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SHORT REPORT

High carbonated soft drink consumption is associated with externalizing but not internalizing behaviours among university students in five ASEAN states

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Background: The investigation aimed to estimate the association between carbonated soft drink consumption frequency and externalizing and internalizing behaviour among university students in five ASEAN counties.

Methods: A cross-sectional survey included 3353 university students from Indonesia, Malaysia, Myanmar, Thailand and Vietnam, median age 20 years (interquartile range 3 years).

Results: In all five ASEAN countries, the study found a prevalence no soft drink consumption in the past 30 days of 20.3%, less than one time a day 44.7%, once a day 25.4% and two or more times a day 9.6%. In the adjusted logistic regression analysis, higher frequency of soft drink consumption (one and/or two or more times a day) was associated with externalizing behaviour (in physical fight, injury, current tobacco use, problem drinking, drug use, pathological internet use and gambling behaviour), and higher frequency of soft drink consumption (two or more times a day) was associated with depression in females, but no association was found for the general student population in relation to internalizing behaviour (depression, posttraumatic stress disorder, suicidal ideation, suicide plan, suicide attempt and sleeping problem).

Conclusions: Findings suggest that carbonated soft drink consumption is associated with a number of externalizing but not internalizing health risk behaviours.

Keywords: soft drink consumption, addictive behaviour, substance use, mental distress, university students, ASEAN

Introduction

Soft drink consumption has been associated with increased body weight, oral and medical problems.[1] Less is known about soft drink consumption and health risk behaviours. Among adolescents, an association between soft drink consumption and health risk behaviours, including substance use, interpersonal violence, injury and poor mental health was found.[2–9] Little is known about the relationship between soft drink consumption and health risk behaviours, including substance use and poor mental health, among emerging adults in Asia.

In a sample of adults in South Australia, Shi et al[10] found that high levels of soft drink consumption were positively associated with depression, stress-related problem, suicidal ideation, psychological distress and a current mental health condition.

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In a study among young women in Texas, USA, "Posttraumatic Stress Disorder (PTSD) symptoms were associated with increased frequency of soda consumption."[11] Several studies found an association between soft drink consumption and depression, eg among female university students in the UK,[12] among adult women in Finland,[13] university students in Ethiopia,[14] among adults in USA,[15] China,[16] Indonesia,[17] and Brazil.[18] A study among adults in Indonesia found an association between soft drink consumption and insomnia).[19]

To our knowledge we could not find any study investigation soft drink consumption and health risk behaviours in emerging adults in Asia. The aimed at investigating the relationship between soft drink consumption frequency and externalizing and internalizing behaviours among university students in five ASEAN countries.

Methods

Sample and procedure

A cross-sectional survey included 3266 university students from five ASEAN countries (Indonesia: Yogyakarta, Malaysia: Kuala Lumpur, Myanmar: Yangon, Thailand: MahaSarakham and Vietnam: Hanoi), median age 20 years (Interquartile Range 3 years). Details of the sampling and data collection procedures have been described previously.[20] Briefly, one university per country was selected by purposeful sampling. In each university, a stratified random sampling procedure was used to randomly select undergraduate students for participating in the survey.[20]

In a class room setting, external research assistants administered a questionnaire and took anthropometric measurements, after informed consent had been obtained from all participating students.[20] Ethics approvals were obtained from all participating universities: "University of Malaya Medical Ethics committee (MECID 201412–905)", "Research and Ethical Committee of University of Medicine 1", "Committee for Research Ethics (Social Sciences) of Mahidol University (MU-SSIRB 2015/116(B2)", "Committee of Research Ethics of Hanoi School of Public Health", and "Research Ethics Committee, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta."

Measures

Outcome variables

Physical fighting was assessed with one item: "During the past 12 months, how many times were you in a physical fight?" Responses were grouped into 0=0 times and 1=1 or more times.[21]

Injury requiring medical attention was assessed with three questions: 1) "In the past 12 months, have you been involved in a road traffic crash as a driver, passenger, pedestrian, or cyclist?" 2) "Did you have any injuries in this road traffic crash which required medical attention?" 3) "In the past 12 months, were you injured accidentally, other than the road traffic crashes which required medical attention?"[22]

Tobacco use was assessed with one question: "Do you currently use one or more of the following tobacco products (cigarettes, snuff, chewing tobacco, cigars, etc.)?" (Yes, No).[23]

Problem drinking was assessed with the "Alcohol Use Disorders Identification Test–Consumption (AUDIT-C)".[24] (Cronbach alpha was 0.89).

Drug use (in the past 12 months) was measured with one question: "How often have you taken drugs in the past 12 months, other than prescribed by the health care provider?" Responses were grouped into 0=0 times and 1=1 or more times.[20]

Pathological internet use was measured with the "Young Diagnostic Questionnaire for Internet Addiction (YDQ)."[25] (Cronbach alpha 0.70).

Gambling behaviour was measured with the "South Oaks Gambling Screen (SOGS),"[26] and classified as 0=none and any of nine gambling behaviours=1. (Cronbach alpha 0.87)

Depressive symptoms were measured with the "Center for Epidemiologic Studies Depression Scale (CES-D, 10 items)", with scores of 15 or more classifying severe depression.[27] (Cronbach's α =0.69).

Posttraumatic stress disorder (PTSD) was assessed with a 7-item questionnaire on past month PTSD symptoms.[28] (Cronbach alpha =0.77).

Suicidal behaviours (ever ideation, plan and attempt) were adapted from a study by Osman et al.[29]

Sleeping problems were defined as "severe or extreme having a problem with sleeping, such as falling asleep, waking up frequently during the night, or waking up too early in the morning in the past 30 days?"[30]

Exposure variables

"Soft drink consumption" was measured with the question, "During the past 30 days, how many times per day did you usually drink carbonated soft drinks (do not include diet

soft drinks)?"[21] Responses were grouped into 1=I did not drink carbonated soft drinks during the past 30 days, 2=Less than one time per day, 3= 1 time per day, and 4= 2 times per day, or 3 times per day, or 4 times per day, or 5 or more times per day.[21]

Confounding variables

Socio-demographic items included country, age, sex, and subjective wealth status.[20]

Social support was assessed with three questions from the "Social Support Questionnaire."[31] (Cronbach alpha 0.65).

Body mass index (BMI) was assessed with anthropometric measures, and classified following Asian criteria: "underweight (<18.50 kg/m^2), normal weight (18.50 to 22.99 kg/m^2), overweight (23.00 to 24.99 kg/m^2), and 25.00+ kg/m^2 as obese."[32]

Physical activity was assessed with the "International Physical Activity Questionnaire (IPAQ) short-form questionnaire", and classified as "low, moderate and high physical activity."[33,34]

Data analysis

Descriptive statistics were applied in order to present tabulations. Logistic regression was utilized to estimate the odds ratios (with 95% confidence interval=CI) for each behaviour outcome separately, in model 1 the outcome was adjusted by country and in model 2 the outcome was adjusted for country, sex, age, wealth status, social support, body weight status, and physical activity. Potential multi-collinearity between variables was assessed with variance inflation factors, none of which exceeded a value of 1.5. $P<0.05$ was considered significant. Missing data were not included in the analysis. All statistical procedures were performed using STATA software version 15.0 (Stata Corporation, College Station, TX, USA).

Results

Sample characteristics

The study sample included 3353 university students (median age 20 years, interquartile range=3) from Indonesia (n=231), Malaysia (n=1023), Myanmar (n=485), Thailand (n=799) and Vietnam (n=815). Majority of the participants (62.9%) were female and had a low wealth status (67.0%). Regarding externalizing behaviour, 6.5% of the students reported having been in a physical fight in the past year, 15.4% had sustained a serious injury in the past year, 3.3% were current tobacco users, 15.8% problem drinkers, 8.4% had used drugs in the past year, 35.5% had engaged in pathological internet use, 3.1% gambled weekly, and 55.0 skipped breakfast. In terms of internalizing behaviour, 10.6% had depression, 24.4% PTSD, 11.6% suicidal ideation, 5.0% had a suicide plan, 2.8% had attempted suicide, and 4.5% had sleep problems. In all five ASEAN countries, the study found a prevalence no soft drink consumption in the past 30 days of 20.3%, less than one time a day 44.7%, once a day 25.4% and two or more times a day 9.6%. (see Table 1).

Associations between soft drink consumption frequency and externalizing behaviours

In the final adjusted logistic regression analysis (model 2), higher frequency of soft drink consumption (one and/or two or more times a day) was associated with in physical fight (Adjusted Odds Ratio-AOR: 1.87, Confidence Interval-CI: 1.23, 2.87), injury (AOR: 1.94, CI: 1.42, 2.65), current tobacco use (AOR: 4.74, CI: 1.93, 11.65), problem drinking (AOR: 4.00, CI: 2.73, 5.86), drug use (AOR: 2.44, CI: 1,45, 4.09), pathological internet use (AOR: 1.88, CI: 1.41, 2.51) and gambling behaviour (AOR: 2.83, CI: 1.30, 6.16) (see Table 2).

Associations between soft drink consumption frequency and internalizing behaviours

In the final adjusted logistic regression analysis (model 2), higher frequency of soft drink consumption (two or more times a day) was associated with depression in females (AOR: 1.34, CI 1.06, 1.67; analysis not shown), but no association was found for the general student population in relation to depression (AOR: 1.21, CI: 0.79, 1.86), PTSD (AOR: 1.01, CI: 0.73, 1.40), suicidal ideation (AOR: 1.16, CI: 0.77, 1.77) suicide plan (AOR: 1.23, CI: 0.72, 2.11), suicide attempt (AOR: 1.10, CI: 0.56, 2.17) and sleeping problem (AOR: 0.44, CI: 0.19, 1.02) (see Table 3).

Discussion

This investigation gives new data on the association between soft drink consumption and externalizing and internalizing behaviours among university students in five ASEAN countries. The study found a prevalence of once or more times daily soft drink consumption of 35.0%, which is lower than the prevalence of at least once daily soft drink consumption in 53 low- and middle-income countries among school-going adolescents (54.3%).[35]

Table 1 Sample characteristics of Association of Southeast Asian Nations university students

Variable (#missing cases)		Carbonated soft drinks during the past 30 days			
	Sample N (%)	None %	<once/day %	Once/day %	≥2 times/day %
Sociodemographic					
All	3353	20.3	44.7	25.4	9.6
Country (#0)					
Indonesia	231 (6.9)	33.8	41.6	19.5	5.2
Malaysia	1023 (30.5)	26.1	59.5	10.8	3.6
Myanmar	485 (14.5)	6.2	10.6	67.2	15.3
Thailand	799 (23.8)	9.3	26.8	33.2	20.8
Vietnam	815 (24.3)	28.5	61.3	6.3	3.9
Age in years (#0)					
18–19	994 (29.6)	19.7	40.0	28.8	11.5
20–21	1496 (44.7)	18.5	41.9	30.2	9.4
22–30	863 (25.7)	24.1	55.0	13.1	7.8
Gender (#0)	2108 (62.9)	21.9	40.9	26.3	10.9
Female	1245 (37.1)	17.7	51.2	23.9	7.3
Male					
Wealth status (#0)					
Low	2245 (67.0)	19.3	43.6	26.9	10.3
High	1108 (33.0)	22.4	47.1	22.4	8.1
Externalizing behaviour					
In a physical fight (past year) (#5)	218 (6.5)	5.3	3.4	12.2	8.8
Injury (past 12 months) (#58)	509 (15.4)	11.1	14.5	19.7	18.3
Tobacco use (current) (#0)	110 (3.3)	1.3	2.9	4.7	5.3
Problem drinking (#19)	527 (15.8)	8.5	14.4	18.7	30.4
Drug use (past year) (#156)	270 (8.4)	5.5	6.8	13.1	11.6
Pathological internet use (#47)	1174 (35.5)	32.1	35.8	32.8	48.4
Gambling (weekly) (#158)	99 (3.1)	1.8	2.0	6.0	7.2
Skipping breakfast (#5)	1842 (55.0)	48.5	56.9	52.8	65.7
Internalyzing behaviour					
Depression (severe)(#0)	354 (10.6)	11.3	9.0	9.9	18.1
PTSD (#46)	807 (24.4)	23.8	25.4	22.8	24.9
Suicidal ideation (#38)	385 (11.6)	12.2	10.8	11.3	15.1
Suicide plan(#39)	166 (5.0)	6.2	4.8	3.2	8.4
Suicide attempt (#42)	91 (2.8)	3.8	1.9	2.5	4.9
Sleeping problem (#8)	152 (4.5)	4.7	5.4	3.7	2.5
Confounding factors					
Social support (#21)					
Low	1565 (47.0)	19.1	43.1	26.6	11.2
High	1767 (53.0)	21.5	46.7	23.7	8.0
Body weight status (#208)					
Normal	1758 (55.9)	21.7	49.1	20.5	8.6
Underweight	675 (21.5)	20.0	42.4	25.9	11.7
Overweight	318 (10.1)	22.0	44.7	24.5	8.8

(*Continued*)

Table 1 (Continued).

Variable (#missing cases)		Carbonated soft drinks during the past 30 days			
	Sample N (%)	None %	<once/day %	Once/day %	≥2 times/day %
Obesity	394 (12.5)	17.5	44.9	27.7	9.9
Physical activity (#25)					
Low	1810 (54.4)	19.6	42.5	27.3	10.6
Moderate	1014 (30.5)	23.4	50.1	19.6	6.9
High	504 (15.1)	17.1	42.9	30.0	10.1

Table 2 Associations between soft drink use frequency and externalizing behaviours

Carbonated soft drink consumption	AOR (95% CI)[a]	AOR (95% CI)[b]
	In physical fight	In physical fight
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	0.68 (0.44, 1.06)	0.61 (0.39, 0.95)*
1 time/day	2.40 (1.61, 3.56)***	1.87 (1.23, 2.87)**
≥2 times/day	1.93 (1.15, 3.24)*	1.48 (0.85, 2.59)
	Injury	Injury
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.28 (0.97, 1.70)	1.29 (0.97, 1.72)
1 time/day	2.05 (1.52, 2.71)***	1.94 (1.42, 2.65)***
≥2 times/day	1.67 (1.15, 2.43)*	1.47 (1.00, 2.17)*
	Current tobacco use	Current tobacco use
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	2.32 (1.13, 4.79)*	2.08 (0.96, 4.02)
1 time/day	3.62 (1.75, 7.52)***	3.57 (1.59, 8.02)**
≥2 times/day	4.34 (1.92, 9.87)***	4.74 (1.93, 11.65)***
	Problem drinking	Problem drinking
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.67 (1.22, 2.27)***	1.73 (1.26, 2.37)***
1 time/day	2.65 (1.92, 3.66)***	2.76 (1.96, 3.88)***
≥2 times/day	4.33 (3.01, 6.23)***	4.00 (2.73, 5.86)***
	Drug use (past 12 months)	Drug use (past 12 months)
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.35 (0.91, 1.99)	1.44 (0.97, 2.14)
1 time/day	2.54 (1.71, 3.78)***	2.22 (1.45, 3.38)***
≥2 times/day	2.51 (1.53, 4.10)***	2.44 (1.45, 4.09)***
	Pathological internet use	Pathological internet use
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.15 (0.95, 1.40)	1.16 (0.95, 1.41)
1 time/day	1.06 (0.85, 1.31)	1.18 (0.94, 1.49)
≥2 times/day	1.92 (1.46, 2.52)***	1.88 (1.41, 2.51)***

(*Continued*)

Table 2 (Continued).

Carbonated soft drink consumption	AOR (95% CI)[a]	AOR (95% CI)[b]
	Gambling behaviour	Gambling behaviour
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.05 (0.54, 2.08)	0.96 (0.48, 1.92)
1 time/day	3.05 (1.53, 6.08)**	2.42 (1.19, 4.94)*
≥2 times/day	3.66 (1.72, 7.78)***	2.83 (1.30, 6.16)**

Notes: [a]adjusted by country; [b]adjusted for country, sex, age, wealth status, social support, body weight status, and physical activity; ***P<0.001, **P<0.01, *P<0.05.
Abbreviations: AOR, Adjusted Odds Ratio; CI, Confidence Interval.

Table 3 Associations between soft drink use frequency and internalizing behaviours

Carbonated soft drinks consumption	AOR (95% CI)[a]	AOR (95% CI)[b]
	Depression (severe)	Depression (severe)
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	0.69 (0.51, 0.93)*	0.69 (0.51, 0.95)*
1 time/day	0.92 (0.66, 1.28)	0.88 (0.61, 1.26)
≥2 times/day	1.52 (1.04, 2.22)*	1.21 (0.79, 1.86)
	PTSD	PTSD
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.09 (0.89, 1.35)	1.08 (0.87, 1.35)
1 time/day	0.94 (0.74, 1.20)	1.03 (0.80, 1.33)
≥2 times/day	1.07 (0.78, 1.44)	1.01 (0.73, 1.40)
	Suicide ideation	Suicide ideation
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	0.92 (0.69, 1.22)	0.92 (0.69, 1.23)
1 time/day	0.89 (0.65, 1.22)	0.89 (0.63, 1.29)
≥2 times/day	1.39 (0.94, 2.03)	1.16 (0.77, 1.77)
	Suicide plan	Suicide plan
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	0.74 (0.50, 1.10)	0.75 (0.50, 1.12)
1 time/day	0.52 (0.31, 0.85)**	0.56 (0.33, 0.93)*
≥2 times/day	1.35 (0.81, 2.25)	1.23 (0.72, 2.11)
	Suicide attempt	Suicide attempt
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	0.47 (0.27, 0.80)**	0.49 (0.29, 0.85)*
1 time/day	0.67 (0.48, 1.21)	0.69 (0.38, 1.26)
≥2 times/day	1.20 (0.62, 2.30)	1.10 (0.56, 2.17)
	Sleep problem	Sleep problem
Did not drink/past 30 days	1 (Reference)	1 (Reference)
<1 time/day	1.14 (0.75, 1.74)	1.13 (0.74, 1.73)
1 time/day	0.78 (0.47, 1.29)	0.71 (0.41, 1.22)
≥2 times/day	0.51 (0.23, 1.12)	0.44 (0.19, 1.02)

Notes: [a]adjusted by country; [b]adjusted for country, sex, age, wealth status, social support, body weight status, and physical activity. Among females, ≥2 times soft drink consumption/day was AOR: 1.80 (95% CI: 1.15, 2.81)**. **P<0.01, *P<0.05.
Abbreviations: AOR, Adjusted Odds Ratio; CI, Confidence Interval.

This investigation found a consistent association between higher frequency of soft drink consumption and externalizing behaviours (in physical fight, injury, tobacco use, problem drinking, drug use, pathological internet use and gambling behaviour). These findings are consistent with a number of studies among adolescents[2-4,6–9] and novel for emerging adults. In agreement with studies among adolescents,[2,8] the strongest associations of soft drink consumption were found for substance use (alcohol, tobacco and drug use) in this study. Soft drinks contain a lot of sugar and other additives, such as caffeine,[2] which may be linked to other addictive substances, such as alcohol and nicotine. Therefore, it could be possible that the combined use of these substances increases each other's addictive effects. Health risk behaviours tend to cluster, and it therefore could be that soft drink consumption is "a marker of other dietary and life-style factors.[10]

In agreement with two previous studies,[12,13] this study found that frequent soft drink consumption among female students increased the odds for depression. The high sugar consumption from soft drinks may affect women differently than men in relation to depression.[15] However, no associations were found between soft drink consumption and other internalizing behaviours (PTSD, suicidal behaviour, and sleep problem), contrary to some previous studies.[10,11,19]

This finding supports addressing the clustering of soft drink consumption with various externalizing behaviours in university health promotion intervention in this population. Further, longitudinal studies are needed to confirm the link between soft drink consumption frequency and externalizing and internalizing behaviours among university students. In addition, more research is needed to investigate the possible mechanisms between soft drink consumption frequency and externalizing and internalizing behaviours in emerging adults.

Study limitations

The study was cross-sectional, which precludes causal inferences. Variables measured was by self-report and may have been underreported. Several study indicators were assessed with single items, and future studies should employ more comprehensive measures.

Conclusion

Study findings concur with previous results that showed an association between higher frequency of soft drink consumption and externalizing behaviours (in physical fight, injury, current tobacco use, problem drinking, drug use, pathological internet use and gambling behaviour), and higher frequency of soft drink consumption (two or more times a day) was associated with depression in females, but no association was found for the general student population in relation to internalizing behaviour (depression, PTSD, suicidal ideation, suicide plan, suicide attempt and sleeping problem).

Disclosure

The authors declare no conflicts of interest in this work.

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