, homicide, and drownings, were ranked in the top 10 causes of death in men aged 15–49 years in Thailand.³⁷ Therefore, any decline in injury for men will reduce the population burden of ill health.

The present cohort study has several advantages. The cohort is large, and members are community-embedded distance learners, a group adept at responding to postal questionnaires and providing epidemiological and socio-demographic information. As recommended, we also gathered information on risk-taking behavior.^{17,23} Comparable studies from hospital emergency departments capture only the most severe cases. Our study could contribute to the understanding of community trends of non-fatal injury, which are often overlooked due to inadequate or inaccessible health facilities.³⁸

Our 8-year analyses are derived from a subset of the original TCS generated in 2005. The main reason for non-responses over the follow-up period was loss of contact with younger, mobile cohort members. There was a small but significant tendency for the lost group to experience more injuries (at baseline: 22.5% for the lost group vs 20.4% for the followed group); likewise, we could also anticipate higher rates of drinking and personal risk taking among non-respondents. This implies that the risks and trends presented here among the respondents are conservative and that the associations noted are likely to be valid.

The study has limitations, as it relies on subjective recall of injury (exceeding the threshold of medical care or interfering with daily activity) and self-reported consumption of alcohol. Both approaches are common in injury and alcohol research. Injury and alcohol consumption are usually under-reported in population studies,^{39,40} suggesting that our findings could be conservative. Our alcohol categories of non-, ex-, and regular drinkers were comparable between the 2005 and 2013 survey. However, occasional heavy and light drinkers may not be comparable due to the different questions. The attenuated association between alcohol consumption and non-traffic injury in 2013 was observed for each of the alcohol consumption categories. Additionally, our cross-sectional analyses might encounter reverse causation between determinants and injury outcome.²⁴ Another limitation of our study was the statistical rarity of heavy-drinking women.

Accordingly, in the final table linking alcohol and injury, we did not stratify relative effect estimates by sex.

Conclusions

Our large nationwide Thai cohort of distance-learning adult Open University students shows that injury and alcohol consumption decreased substantially during the study period. The 2005 baseline association between non-fatal injury and alcohol consumption patterns became weaker by 2013. Over this period, people who engaged in more healthy behaviors were less likely to have non-fatal injury. Changing social circumstances and health promotion about the dangers of alcohol may have weakened the relationship between alcohol and non-fatal injury. This finding may indicate that similar changes will soon be underway in the greater Thai population. Thais, and potentially other Southeast Asian groups, may be responsive to laws, regulation, and national health promotion on responsible drinking and injury prevention.

ONLINE ONLY MATERIAL

Abstract in Japanese.

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