Underweight and overweight or obesity and associated factors among school-going adolescents in five ASEAN countries, 2015

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ABSTRACT

Purpose: The study examined the prevalence of underweight and overweight or obesity and its correlates among in-school adolescents in five ASEAN countries (Indonesia, Laos, Philippines, Thailand and Timor-Leste) in 2015.
Methods: Cross-sectional data were analysed from 30145 school-going adolescents (median age 14 years, interquartile range = 2) from Indonesia, Laos, Philippines, Thailand and Timor-Leste that took part in the "Global School-Based Student Health Survey (GSHS)" in 2015. Body weight was examined by self-reported weight and height and the "international child body mass index standards". Associations with underweight and overweight or obesity were assessed using multinomial logistic regression analyses.
Results: The prevalence of underweight was 8.7% and overweight or obesity 14.0%. In adjusted multinomial logistic regression analysis, students residing in Timor-Leste, older age, male sex, bullying victimization and parental supervision were positively associated with underweight, while residing in Laos, current alcohol use and peer support were negatively associated with underweight. Coming from the Philippines and Timor-Leste, older age, experiencing hunger, current alcohol use, and in a physical fight decreased the odds for overweight or obesity, while male sex, fruit consumption, sedentary behaviour, physically attacked and parental bonding increased the odds for overweight or obesity.
Conclusion: High prevalences of underweight and overweight/obesity were identified in ASEAN countries and several correlates were identified which can help to tailor interventions.

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1. Introduction

Under- and over-nutrition are major risk factors of non-communicable diseases contributing to a large burden of morbidity and mortality [1]. Globally, among adolescents the prevalence underweight decreased from 1975 to 2016 ("from 9.2% to 8.4% in girls and from 14.8% to 12.4% in boys"), and the prevalence of obesity increased from 1975 to 2016 ("from 0.7% to 5.6% in girls, and from 0.9% to 7.8% in boys") [1]. For example among children and adolescents in China, mean thinness prevalence decreased from 7.5% in 1995 to 4.1% in 2014, and the overweight and obesity mean prevalence increased from $5 \cdot 3\%$ to $20 \cdot 5\%$ [2].

Based on data from the "Global School-based Student Survey (GSHS)", the underweight prevalence among girls from 40 countries was 6.3% [3], and in adolescents (12—15 years) from 58 "low- and middle-income countries (LMICs)", "the overall prevalence of weight categories was 13.4%/4.7% for underweight, 15.4%/17.3% for overweight and 5.6%/8.6% for obesity" [4], confirming "the continued dual burden of underweight and overweight in young adolescents in many LMICs." [4] In a review in ASEAN countries, under- and over-nutrition (household double burden) "ranged from 5.0% in Vietnam to 30.6% in Indonesia" [5]. Among adolescents, "there is substantial variation across and within regions in the burden of under- and overweight, with increasing dual burdens in urban areas." [6] Both under- and overweight can negatively impact on the health status in adolescence and adulthood [1,7]. For designing and evaluating intervention strategies, assessing and monitoring the prevalence of adolescent underweight, overweight

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and obesity is crucial [4,8].

Among ASEAN countries, the prevalence of underweight among school-going adolescents in the 2013 Cambodia GSHS was 14.2% [9], in Malaysia 7.3% in 2012 [10] and in Vietnam 16.4% in 2014 [11]. The prevalence of "overweight or obesity among school-going adolescents in seven ASEAN countries was 9.9%", ranging from 2.9% in Myanmar to 23.7% in Malaysia [12], and in Brunei Darussalam 35.1% [13]. There is lack of data on the more recent prevalence of underweight and overweight or obesity and its correlates in ASEAN countries (Indonesia, Laos, Philippines, Thailand and Timor-Leste).

Factors associated with underweight among adolescents may include early adolescents (12–14 years) [3], male sex [14,15], going to bed hungry sometimes [3], food insecurity (lack of access to food to meet nutritional demands) at both the household and individual levels [16], inadequate fruit and vegetable consumption [15], exercise (among girls) [17], less physical education in girls [18], physical inactivity in boys [18], alcohol use [15], have physical attacks [15], in physical fight [15], hanging out with friends in the past week [19] anxiety [15], considered themselves poor students [19].

As previously reviewed [12,20], correlates of overweight and/or obesity among adolescents include: (1) sociodemographic variables (males, younger adolescence, greater economic wealth, and wealthier country); (2) nutrition and substance use (soft drink consumption, fast food consumption, inadequate fruit consumption, and tobacco use); (3) "physical inactivity, not walking or biking to school and sedentary behaviour; (4) psychosocial factors such as being bullied, and (5) social-familial factors." The prevalence and risk factors of underweight and overweight or obesity identified may be different in more recent national school surveys in ASEAN countries. Therefore, the study examined the prevalence of underweight and overweight or obesity and its correlates among in-school adolescents in five ASEAN countries (Indonesia, Laos, Philippines, Thailand and Timor-Leste) in 2015.

2. Methods

2.1. Sample and procedure

Cross-sectional data from the GSHS of five ASEAN countries (which had collected data, as recent as 2015) were analysed. The GSHS uses a "cluster sampling design in two stages (schools and classrooms) in order to produce nationally representative samples of school children in middle schools" [21]. "Students completed a self-administered questionnaire under the supervision of trained survey administrators" [21]. The study proposal was approved by the Ministry of Education and a national ethics committee, and "necessary approvals and permission were obtained from the participating schools, parents and students before the survey was administered." [21]. "The study has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards."

2.1.1. Measures

The GSHS measure was used in this survey consisting of topics ranging from demographic information to substance use behaviour [21]. Underweight was defined "as less than -2SD from median for BMI by age and sex", and overweight or obesity was defined as "more than +1 standard deviation (SD) from the median body mass index by age and sex" [22]. Adequate fruit consumption was classified as "two or more servings in a day and adequate consumption of vegetables as three or more servings a day" [23]. Adequate physical activity was defined as "at least 60 min of moderate to vigorous-intensity physical activity daily" [24].

All questions that were used in this investigation are detailed in Table 1.

2.2. Data analysis

Data analysis was conducted with STATA software version 15.0 (Stata Corporation, College Station, TX, USA), taking into account the complex study design. Differences in proportions were tested with Chi-square statistics. Multinomial logistic regression was used to assess the associations between sociodemographic and lifestyle factors and underweight and overweight or obesity, with normal weight as reference category. Variables that were found statistically significant in bivariate analyses were subsequently included in the multivariable model. P values < 5% were considered significant.

3. Results

3.1. Sample characteristics

The study sample consisted of 30145 adolescents (median age 14 years, interquartile range = 2) with complete self-reported height and weight measurements from Indonesia (overall response rate = 94%), Laos (72%), Philippines (79%), Thailand (89%) and Timor-Leste (response rate = 79%) [21]. The participation rate of students from each country ranged from 3024 in Timor-Leste to 10554 in Indonesia. In all five ASEAN countries, the study found a prevalence of 77.3% normal weight, 8.7% underweight and 14.0% overweight or obesity.

Fifteen percent of the participants drank two or more soft drinks in a day, 17.7% had on three or more days fast foods in a week, 36.7% had two or more servings of fruit and 28.6% three or more servings of vegetable in a day, 5.0% indicated food insecurity (hunger), 12.6% were currently using tobacco, 11.6% were currently drinking alcohol and 2.1% used currently cannabis. Only 11.1% of the students were meeting the "physical activity recommendations (at least 60 min/day)", 53.9% "did not bike or walk to school", 33.2% "spent during their leisure time three or more hours sitting in a day", and 22.3% "participated in three or more days of physical education in a week". Among the eight measured psychosocial variables, the highest prevalence was physically attacked (32.1%), followed by bullying victimization (28.8%), in a physical fight (26.4%), loneliness (9.7%) and suicide attempt (7.7%). Among socio-familial influences parental respect for privacy scored the highest points (see Table 2).

3.1.1. Associations with underweight and overweight or obesity

In adjusted multinomial logistic regression analysis, students residing in Timor-Leste, older age, male sex, bullying victimization and parental supervision were positively associated with underweight, while residing in Laos, current alcohol use and peer support were negatively associated with underweight. In sex specific stratified analysis among boys, bullying victimization (Odds Ratio-OR: 1.25, Confidence Interval-CI: 1.06, 1.46) and soft drink consumption (OR: 1.25, CI: 1.02, 1.52) were positively associated with underweight, and among girls current alcohol use (OR: 0.56, CI: 0.41, 0.75) and attending physical education classes (OR: 0.77, CI: 0.62, 0.95) were negatively associated with underweight.

Coming from the Philippines and Timor-Leste, older age, experiencing hunger, current alcohol use, and in a physical fight decreased the odds for overweight or obesity, while male sex, fruit consumption, sedentary behaviour, physically attacked and parental bonding increased the odds for overweight or obesity. In sex specific stratified analysis among boys, current alcohol use (OR: 0.69, CI: 0.54, 0.89) was negatively and parental supervision (OR: 1.17, CI: 1.02, 1.33) was positively associated with overweight or obesity, and among girls, fruit consumption (OR: 1.32, CI: 1.15, 1.52) was positively associated with overweight or obesity. Higher sedentary behaviour increased in both boys (OR: 1.44, CI: 1.21, 1.72) and girls (OR: 1.30, CI: 1.12, 1.50) the odds for overweight or obesity (see Table 3).

Table 1
Variable description.

Variables	Question	Response options
Height	"How tall are you without your shoes on?"	…cm
Body weight	"How much do you weigh without your shoes on?"	…kg
Age	"How old are you?"	"11 years old or younger to 16 years old or older"
Sex	"What is your sex?"	"Male, Female"
Dietary behaviour and substance use		
Soft drinks	"During the past 30 days, how many times per day did you usually drink carbonated soft drinks, such as … country specific names?"	"1 = not in the past days to 7 = 5 or more times per day (coded 1 = 1, 2 = 2, 3 = 3 and 4–7 = 4)"
Eating food from a fast food restaurant	"During the past seven days, on how many days did you eat food from a fast food restaurant, such as … country specific names?"	"1 = 0 to 8 = 7 days (coded 1–3 = 0 and 4–8 = 1)"
Fruits	"During the past 30 days, how many times per day did you usually eat fruit such as … country specific names?"	"1 = I did not eat fruit during the past 30 days to 7 = 5 or more times per day (coded 1–3 = 0 and 4–8 = 1)"
Vegetables	"During the past 30 days, how many times per day did you usually eat vegetables, such as … country specific names?"	"I did not eat vegetables during the past 30 days to 7 = 5 or more times per day (coded 1–4 = 0 and 5–8 = 1"
Hunger	"During the past 30 days, how often did you go hungry because there was not enough food in your home?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Current tobacco use	"During the past 30 days, on how many days did you smoke cigarettes/use any tobacco products other than cigarettes, such as … country specific names?"	"1 = 0 days to 7 = All 30 days (coded 1 = 0 and 2–7 = 1)"
Current alcohol use	"During the past 30 days, on how many days did you have at least one drink containing alcohol?"	"1 = 0 days to 7 = All 30 days (coded 1 = 0 and 2–7 = 1)"
Current cannabis use	"During the past 30 days, how many times have you used marijuana (also called …. country specific names)?"	1 = 0 times to 5 = 20 or more times (coded 1 = 0 and 2–5 = 1)
Physical activity and sedentary behaviour		
Physical activity	"Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, playing with friends, or walking to school. Some examples of physical activity are … country specific examples. During the past 7 days, on how many days were you physically active for a total of at least 60 min per day?"	"0 = 0 days to 7 = 7 days (coded 0–6 = 0 and 7 = 1)"
Walking/biking to school	"During the past 7 days, on how many days did you walk or ride a bicycle to or from school?"	"0 = 0 to 7 = 7days (code 1–7 = 0 and 0 = 1)"
Sedentary behavior	"How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities, such as main play station?"	"1 = Less than 1 h per day … 3 = 3–4 h per day … 6 = 8 or more hours a day"
Physical education	"During this school year, on how many days did you go to physical education (PE) class each week?"	"1 = 0 days to 6 = 5 or more days (coded 1–3 = 0 and 4–6 = 1)"
Psychosocial factors		
No close friends	"How many close friends do you have?"	"1 = 0 to 4 = 3 or more (coded 2–5 = 0 and 1 = 1)"
Loneliness	"During the past 12 months, how often have you felt lonely?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Anxiety	"During the past 12 months, how often have you been so worried about something that you could not sleep at night?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Suicide ideation	"During the past 12 months, did you ever seriously consider attempting suicide?"	"Yes, No"
Suicide plan	"During the past 12 months, did you make a plan about how you would attempt suicide?"	"Yes, No"
Suicide attempt	"During the past 12 months, how many times did you actually attempt suicide?"	"1 = 0 times to 5 = 6 or more times (coded 1 = 0 and 2–5 = 1)"
Bullied	"During the past 30 days, on how many days were you bullied?"	"1 = 0 days to 7 = All 30 days (coded 1 = 0 and 2–7 = 1)"
Physically attacked	"During the past 12 months, how many times were you physically attacked?"	"1 = 0 times to 8 = 12 or more times (coded 1 = 0 and 2–8 = 1)"
In a physical fight	"During the past 12 months, how many times were you in a physical fight?"	"1 = 0 times to 8 = 12 or more times (coded 1 = 0 and 2–8 = 1)"
Social-familial factors		
Peer support	"During the past 30 days, how often were most of the students in your school kind and helpful?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Parental supervision	"During the past 30 days, how often did your parents or guardians check to see if your homework was done?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Parental connectedness	"During the past 30 days, how often did your parents or guardians understand your problems and worries?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Parental bonding	"During the past 30 days, how often did your parents or guardians really know what you were doing with your free time?	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"
Parental respect for privacy	"During the past 30 days, how often did your parents or guardians go through your things without your approval?"	"1 = never to 5 = always (coded 1–3 = 0 and 4–5 = 1)"

4. Discussion

The investigation aimed to estimate the prevalence of underweight and overweight or obesity and its correlates among in-school adolescents in five ASEAN countries (Indonesia, Laos, Philippines, Thailand and Timor-Leste) in 2015, and found a prevalence of 8.7% underweight, with a large country variations, ranging from 5.3% in Laos to 21.0% in Timor-Leste, and 14.0% overweight or obesity, with a country variation, ranging from 5.7% in Timor-Leste to 17.1% in Thailand. It is possible that as globally [1,2]

the prevalence of underweight has been further decreasing compared to older surveys in ASEAN countries (e.g., in Cambodia (14.2%) [9], Malaysia (7.3%) [10] and in Vietnam (16.4%) [11]. However, the prevalence of underweight (21.0%) was very high in Timor-Leste. On the other hand, as globally [1,2], the prevalence of overweight or obesity has been increasing in this survey among 5 ASEAN countries (14.0%) compared to older surveys in seven ASEAN countries (9.9%) [12]. The study confirms the dual burden of underweight and overweight among adolescents in ASEAN countries [4]. The low prevalence of underweight in Laos, compares with

Table 2
Sample characteristics and body weight status of middle school children in five ASEAN countries, 2015.

Variable	Total sample	Normal weight	Underweight	Overweight/obesity	P-value
	N (%)	N (%)			
Socio-demographics					
All	30145	77.3	8.7	14.0	
Country					
Indonesia	10554 (35.0)	76.3	7.9	15.8	<0.001
Laos	3537 (11.7)	83.7	5.3	11.1	
Philippines	7455 (24.7)	80.5	10.3	9.3	
Thailand	5575 (18.5)	74.4	8.5	17.1	
Timor-Leste	3024 (10.0)	73.4	21.0	5.7	
Age in years					
13 or less	8539 (28.3)	74.6	7.3	18.1	<0.001
14	6160 (20.4)	76.8	10.2	13.0	
15	5920 (19.6)	78.9	10.6	10.5	
16 or more	9526 (31.6)	81.5	9.9	8.5	
Sex					
Female	16769 (52.1)	81.4	7.1	11.5	<0.001
Male	13376 (47.9)	73.9	12.2	13.8	
Dietary behaviour and substance use					
Two or more carbonated soft drinks per day in the last 30 days	5187 (15.0)	77.1	10.1	12.8	0.031
Fast foods ≥3 days past 7 days	5494 (17.7)	75.0	9.5	15.6	0.002
Fruits (≥2 servings/day)	9901 (36.7)	76.4	9.4	14.2	<0.001
Vegetables (≥3 servings/day)	7921 (28.6)	77.9	8.6	13.4	0.174
Hunger (mostly/always)	1633 (5.0)	79.6	11.6	8.8	<0.001
Current tobacco use	3828 (12.6)	76.4	12.4	11.2	0.058
Current alcohol use	4313 (11.6)	79.6	9.0	11.4	<0.001
Current cannabis use	724 (2.1)	73.0	14.0	13.0	0.066
Physical activity and sedentary behaviour					
Physical activity at least 60 min per day/daily in past week	3313 (11.1)	77.7	9.0	13.3	0.121
Walk/bike to school (0 days in the past 7 days)	16299 (53.9)	76.8	10.0	13.2	0.175
Sitting (≥3 h/day)	9100 (33.2)	76.1	8.6	15.3	<0.001
Physical education ≥3 days/week	6718 (22.3)	79.8	10.0	10.2	<0.001
Psychosocial factors					
No close friends	1177 (3.7)	77.0	8.8	14.2	0.513
Loneliness	3007 (9.7)	78.7	9.3	11.9	0.363
Anxiety	2319 (7.1)	79.3	9.6	11.1	0.016
Suicidal ideation	2283 (7.6)	77.9	8.8	13.3	0.234
Suicide attempt	2461 (7.7)	78.4	9.6	14.2	0.141
Bullied	8033 (28.8)	77.0	10.8	12.2	0.003
Physically attacked	9088 (32.1)	76.0	10.8	13.2	0.004
In physical fight	7590 (26.4)	76.2	11.1	12.7	0.003
Social-familial factors					
Peer support (mostly/always)	10315 (37.8)	78.0	8.8	13.2	0.002
Parental supervision	8575 (31.4)	75.2	10.4	14.4	<0.001
Parental connectedness	8446 (32.2)	75.5	9.8	14.7	0.009
Parental bonding	10675 (38.1)	76.2	9.1	14.7	<0.001
Parental respect for privacy	20390 (63.7)	76.4	10.3	13.3	0.074

a low adult underweight prevalence (9.7%), lower than other countries in ASEAN (Indonesia, Myanmar, and Vietnam) [25]. The high prevalence of underweight in Timor-Leste compares with the Timor-Leste 2014 STETS survey among adults, 18.5% were underweight [26], higher than the prevalence of overweight or obesity (BMI ≥25.0) (11.2%) [26], indicating that Timor-Leste is only at the beginning of the epidemiological transition.

The prevalence of underweight was significantly higher in male than female school adolescents, as also found previously in low- and middle-income countries [14,15]. The prevalence of overweight or obesity was also significantly higher in male than female school adolescents in this study, which is consistent with studies in ASEAN countries (Malaysia, Thailand) [4], most countries in Europe [27], and some countries in Oceania [20]. Sex differences may be related to socioeconomic and socio-cultural factors and differences in the levels of sedentary behaviour and dietary behaviour [4]. Contrary to a previous study among girls [3], this study found that older age or late adolescents increased the odds for underweight, although this was not significant for girls (analysis not shown). These possible sex differences may be related to weight gain in girls "associated with earlier growth and sexual maturation" [4]. Older age decreased the

odds for overweight or obesity in this study, as also found among in-school adolescents in seven African countries [14] and seven ASEAN countries [12]. It is possible that this change can be attributed to greater participation in physical activity and "walking and/ or biking to school" and less soft drink and fast food consumption among older than younger adolescents (analysis not shown).

In consistence with some previous investigations in South Asia, Indonesia and Vietnam [28–30], this study found an association between no food insecurity (no hunger) or higher socioeconomic status and overweight or obesity. Students from a higher socioeconomic background may to a greater extent participate in rapid sociocultural changes, such as unhealthy diet and sedentary behaviours, and thus develop overweight [31]. This study found in bivariate analysis an association between the experience of hunger and underweight. Several other studies found that going to bed hungry [3] and food insecurity [16] were associated with underweight.

In terms of nutrition and substance use, contrary to previous studies [20,28,32], this study did not find a correlation between the consumption of fast food and soft drinks and overweight or obesity. Similar results were found in a study among adolescents in

Table 3
Associations with overweight or obesity prevalence in school going adolescents from five ASEAN countries.

Variable	Underweight	Overweight
	ARRR (95% CI)	ARRR (95% CI)
Sociodemographics		
Country		
Indonesia	1 (Reference)	1 (Reference)
Laos	0.57 (0.42, 0.77)***	0.98 (0.68, 1.42)
Philippines	1.21 (0.99, 1.49)	0.68 (0.52, 0.90)**
Thailand	1.13 (0.88, 1.46)	1.11 (0.88, 1.38)
Timor-Leste	2.64 (1.86, 3.74)***	0.57 (0.38, 0.86)**
Age in years		
13 or less	1 (Reference)	1 (Reference)
14	1.35 (1.16, 1.58)***	0.78 (0.68.0.90)
15	1.53 (1.24, 1.88)***	0.62 (0.51, 0.76)***
16 or more	1.29 (1.04, 1.59)*	0.50 (0.39, 0.86)***
Sex		
Female	1 (Reference)	1 (Reference)
Male	1.89 (1.64, 2.17)***	1.43 (1.26, 1.62)***
Dietary behaviour and substance use		
Two or more carbonated soft drinks per day in the last 30 days	1.15 (0.98, 1.36)	0.94 (0.83, 1.06)
Fast foods ≥3 days past 7 days	0.96 (0.81, 1.14)	1.07 (0.94, 1.28)
Fruits (≥2 servings/day)	1.02 (0.91, 1.14)	1.12 (1.03, 1.23)**
Hunger (mostly/always)	1.01 (0.78, 1.32)	0.79 (0.63, 0.99)*
Current alcohol use	0.84 (0.70, 0.99)*	0.80 (0.66, 0.98)*
Physical activity and sedentary behaviour		
Sitting (≥3 h/day)	0.95 (0.83, 1.08)	1.38 (1.21, 1.56)***
Physical education ≥3 days/week	0.94 (0.80, 1.10)	0.90 (0.74, 1.08)
Psychosocial factors		
Anxiety	0.83 (0.63, 1.11)	0.89 (0.72, 1.11)
Bullied	1.14 (1.01, 1.28)*	1.05 (0.92, 1.20)
Physically attacked	1.02 (0.90, 1.16)	1.14 (1.03, 1.27)*
In physical fight	0.97 (0.85, 1.10)	0.89 (0.80, 0.99)*
Social-familial factors		
Peer support (mostly/always)	0.88 (0.78, 0.98)*	1.08 (0.97, 1.20)
Parental supervision	1.13 (1.00, 1.26)*	1.04 (0.93, 1.16)
Parental connectedness	1.06 (0.95, 1.18)	1.08 (0.97, 1.21)
Parental bonding	0.93 (0.83, 1.06)	1.12 (1.00, 1.25)*

ARRR = Adjusted Relative Risk Ratio, ***P < 0.001; **P < 0.01; *P < 0.05.

Indonesia [29]. Alcohol use was in this study, among girls protective from underweight and among boys protective from overweight or obesity. In a previous study in Cambodia [15] alcohol use was associated with underweight. Some study found inadequate fruit and vegetable consumption [15] was associated with underweight, while this study did not find an association. This study found that adequate fruit consumption increased the odds for overweight or obesity, which was also found in the seven African countries study [14]. It is possible that an increase in fruit consumption is associated with a higher economic status, and accompanies other obesogenic behaviours. In contrast to previous investigations [33,34], this investigation did not find an association between tobacco use and underweight nor overweight or obesity. However, in bivariate analysis current tobacco use marginally increased the risk for underweight and decreased the risk for overweight or obesity in this study.

Recommended physical activity was found protective from underweight and from overweight or obesity in some previous studies [18,28,35,36], while no such association was found in this study. Only 11.1% of students in this investigation had "physical activity for more than 60 min/day", which is similar to a study in Brunei Darussalam [13], which also did not find an effect of physical activity on overweight or obesity. In agreement with several studies [20,29,36], this study found an association between sedentary behaviour and overweight or obesity. "Walking or biking to school" and "attending physical education classes" were not found associated with overweight or obesity in this study, while among girls attending physical education was protective from underweight. In a study among American adolescent girls less physical education [18]

and more exercise [17] was associated with underweight and in Korean adolescents attending physical education reduced the risk for overweight or obesity and increased the risk for underweight [37].

Regarding psychosocial factors, bullying victimization was, particularly among boys, associated with underweight, and while physically attacked was correlated with overweight or obesity in this study. In a physical fight was inversely associated with overweight or obesity in this study. In a study among adolescents in Cambodia [15], physical attacks and in a physical fight were associated with underweight. While some previous studies found an association between anxiety [15] and underweight, and loneliness [33] with overweight or obesity, this study did not find an association. Psychosocial factors should be linked in adolescent underweight and overweight prevention [38]. Peer support was protective from underweight and parental supervision was associated with underweight and parental bonding with overweight or obesity. In a study among American adolescents, peer support (hanging out with friends in the past week) [19] was associated with underweight.

4.1. Study limitations

The GSHS was cross-sectional so that no causal inferences can be made. Underweight and overweight or obesity may have been under- or overestimated in this study because of self-reported weight and height assessments [39]. However, a previous study among school adolescents in Malaysia found "a very good intraclass correlation between self-reported and directly measured weight

[r = 0.96] and height (r = 0.94)" [40].

5. Conclusion

A high prevalence of both underweight and overweight or obesity were found among in-school adolescents in five ASEAN countries. The study identified several factors, which may be considered in programmes designed to prevent and treat underweight and overweight or obesity in this school population.

Declaration of competing interest

The authors declare that they have no competing interests.

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