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Lifestyle and psychosocial correlates of oral hygiene practice among Indonesian adolescents

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Abstract

Poor oral hygiene leads to poor oral health, which in turn has negative impacts on overall health and quality of life. This study aimed to evaluate the prevalence and associated factors of oral hygiene practice among school-going adolescents in Indonesia. Secondary analysis of cross-sectional, nationally representative data from the 2015 Indonesia Global School-based Health Survey, covering 11,142 students aged 11-18 years, was performed. Multiple logistic regression was employed to explore associations between lifestyle, psychosocial factors, and tooth-brushing frequency. Around 10.8% of the students brushed their teeth less frequently than the recommended twice-daily regimen. Male gender, lower socio-economic status, poor dietary practice, longer sedentary time, drug use, psychological distress, less peer support, and no parental support were associated with infrequent tooth brushing. The findings support the need to integrate oral health promotion into general health actions that target families, schools, and social environments of adolescents to develop healthier habits.

KEYWORDS
adolescents, epidemiology, Indonesia, lifestyle, social support

INTRODUCTION

Poor oral hygiene leads to poor oral health, which in turn has negative impacts on overall health and quality of life. These impacts can take the form of pain, discomfort, lower self-esteem, and poor school attendance and performance [1–3]. One of the main indicators for oral hygiene is tooth-brushing frequency [4]. Regular tooth-brushing habits adopted in adolescence are usually sustained into adulthood and may reduce the burden of disease, as they may have a protective role against cardio-metabolic risk factors [5, 6]. Despite the well-known benefits of tooth brushing, approximately 5%–10% of adolescents in low- and middle-income countries (LMICs) have been found to never or rarely brush their teeth [7].

Oral health behaviours are influenced by psychosocial, economic, cultural, and environmental determinants

[8–11]. Family environments, including socio-economic status (SES), culture, parental support, and role modelling, play a key role in enabling and supporting healthy choices and lifestyle [9, 12]. Family influence is particularly important in the development of tooth-brushing habits, which are initiated at early ages [13]. In addition, school and the social environment where children live, learn, and play, affect their oral health behaviours [9]. As children enter adolescence, which is a transitional period of life marked by physical and psychological changes, social influence becomes increasingly important, particularly from peers [12, 14]. Social interaction is known to be a motivation for tooth brushing [15]. A study also suggested that psychological distress could negatively affect oral health behaviours [16]. The impact of psychosocial factors on health behaviours might differ in different socio-cultural settings [17, 18].

Tooth-brushing habits are enmeshed in complex daily habits and can indicate the wider context of adolescents' lifestyles [8, 10, 19]. The association between tooth-brushing frequency and elements of lifestyle, such as dietary behaviour, physical activity, sedentary behaviour, nutritional status, smoking, and alcohol and cannabis use, have been demonstrated [4, 15, 20–24]. It has been suggested that lifestyle might reflect the health consciousness and personal characteristics of a person and is also associated with psychosocial factors shaped by the local cultures and shared contexts [11, 25–28].

Although there have been several studies on oral health behaviours, there is still limited evidence of the associations between lifestyle, psychosocial factors, and oral hygiene practice among adolescents in developing countries, such as Indonesia. Most of the existing studies have been from developed countries. Health behaviours differ across countries. Owing to the fact that Indonesia is a developing country with an unequal distribution of healthcare resources [29], rapid economic transition and modernisation leading to social change, the health behaviours of Indonesian adolescents might differ from those in developed countries. The prevalence of Indonesian adolescents reporting oral health problems has increased from 25% in 2013 to 56% in 2018, and 73% had suffered from caries in 2018 [30, 31]. Considering the important role of oral hygiene practice in maintaining oral health, the identification of factors that can predict oral hygiene practice in this population is necessary for developing oral health policies and programmes.

The aim of this study was to evaluate the prevalence of oral hygiene practice and its associated factors among school-going adolescents in Indonesia. We hypothesised that lifestyle and psychosocial factors were positively associated with oral hygiene practice.

MATERIAL AND METHODS

This study was a secondary data analysis of the 2015 Indonesia Global School-based Health Survey (GSHS) data. The dataset was publicly available from the website of the World Health Organisation (WHO) [32]. The GSHS is a school-based survey project developed by the WHO and the Centers for Disease Control and Prevention (CDC) to evaluate health behaviours and protective factors among students aged 13–17 years [33, 34]. A two-stage cluster sampling design was used for the survey. The first stage was to select school samples with probability proportional to size. The next stage was to systematically sample the classrooms. All students in the selected schools and classrooms completed the anonymous, self-reported questionnaires in one regular class period. In Indonesia, a total of 75 schools across 3 regions (Sumatra, Java-Bali, and outside of Sumatra, Java-Bali) in 26 provinces and 68 districts or cities were selected [33, 35].

The respective response rates of schools and students were 100% and 94%. The total number of students included was 11,142 [34].

The implementation of the GSHS in Indonesia was approved by the national government administration and institutional review board or ethics committee (LB.02.01/5.2/ KE.158/2015). Informed consent to participate was obtained from students and their parents [35].

The dependent variable in our study was oral hygiene practice, assessed through the question of tooth-brushing frequency (times/day).

Independent variables

Demographic variables included age, sex, and hunger status (used as a proxy for SES). Lifestyle variables included dietary practice, physical activity, sedentary behaviour, nutritional status, smoking, and alcohol and drug use. The dietary practice variable was constructed from diet-related items measured in the GSHS. One point each was given for the following responses: fruits ≥2 times/day, vegetables ≥3 times/ day, soft drink <1 times/day, and fast food <3 times/week. The cut-off values used to dichotomise these responses were based on a previous study [36]. The scores were summed and categorised based on the median value into two groups: unhealthy (score 0–2) and healthy (score 3–4) dietary practice. Physical activity was defined, following the WHO recommendation, as being physically active for at least 60 min/ day [37], while sedentary behaviour was defined as sitting for ≥3 h/day [36]. The body weight and height of the students were measured to calculate body mass index (BMI), which indicated their nutritional status. It was categorised into underweight, normal weight, and overweight/obese [33]. Smoking and alcohol use were defined as ≥1 day use in the past 30 days, while drug use as ≥1 time marijuana use in life.

The psychological variable was psychological distress. Following a previous study [38], psychological distress was measured from five indicators. One point each was given for the following responses: no close friends, mostly/always lonely, mostly/always anxious, having suicidal ideations, and having suicidal attempts. The scores from these indicators were summed and categorised based on the median value into no (score 0) and yes (score 1–5).

Social support variables included peer and parental support. Peer support was defined as students in the school mostly/always being kind and helpful. The parental support variable was developed from three questions related to parents in the GSHS. One point each was given for the following responses: parental/guardian mostly/always checking homework, mostly/always understanding children's problems and worries, and mostly/always knowing children's activities in their free time [36]. The scores were summed and categorised

based on the median value into no (score 0) and yes (score 1–3).

Details of these variables and their categorisations can be seen in Table S1.

Conceptual framework

A directed acyclic graph (DAG) was created using Dagitty, to illustrate the assumed relationships among variables in our study, and to aid in the selection of variables to be adjusted for [39]. The lifestyle group of variables included dietary practice, physical activity, sedentary behaviour, nutritional status, smoking, and alcohol and drug use. The psychological variable was psychological distress. The social support group of variables included peer and parental support.

Figure 1 shows variables that had to be adjusted for when social support variables were set as exposures. These were age, sex, and SES. Figure 2 shows variables that had to be adjusted for when lifestyle variables were set as exposures. These were age, sex, SES, and social support variables. Figure 3 shows variables that had to be adjusted for when
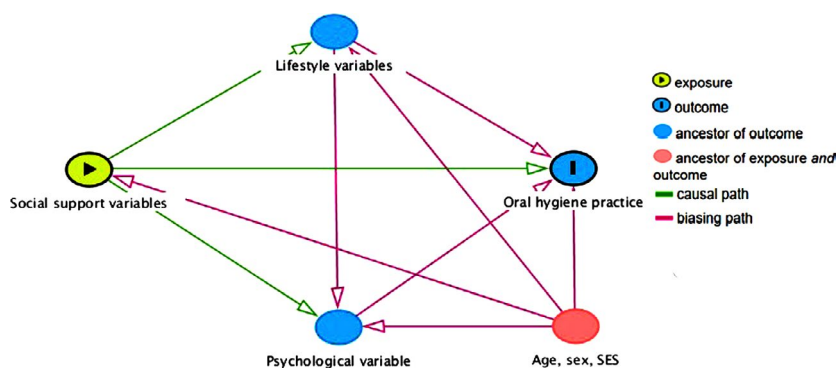

FIGURE 1   The DAG when social support variables were set as exposures
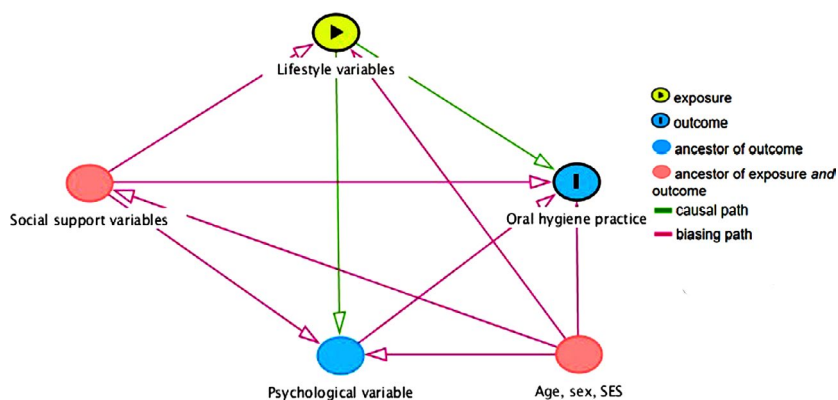

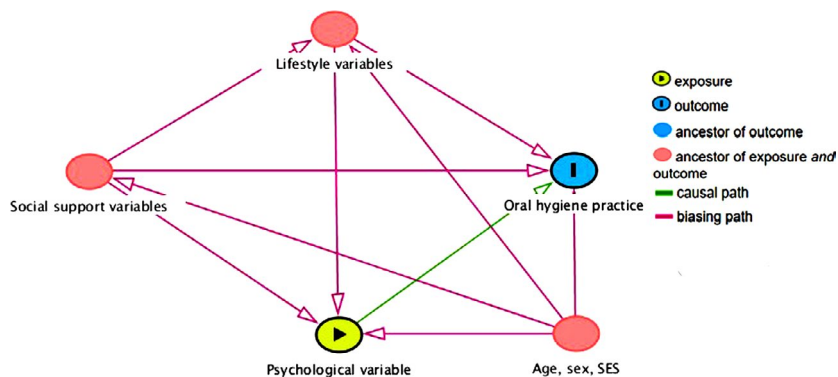**FIGURE 2**   The DAG when lifestyle variables were set as exposures

FIGURE 3   The DAG when psychological variable was set as an exposure

psychological variable was set as an exposure. These were age, sex, SES, lifestyle, and social support variables.

Based on the DAG, three models were developed. Model 1 included age, sex, SES, and social support variables. Model 2 included age, sex, SES, lifestyle, and social support variables. Model 3 included age, sex, SES, lifestyle, psychological, and social support variables.

Data analysis

Data analysis was conducted using SPSS 23.0 (IBM), taking into account the complex study design. The data weighting process followed the GSHS guidance, involving three weighting variables (primary sampling unit, stratum, and weight). Weighting made the results representative of the target population and was applied to adjust for the sampling design, non-response, and population distribution by grade and sex [33, 40].

Descriptive analysis was performed to summarise the characteristic of the sample and report the weighted percentages. Differences in tooth-brushing frequency among the selected variables were statistically tested by the adjusted F (a variant of the second-order Rao-Scott adjusted chi square statistic) and its degrees of freedom. Multiple logistic regression was employed to evaluate the association between different groups of variables and tooth-brushing frequency. The significance level was set at a p-value < 0.05.

RESULTS

The sociodemographic characteristics of the sample can be seen in Table 1. The weighted mean ($\pm$SE) age of the students was 14.0 ($\pm$0.2) years; 48.9% were male, and 4.1% had lower SES (indicated by mostly/always experiencing hunger). The prevalence of students brushing their teeth less than twice daily and at least twice daily was 10.8% and 89.2%, respectively. Males and lower SES students brushed their teeth less frequently than females and higher SES students. There were no significant differences in tooth-brushing frequency by age.

Table 2 presents tooth-brushing frequency by lifestyle and psychosocial characteristics. Participants with infrequent tooth-brushing habits tended to have unhealthy dietary practice and longer sedentary time, and were more likely to smoke cigarettes, use alcohol and drugs, have psychological distress, less peer support, and no parental support compared to their counterparts with frequent tooth-brushing habits. There were no significant differences in tooth-brushing frequency within the physical activity levels or within those of nutritional status.

Table 3 presents the outcome of the analyses of the associations between lifestyle, psychosocial correlates, and tooth-brushing frequency. Besides sex and SES, model 1 shows that peer and parental support were associated with tooth-brushing frequency, and the associations remained

TABLE 1 Tooth-brushing frequency by sociodemographic characteristics

Variables	Total sample N [a]	Total sample % (95% CI) [b]	Less than twice daily N [a]	Less than twice daily % (95% CI) [b]	At least twice daily N [a]	At least twice daily % (95% CI) [b]	p-Value [c]
Tooth-brushing frequency							
Less than twice daily	1191	10.8 (9.3–12.5)					
At least twice daily	9873	89.2 (87.5–90.7)					
Sex							
Male	5090	48.9 (47.2–50.5)	807	15.7 (13.6–18.0)	4241	84.3 (82.0–86.4)	**<0.001**
Female	6020	51.1 (49.5–52.8)	381	6.1 (5.0–7.5)	5604	93.9 (92.5–95.0)	
Age							
≤12 years old	2047	19.4 (16.3–23.1)	238	11.5 (9.6–13.8)	1794	88.5 (86.2–90.4)	0.546
13 years old	2502	24.2 (20.3–28.5)	279	10.6 (8.7–12.9)	2204	89.4 (87.1–91.3)	
14 years old	2565	24.1 (20.7–28.0)	280	11.0 (8.8–13.5)	2263	89.0 (86.5–91.2)	
15 years old	1943	14.7 (12.2–17.5)	203	11.4 (9.5–13.6)	1727	88.6 (86.4–90.5)	
≥16 years old	2067	17.6 (11.0–26.9)	188	9.5 (6.7–13.1)	1871	90.5 (86.9–93.3)	
Hunger status (proxy for SES)							
Never/rarely/sometimes	10,609	95.9 (95.2–96.4)	1095	10.4 (9.0–12.1)	9444	89.6 (87.9–91.0)	**<0.001**
Mostly/always	482	4.1 (3.6–4.8)	87	18.3 (14.7–22.6)	389	81.7 (77.4–85.3)	

[a]N is unweighted frequency.

[b]% (95% CI) is weighted percentage and 95% compatibility intervals.

[c]Differences in the distribution of variables across tooth-brushing frequency were statistically analysed by the adjusted F (a variant of the second-order Rao-Scott adjusted chi square statistic) and its degrees of freedom. Bold values represent significant differences (two-sided p-value < 0.05).

TABLE 2 Tooth-brushing frequency by lifestyle and psychosocial characteristics

Variables	Total sample		Less than twice daily		At least twice daily		
	N [a]	% (95% CI)[b]	N[a]	% (95% CI)[b]	N[a]	% (95% CI)[b]	p-value[c]
Lifestyle							
Dietary practice							
Unhealthy (score 0–2)	7476	66.9 (64.3–69.4)	892	12.2 (10.4–14.3)	6532	87.8 (85.7–89.6)	**<0.001**
Healthy (score 3–4)	3453	33.1 (30.6–35.7)	269	7.8 (6.7–9.2)	3164	92.2 (90.8–93.3)	
Physical activity							
0–6 day/week	9594	87.8 (86.5–89.0)	1039	11.0 (9.4–12.7)	8490	89.0 (87.3–90.6)	0.603
7 day/week	1316	12.2 (11.0–13.5)	135	10.4 (8.0–13.4)	1175	89.6 (86.6–92.0)	
Sedentary behaviour							
≤1–2 h/day	8016	72.7 (69.7–75.5)	792	9.8 (8.5–11.3)	7164	90.2 (88.7–91.5)	**0.001**
≥3–4 h/day	2906	27.3 (24.5–30.3)	373	13.3 (10.8–16.2)	2519	86.7 (83.8–89.2)	
Nutritional status							
Normal weight	8139	76.3 (74.5–78.0)	842	10.5 (8.7–12.6)	7242	89.5 (87.4–91.3)	0.312
Underweight	863	7.9 (7.1–8.9)	102	12.0 (9.2–15.6)	755	88.0 (84.4–90.8)	
Overweight/obese	1552	15.8 (14.2–17.5)	142	9.4 (8.1–11.0)	1400	90.6 (89.0–91.9)	
Current smoking							
0 day	9813	88.4 (86.7–90.0)	963	9.9 (8.5–11.6)	8797	90.1 (88.4–91.5)	**<0.001**
≥1 day	1172	11.6 (10.0–13.3)	195	16.1 (13.1–19.7)	958	83.9 (80.3–86.9)	
Current alcohol use							
0 day	10,448	95.6 (94.6–96.5)	1066	10.4 (8.9–11.9)	9315	89.6 (88.1–91.1)	**<0.001**
≥1 day	473	4.4 (3.5–5.4)	85	17.0 (13.1–21.7)	379	83.0 (78.3–86.9)	
Drug use							
0 time	10,771	98.3 (97.6–98.8)	1109	10.4 (8.9–12.1)	9596	89.6 (87.9–91.1)	**<0.001**
≥1 time	172	1.7 (1.2–2.4)	47	28.5 (22.4–35.4)	120	71.5 (64.6–77.6)	
Psychological factor							
Psychological distress							
No (score 0)	9117	84.5 (83.4–85.7)	893	9.9 (8.5–11.4)	8171	90.1 (88.6–91.5)	**0.001**
Yes (score 1–5)	1705	15.5 (14.3–16.6)	234	13.8 (11.1–17.1)	1460	86.2 (82.9–88.9)	
Social support							
Peer support							
Never/rarely/sometimes	6695	60.9 (58.6–63.0)	818	12.3 (10.5–14.4)	5830	87.7 (85.6–89.5)	**<0.001**
Mostly/always	4282	39.1 (37.0–41.4)	353	8.4 (7.0–10.0)	3904	91.6 (90.0–93.0)	
Parental support							
No (score 0)	3907	35.6 (33.8–37.5)	540	14.0 (11.9–16.5)	3343	86.0 (83.5–88.1)	**<0.001**
Yes (score 1–3)	6900	64.4 (62.5–66.2)	616	9.0 (7.6–10.7)	6242	91.0 (89.3–92.4)	

[a]N is unweighted frequency.

[b]% (95% CI) is weighted percentage and 95% compatibility intervals.

[c]Differences in the distribution of variables across tooth-brushing frequency were statistically analysed by the adjusted F (a variant of the second-order Rao-Scott adjusted chi square statistic) and its degrees of freedom. Bold values represent significant differences (two-sided p-value < 0.05).

after additional adjustment of other variables in models 2 and 3. Model 2 shows that healthy dietary practice was associated with frequent tooth brushing, while longer sedentary time and drug use were associated with infrequent tooth brushing. These associations persisted after the inclusion of the psychological factor. Model 3 further shows that psychological distress was associated with infrequent tooth brushing. Associations between tooth-brushing frequency and age, physical activity, nutritional status, smoking, and alcohol use were not demonstrated.

TABLE 3 Summary of multivariable models for tooth-brushing frequency

Variables	Model 1[a] OR (95% CI)	Model 2[b] OR (95% CI)	Model 3[c] OR (95% CI)
Demographics			
Sex			
Female	Ref.	Ref.	Ref.
Male	**0.37 (0.31–0.44)**	**0.37 (0.31–0.44)**	**0.36 (0.30–0.43)**
Age[d]	1.04 (0.96–1.12)	1.05 (0.97–1.15)	1.06 (0.97–1.15)
Hunger status (proxy for SES)			
Never/rarely/sometimes	Ref.	Ref.	Ref.
Mostly/always	**0.58 (0.46–0.74)**	**0.54 (0.41–0.71)**	**0.60 (0.46–0.79)**
Lifestyle			
Dietary practice			
Unhealthy (score 0–2)		Ref.	Ref.
Healthy (score 3–4)		**1.60 (1.35–1.90)**	**1.65 (1.39–1.96)**
Physical activity			
0–6 days		Ref.	Ref.
7 days		1.01 (0.78–1.31)	1.01 (0.78–1.29)
Sedentary behaviour			
≤1–2 h/day		Ref.	Ref.
≥3–4 h/day		**0.66 (0.54–0.81)**	**0.64 (0.52–0.79)**
Nutritional status			
Normal weight		Ref.	Ref.
Underweight		1.00 (0.70–1.42)	0.97 (0.68–1.38)
Overweight/obese		1.15 (0.91–1.45)	1.15 (0.91–1.47)
Current smoking			
0 day		Ref.	Ref
≥1 day		1.04 (0.76–1.42)	1.07 (0.78–1.47)
Current alcohol use			
0 day		Ref.	Ref
≥1 day		1.08 (0.66–1.78)	0.99 (0.63–1.56)
Drug use			
0 time		Ref.	Ref.
≥1 time		**0.45 (0.23–0.90)**	**0.52 (0.27–0.99)**
Psychological factor			
Psychological distress			
No (score 0)			Ref.
Yes (score 1–5)			**0.71 (0.58–0.88)**
Social support			
Peer support			
Never/rarely/sometimes	Ref.	Ref.	Ref.
Mostly/always	**1.28 (1.07–1.53)**	**1.21 (1.02–1.45)**	**1.23 (1.03–1.47)**
Parental support			
No (score 0)	Ref.	Ref.	Ref.
Yes (score 1–3)	**1.41 (1.15–1.74)**	**1.35 (1.09–1.68)**	**1.33 (1.07–1.66)**

OR (odds ratios) and 95% CI (compatibility intervals) were derived from multiple logistic regression analyses, with tooth-brushing frequency <2 times/day as a reference group. Bold values represent significant associations.

[a]Model 1 included age, sex, hunger status (proxy for SES), social support variables, adjusted simultaneously.

[b]Model 2 included age, sex, hunger status (proxy for SES), lifestyle and social support variables, adjusted simultaneously.

[c]Model 3 included age, sex, hunger status (proxy for SES), lifestyle, psychological, and social support variables, adjusted simultaneously.

[d]Age was treated as a continuous variable.

DISCUSSION

Our study investigated associations between lifestyle, psychosocial factors, and oral hygiene practice among adolescents in Indonesia. After adjusting for covariates, unhealthy dietary practice, sedentary behaviour, drug use, psychological distress, less peer support, and no parental support were shown to be associated with poor oral hygiene practice. Around one tenth of Indonesian school adolescents had poor oral hygiene practice.

The proportion of adolescents in Indonesia adhering to the recommended regular tooth brushing of at least twice daily was similar to estimates from neighbouring countries, such as Malaysia (87%) [41] and the Philippines (89%) [7]. This proportion was higher than in China (44%) [42], the United Arab Emirates (57%) [7], the average in Europe and North America (65%) [43], and nine African countries (77%) [44], but lower than in South Korea (93%) [45].

Oral and general health behaviours are based on the complex interplay between personal characteristics and family, social, cultural, and environmental influences [46, 47]. Our observation that males tended to have poorer oral hygiene practice than females was similar to findings from other studies [21, 44]. This difference might be because females were more concerned about aesthetics and more aware of dental problems than males [48]. We did not observe any association between age and oral hygiene practice, as confirmed by other studies [21, 44]. In line with previous findings, lower SES was associated with poor oral hygiene. Adolescents of higher SES tended to have better resources, environments encouraging healthy behaviours, and higher education levels, all of which lead to better awareness. They were also known to attend to dental care more frequently, and thus the importance of oral hygiene may have been more reinforced for them [13, 49].

The finding that dietary practice was associated with oral hygiene practice is in line with prior studies [8, 21]. Children with unhealthy dietary practice tended to have poor oral hygiene, concentrating the two most important risk factors for oral diseases. Family environment plays a key role in the development of these two behaviours, since tooth brushing is usually done at home, and the meals are mostly consumed in the family environment. Parents particularly exert influence on these behavioural modalities, since children tend to imitate their behaviours [8, 13]. Similarly, our study revealed that sedentary behaviour was associated with infrequent tooth brushing. Children's sedentary behaviours, such as the use of electronic media or screen-based activities, usually depend on the family environment [50]. It was also suggested that excessive game players had less free time for tooth brushing as they chose to engage in video games. Excessive game players tended to have a poor sense of coherence, which was also reflected in their oral health behaviour [22].

A previous study among Finnish adolescents demonstrated the associations between physical activity, nutritional status, and oral hygiene practice [23]. Physical activity and nutritional status could indicate a disposition towards a healthy lifestyle and the capacity to maintain health and well-being [51, 52]. However, such associations of physical activity and nutritional status with tooth-brushing frequency could not be demonstrated in our study, consistent with another study [21]. One possible reason could be low awareness of the WHO-recommended physical activity level, since only around one tenth of adolescents in our study were physically active for at least 60 min/day.

Prior studies have shown that the use of substances, such as cigarettes, alcohol, and cannabis, was associated with less favourable tooth-brushing habits [24, 53]. Health risk behaviours tend to occur in the same social context. It was also known that smokers tended to brush for appearance reasons, instead of for oral health maintenance reasons [54]. Alcohol drinkers likewise tended to have neglected tooth-brushing behaviours after drinking [55], while drug abusers might have had a low priority for oral health [56]. Our study demonstrated only a marginal association between drug use and infrequent tooth brushing, and it could not demonstrate any association between smoking, alcohol use, and tooth-brushing frequency. It was possible that there were no differences in the frequency of tooth brushing between smokers and non-smokers, but there were differences, rather, in the duration of tooth brushing, as reported by another study [53]. Low prevalence of alcohol use might also contribute to the different findings in our study. Alcohol consumption is rather uncommon in Indonesia due to cultural and religious reasons [57].

Parental support was associated with good oral hygiene practice in our sample. Regular tooth-brushing habits tend to be adopted in a home with a set routine and positive family relationships [13]. Children with parental support have better psychological well-being, and receive more supervision and reinforcement for engagement in healthy behaviours. Parental support may also concur with monitoring children's tooth-brushing behaviours [58, 59]. In line with a previous study, peer support was associated with frequent tooth brushing [60]. Peers contribute to the formation of identity in adolescents by affecting social norms and values. The influences may also extend to oral health behaviours as they often relate to appearance, which is regarded as important by adolescents [60, 61]. Stronger interpersonal relationships had a greater influence on adolescents, as they tried to adjust with the behavioural patterns of their peer groups. Adolescents also tend to befriend those whose behavioural patterns are similar to theirs [60, 62]. Our findings confirm the association between psychological distress and oral hygiene practice. It has been suggested in an earlier study that some depressive symptoms, such as fatigue, psychomotor

impairment, and lack of motivation, could undermine people's oral health behaviours [16].

This study is among the few to explore such associations between lifestyle, psychosocial factors, and oral hygiene practice. It is also the first to be conducted among Indonesian adolescents using a large, nationally representative sample. A wide range of health behaviours covered in the survey made it possible to study lifestyle in a comprehensive way. Since the GSHS is an international standard survey, the findings may also be compared with those from other countries.

Our study was only concerned with the frequency of tooth brushing. The timing, duration, and technique of tooth brushing, as well as the use of fluoridated toothpastes, were not measured. The use of fluoridated toothpastes is an important aspect of oral health behaviours due to its effectiveness in preventing caries [63]. Hence, high self-reported frequency of tooth brushing in our study cannot be directly translated into improved oral health status. This cross-sectional study cannot infer causality, and thus, interpretation was limited to observing associations. Generalisation of findings to out-of-school adolescents should also be approached with caution. Although self-reported data might be prone to inaccuracy, social desirability bias was minimised by informing students that it was an anonymous and confidential questionnaire. The analyses in our study were limited to the information collected in the survey, and thus, there might be effects of unmeasured confounders, such as adolescents' oral health knowledge and parental oral health behaviours. Future studies capturing more indicators of psychosocial factors (e.g. sense of coherence), family, and broader socio-economic determinants, will allow deeper exploration of factors associated with oral hygiene practice.

In summary, our study shows that there is still a need to improve oral hygiene practice among Indonesian adolescents. Positive associations between some lifestyle, psychosocial factors and oral hygiene practice were confirmed. Developing interventions that target the underlying social context of adolescents may not only improve oral health, but also general health. Integration of oral health promotion into general health actions may be beneficial and eliminate duplication of efforts. Besides school, this study supports the evidence for the roles of parents in promoting oral health in Indonesia.

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CONFLICTS OF INTEREST
No conflicts of interest.

AUTHOR CONTRIBUTIONS
CMAS: conceptualisation, formal analysis, writing – original draft preparation, writing – review and editing; TB: writing – review and editing; MCN: writing – review and editing; AN: conceptualisation, methodology, writing – review and editing and supervision.

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REFERENCES
1. Rebelo MAB, Rebelo Vieira JM, Pereira JV, Quadros LN, Vettore MV. Does oral health influence school performance and school attendance? A systematic review and meta-analysis. Int J Paediatr Dent. 2019;29:138–48.
2. Silk H, Kwok A. Addressing adolescent oral health: a review. Pediatr Rev. 2017;38:61–8.
3. Kaur P, Singh S, Mathur A, Makkar DK, Aggarwal VP, Batra M, et al. Impact of dental disorders and its influence on self esteem levels among adolescents. J Clin Diagnostic Res. 2017;11:ZC05–8.
4. Liu W, Su L, Xie X, Xiang X, Huang J, Ji P. Association between toothbrushing and behavioral risk factors of non-communicable diseases: a population based survey of 4500 adults in China. Sci Rep. 2019;9. Article number: 8498.
5. Bast LS, Nordahl H, Christensen LB, Holstein BE. Tooth brushing among 11- to 15-year-olds in Denmark: combined effect of social class and migration status. Community Dent Health. 2015;32:51–5.
6. Kelishadi R, Mirmoghtadaee P, Qorbani M, Motlagh ME, Heshmat R, Taslimi M, et al. Tooth brushing and cardiometabolic risk factors in adolescents: is there an association? The CASPIAN-III study. Int J Prev Med. 2013;4:271–8.
7. Mckittrick TR, Jacobsen KH. Oral hygiene practices among middle-school students in 44 low- and middle-income countries. Int Dent J. 2014;64:164–70.
8. Fernandez De Grado G, Ehlinger V, Godeau E, Sentenac M, Arnaud C, Nabet C, et al. Socioeconomic and behavioral determinants of tooth brushing frequency: results from the representative French 2010 HBSC cross-sectional study. J Public Health Dent. 2018;78:221–30.
9. Duijster D, De Jong-Lenters M, Verrips E, Van Loveren C. Establishing oral health promoting behaviours in children – parents' views on barriers, facilitators and professional support: a qualitative study. BMC Oral Health. 2015;15. Article number: 157.
10. Aarø LE, Laberg JC, Wold B. Health behaviours among adolescents: Towards a hypothesis of two dimensions. Health Educ Res. 1995;10:83–93.
11. Newton JT, Bower EJ. The social determinants of oral health: new approaches to conceptualizing and researching complex causal networks. Community Dent Oral Epidemiol. 2005;33:25–34.

12. Fisher-Owens SA, Gansky SA, Platt LJ, Weintraub JA, Soobader MJ, Bramlett MD, et al. Influences on children's oral health: a conceptual model. Pediatrics. 2007;120:e510–20.

13. Levin KA, Currie C. Adolescent toothbrushing and the home environment: Sociodemographic factors, family relationships and mealtime routines and disorganisation. Community Dent Oral Epidemiol. 2010;38:10–8.

14. Knoll LJ, Magis-Weinberg L, Speekenbrink M, Blakemore SJ. Social influence on risk perception during adolescence. Psychol Sci. 2015;26:583–92.

15. Macgregor ID, Balding J, Regis D. Toothbrushing schedule, motivation and "lifestyle" behaviours in 7,770 young adolescents. Community Dent Heal. 1996;13:232–7.

16. Anttila S, Knuuttila M, Ylostalo P, Joukamaa M. Symptoms of depression and anxiety in relation to dental health behavior and self-perceived dental treatment need. Eur J Oral Sci. 2006;114:109–14.

17. Paulsson-Do U, Edlund B, Stenhammar C, Westerling R. Psychosocial vulnerability underlying four common unhealthy behaviours in 15–16-year-old Swedish adolescents: a cross-sectional study. BMC Psychol. 2017;5:1–11.

18. Morgan AR, Rivera F, Moreno C, Haglund BJA. Does social capital travel? Influences on the life satisfaction of young people living in England and Spain. BMC Public Health. 2012;12. Article number: 138.

19. Maes L, Vereecken C, Vanobbergen J, Honkala S. Tooth brushing and social characteristics of families in 32 countries. Int Dent J. 2006;56:159–67.

20. Harada S, Akhter R, Kurita K, Mori M, Hoshikoshi M, Tamashiro H, et al. Relationships between lifestyle and dental health behaviors in a rural population in Japan. Community Dent Oral Epidemiol. 2005;33:17–24.

21. Peltzer K, Pengpid S. Oral and hand hygiene behaviour and risk factors among in-school adolescents in four Southeast Asian countries. Int J Environ Res Public Health. 2014;11:2780–92.

22. Tsuchiya M, Momma H, Sekiguchi T, Kuroki K, Kanazawa K, Watanabe M, et al. Excessive game playing is associated with poor toothbrushing behavior among athletic children: a cross-sectional study in Miyagi, Japan. Tohoku J Exp Med. 2017;241:131–8.

23. Virtanen JI, Muikku T, Similä T, Cinar AB, Pohjola V. Physical activity, BMI and oral health behaviour among adolescents: Finnish School Health Promotion Study. Eur J Public Health. 2019;29:296–302.

24. Siziya S, Muula A, Rudatsikira E. Self-reported poor oral hygiene among in-school adolescents in Zambia. BMC Res Notes. 2011;4:1–4.

25. Sakki TK, Knuuttila MLE, Vimpari SS, Hartikainen MSL. Association of lifestyle with periodontal health. Community Dent Oral Epidemiol. 1995;23:155–8.

26. Kraft FB, Goodell PW. Identifying the health conscious consumer. J Health Care Mark. 1993;13:18–25.

27. Moor I, Rathmann K, Stronks K, Levin K, Spallek J, Richter M. Psychosocial and behavioural factors in the explanation of socioeconomic inequalities in adolescent health: a multilevel analysis in 28 European and North American countries. J Epidemiol Community Health. 2014;68:912–21.

28. Arbour-Nicitopoulos KP, Faulkner GE, Irving HM. Multiple health-risk behaviour and psychological distress in adolescence. J Can Acad Child Adolesc Psychiatry. 2012;21:171–8.

29. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia Tahun 2013. Jakarta: Kementerian Kesehatan Republik Indonesia; 2014:27–60.

30. Badan Penelitian Dan Pengembangan Kesehatan. Riset Kesehatan Dasar (Riskesdas) 2013. Jakarta; 2013:147–57.

31. Badan Penelitian Dan Pengembangan Kesehatan. Laporan Nasional Riskesdas 2018. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan (LPB); 2019:179–219.

32. World Health Organisation. Global school-based student health survey (GSHS). https://www.who.int/ncds/surveillance/gshs/indonesiadataset/en/. Accessed 5 Apr 2020

33. Centers for Disease Control And Prevention. Global School- based Student Health Survey: 2013 GSHS Data User's Guide. https://www.cdc.gov/gshs/pdf/gshs-data-users-guide.pdf. Accessed 7 Sep 2018

34. World Health Organisation. Global School-based Student Health Survey Indonesia 2015 Fact Sheet. http://www.who.int/ncds/surveillance/gshs/2015_Indonesia_GSHS_Fact_Sheet.pdf. Accessed 14 Sep 2018

35. Kusumawardani N, Rachmalina S, Wiryawan Y, Anwar A, Handayani K, Mubasyiroh R, et al. Perilaku Berisiko Kesehatan Pada Pelajar SMP Dan SMA Di Indonesia. Jakarta; 2015:11–20.

36. Manyanga T, El-Sayed H, Doku DT, Randall JR. The prevalence of underweight, overweight, obesity and associated risk factors among school-going adolescents in seven African countries. BMC Public Health. 2014;14. Article number: 887.

37. World Health Organisation. Physical activity and young people. https://www.who.int/dietphysicalactivity/factsheet_young_people/en/. Accessed 31 May 2020

38. Pengpid S, Peltzer K. Leisure-time sedentary behavior is associated with psychological distress and substance use among school-going adolescents in five southeast Asian countries: a cross-sectional study. Int J Environ Res Public Health. 2019;16:2091.

39. Textor J, Van Der Zander B, Gilthorpe MS, Liskiewicz M, Ellison GT. Robust causal inference using directed acyclic graphs: the R package, "Dagitty". Int J Epidemiol. 2016;45:1887–94.

40. Centers for Disease Control and Prevention. Software for Analysis of YRBS Data. http://www.cdc.gov/yrbss. Accessed 16 Dec 2019

41. Che Salleh N, Mohamad Anuar MF, Abdullah NA, Yaw SL, Ibrahim Wong N, Teck Pei T, et al. Prevalence and factors associated with oral and hand hygiene practices among adolescents in malaysia: findings from the National Health and Morbidity Survey 2017. Asia-Pacific J Public Heal. 2019;31(Suppl 8):97S–104S.

42. Zhu L, Petersen PE, Wang HY, Bian JY, Zhang BX. Oral health knowledge, attitudes and behaviour of children and adolescents in China. Int Dent J. 2003;53:289–98.

43. Currie C, Zanotti C, Morgan A, Currie D, De Looze M, Roberts C, Samdal O, Smith ORF, Barnekow V. Social determinants of health and well-being among young people. Health Behaviour in School-aged Children (HBSC) study: international report from the 2009/2010 survey. Copenhagen: World Health Organisation Regional Office for Europe; 2012:123–8.

44. Pengpid S, Peltzer K. Hygiene behaviour and associated factors among in-school adolescents in nine African countries. Int J Behav Med. 2011;18:150–9.

45. Kim S-I, Jung S-H. Differences in smoking and tooth brushing habits among general high school and vocational high school students. J Korean Acad Oral Heal. 2018;42:61–6.

46. Verstraeten R, Leroy JL, Pieniak Z, Ochoa-Avilès A, Holdsworth M, Verbeke W, et al. Individual and environmental factors

influencing adolescents' dietary behavior in low- and middle-income settings. PLoS One. 2016;11:e0157744.

47. Puri S, Vasthare R, Munoli R. The impact of sibling behavior on oral health: a narrative review. J Int Soc Prev Community Dent. 2019;9:106–11.

48. Soares Luís HP, Assunção VA, Soares Luís LF. Oral health habits, attitudes and behaviors of Portuguese adolescents. Int J Adolesc Med Health. 2016;28:39–43.

49. Casanova-Rosado JF, Vallejos-Sánchez AA, Minaya-Sánchez M, Medina-Solís CE, De La Rosa-Santillana R, Márquez-Corona ML, et al. Frequency of tooth brushing and associated factors in Mexican schoolchildren six to nine years of age. West Indian Med J. 2013;62:68–72.

50. Granich J, Rosenberg M, Knuiman M, Timperio A. Understanding children's sedentary behaviour: a qualitative study of the family home environment. Health Educ Res. 2010;25:199–210.

51. Macgregor IDM, Balding JW. Toothbrushing frequency and physical recreation in 14-year-old schoolchildren. Health Educ J. 1988;48:89–91.

52. Santha B, Sudheer H, Saxena V, Jain M, Tiwari V. The impact of body mass index on oral hygiene practices of adolescents in Bhopal City, India. J Coll Physicians Surg Pakistan. 2016;26:125–9.

53. Macgregor IDM. Toothbrushing efficiency in smokers and non-smokers. J Clin Periodontol. 1984;11:313–20.

54. Macgregor IDM, Balding JW, Regis D. Motivation for dental hygiene in adolescents. Int J Paediatr Dent. 2003;7:43–8.

55. Mizutani S, Ekuni D, Tomofuji T, Yamane M, Azuma T, Iwasaki Y, et al. Gingival condition and tooth-brushing behavior after alcohol consumption. J Periodontal Res. 2015;50:494–9.

56. Robinson PG, Acquah S, Gibson B. Drug users: oral health-related attitudes and behaviours. Br Dent J. 2005;198:219–24.

57. Gmel G, Rylett M, Labhart F, Shield KD, Lachenmeier DW, Rehm J. A global overview of alcohol consumption patterns. In: Boyle P, Boffetta P, Lowenfels AB, Burns H, Brawley O, Zatonski W, Rehm J, editors. Alcohol: science policy and public health. Oxford: Oxford University Press; 2013. p. 115–24.

58. De Jong-Lenters M, Duijster D, Bruist MA, Thijssen J, De Ruiter C. The relationship between parenting, family interaction and childhood dental caries: a case-control study. Soc Sci Med. 2014;116:49–55.

59. Chen Y, Haines J, Charlton BM, Vanderweele TJ. Positive parenting improves multiple aspects of health and well-being in young adulthood. Nat Hum Behav. 2019;3:684–91.

60. Dorri M, Sheiham A, Watt R. The influence of peer social networks on toothbrushing behaviour in Iranian adolescents in Mashhad. Community Dent Oral Epidemiol. 2010;38:498–506.

61. Graça SR, Albuquerque TS, Luis HS, Assunção VA, Malmqvist S, Cuculescu M, et al. Oral health knowledge, perceptions, and habits of adolescents from Portugal, Romania, and Sweden: a comparative study. J Int Soc Prev Community Dent. 2019;9:470–80.

62. Solomon S, Knafo A. Value similarity in adolescent friendships. In: Rhodes TC, editor. Focus on adolescent behavior research. New York: Nova Science Publishers; 2007. p. 133–55.

63. Hausen H. Fluoride toothpaste prevents caries. Evid Based Dent. 2003;4:28.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

Table S1. List of the GSHS variables used in this study.