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ORIGINAL RESEARCH

Prevalence and Risk Factors of Poor Hand and Oral Hygiene Practices Among Adolescent Students in Eastern China: A Cross-Sectional Study

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Purpose: This study aimed to investigate the current status and associated factors of hand and oral hygiene behaviors among adolescent students in Zhejiang Province, Eastern China.

Methods: This study utilized a cross-sectional survey conducted in Zhejiang Province between April and June 2022. Data were collected through a self-administered, structured questionnaire that assessed tooth brushing frequency, hand washing practices before meals, after toilet use, and hand washing with soap. Multivariate logistic regression was performed to identify associations between hygiene practices and socio-demographic factors.

Results: The study included 26,101 adolescent students. Of these, 29.25% had poor oral hygiene practices, and the majority brushed their teeth twice per day (51.43%). Regarding hand hygiene, 78.06% exhibited poor hand hygiene before meals, 24.67% after toilet use, and 82.56% when using soap. Multivariate logistic regression analysis indicated that higher parental education and greater family income were linked to a reduced likelihood of poor oral and hand hygiene practices. Conversely, older age and parental marital status (divorced, widowed, or separated) were linked to an increased risk of both poor oral and hand hygiene practices. Additionally, girls and only children were less likely to exhibit poor oral hygiene but more likely to have poor hand hygiene.

Conclusion: The prevalence of poor hand and oral hygiene practices among adolescent students in Zhejiang Province, Eastern China was very high. Several socio-demographic factors were identified to guide future targeted interventions aimed at improving hygiene practices among this population.

Keywords: toothbrushing, handwashing, hygiene behavior, adolescent, school

Introduction

Hygiene practices, particularly hand and oral hygiene, are crucial for preventing both infectious and chronic diseases.[1, 2] Since the COVID-19 pandemic, the significance of hand hygiene has gained renewed attention. [3] Hand hygiene is a simple yet highly effective method for minimizing the transmission of infectious diseases, including respiratory and gastrointestinal infections, which are prevalent in communal environments such as schools. Public health authorities emphasize handwashing as a key preventive strategy. [4, 5] Their guidelines recommend regular handwashing, especially before eating, after using the restroom, and after touching potentially contaminated surfaces. Similarly, oral hygiene plays a vital role in maintaining overall health and preventing various diseases. [6] Poor oral hygiene is linked to dental caries, periodontal diseases, and systemic conditions such as cardiovascular diseases and diabetes. [7] Moreover, inadequate oral

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hygiene can affect quality of life by causing dental pain, tooth loss, and oral infections, which impair eating, speaking, and social interactions, leading to psychological distress and reduced self-esteem. [8]

While hand and oral hygiene are often studied independently, integrating these practices into a single study provides a more comprehensive understanding of personal hygiene behaviors. Both practices share common determinants, such as access to health education, socioeconomic factors, and personal habits, and they reflect broader health awareness and preventive behaviors. [9] Examining these hygiene practices together can help identify shared barriers and facilitators, which is critical for designing holistic health promotion strategies.

Adolescents, who are transitioning from childhood to adulthood, are particularly susceptible to developing poor hygiene habits that may persist into adulthood. Promoting good hygiene practices in this age group is important for improving long-term health outcomes. In China, where rapid urbanization and lifestyle changes impact health behaviors, understanding the state of hand and oral hygiene among adolescent students is essential. Despite the recognized importance of hygiene practices, there is limited research focusing specifically on hand and oral hygiene among Chinese adolescent students. Existing studies conducted in other countries may not be directly applicable to Chinese adolescent students due to unique cultural, environmental, and socioeconomic factors.[10–13] The lack of region-specific data hinders our understanding of hygiene practices in China, emphasizing the need for targeted research.

This study seeks to fill the existing knowledge gap by investigating the prevalence of and factors influencing hand and oral hygiene behaviors among adolescent students in Zhejiang Province, Eastern China. Identifying the key factors influencing these practices will not only enhance hygiene behaviors in this population but also support the development of targeted public health policies that can reduce the incidence of infectious diseases and promote better overall health outcomes.

Materials and Methods

Study Design and Population

Our study utilized data derived from the 2022 Zhejiang Province Youth Risk Behavior Survey (YRBS) of China, an ongoing school-based, cross-sectional survey carried out by the Zhejiang Provincial Center for Disease Control and Prevention (CDC). Launched in 2007, the YRBS was designed to assess the prevalence of health-related behaviors and influencing factors among adolescent students, and it has been conducted every five years since its inception. The study population comprised all middle and high school students in 30 surveillance districts of Zhejiang Province. The participants were students with household registration in Zhejiang Province, excluding those from adult education institutions (eg, adult middle schools, adult high schools, and adult specialized secondary schools) and schools for students with disabilities.

A multistage stratified cluster sampling method, consisting of three stages, was employed to ensure economical and efficient sampling. In the first stage, data from all schools in 30 surveillance counties or districts were collected based on the sample framework of Zhejiang Province's health surveillance districts. Schools were then categorized into three strata: middle schools, vocational high schools and academic high schools. In the second stage, within each stratum, classes were organized in sequence according to the geographic location of the surveillance site (from north to south and from west to east) and by grade level (from lower to higher grades). 706 classes out of 376 schools were selected by a simple random sampling technique. Finally, all adolescent students within the selected classes were surveyed. Detailed descriptions of the study design and sampling strategy are available in prior publication.[14] During the sampling procedure, the Probability Proportional to Size (PPS) method was applied, ensuring that the proportion of students selected from each type of school (middle school, academic high school, and vocational high school) accurately reflected their relative distribution in the overall adolescent population.

Sample Size Calculation

The sample size was calculated using the following formula: $N = deff \times \mu^2 \times P \times (1 - P)/d^2$where the parameters were defined as follows: the design effect (*deff)* was set at 5.0, $P = 0.556$ (the prevalence of poor oral hygiene practices among Chinese adolescents in 2003),[15] $\mu = 1.96$, and the relative error, $d = r \times P$ with $r = 0.1$. Using these parameters,

the sample size for each stratum was calculated to be 1535 cases. Considering the stratification of the study population into 12 strata (2 strata for urban and rural areas, 2 for gender, and 3 for school types) and adjusting for a non-response rate of 15.0%, the final required sample size for the survey was calculated to be 21,670 participants.

Data Collection and Quality Control

The questionnaire was specifically designed for this study, drawing on references from the Global School-based Student Health Survey (GSHS) and the US Youth Risk Behavior Surveillance System (YRBSS). It covered a broad range of topics, including sociodemographic details, awareness of hypertension, physical activity, overall health and quality of life, smoking habits, alcohol consumption, usage of mobile phone, dietary patterns, weight management, hygiene practices, among others. The data were collected using a self-administered questionnaire, which students completed collectively in their classrooms. Prior to the survey, investigators provided an explanation of the study's purpose and importance, emphasizing the anonymity of the responses. Students were assured that their teachers and parents would not have access to their answers and that their participation would have no impact on their academic performance. To ensure privacy during the survey, students were seated at least one meter apart, and the classroom environment was kept quiet. Neither school doctors nor teachers were present during the survey process. Upon completion, students individually placed their questionnaires into a sealed collection box to maintain confidentiality.

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Zhejiang Provincial CDC's ethics committee (Approval No: 2022–007-01). Written informed consent was obtained from all participating students. For students under 18 years of age, written informed consent was provided by a parent or legal guardian prior to their participation in the study.

Definition of the Variables

In this study, oral and hand hygiene practices were primary outcome variables. Oral hygiene practice was assessed with the question, "In the past month, how many times did you usually brush your teeth per day"? The response options ranged from 1 (never brushed) to 6 (four or more times per day). For analysis, responses 1–3 were recoded as 1, indicating poor oral hygiene, and responses 4–6 were recoded as 0, indicating good oral hygiene practice. Hand hygiene practices were evaluated using three specific questions: (1) "In the past month, did you wash hands before meals"?; (2) "In the past month, did you wash hands after using the restroom"?; and (3) "In the past month, did you use hand sanitizer, soap, or liquid soap while washing hands"? Each of these questions had response options ranging from 1 (never) to 5 (always). For analysis, each question was dichotomized: "always" was recoded as 0, representing good hygiene, while all other responses were recoded as 1, representing poor hygiene. The study also collected sociodemographic data, including age, gender, parents' marriage status, parental education levels, only-child status, school type, current living situation, household registration, and family economic status.

Statistical Methods

Data collected by the self-administered questionnaire were input using EpiData software, and double-entry verification was conducted to ensure the accuracy of the data input. SAS software (version 9.4), was used to analyze the research data. Continuous variables were presented as mean ± standard deviation. Categorical data were summarized by reporting their frequencies and percentages. To examine the factors influencing poor oral and hand hygiene behaviors, a multivariate logistic regression analysis was employed. The significance level for statistical tests was set at $\alpha = 0.05$.

Results

General Characteristics of the Participants

In this survey, 27,070 individuals were approached, yielding a high response rate of 96.53%. Out of these, 26,101 met the World Health Organization's definition of adolescents (ages 10–19)[16] and provided complete survey data. Table 1 summarizes the general characteristics of the participants. The average age of students was 15.92 ± 1.74 years, with most participants being 16 years or older (58.28%), followed by those aged 14–15 years (31.87%). The gender

Table 1 General Characteristics of the Subjects (n=26,101)

Characteristics	Frequency (n)	Percent (%)
Age group (years)		
≤13	2571	9.85
14–15	8319	31.87
≥16	15,211	58.28
Gender		
Boys	13,456	51.55
Girls	12,645	48.45
Area		
Urban	8332	31.92
Rural	17,769	68.08
School type		
Middle school	12,281	47.05
Academic high school	7176	27.49
Vocational high school	6644	25.45
Parental marital status		
Married	22,751	87.17
Others	3350	12.83
Paternal education level		
Middle school or below	14,401	55.17
High school	6963	26.68
College or above	4737	18.15
Maternal education level		
Middle school or below	15,409	59.04
High school	6191	23.72
College or above	4501	17.24
Only child		
No	16,205	62.09
Yes	9896	37.91
Accommodation		
School dormitory	11,835	45.34
Others	14,266	54.66

(*Continued*)

Table 1 (Continued).

Characteristics	Frequency (n)	Percent (%)
Family income		
Very low/low	1495	5.73
Middle	22,394	85.80
High/very high	2212	8.47

distribution was relatively balanced, with 13,456 boys (51.55%) and 12,645 girls (48.45%). A significant proportion of the participants were from rural areas (68.08%), compared to 31.92% from urban areas. The participants were predominantly from middle schools (47.05%), while 27.49% attended academic high schools and 25.45% vocational high schools. Most participants came from families with married parents (87.17%). The educational levels of the parents varied, with a majority of fathers (55.17%) and mothers (59.04%) having a middle school education or below. Additionally, 62.09% of the participants were not only children, and a slight majority (54.66%) lived outside school dormitories. Regarding family income, 85.80% of participants reported being from middle-income families.

Prevalence of Poor Oral Hygiene Practice

Table 2 presents the prevalence of poor oral hygiene practices among the 26,101 adolescents, categorized by socio-demographic variables. Overall, 29.25% of participants exhibited poor oral hygiene, with boys (34.45%) showing a higher prevalence than girls (23.72%). Adolescents from rural areas reported a higher prevalence of poor oral hygiene

Table 2 Prevalence of Poor Oral Hygiene Practice Among the Subjects (n=26,101)

Characteristics	Frequency (n)	Percent (%)	χ^2	p-value
Overall, n(%)	7635	29.25		
Age group(years)			4.47	0.107
≤13	726	28.24		
14–15	2501	30.06		
≥16	4408	28.98		
Gender			362.05	<0.001
Boys	4635	34.45		
Girls	3000	23.72		
Area			16.52	<0.001
Urban	2298	27.58		
Rural	5337	30.04		
School type			26.81	<0.001
Middle school	3679	29.96		
Academic high school	1931	26.91		
Vocational high school	2025	30.48		

(*Continued*)

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Table 2 (Continued).

Characteristics	Frequency (n)	Percent (%)	χ^2	p-value
Parental marital status			17.92	<0.001
Married	6551	28.79		
Others	1084	32.36		
Paternal education level			175.32	<0.001
Middle school or below	4645	32.25		
High school	1923	27.62		
College or above	1067	22.52		
Maternal education level			161.39	<0.001
Middle school or below	4904	31.83		
High school	1730	27.94		
College or above	1001	22.24		
Only child			9.65	0.002
No	4851	29.94		
Yes	2784	28.13		
Accommodation			0.27	0.605
School dormitory	4192	29.38		
Others	3443	29.09		
Family income			88.77	<0.001
Very low/low	558	37.32		
Middle	6568	29.33		
High/very high	509	23.01		

(30.04%) compared to those from urban areas (27.59%). Vocational high school students showed the highest prevalence (30.48%), followed by middle school students (29.96%) and academic high school students (26.91%). Adolescents from non-traditional families (eg, divorced or separated) had a higher prevalence of poor oral hygiene (32.36%) compared to those from married families (28.79%). Poor oral hygiene was also more common among adolescents whose parents had lower educational attainment, with the highest prevalence observed in those whose fathers (32.25%) and mothers (31.83%) had a middle school education or below, and the lowest prevalence among those with college-educated parents (paternal: 22.52%, maternal: 22.24%). Adolescents who were not the only child had a slightly higher prevalence of poor oral hygiene (29.94%) compared to only children (28.13%). Adolescents from low/very low-income families exhibited the highest prevalence of poor oral hygiene (37.32%), compared to those from middle-income (29.33%) and high/very high-income families (23.01%).

Figure 1 illustrates the frequency of tooth brushing among boys, girls, and the overall participants. The majority (51.43%) reported brushing their teeth twice daily, with notable gender differences: 59.98% of girls versus 43.39% of boys reported brushing twice a day.

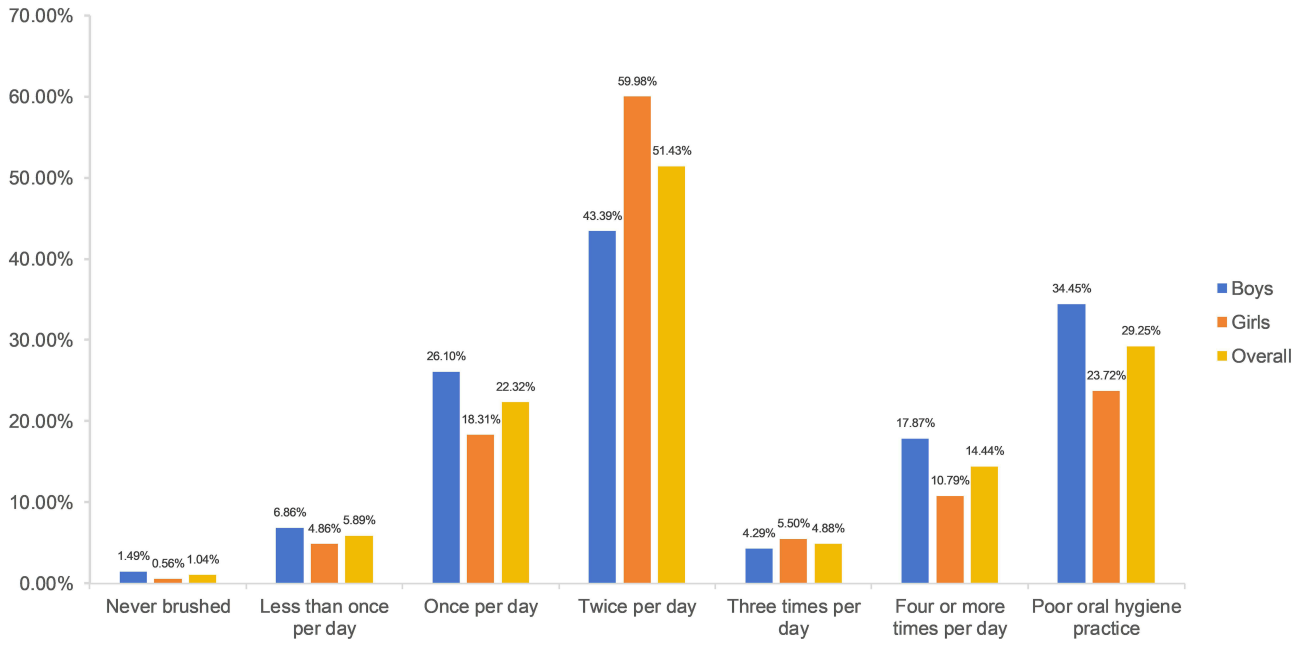

Figure 1 The frequency of tooth brushing among boys, girls, and the overall participants.

Prevalence of Poor Hand Hygiene Practices

Table 3 details the prevalence of poor hand hygiene practices among the adolescents. Overall, 78.06% reported poor hygiene before meals, 24.67% after using the toilet, and 82.56% when using soap. The prevalence of poor hand hygiene before meals and when using soap was higher among older adolescents (≥16 years), girls, rural residents, academic high school students, those from non-traditional families, adolescents whose parents had lower educational attainment, those living outside school dormitories, and those from lower-income families. In contrast, poor hand hygiene practice after

Table 3 Prevalence of Poor Hand Hygiene Practices Among the Subjects (n=26,101)

Characteristics	Poor Hand Hygiene Practice Before Meals, n(%)	p-value	Poor Hand Hygiene Practice After Toilet, n(%)	p-value	Poor Hand Hygiene Practice with Soap, n(%)	p-value
Overall, n(%)	20,374 (78.06)		6440 (24.67)		21,550 (82.56)	
Age group(years)		<0.001		<0.001		<0.001
≤13	1741 (67.72)		762 (29.64)		1877 (73.01)	
14–15	6053 (72.76)		2346 (28.20)		6541 (78.63)	
≥16	12,580 (82.70)		3332 (21.91)		13,132 (86.33)	
Gender		<0.001		0.003		<0.001
Boys	10,020 (74.46)		3423 (25.44)		10,767 (80.02)	
Girls	10,354 (81.88)		3017(23.86)		10,783 (85.27)	
Area		0.160		0.018		<0.001
Urban	6460 (77.53)		2133 (25.60)		6675 (80.11)	
Rural	1,3914 (78.30)		4307 (24.24)		14,875 (83.71)	

(*Continued*)

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Table 3 (Continued).

Characteristics	Poor Hand Hygiene Practice Before Meals, n(%)	p-value	Poor Hand Hygiene Practice After Toilet, n(%)	p-value	Poor Hand Hygiene Practice with Soap, n(%)	p-value
School type		<0.001		<0.001		<0.001
Middle school	8840 (71.98)		3505 (28.54)		9527 (77.58)	
Academic high school	6148 (85.67)		1203 (16.76)		6385 (88.98)	
Vocational high school	5386 (81.07)		1732 (26.07)		5638 (84.86)	
Parental marital status		0.004		0.004		0.461
Married	17,695 (77.78)		5547 (24.38)		18,769 (82.50)	
Others	2679 (79.97)		893 (26.66)		2781 (83.01)	
Paternal education level		<0.001		0.336		<0.001
Middle school or below	11,376 (78.99)		3539 (24.57)		12,164 (84.47)	
High school	5426 (77.93)		1694 (24.33)		5711 (82.02)	
College or above	3572 (75.41)		1207 (25.48)		3675 (77.58)	
Maternal education level		<0.001		0.004		<0.001
Middle school or below	12,204 (79.20)		3770 (24.47)		13,013 (84.45)	
High school	4781 (77.23)		1475 (23.82)		5046 (81.51)	
College or above	3389 (75.29)		1195 (26.55)		3491 (77.56)	
Only child		0.466		0.005		<0.001
No	12,673 (78.20)		3904 (24.09)		13,509 (83.36)	
Yes	7701 (77.82)		2536 (25.63)		8041 (81.26)	
Accommodation		<0.001		<0.001		<0.001
School dormitory	10,594 (74.26)		3776 (26.47)		11,143 (78.11)	
Others	9780 (82.64)		2664 (22.51)		10,407 (87.93)	
Family income		<0.001		<0.001		<0.001
Very low/low	1220 (81.61)		436 (29.16)		1264 (84.55)	
Middle	17,558 (78.40)		5454 (24.35)		18,657 (83.31)	
High/very high	1596 (72.15)		550 (24.86)		1629 (73.64)	

using the toilet was more prevalent among younger adolescents (≤13 years), boys, urban residents, middle school students, those from non-traditional families, those with mothers who had higher educational attainment, only children, those living in school dormitories, and those from lower-income families.

Associated Factors of Poor Oral Hygiene Practice

Multivariable logistic regression analysis (Table 4) revealed that adolescents whose parents had other marital statuses (divorced, widowed, separated) were at higher risk of poor oral hygiene practices (OR: 1.18, 95% CI: 1.09–1.28). Conversely, being a girl (0.58, 0.55–0.62), attending an academic high school (0.83, 0.73–0.95), having a father with

Table 4 Multivariable ORs and 95% CIs for the Association Between Hand and Oral Hygiene Practices and Sociodemographic Factors (n=26,101)

Characteristics	Poor Oral Hygiene, OR (95% CI)	Poor Hand Hygiene		
		Before Meals, OR (95% CI)	After Toilet, OR (95% CI)	With Soap, OR (95% CI)
Age group (years)				
≤13	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
14–15	1.08 (0.98–1.19)	1.28 (1.16–1.41)***	0.93 (0.84–1.02)	1.38 (1.24–1.53)***
≥16	1.13 (0.98–1.30)	1.46 (1.26–1.69)***	0.93 (0.81–1.08)	1.46 (1.24–1.70)***
Gender				
Boys	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Girls	0.58 (0.55–0.62)***	1.55 (1.46–1.65)***	0.94 (0.89–1.00)	1.42 (1.33–1.52)***
Area				
Urban	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Rural	0.97 (0.91–1.03)	0.93 (0.87–1.00)	0.94 (0.88–1.00)	1.05 (0.97–1.13)
School type				
Middle school	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Academic high school	0.83 (0.73–0.95)**	1.74 (1.52–2.01)***	0.51 (0.45–0.58)***	1.71 (1.47–1.99)***
Vocational high school	0.89 (0.79–1.01)	1.26 (1.10–1.45)***	0.90 (0.79–1.03)	1.16 (1.00–1.35)
Parental marital status				
Married	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Others	1.18 (1.09–1.28)***	1.13 (1.03–1.24)*	1.04 (0.96–1.14)	1.04 (0.94–1.15)
Paternal education level				
Middle school or below	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
High school	0.87 (0.81–0.93)***	0.98 (0.91–1.06)	1.00 (0.93–1.07)	0.92 (0.85–1.00)
College or above	0.77 (0.69–0.85)***	0.93 (0.84–1.04)	0.98 (0.89–1.09)	0.83 (0.74–0.93)**
Maternal education level				
Middle school or below	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
High school	0.91 (0.85–0.98)*	0.93 (0.86–1.01)	0.96 (0.89–1.04)	0.92 (0.84–1.00)
College or above	0.76 (0.68–0.84)***	0.93 (0.84–1.04)	1.09 (0.98–1.21)	0.88 (0.78–0.98)*
Only child				
No	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Yes	0.91 (0.86–0.97)**	1.01 (0.95–1.08)	1.10 (1.04–1.17)**	0.95 (0.88–1.02)
Accommodation				
School dormitory	0.96 (0.91–1.02)	1.30 (1.22–1.39)***	0.97 (0.91–1.03)	1.61 (1.49–1.73)***
Others	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)

(*Continued*)

Table 4 (Continued).

Characteristics	Poor Oral Hygiene, OR (95% CI)	Poor Hand Hygiene		
		Before Meals, OR (95% CI)	After Toilet, OR (95% CI)	With Soap, OR (95% CI)
Family income				
Very low/low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Middle	0.77 (0.69–0.86)***	0.89 (0.78–1.03)	0.76 (0.67–0.85)***	1.04 (0.89–1.2)
High/very high	0.60 (0.52–0.70)***	0.73 (0.62–0.86)***	0.73 (0.63–0.86)***	0.70 (0.59–0.83)***

Notes: ***p<0.001; **p<0.01; *p<0.05.
Abbreviations: OR, odds ratio; CI, confidence interval.

a high school education (0.87, 0.81–0.93) or higher (0.77, 0.69–0.85), having a mother with a high school education (0.91,0.85–0.98) or higher (0.76, 0.68–0.84), being an only child (0.91, 0.86–0.97), and having a middle (0.77, 0.69–0.86) or high/very high family income (0.60, 0.52–0.70) were all linked to a reduced risk of poor oral hygiene practices (all $p < 0.05$).

Associated Factors of Poor Hand Hygiene Practices

Table 4 further shows that the adolescents aged 14–15 years (1.28, 1.16–1.41) and those 16 years or older (1.46, 1.26–1.69), being a girl (1.55, 1.46–1.65), attending an academic high school (1.74, 1.52–2.01) or vocational high school (1.26, 1.10–1.45), having parents with other marital status (divorced, widowed, separated) (1.13, 1.03–1.24), and those living in school dormitories (1.30, 1.22–1.39) were all linked to an increased risk of poor hand hygiene before meals. In contrast, adolescents from high/very high-income families (0.73, 0.62–0.86) were less likely to have poor hand hygiene before meals. Regarding poor hand hygiene after using the toilet, being an only child (1.10, 1.04–1.17) was a risk factor, while attending an academic high school (0.51, 0.45–0.58) and belonging to a middle-income (0.76, 0.67–0.85) or high/very high-income family (0.73,0.63–0.86) were protective. Moreover, the adolescents aged 14–15 years (1.38, 1.24–1.53) and those 16 years or older (1.46, 1.24–1.70), being a girl (1.42, 1.33–1.52), attending an academic high school (1.71, 1.47–1.99), and those living in dormitories (1.61, 1.49–1.73) were linked to an increased risk of poor hand hygiene with using soap. Conversely, adolescents whose fathers (0.83, 0.74–0.93) or mothers (0.88, 0.78–0.98) had a college or higher education, and those from high/very high-income families (0.70, 0.59–0.83) were less likely to exhibit poor hand hygiene with using soap (all $p < 0.05$).

Discussion

Our study offers the latest evaluation of oral and hand hygiene practices among adolescent students in Zhejiang Province during the COVID-19 pandemic, providing crucial insights into the prevalence and influencing factors of poor hygiene behaviors in this population. The prevalence of poor oral hygiene practice was 29.25%. This rate is higher than that observed in adolescents from 4 Southeast Asian countries (India, Indonesia, Myanmar, and Thailand) (22.4%), [12] Malaysia (12.9%),[11] 9 African countries (Botswana, Kenya, Namibia, Senegal, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe) (22.7%), [17] and France (23.9%). [18] However, it is lower compared to Chinese adolescents in 2003 (55.6%), [15] adolescents in Bangladesh (36.4%),[10] school adolescents in Southern India (38.1%), [19] and those in Finland, Belgium, and Lithuania (34.9–49.2%). [18] In terms of hand hygiene before meals, the prevalence was 78.06%, which is higher than in the Trinidad and Tobago, Suriname and Dominican Republic (68.2%), [20] 6 Southeast Asian countries (Bangladesh, Indonesia, Laos, Philippines, Thailand, and Timor-Leste) (44.8%),[10] 4 Southeast Asian countries (India, Indonesia, Myanmar, and Thailand) (45.2%),[12] Pacific island states (30–35%), [21] 9 African countries (Botswana, Kenya, Namibia, Senegal, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe) (37.8%),[17] and global data (43.3%). [22] Poor hand hygiene after using the toilet was 24.67%, similar to that in 4 Southeast Asian countries (India, Indonesia,

Myanmar, and Thailand) (26.5%), [12] but lower compared to global data (31.7%), [22] 6 Southeast Asian countries (Bangladesh, Indonesia, Laos, Philippines, Thailand, and Timor-Leste)(31.9%),[10] and 9 African countries (Botswana, Kenya, Namibia, Senegal, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe) (41.6%). [17] The prevalence of poor hand hygiene with using soap was 82.56%, higher than in Thailand (73.4%),[10] 9 African countries (Botswana, Kenya, Namibia, Senegal, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe) (65.0%),[17] 6 Southeast Asian countries (Bangladesh, Indonesia, Laos, Philippines, Thailand, and Timor-Leste) (55.8%) [10] and global data (54.7%).[22] These findings indicate that poor hand and oral hygiene practices are alarmingly prevalent among adolescent students in Zhejiang Province, Eastern China.

The low percentage of adolescents reporting handwashing after toilet use is concerning and may be attributed to several factors. First, some school restrooms may lack essential supplies, such as paper towels for drying hands, which may discourage students from washing their hands properly. Second, the absence or inconsistent replenishment of soap in school facilities further hinders effective hand hygiene practices. Third, the short duration of breaks between classes may lead students to prioritize other activities over handwashing, as they may perceive it as time-consuming or unnecessary. Additionally, schools often fail to emphasize the importance of handwashing after toilet use through educational campaigns or reminders, which could contribute to a lack of awareness and motivation among students. Addressing these barriers through improved infrastructure, consistent provision of hygiene supplies, targeted educational initiatives, and increased awareness campaigns could help promote better hygiene practices among adolescents.

The multivariable analysis showed that several factors were significantly linked to poor hand and oral hygiene practices. Gender emerged as a significant influence on hygiene behaviors. [18] This study confirmed previous findings[10], [18], [23–26] that boys are more likely to exhibit poor oral hygiene compared to girls. However, our study revealed a positive association between girls and poor hand hygiene, which contrasts with other studies.[25], [26] Notably, higher family income appeared to serve as a protective factor for both oral and hand hygiene practices, aligning with other study.[21] This suggests that financial resources may enhance access to hygiene products and education, which could explain the lower prevalence of proper hand hygiene in lower-income countries due to limited resources and knowledge. Additionally, even in more affluent countries, people from lower socioeconomic backgrounds are more likely to experience poor hygiene and face higher infection risks. [27] Consistent with Schwendicke et al[28] our study found that adolescents with higher levels of parental education tend to have better oral hygiene practices. As parents are pivotal in forming children's hygiene habits, those from lower socioeconomic backgrounds generally display poorer oral hygiene. [29], [30] This is supported by research showing that parents with higher educational levels and incomes are more knowledgeable about preventive dental care programs. [31] Furthermore, our study noted that being an only child correlated with better oral hygiene, consistent with Liu's findings that only children often have better oral health. [32]

Our findings also indicate that adolescents with divorced, widowed, or separated parents, and those residing in school dormitories, face a higher risk of poor hygiene practices. This underscores the importance of family stability and parental supervision in fostering healthy behaviors. Additionally, older adolescents were found to have poorer hand hygiene practices, a finding not always consistent with other researches.[11,33] This disparity may be attributed to increased independence and reduced supervision, leading to neglect or shortcuts in hygiene routines. Higher academic pressures could also diminish their focus on personal hygiene.

Cultural factors may play a significant role in shaping both oral and hand hygiene practices.[34–36] In some Chinese households, there is a belief that nighttime brushing is more effective in removing accumulated plaque and food debris from the day, thereby preventing dental issues. This cultural preference may lead to neglect of morning brushing, especially among students who face early school start times. Many students struggle to wake up early and often rush through their morning routines, leaving little time for brushing their teeth after breakfast.

Regarding hand hygiene, traditional Chinese cultural attitudes may also influence behaviors.[37] A Chinese proverb, "little dirt, never hurt", may reflect a lack of urgency or awareness about the risks of poor hand hygiene, particularly in informal or non-critical settings. Such cultural beliefs, combined with limited access to handwashing facilities and insufficient education, may explain the low prevalence of handwashing after toilet use or before meals.

This study is crucial for drawing attention to the troubling state of oral and hand hygiene behaviors among adolescent students in Zhejiang Province, Eastern China. It also identifies key high-risk groups and factors that influence hygiene

behaviors in this population. The insights gained can guide public health strategies aimed at improving hygiene behaviors among adolescents. By understanding the underlying factors contributing to poor hygiene, targeted educational programs and policies can be developed to promote healthier behaviors among adolescents.

Understanding the limitations inherent in our study is essential. First, due to the cross-sectional nature of the study, establishing causal relationships between the identified factors and hygiene practices is not feasible. Second, the reliance on self-reported data may introduce reporting bias, as participants might underreport or overreport their hygiene behaviors. Lastly, since the research was carried out in a specific region of China, the results may not be applicable to other regions or populations.

Conclusion

In conclusion, adolescent students in Zhejiang Province, Eastern China, exhibit a notably high prevalence of poor oral and hand hygiene practices. Despite increased awareness of hygiene due to the COVID-19 pandemic, a significant portion of adolescents still engage in sub-optimal hygiene practices. This highlights the urgent need to motivate and empower adolescents to take greater responsibility for their personal hygiene. Furthermore, these results emphasize the importance of improving existing oral and hand hygiene promotion programs by incorporating sociodemographic considerations. This study provides valuable baseline data that can inform future research and public health interventions aimed at improving adolescent students' hygiene practices.

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Disclosure

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