International Journal of Public Health (2019) 64:1129–1138
https://doi.org/10.1007/s00038-019-01282-5

ORIGINAL ARTICLE

Sitting time among adolescents across 26 Asia–Pacific countries: a population-based study

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Received: 9 April 2019 / Accepted: 29 June 2019 / Published online: 5 July 2019

Abstract

Objectives To assess the prevalence of sitting time (ST) and examine sex and age disparities in the prevalence among adolescents from Asia–Pacific countries.

Methods We used the Global School-based Student Health Survey data (n = 101,785) from 26 Asia–Pacific countries and computed the pooled prevalence of high ST ($\geq$ 3 h/day) using random effect meta-analysis. We used logistic regression to examine sex and age disparities in the prevalence, and meta-regression to assess whether the prevalence was associated with common global indices.

Results The overall prevalence of ST was 29.9% (95% CI 24.1–35.8) with 29.8% (24.4–35.2) among male and 29.9% (23.4–36.3) female adolescents. Males had higher odds of high ST than females in seven countries, while females had higher odds in six countries. Older adolescents had higher prevalence than their younger counterparts. High ST was more common in high-income countries and was positively associated with country Human Development Index (β = 1.28, 95% CI 0.88–1.68).

Conclusion Continued monitoring of adolescents' ST is warranted in this region to generate consistent and comparable surveillance data that can inform policies and actions for the health and well-being of the regional adolescents.

Keywords Active lifestyle · Adolescent health · GSHS · Pacific islands · Sedentary behaviour

Introduction

Non-communicable diseases (NCDs) are the leading cause of morbidity and mortality around the world, and inactive lifestyle behaviours including prolonged time in different sedentary pursuits are known risk factors (Hebestreit et al. 2019; Owen et al. 2009; Pogrmilovic et al. 2018). In modern society, a sedentary lifestyle has become more pervasive than ever before (Bauman et al. 2018; Ng and Popkin 2012). The gradual transition from labour-intensive employment to more sedentary-based occupations, easy access to discretionary sedentary pursuits, and ubiquity of motorised passive commuting have precipitated opportunities for a sedentary lifestyle (Bauman et al. 2011, 2018). This has resulted in greater increases of sedentariness in many countries around the world in recent decades (Bauman et al. 2018; Ng and Popkin 2012).

Sedentary behaviour is defined as any waking behaviour characterised by an energy expenditure $\leq$ 1.5 metabolic equivalents while in a sitting, reclining, or lying posture (Tremblay et al. 2017). Available evidence suggests that

Major Revisions: 29 May 2019.
Minor Revisions: 26 June 2019.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00038-019-01282-5) contains supplementary material, which is available to authorized users.

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excessive sedentariness is associated with poor metabolic and psychological health across the life course (Henson et al. 2013; Marshall and Ramirez 2011; Owen et al. 2009). Adolescence is the period of life when most independent lifestyle behaviours develop and therefore, adolescents are particularly vulnerable to the health consequences of sedentariness (Ayala et al. 2019). Several systematic reviews indicated that prolonged time in sitting, including screen time, among adolescents is associated with poor cardiometabolic health, unfavourable body composition, lower fitness, lower self-esteem, diminished prosocial behaviours (Carson et al. 2016), depression symptomology (Hoare et al. 2016; Liu et al. 2016; Vancampfort et al. 2018), and psychological distress (Hoare et al. 2016). Furthermore, excessive sedentary habits developed during adolescence can have long-term health consequences (Biddle et al. 2004).

Sedentary behaviour, especially in the form of high screen time and passive sitting [sitting time (ST)], is common among contemporary youth (Aubert et al. 2018a, b; Manyanga et al. 2018). Globally, adolescents aged 12–18 years spend more than half of their waking hours in different sedentary pursuits including screen-based activities such as watching television (TV) and playing video games (Bauman et al. 2018). A study of 72,845 adolescents aged 13–15 years across 34 countries around the globe reported that more than one-third spent $\geq$ 3 h/day in sitting, not including sitting at school (Guthold et al. 2010). In addition, a recent study among adolescents aged 11–18 years in 26 Latin American and the Caribbean countries found that the prevalence of ST (excluding time at school) for $\geq$ 3 h/day ranged from 24.2 to 65.0% across the countries, with 50% of the adolescents in 12 countries reporting $\geq$ 3 h/day of sitting outside of school (Aguilar-Farias et al. 2018).

The Asia–Pacific region has a high burden of NCDs with 55% of total deaths attributed to NCDs in South-East Asia and 75% in Western Pacific countries (Low et al. 2015). Changes in lifestyle behaviours paralleled with socio-epidemiological transitions have been identified as major risk factors for high NCD burden in the region (Low et al. 2015) with sedentariness seeming to be highly prevalent among adolescents in many Asia–Pacific countries (Peltzer and Pengpid 2016; Vancampfort et al. 2018). However, there is a paucity of data and regional comparisons of the prevalence of sedentary behaviours across these countries. Though a recent study reported the prevalence of ST among adolescents in seven Asia–Pacific countries (Vancampfort et al. 2018), the study reported ST data that were collected between 2003 and 2008. Hence, it is imperative to examine data that are more recent to understand possible cross-country differences in sedentariness among adolescents in the region, which can facilitate national and regional policies and programs for an active lifestyle of adolescents in the Asia–Pacific region. This is consistent with the mandates of the WHO's Global Action Plan on Physical Activity 2018–2030 (World Health Organization 2018) and other international charters (Global Advocacy Council for Physical Activity, International Society for Physical Activity and Health 2010; ISPAH International Society for Physical Activity and Health 2017). In this study, we aimed to examine prevalence of high ST and additionally investigate sex- or age-group disparities, if any, in the prevalence of high ST among adolescents in 26 Asia–Pacific countries.

Methods

Data sources and participants

Data for this study were from students of Asia–Pacific countries who participated in the Global School-based Student Health Survey (GSHS) (World Health Organization 2019). The GSHS is a population-based survey of school-going children and adolescents around the world and uses the standardised sampling technique, study methodology, and the same self-administered anonymous questionnaire across all participating countries. For countries that had more than one GSHS dataset, we used the most recent one available.

As of the 31st of January, 2019, 29 Asia–Pacific countries/territories had at least one GSHS dataset publicly available with the surveys being conducted between 2007 and 2016 (World Health Organization 2019). Of the 28 Asia–Pacific countries who had ST data in the GSHS, two (Niue, n = 141; Tokelau, n = 140) were excluded from the analyses due to their relatively small sample sizes ($n < 150$) compared to the other countries. Of the 26 remaining countries, 101,785 students aged 13–17 years completed the ST item of the survey and thus formed the analytical sample for this study. All countries included in this study provided nationally representative samples. According to the World Bank (World Bank 2018), 15 countries were classified as low- and lower-middle income, seven as upper-middle-income, and three as high-income economies. Information on Cook Island's income classification was not available.

In addition to country-level analyses in the Asia–Pacific region, an attempt was made to examine region-level pooled analyses of ST across the WHO regions. Countries of these regions who had at least one GSHS dataset (collected between 2007 and 2016) publicly available with ST information were collated for this purpose: Africa (n = 10), the Americas (n = 26), Eastern Mediterranean (n = 18), South-East Asia (n = 8), and Western Pacific region

(n = 18). The European region was excluded as there was only one country that had a comparable dataset.

Outcome

The study participants were asked the following question about the time they spend mostly sitting when they are not in school: "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?" Response options were "Less than 1 hour per day"; "1 to 2 hours per day"; "3 to 4 hours per day"; "5 to 6 hours per day"; "7 to 8 hours per day"; and "more than 8 hours per day". For this study, high ST was defined as $\geq$ 3 h/day of sitting time outside of school, as used elsewhere (Aguilar-Farias et al. 2018; Guthold et al. 2010).

Other behaviours

Cigarette smoking and alcohol consumption were assessed with the questions "During the past 30 days, on how many days did you smoke cigarettes?" and "During the past 30 days, on how many days did you have at least one drink containing alcohol?", and current smoking was defined as reporting $\geq$ 1 day in the past 30 days and current alcohol consumption as having $\geq$ 1 drink in the past 30 days, respectively. Fruit and vegetable consumption was assessed with the questions "During the past 30 days, how many times per day did you usually eat fruit, such as [*country specific examples*]?" and "During the past 30 days, how many times per day did you usually eat vegetables, such as [*country specific examples*]", and low fruit and vegetable intake was defined as having fruit and vegetables $<$ 5 times per day during the past 30 days. Fast food consumption was assessed with the question "During the past 7 days, on how many days did you eat food from a fast food restaurant, such as [*country specific examples*]?", and frequent intake was defined as eating $\geq$ 1 day in the past 7 days. Sugar-sweetened beverage was assessed with the question "During the past 30 days, how many times per day did you usually drink carbonated soft drinks, such as [*country specific examples*], and frequent intake was defined as drinking $\geq$ 1 time per day?"

Statistical analyses

Country-specific weighted estimates were computed for the prevalence of high ST and their 95% confidence interval (95% CI) for male adolescents (hereafter males), female adolescents (hereafter females) and overall, by taking into account the weighting factor that was applied to each student record to adjust for non-response and the varying probability of selection (Centers for Disease Control and Prevention 2013). This weighting factor was applied in an identical way to estimate the outcome variable of interest in each country survey where the GSHS was implemented.

Random effects meta-analysis with the DerSimonian and Laird inverse-variance method was used to generate pooled estimates of prevalence of high ST, and the high ST prevalence by country income category. *metaprop*, a Stata meta-analysis routine for binary outcomes, was used to estimate the pooled prevalence with exact method to compute the 95% CI for the estimates. Possible sex and age (13–15 vs. 16–17 years) differences were examined using logistic regression with weights. This approach was also adopted to estimate region-level pooled prevalence across the WHO regions. Logistic regression was also implemented to examine whether high ST was associated with other unhealthy behaviours such as smoking, dietary behaviours.

Meta-regression was used to assess whether prevalence of high ST was associated with common global indices, adjusted for sex and age. The global indices included country Human Development Index (2007–2016 data; a high score represents greater human development) (United Nations Development Programme 2019c), Gender Inequality Index (2005–2016 data; a higher score represents greater gender inequality) (United Nations Development Programme 2019b) and the Gini coefficient (2010–2015 data; a higher coefficient represents greater income inequality) (United Nations Development Programme 2019d). Expenditure on health (total health expenditure as percentage of GDP, 2005–2015 data) (United Nations Development Programme 2019a) was also used to assess its association with the prevalence of high ST.

Results

The mean age of participants in the analytical sample (n = 101,785) was 14.7 (SD 1.29; range 13–17) years, and 52.5% were females. Response rate ranged from 65% in Brunei Darussalam and Cook Island to 96% in Vietnam (Table 1).

The overall weighted pooled prevalence of high ST was 29.9% (95% CI 24.1–35.8). The prevalence increased with the increase of country's economic status with a pooled prevalence of 22.9% (17.7–28.3) in low- and lower-middle-income countries, 36.6% (27.7–45.5) in upper-middle-income countries, and 44.8% (33.1–56.5) in high-income countries. The highest prevalence was in Thailand (56.3%, 54.6–58.1), and the lowest was in Myanmar (10.5%, 9.4–11.7) (Fig. 1). Over a third of the adolescents reported high ST in 42% (n = 11) of the participating countries with three from high-income countries, four from upper-middle-

Table 1 Descriptive characteristics of each of the Asia–Pacific countries included in the study, Global School-based Student Health Survey, 2007–2016

Country	Survey year	Country income classification	Response rate (%)	Analytical sample	Females (%)	13–15 years (%)
Bangladesh	2014	LMC	91	2777	59.0	92.4
Brunei Darussalam	2014	HIC	65	2380	53.4	70.7
Cambodia	2013	LMC	85	2809	55.0	61.0
Cook Island	2015	n/a	65	649	50.5	55.9
Fiji	2016	UMC	90	2937	50.8	49.9
French Polynesia[a]	2015	HIC	70	2597	53.0	63.4
India	2007	LMC	83	7193	43.2	91.0
Indonesia	2015	LMC	94	8731	53.9	78.8
Kiribati	2011	LMC	85	1494	56.8	85.7
Laos	2015	LMC	70	3605	54.6	45.4
Malaysia	2012	UMC	89	24,984	50.1	64.2
Mongolia	2013	LMC	88	4519	53.0	68.5
Myanmar	2007	LMC	95	2524	49.6	78.4
Nauru	2011	UMC	73	456	60.5	62.7
Nepal	2015	LMC	69	5665	53.0	71.7
Philippines	2015	LMC	79	7708	55.3	72.3
Samoa	2011	UMC	79	2006	59.8	93.1
Solomon Islands	2011	LMC	85	1246	47.9	67.9
Sri Lanka	2008	LMC	89	2318	55.0	96.6
Thailand	2015	UMC	89	4897	57.6	69.8
Timor Leste	2015	LMC	79	2821	55.6	51.7
Tonga	2010	UMC	80	2059	53.7	88.4
Tuvalu	2013	UMC	90	677	51.9	68.2
Vanuatu	2011	LMC	72	868	56.7	80.5
Vietnam	2013	LMC	96	3041	53.2	57.1
Wallis and Futuna[a]	2015	HIC	82	824	54.1	65.3

[a]French Polynesia and Wallis and Futuna are overseas collectivities of the French Republic, which is a high-income country

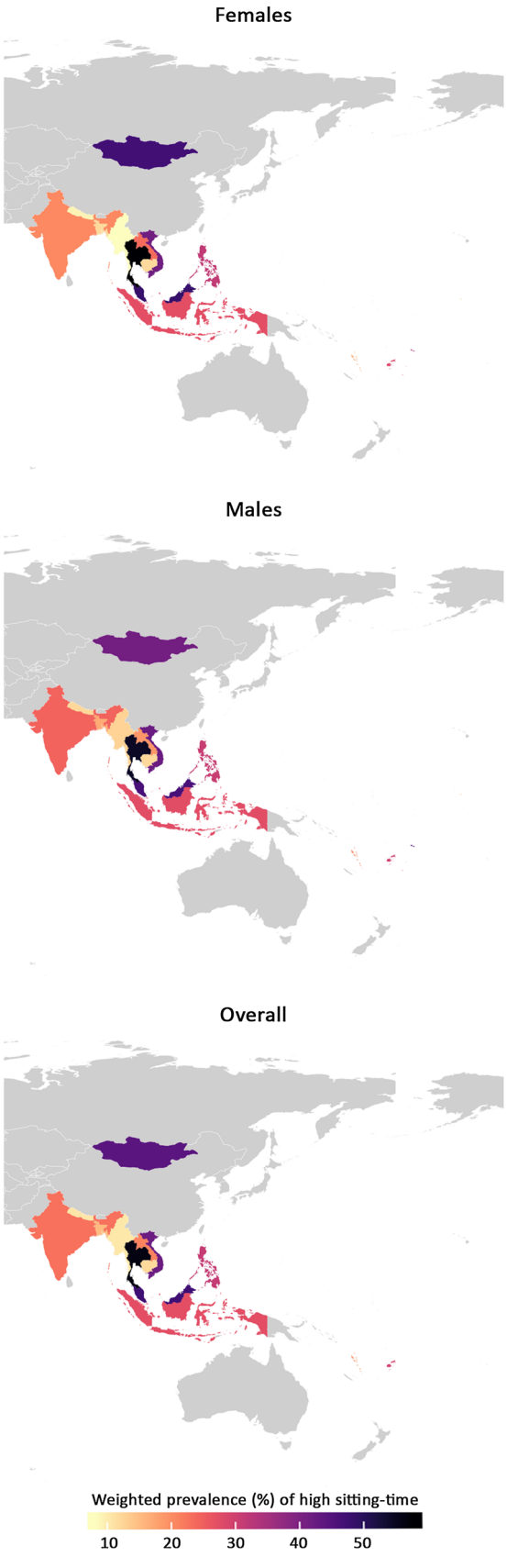
LMC low- and lower-middle-income country, *UMC* upper-middle-income countries, *HIC* high-income countries, *n/a* data not available

income countries, and three from low- and lower-middle-income countries.

The weighted pooled prevalence of high ST among males was 29.8% (24.4–35.2) (Fig. 2a) and that of females was 29.9% (23.4–36.3) (Fig. 2b). Significant sex differences were observed in half ($n = 13$) of the countries with females having a higher prevalence in six countries (Cook Island, French Polynesia, Laos, Malaysia, Mongolia, and Wallis and Futuna), and males having a higher prevalence in seven countries (Bangladesh, India, Myanmar, Nepal, Samoa, Timor Leste, and Tuvalu) (Online Resource 1). For example, females in Cook Island had 72% higher odds of reporting a high ST than males of the Island (OR 1.72, 95% CI 1.26–2.35); while Samoan females had 39% lower odds of reporting high ST compared to Samoan males (0.61, 0.51–0.73).

A higher prevalence of high ST was reported by older adolescents (aged 16–17 years) compared to younger adolescents (13–15 years) with the prevalence being 34.7% (27.1–42.3) and 28.6% (23.4–33.8), respectively. Older adolescents had significantly higher odds of reporting a high ST than their younger counterparts in half ($n = 13$) of the countries (Online Resource 2).

Meta-regression analyses showed a positive association of prevalence of high ST with country Human Development Index ($\beta = 1.28$, 95% CI 0.88–1.68, $p < 0.001$, Fig. 3a) and a negative association with Gender Inequality Index (-0.95, -1.48 to -0.41, $p = 0.01$, Fig. 3c). However, prevalence of high ST was not associated with country expenditure on health and Gini coefficient. An additional meta-regression was not able to identify any significant association between prevalence of high ST and survey years.



◀**Fig. 1** Distribution of high sitting time (≥ 3 h/day) among adolescents aged 13–17 years for 26 countries across the Asia–Pacific region, Global School-based Student Health Survey, 2007–2016. Note: A change in colour from yellow to black indicates a higher prevalence

While comparing the regional pooled estimates, the highest prevalence was in the Americas [45.4% (95% CI 41.1–49.8)] and the lowest in South-East Asian region (23.9%, 14.3–33.4) [Online Resource 3]. A considerable sex difference was observed in the region of the Americas with 47.4% (42.8–52.1) in females and 43.3% (39.3–47.3) in males.

Logistic regression analysis showed that high ST was positively associated with smoking (OR 1.32, 95% CI 1.21–1.45); alcohol intake (1.81, 1.67–1.96); frequent intake of fast food (1.45, 1.37–1.54); and high intake of sugar-sweetened beverage (1.07, 1.01–1.13). However, fruit and vegetable intake was not significantly associated with prevalence of high ST (0.96, 0.90–1.03).

Discussion

This study examined the country-level prevalence of ST and sex- and age-related disparities in ST among adolescents in 26 Asia–Pacific countries. The results generally show a high prevalence of overall ST ($\sim$ 30%) with higher levels coinciding with higher economic development in the Asia–Pacific region. In addition, apparent age and sex differences in ST were observed in approximately a half of the countries included in the analysis. ST was positively associated with Human Development Index and negatively with Gender Inequality Index. This study also showed that high ST is the highest in the Americas region followed by Eastern Mediterranean, Western Pacific, African, and the South-East Asian region.

Some variations existed in the ST prevalence among the Asia–Pacific countries; however, collectively, the levels and patterns of the prevalence of ST in relation to Human Development Index are a growing concern. Many of the countries included in this study are experiencing rapid economic and developmental changes that concurrently promote lifestyle transitions towards sedentariness (Bauman et al. 2011; Peltzer and Pengpid 2016). These transitions, supported by the processes of urbanisation and globalisation, have significant implications for the rapid rise of NCD-related mortality and morbidity in the region. Hence, there is an urgency to intervene on unfavourable transitions in lifestyle habits, including ST among people in the Asia–Pacific region, to mitigate negative health consequences and subsequent health care burden that many

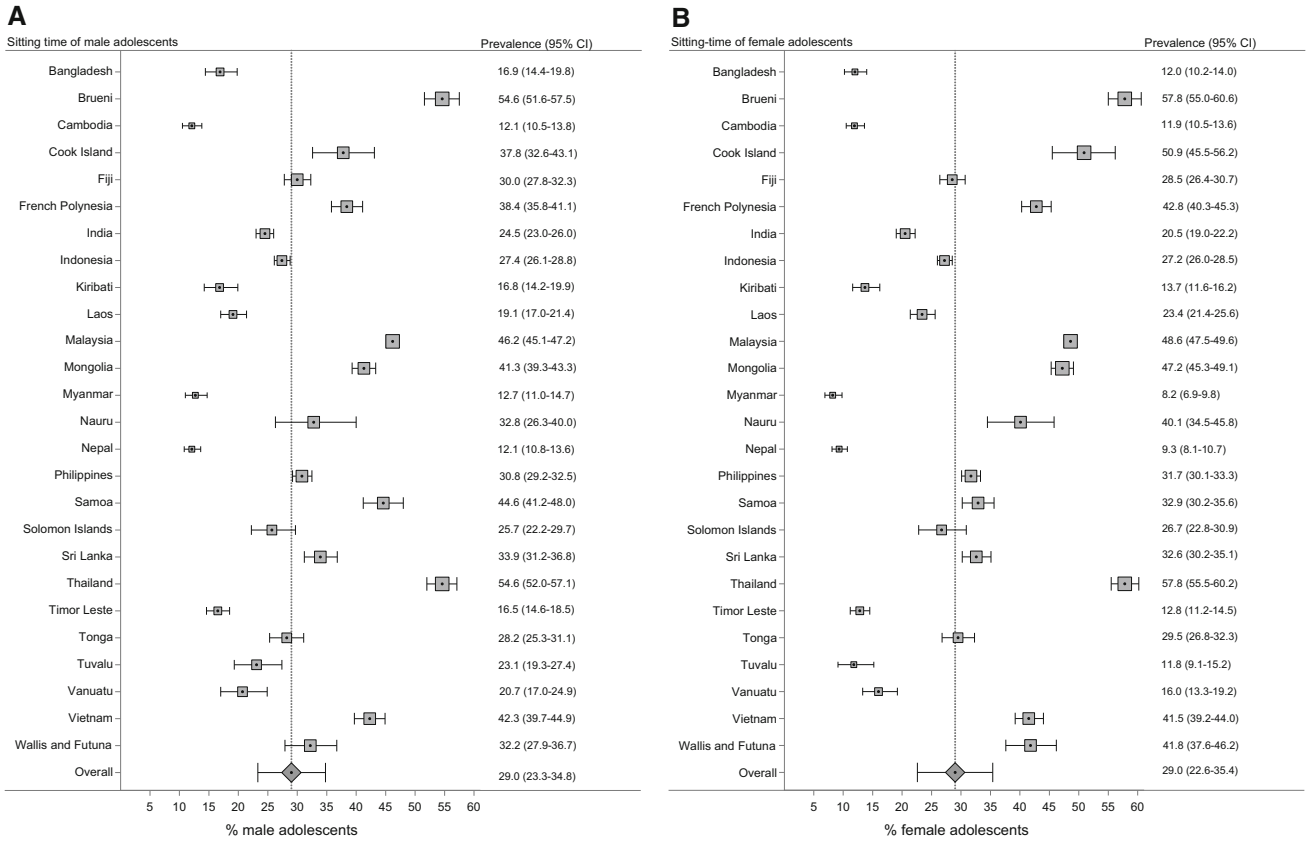


Fig. 2 Prevalence of high sitting time (≥ 3 h/day) among male (**a**) and female adolescents (**b**) from 26 Asia–Pacific countries, Global School-based Student Health Survey, 2007–2016

developed countries have experienced (Aubert et al. 2018a; Tremblay et al. 2016).

Though no sex differences in ST were found in the pooled sample, the analysis showed some country-level variations in different directions. In previous literature, sex differences in ST have been mixed across countries (Al-Hazzaa et al. 2011; Lazarou and Soteriades 2009; Loucaides et al. 2011; Maia et al. 2018) and varied by specific behaviour. For example, playing video games and surfing the internet were generally preferred by males compared to females, while watching TV, listening to music, or engaging in social behaviours while sitting were preferred by females among East Asian youth (Lee et al. 2017). Potential sex differences in specific ST behaviours cannot be confirmed in our study due to the absence of relevant data. Future global surveillance efforts should incorporate specific ST behaviours to have a better understanding of where sex differences in ST lie and to develop targeted intervention strategies at national and regional levels.

Greater prevalence of high ST with higher age during adolescence has been noted previously in national and international studies (Nelson et al. 2006; Tremblay et al. 2016). As young adolescents become more independent and autonomous in choosing their own recreational pursuits during discretionary time, sedentary pursuits are often the preferred activities among older adolescents (Lee et al. 2017). This highlights the importance of adolescence as an intervening period for promoting active lifestyle behaviours for the current and future health of adolescents (Carson et al. 2016; Cliff et al. 2016). ST also tends to track over time from adolescence to adulthood (Gordon-Larsen et al. 2004). Consequently, it is important to implement well-designed targeted interventions among adolescents during these formative years to reduce sitting in and outside of school.

Though age and sex differences in ST in some parts of the Asia–Pacific region are noteworthy, the results are comparable to the patterns in other parts of the world. For example, the higher ST in older adolescents than younger ones shown in our study is a globally homogeneous pattern (Nelson et al. 2006; Peltzer and Pengpid 2016; Trang et al. 2013). Also, varying patterns of sex differences in high ST outside of school were observed in 26 Latin American and Caribbean countries (Aguilar-Farias et al. 2018). Specifically, significant sex differences in ST (as high as 11.6%) were observed in 11 countries, whereas the results were null in the rest 15 countries. Though the prevalence of high ST was comparable among 34 countries across five WHO

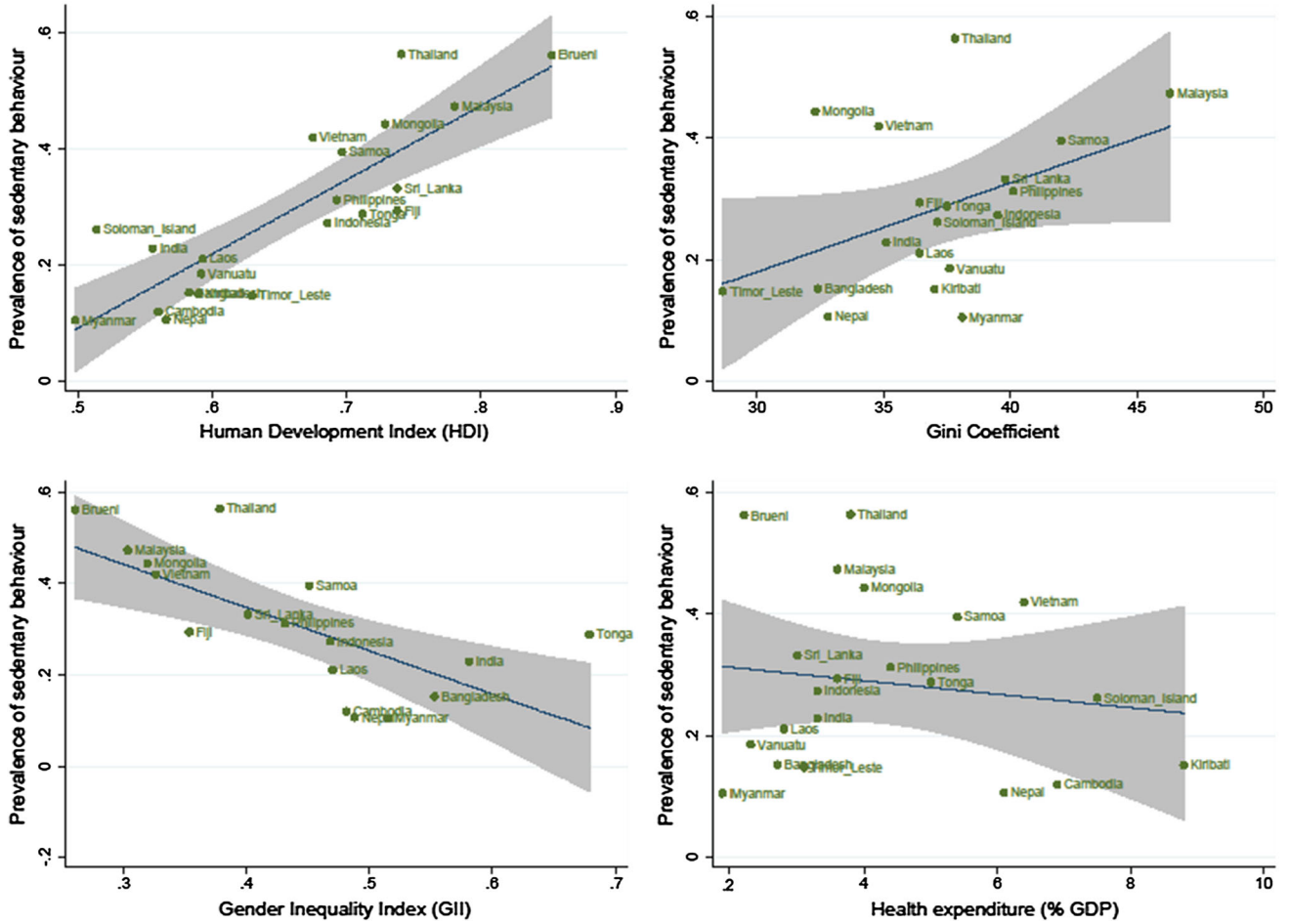


Fig. 3 Associations of prevalence of high sitting time (≥ 3 h/day) with common global indices among adolescents in Asia–Pacific countries, Global School-based Student Health Survey, 2007–2016. Note: The Human Development Index and expenditure on health were available for all but five countries (Cook Island, French Polynesia, Nauru, Tuvalu, and Wallis and Futuna). The Gini coefficient was available for all but seven countries (Brunei Darussalam, Cambodia, Cook Island, French Polynesia, Nauru, Tuvalu, and Wallis and Futuna). The Gender Inequality Index was available for all but nine countries (Cook Island, French Polynesia, Kiribati, Nauru, Solomon Islands, Timor Leste, Tuvalu, Vanuatu, and Wallis and Futuna)

regions, high ST was particularly prevalent among females in the Americas region (up to 64%) with Chile showing the greatest sex gaps in high ST (39% in males vs. 50% in females) (Guthold et al. 2010).

Patterns of sex gaps in high ST prevalence varied by countries. High ST was more prevalent in countries with lower sex inequality in our study. Specifically, countries with lower sex inequality (indicated as lower Gender Inequality Index) showed a greater prevalence, whereas countries with higher sex inequality (indicated as higher Gender Inequality Index) showed a lower prevalence. In countries with low sex inequality, high ST was more prevalent in females, whereas in the high sex inequality countries, high ST was more prevalent in males. This may suggest that in developing countries where sex inequality remains high, females are more engaged in domestic chores, and their access and opportunities for sedentary-based discretionary time are limited compared to males. In countries with apparent sex inequality, women and females may face discrimination against health, education, political representation, and labour market, which in turn can limit their capabilities and freedom of choice in their daily lives (United Nations Development Programme 2019b).

As observed in other multi-country studies (Aguilar-Farias et al. 2018; Guthold et al. 2010), high ST has become more prevalent as the country develops, which involves widening income gaps while closing sex disparities. This is of particular concern when our study has demonstrated significant association of high ST with other unhealthy behaviours including smoking, alcohol intake, and high intake of fast food and sugary drinks. Such clustering of unhealthy behaviours in young people, if unaddressed, could lead to catastrophic health consequences in adult life. Hence, there is an urgency to

intervene with adolescents living in high Human Development Index countries in the Asia–Pacific region in order to decelerate the increasing trend of adolescents' ST in this region. Given that high ST often accompanies declining levels of habitual physical activity due to the shift towards more sedentary leisure choices and motorised vehicle ownership (Bauman et al. 2011), strategies to reduce ST among adolescents should focus on providing more opportunities for alternative active leisure choices and increasing habitual physical activity such as active travel with supportive urban planning and intervention programs. In this study, we have not been able to decompose ST exposure. Therefore, it is important that future research includes various aspects of sedentary behaviours (e.g. TV use, video games, computer use for academic and recreational purposes, social media use) to better understand the current sedentary patterns of adolescents. Computer or social media use may replace time spent in other activities, including both sedentary and active pursuits; as such, detailed sedentary time-use data are needed to comprehend possible mechanisms and to inform appropriate intervention strategies to minimise recreational sedentariness among adolescents.

Strengths and limitations

A major strength of this study is including 101,785 adolescents from 26 Asia–Pacific countries to investigate and compare ST within and across countries with the inclusion of the most up-to-date GSHS data. GSHS is a continuous cross-sectional global surveillance system; thus, findings of this study are comparable to other studies that have used GSHS data (Aguilar-Farias et al. 2018; Guthold et al. 2010; Peltzer and Pengpid 2016). The survey had high response rates with nationally representative samples and used the standardised sampling technique, study methodology, and questionnaire across the countries. Another advantage is the addition of countries at various stages of development, providing a more comprehensive assessment of the region. The study also provided the prevalence estimates of ST in other WHO regions to enable global comparisons.

This study is not without limitations. GSHS is self-reported and subject to various biases including measurement bias, misclassification bias, and recall bias. Measure of ST, which excluded the time sitting at school, may under-represent the real ST across the day. ST was captured in categorical responses with six options, which provides an approximate estimate of ST distributions. A breakdown of ST specific behaviours (e.g. screen time, reading, travelling in a vehicle) was not available. Human Development Index, Gender Inequality Index, and Gini coefficient values were not available for some countries included in the study; therefore, the results in relation to these indices should be interpreted within the context of countries with information for each index. Though DerSimonian and Laird random effects model is widely used in meta-analysis, this method may underestimate the true between-study variance, potentially producing overly narrow confidence intervals for the mean effect, especially when the between-study variance is large. Hence, confidence intervals derived from this method are slightly too narrow to encompass full uncertainty resulting from having estimated the degree of heterogeneity. Lastly, apart from age and sex, the GSHS data did not include any other socio-demographic covariates, which limited adjustment of the analysis. Despite these limitations, this study provides population-level information on ST of Asia–Pacific adolescents with apparent between- and within-country sex and age differences, and argues for more surveillance efforts using reliable and valid measures of ST to obtain accurate estimates of sedentariness in the Asia–Pacific region and beyond. Advancing surveillance data is particularly important and timely along with the efforts from international organizations (e.g. WHO) (World Health Organization 2018) and consensus statements such as the 2017 Bangkok Declaration (ISPAH International Society for Physical Activity and Health 2017) and 2010 Toronto Charter (Global Advocacy Council for Physical Activity, International Society for Physical Activity and Health 2010) as collective efforts to promote active living globally.

Conclusion

This study showed varying levels of prevalence of high ST across countries with sex- and age-related disparities. Prevalence of high ST was more common among countries with high Human Development Index and low Gender Inequality Index. Continued monitoring of ST using more comprehensive and accurate measures in this region is warranted to provide consistent and comparable data that can better inform policies and actions for the health of the regional populations. This effort should also be accompanied by creating sociocultural and physical environments that enable active lifestyles to help combat rising NCDs in the region. These initiatives to reduce sedentariness in the Asia–Pacific region should be aligned with current global health promotion strategies. Future research should measure various aspects of ST exposure to better understand the current recreational sedentary patterns of the adolescents.

Acknowledgements The authors would like to thank the US Centers for Disease Control and Prevention and the World Health Organization for making the Global School-based Student Health Survey (GSHS) data publicly available for analysis. The authors thank the GSHS country coordinators and other staff members.

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The corresponding author had full access to all of the data and the final responsibility to submit for publication.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest concerning this article.

Ethical approval In each of the participating countries, the GSHS received ethics approval from the Ministry of Education or a relevant Institutional Ethics Review Committee, or both. Only adolescents and their parents who provided written or verbal consent participated. As the current study used retrospective publicly available data, we did not seek ethics approval from any Institutional Ethics Review Committee.

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