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Hand-washing Practice, Barriers, and Associated Factors among Jordanian Students in Public and Private Schools: A Cross-sectional Study

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ABSTRACT

Background: Hand washing with soap and neat running water is a proven infection control component in the school setting that limits the transmission of numerous communicable diseases. In Jordanian schools, students are at a high risk of contracting diseases and facing significant barriers to education because of the limited access to basic, functioning, and dignified sanitation facilities in schools. ***Purpose*****:** This study aimed to evaluate the steps of hand-washing practices in detail, and identify the hand-washing barriers among Jordanian students aged 9-15 years in public and private schools in Amman governorate. ***Methods*****:** This is a correlational cross-sectional study. Participants were school students aged between 9 years and 15 years from Amman governorate. The sample was drawn based on a multistage stratified random sampling technique to guarantee random and equal selection of participants. Data was collected using the core questions and indicators developed by WHO and UNICEF for monitoring hygiene in schools, hand-washing barriers self-reported questionnaire, and WHO hand-washing checklist. Descriptive, Pearson r correlation, independent *t*-test, and hierarchical linear regression analysis were used in our study. ***Results*****:** In this study, a total of 288 students have a moderate level of hand-washing practice. Inferential statistics revealed that the five hand-washing barriers identified in this study have a negative correlation with hand-washing scores ($p < 0.001$). Moreover, the analysis revealed associations between selected demographic variables and hand-washing practices. Female students, students attending private schools, and students from smaller households, and those with higher parental education ($p < 0.005$), ($p < 0.005$, $p < 0.001$, $p < 0.001$, respectively). The results of the t-test showed a significant difference in hand-washing practice between public and private schools ($p < 0.001$). Furthermore, the multiple hierarchical linear regression confirmed that lack of time, lack of hand-washing facilities, dirty hand-washing facilities, gender, and school type were significant predictors for students' hand-washing practices. ***Conclusion*****:** Students demonstrated moderate hand-washing practice levels, underscoring the need for better adherence, particularly for public schools where the students had lower level of hand-washing practices compared to students of public schools. Time constraints, lack of hand-washing facilities, unclean hand-washing facilities, gender, and school type were significant predictors for students' hand-washing

practices. ***Implications for Nursing:*** Improving students' hand hygiene requires stricter monitoring, by school nurses, adequate resources for infrastructure and supplies, integration of health education with visual reminders, and active parental involvement.

Keywords: Hand-washing, Students, Schools, Practices, Barriers.

What does this paper add?

1. This study provides new evidence on hand-washing practices and barriers among school children in Jordan by combining self-reported data with direct observation of hand-washing steps using the WHO checklist.
2. The findings highlight moderate levels of hand-washing practice and demonstrate that factors such as lack of time, limited accessibility of facilities, and unclean hand-washing stations negatively influence students' practices.
3. School type and gender emerged as significant predictors of hand-washing behavior, offering important insights for policymakers and school health programs aiming to improve hygiene practices in Jordanian schools.

Introduction

Hand washing with soap (HWWS) and neat running water is a proven infection control component in the school setting that limits the transmission of numerous communicable diseases, like Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (CDC, 2024; Ezezika et al., 2023), and according to the Centers for Disease Control and Prevention, HWWS is recommended for at least 20 seconds, or using hand sanitizer with at least 60% alcohol when soap and water are not easily accessible (CDC, 2024).

To carry out the recommended hygiene-related practices, schools require financial support, sufficient hygiene tools, and qualified staff (Carry et al., 2024), and barriers, such as the absence of proper hygienic facilities and resources, can hinder students' compliance (Ghrayeb et al., 2015). Due to the high personal contact between students, schools are a focal point for disease transmission. If proper precautions are not taken, students become vulnerable to illnesses linked to poor hygiene (Wada & Oloruntoba, 2021); and implementing plans to limit the spreading of infectious diseases in schools should be taken into account to foster the students' health and maximize their attendance (CDC, 2024; khan et al., 2021).

Notwithstanding, a great deal of time and effort was devoted globally to hand hygiene promotion with various strategies (Aboul-Enein et al., 2024; Loftus et al., 2019). Nearly 462 million school students around the world attend schools where the toilets lack soap, and 355 million students lack basic hand-washing facilities in their school settings, meaning that school basic hand-washing facilities are absent from nearly 818 million students. These barriers to hand-washing put children at high risk of transmittable diseases (WHO, 2020), which ranked among the primary causes of death in low-middle-income countries (Damani et al., 2017; Loftus et al., 2019; WHO, 2024). One out of five young children can be protected from contracting respiratory illnesses, like pneumonia, and approximately one out of three from diarrhea by HWWS (CDC, 2024), which has been shown beyond doubt in previous studies as a simple and cost-effective common public health measure to prevent the spread of communicable diseases; however, it still needs efforts of interventions to be a routine global health behavior (Aboul-Enein et al., 2024; Burton et al., 2011; Kothari et al., 2023; Loftus et al., 2019; Smith et al., 2020).

In the Jordanian context, the Hashemite kingdom remains one of the top water-scarce countries worldwide, and with hosting a large number of refugees, the situation is deteriorating, putting pressure upon water resources (ACTED, 2019). School children are particularly affected, as there is a high risk of contracting diseases and facing significant barriers to education because of the limited access to basic, functioning, and dignified sanitation facilities in the Jordanian schools (UNICEF, 2020).

This study falls under the umbrella of taking action to achieve the universal sustainable development goals, including the goals (3, 4, 6), which stipulate that every human being of all ages has the right to good health, quality education, safe drinking water, and sanitation throughout the world (UN, 2023). To the best of our knowledge, this is the first study of its kind in Amman governorate and only two earlier descriptive studies in Jordan addressed the prevalence of hand-washing habits among public school students without considering private schools, as a minor aspect of personal hygiene

rather than investigating it independently, with the absence of observational testing. In Al-Karak and Al-Mafraq governorates, only self-reported questionnaires were used to evaluate the students' hand-washing practice in public schools (ALBashtawy, 2017; Khamaiseh & Leimoon, 2024), while this study's aims and tools are completely different; it is a correlational school-based study that aimed to evaluate the steps of hand-washing practices in detail, and identify the hand-washing barriers among Jordanian students aged 9-15 years in public and private schools in Amman governorate, using different tools to clarify the present situation and assess the need for health promotion and education interventions in schools. This study is critically important, not only for school students, but also for school staff, and families who could benefit from the findings. Students should have an excellent hand-washing practice and understand its connection to preventing the spread of communicable diseases in schools and in their homes, as they serve as community-changing agents. Therefore, the research questions were as follows: 1. Is there any association between hand-washing practice and the barriers reported by the school students? 2. Is there any association between hand-washing practice and socio-demographics? 3. Is there any difference between students in private and public schools regarding hand-washing practice? 4. What are the predictors of students' hand-washing practices at schools?

Methods

Study Design and Setting

In this study, a correlational, cross-sectional methodological design was used to investigate the hand hygiene practices and barriers among school students in Amman city, the capital of the Hashemite Kingdom of Jordan. This study design enabled us to assess hand-washing practices and barriers in schools, and compare them between public and private schools. Moreover, predictors and correlations between students' hand-washing practices and demographics were applicable in this study design. The study was conducted in Amman city including these areas following to the selected directorates Jabal Al-Nuzhah, Abu Nseir, Jabal Al-Hussein, Al-Sweifieh, Al-Shmeisani, Tabarbour, Arjan, and Shafa Badran.

Study Population

The reference population in this study was the school students in Jordan; the accessible population was the students who met the study's eligibility criteria. The inclusion criteria of this study were: (1) schools must be in Amman city, (2) schools that include students 9-15 years old, (3) and schools affiliated to the selected directorates. No exclusion criteria were defined.

Study Sample and Sampling Method

This is a correlational cross-sectional study, which was carried out using a multistage stratified random sampling technique to break the large population into smaller clusters based on their demographics to select randomly the study participants from the sub-divided group to guarantee a representative sample of the study population.

The study sample frame compromises all students enrolled in public and private schools in Amman city with an age group of 9-15 years. The study sampling stratifies into three stages: at the first stage, the researchers selected four school directorates out of nine in Amman governorate using a simple random sampling technique. The second stage involved selecting four public schools out of 893 schools and four private schools out of 1439 schools from the chosen directorates. The third stage included randomly choosing 288 students, 144 students from public schools and 144 students from private schools, assuring an equal number of (72) females and (72) males based on their eligibility criteria.

G*power 3.1 (Faul et al., 2009) was used to determine the study sample size required with a linear bivariate regression: one group, size of slope, with one-tailed test, and medium effect size r= 0.15, a statistical power of 0.80, and a significant alpha of 0.05. The required sample size for this study is 270, and 12% was added to cover the incomplete questionnaires; therefore, the sample size was 302 participants. Figure 1 shows the multi-stage stratified random sampling method used in the study.

Questionnaire and Psychometric Properties

1. Hand-washing facility characteristics

In this study, the researchers used the core questions and indicators developed by WHO and UNICEF for monitoring hygiene in schools to observe and report the characteristics of hand-washing facilities in schools.

2. Hand-washing barriers questionnaire

A short self-reported questionnaire administered by the researchers consisted of two sections, the first section consisted of nine items of demographics, including grade, gender, school type, age, place of residence, father's education level, mother's education level, household income, and household number, the second section consisted of 5 items of hand-washing barriers at schools with dichotomous scale 'yes", or "no" answers, and the questionnaire responses were scored as percentages, with each participant's score representing the proportion of correct or selected responses relative to the total possible score. The hand-washing barriers questions were adapted from the published paper (ALBashtawy, 2017) and translated into Arabic based on WHO translation guidelines. The questionnaire was reviewed by 4 experts and found to meet a satisfactory level of content validity. S-CVI average based on proportional relevance was 0.93, and the S-CVI Universal agreement average was 0.8. The researchers conducted a pilot study to assess the questionnaire's feasibility and reliability prior to data collection, on 46 students. The internal consistency of Cronbach's alpha was 0.681, indicating that the questionnaire is reliable. The time needed to complete the questionnaire and participate in the hand-washing test was estimated at 15 minutes on average in the pilot study.

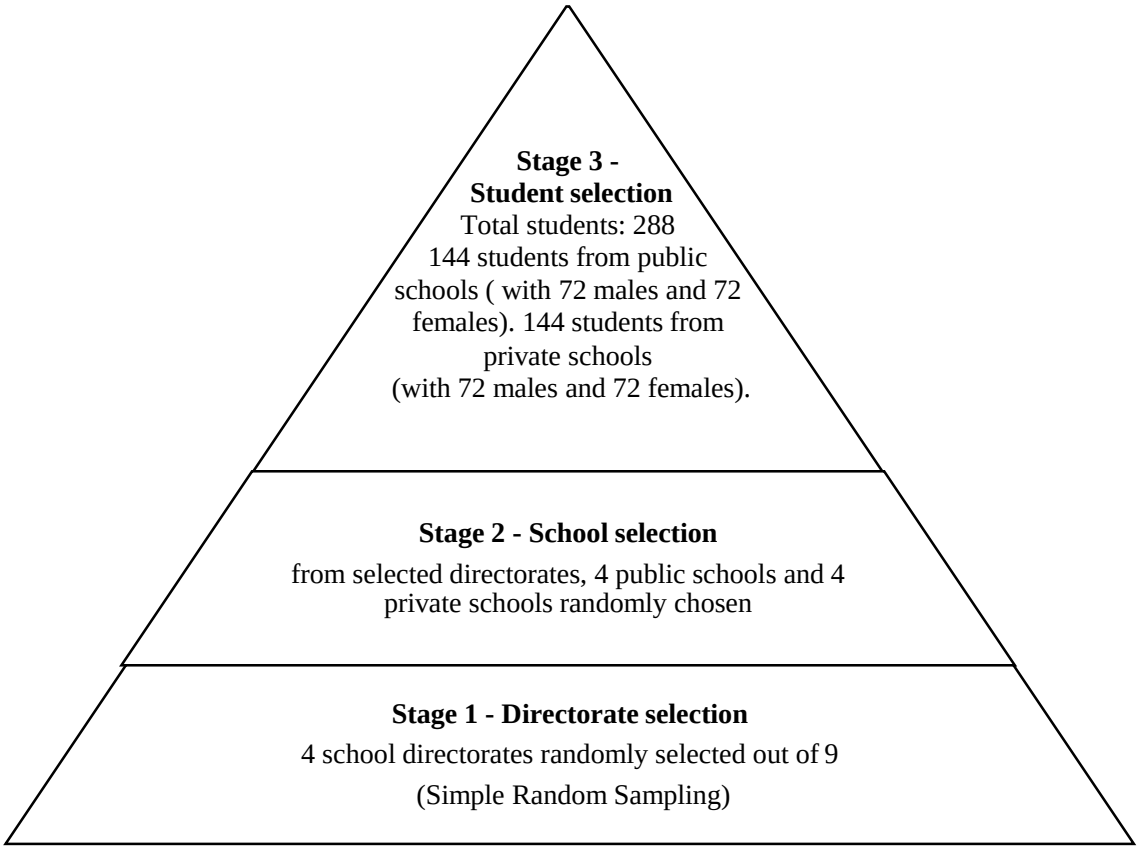

Figure 1. Multistage stratified random sampling method

3. Students' hand-washing test

Hand-washing observation test was held in the schools' hand-washing facilities by the researchers to observe and report the students' hand-washing practice in detail, using the WHO hand-washing checklist (WHO, 2009), and an electronic timer. The test comprised 11 steps, and the time duration spent during hand washing was reported, and added as the 12 step to the items after coding it into "compliant" for twenty seconds and more, and "not compliant" for less than 20 seconds, as hand-washing with soap should be performed for a minimum of 20 seconds, as recommended by the Centers for Disease Control and Prevention. (CDC, 2024). The total score of the items was 12, and the quartile equation was used to classify the scores into high, moderate, and low hand-washing practice levels.

Data Collection Procedure

The data collection procedure of this study was conducted from January 2025 to February 2025 in Jordanian schools in Amman. The researchers obtained cover letters from the school directorates and verbal permission from each school following receiving all of the study's details and data collection process. A consent form with a thorough explanation of the study goals, confidentiality, and the fact that participation is voluntary. was sent to the students' parents/guardians to sign it and return it back and familiarize them with the study's objectives. After returning the parents' consent forms, the participants were sorted according to the inclusion criteria of the study and received a full explanation of the study aims and benefits. The first step of the data collection was conducting a pilot study on 46 students to assess the tool's validity and feasibility, noting that these participants were excluded from the final analysis. The second step was distributing a short self-reported questionnaire to be filled out by the participants keeping anonymity, and returned back to the researchers. The filled questionnaires were kept in a secure file for each school separately with the researchers. The third step of the data collection was accompanying the participants individually to the school washing-hand facilities to observe and report their hand-washing steps, and record the duration spent by this process using an electronic timer. The last step was observing and reporting the hand-washing facilities' characteristics by the investigators.

Ethical Considerations

This study adheres to the Helsinki Declaration and was conducted in accordance with ethical principles for research including human participants, and approved by the institutional review board (IRB) at the Jordanian Ministry of Education (protocol code 42074/10/3, approval date: 2/9/2024).

A paper-based consent form with a clear description of the study's purpose, anonymity, procedures, risks, and benefits, along with explaining that participation is voluntary, was sent and signed by parents/ guardians before participation in the study. After providing age-appropriate explanations of the study for the students, a written assent was obtained from them after assuring that participation was voluntary and that they had the right to withdraw from participation anytime.

Data Analysis

The independent variables in this study were students hand-washing barriers, school type, age, gender, while the dependent variable was hand-washing practice score.

Based on the research questions, Statistical Package for Social Sciences (SPSS), version 29, was used in the study analysis; an alpha level of 0.05 was used. Data was collected, screened, cleaned, and coded. Setting errors, checking assumptions of Pearson correlation, and independent t-test were applied to ensure appropriate analysis by determining the issues with the data prior to analysis. No missing data was discovered. Mean, standard deviation, and percentage were calculated and used to describe the population characteristics. A bivariate Pearson correlation test was used to investigate a linear association between continuous variables, an independent t-test was utilized to obtain the mean differences between two independent groups, and multiple hierarchical linear regression analysis was applied to estimate the predictors of the dependent variable based on the independent variables.

Results

School Characteristics

A total of eight schools were assessed and observed carefully; out of the total schools, four public schools lack soaps 50%(n=4). Meanwhile, all eight schools had hand-washing facilities 100% (n=8), and only one out of the eight schools offered hand-washing practice education 12.5% (n=1).

Water was always available in the hand-washing facilities in 62.5% of the schools (n=5), four private schools 50%, and one public school 12.5%. Moreover, no kind of soap was provided outside the toilet facilities in all the schools 0% (n=0). Furthermore, only two private schools had clean hand-washing facilities 25% (n= 2).

Demographic Characteristics

A total of 302 questionnaires were distributed, and 288 were completed, with a good response rate of 95%. Table 1 indicates that 50% of the sample (n = 144) were males and the remaining were females; likewise, 50% of the sample (n = 144) were in private schools, and 50% of them were in public schools. The students were from 5^{th},6^{th}, 7^{th}, 8^{th}, 9^{th}, 10^{th} grades equally accounted to 16.7% (n=48) from each grade, and the sample mean age

was 12.36 years (SD = 1.85 years), ranging from 9-16 years. The monthly household income was between 500 and 1000 JD for the majority of the sample 44.1% (n=127), less than 500 JD for 22.2% (n=64), and more than 1000 JD for 33.7% (n = 97) of the sample. Regarding parents' education, 37.2% (n =107) of the mothers had a high school education or less, while the majority, 62.8% (n=181) hold a university degree. Likewise, 34% (n=98) of the fathers had a high school education or less, while the remaining 66% (n =190) hold a university degree. The sample mean household number was 5.64 (SD = 1.32).

Table 1. Demographic characteristics of study participants (n=288)

Categorical variables			
Variables		**n**	**%**
Gender	Male	144	50
	Female	144	50
School	Public	144	50
	Private	144	50
Grade	5th grade	48	16.7
	6th grade	48	16.7
	7th grade	48	16.7
	8th grade	48	16.7
	9th grade	48	16.7
	10th grade	48	16.7
Monthly household income	Less than 500 JD	64	22.2
	Between 500 and 1000 JD	127	44.1
	More than 1000 JD	97	33.7
Mother education	High school or less	107	37.2
	University Degree	181	62.8
Father Education	High school or less	98	34
	University Degree	190	66
Continuous variables			
		M	**SD**
Age		12.36	1.85
Household number		5.64	1.32

A total score of hand-washing practice steps was calculated, and the results indicated that the scores ranged from 3 to 11 with a mean of 6.07 (SD = 2.18)., given that the higher the score, the higher the level of hand-washing practice. Using the quartile equation, it was revealed that 25% of the study participants had a score of 8 or higher, and 50% had a score of 6 or higher. This indicates that the participants had a moderate level of hand-washing practice.

The total number of barriers was five, and out of 288 students, 30.9% (n=89) reported that barrier 1 "no need to wash hands", 36.5% (n =105) agreed on barrier 2 "no time to wash hands", 45.1% (n =130) confirmed on barrier 3 "hand-washing facilities are not easily accessible at my school ", 37% (n = 107) concurred with barrier 4 "washing facilities are not available in my school", and 52% (n = 147) agreed on barrier 5 "the hand-washing facilities are dirty", which has the highest agreement among all the five barriers.

To answer the first research question, "Is there any association between hand-washing practice and barriers reported by the school students?", bivariate analysis was performed to determine the barriers of hand-washing at schools, setting a significance level at alpha < 0.05. Following testing and assuring all parametric test assumptions, all variables assured normal distribution (skewness values were within the range -2 to +2, and kurtosis values were within the range (-7 to +7); all variables assured equality of variances. Results indicated a significant negative relationship between the

five barriers, barriers1 "no need to wash my hands", barrier 2 "no time to wash my hands", barrier 3 "hand-washing facilities are not easily accessible at my school", barriers 4 "washing facilities are not available in my school", and barrier 5 "The hand-washing facilities are dirty" with hand-washing practice ($r = -0.270^{**}$, -0.336^{**}, -0.504^{**}, -0.273^{**}, -0.330^{**}, respectively, $P < 0.001$). This means that students who confirmed these barriers are more likely to have lower scores of hand-washing (Table 2).

Table 2. Correlation analysis between hand-washing barriers and hand-washing practices

Variable	H.W. practice	Barrier1	Barrier2	Barrier3	Barrier4	Barrier5
H.W practice	1					
Barrier1	-0.270**	1				
Barrier2	-0.336**	0.321**	1			
Barrier3	-0.504**	0.269**	0.386**	1		
Barrier4	-0.273**	0.232**	0.224**	0.400**	1	
Barrier5	-0.330**	0.159**	0.266**	0.330**	0.394**	1

**. Correlation is significant at the 0.01 level (2-tailed).

To answer the second research question, "Is there any association between hand hygiene and socio-demographics?", Pearson r correlation was used to evaluate the association between hand-washing and socio-demographics, setting the significance level at alpha < 0.05. After meeting and assuring all parametric test assumptions, results revealed a significant positive correlation ($r = 0.150^{*}$, $p < 0.05$) between hand-washing practice and gender. This means that female students are more likely to have a higher hand-washing practice score. In addition, there was a significant relationship ($r = 0.771^{**}$, $p < 0.01$) between hand-washing practice and school type. This means that students in private schools are more likely to have better hand-washing practices. Moreover, there was a negative correlation ($r = -0.192^{**}$, $p < 0.01$) between household number and hand-washing practices, which means that the smaller the household, the more likely the student to perform better hand-washing practices. Furthermore, there was a significant association of hand-washing with mother's and father's education ($r= 0.256^{**}$, 0.242^{**} respectively, $p < 0.01$), indicating that the higher the education of the parents, the better the possibility of their child to have good hand-washing practice (Table 3).

Table 3. The correlation between hand-washing practice, gender, school type, age, family#, mother's education, and father's education

Variable	Hand-washing	Gender	School type	Age	Family #	Mother's education	Father's education
Hand-washing	1						
Gender	0.150*	1					
School type	0.771**	0.000	1				
Age	0.098	0.015	-0.030	1			
Family #	-0.192**	0.005	-0.190**	0.132*	1		
Mother's education	0.256**	0.079	0.323**	-0.033	-0.091	1	
Father's education	0.242**	0.044	0.322**	-0.042	-0.063	0.358**	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

To answer the third research question, "Is there any difference between students in private and public schools regarding hand-washing practice?", an independent t-test was used, setting the significance point at alpha < 0.05. Following testing and assuring all parametric test assumptions, the statistics revealed statistically significant differences between public and private schools in hand-washing practices, scoring {(*t* 286) = -20.445, *P* <0.001} (Table 4).

Table 4. Hand-washing practice comparison between public and private schools

Variable		Descriptive				t-test		
Dependent	**School type**	**N**	**M**	**SD**	**Std. Error Mean**	**T**	***df***	**P**
Hand-washing score	Public	144	4.3958	1.37	0.11418	-20.445	286	<0.001
	Private	144	7.7431	1.41	0.11733			

To answer the last research question, "What are the predictors of students' hand-washing practices?", a multiple hierarchical linear regression analysis was used to determine the predictors of handwashing in schools, setting the significance point at alpha < 0.05. In this multiple hierarchal linear regression, demographic factors including gender, school type, parents' education, household number, and the five barriers that were significant in the bivariate analysis were included in the regression as independent variables to control for their influences on the outcome, ensuring that the effects of the main predictors were not confounded by these variables, and hand-washing practice was the dependent variable. The assumption of collinearity was met, and a three-step multiple hierarchical linear regression analysis was applied with the "Enter" method to assess the prediction power of hand-washing practices, controlling for the barriers and selected demographics. The analysis (Table 5) showed that step 1, which includes the demographic factors for students, including household number, mother's education, father's education, and gender, was significant (F = 11.077, p <0.001) with R^2 = 0.135 (13.5%). In step 2, when barriers were added, the model was significant (F = 19.473, p <0.001) with R^2 = 0.387 (38.7%). In step 3, by adding school type, the model continued to be significant (F = 48.709, p<0.001) with R^2 = 0.637 (63.7%). The R^2 change from step 1 to 2 was 0.252 (25.2%), from steps 2 to 3 was 0.250 (25.0%), and from model 1 to 3 was 0.502 (50.2%).

The results indicate that 63.7% of the variation in students' hand-washing practice is explained by model 3, which contains school type, controlling for barriers and demographics. Also, 38.7% of the variation in hand-washing practice is explained by model 2, which contains barriers, controlling for selected demographics; all barriers were significant except barrier 1 (no need to wash hands), and barrier 4 (washing facilities in my school are not available). Furthermore, model 1 (the selected demographics) explained 13.5% of the variations in students' hand-washing practices; all the selected demographics were significant; gender, school type, and age variables were significant predictors of the students' hand-washing practice.

Model 3, which contains school type, controlling for barriers and selected demographics, was significant; school type was a positive significant predictor for hand-washing practices (β= 0.771, p < 0.001), indicating that private school students have better hand-washing practice. Furthermore, gender was a positive significant predictor for students' hand-washing practice (β= .0.145, P <0.001), indicating that female students have better hand-washing practice than males. Nevertheless, the other selected demographics, and barriers were not significant predictors (p > 0.05).

Table 5. Predictors of students' hand-washing practices at schools

Variables	Step 1		Step 2		Step 3	
	β	p	β	p	β	p
Family #	-0.166	0.003	-0.129	0.008	-0.050	0.187
Mother's education	0.172	0.004	0.075	0.148	-0.009	0.818
Father's education	0.164	0.006	0.086	0.098	-0.007	0.866
Gender	0.130	0.019	0.200	<0.001	0.145	<0.001
Barrier 1			-0.062	0.229	-0.103	0.010
Barrier 2			-0.172	0.002	-0.020	0.651
Barrier 3			-0.344	<0.001	-0.028	0.567
Barrier 4			0.007	0.906	0.112	0.010
Barrier 5			-0.138	0.011	0.005	0.898
School type					0.771	<0.001
R^2	0.135		0.387		0.637	
Model fit	F = 11.077 p < 0.001		F = 19.473, p < 0.001		F = 48.709, p < 0.001	
R^2 change			0.252		0.250	

Discussion

The study findings demonstrated that despite the availability of hand-washing facilities in all the school settings, soap was not provided outside the toilet facilities in all the schools, and in toilets in all public schools, alongside the lack of cleanness and availability of water. Moreover, in a comparison between public and private schools, none of the public schools offered hand-washing practice education, whereas one private school did. These statistics translate the urgent need for comprehensive amendments of the hand hygiene system at Jordanian schools. Consistent with these statistics, several international studies reported poor conditions in their schools. (Afroz et al., 2024; Douglas Doyle Kebati et al., 2024; Melaku & Addis, 2023; Okello et al., 2019; Parkinson et al., 2018; Ramatu Asabe et al., 2024; Wada & Oloruntoba, 2021). Conversely, a study from Bosnia and Herzegovina indicated a proper basic hand-washing facility at its schools (Kotur et al., 2024).

Unlike previous Jordanian studies that assessed only public schools outside Amman and found that school students had good to excellent hand-washing practice levels after various critical situations (ALBashtawy, 2017; Khamaiseh & Leimoon, 2024), in the current study students had a moderate level of hand-washing practice, indicating the need for improvement. This discrepancy may be attributed to variations in the socio-demographic characteristics of the study population or the different tools used to assess the students' hand hygiene. On the other hand, a Jordanian study in the Badia region revealed similar findings of inadequate hygiene practices regarding menstruation among schoolgirls and underscored the necessity for hygiene education to enhance these practices in Jordanian schools (Qasass et al., 2023).

Our findings identified five hand-washing barriers among school students, including students' beliefs that hand-washing is unnecessary, lack of time, lack of hand-washing facilities, limited access, and dirty hand-washing facilities. Similar to our findings from the United States, lack of time, insufficient funds for hygiene equipment, the ability of educators to supervise students, and the limited cleaning and disinfecting staff were the main obstacles to practicing hand hygiene in American schools (Carry et al., 2024). Furthermore, a study from Ethiopia revealed that students' hand hygiene practices are influenced by the availability of hand-washing facilities, and access to water and soap in schools (Berhanu et al., 2022).

The current study provided evidence that there is a statistically significant negative correlation between the five hand-washing barriers; "students' beliefs that hand-washing is unnecessary, lack of time, lack of hand-washing facilities, limited access, and dirty hand-washing facilities," as independent variables, and hand-washing scores as a dependent variable, which means that the students' scores can be negatively influenced by these barriers. These findings are consistent with a systematic review study that identified and correlated barriers and facilitators to hand-washing (Ezezika et al.,

2023). On the contrary, two international studies contradicted the relationship between barrier perception toward hand-washing compliance; and availability of hand-washing facilities and students' hand-washing behaviors (Engdaw et al., 2024; Nazliansyah et al., 2016).

Despite the fact that several studies assessed the differences in hand-washing practices between urban, and rural schools (Berhanu et al., 2022; Mekonnen et al., 2018; Pieters et al., 2023), only a few studies compared students' hand-washing practices between different school types, and a significant difference was reported in a study from Ghana, indicating that governmental school students had superior hand-washing practices compared to their peers in private schools (Steiner-Asiedu et al., 2011). Meanwhile, a finding from Addis Ababa revealed that public school students had poor hand-washing practices compared to their private school counterparts, attributing this result to socio-demographic differences. In our comparison between public and private schools, students in Jordanian private schools have much better hand-washing scores than students in public schools, and on top of that, school type was not only correlated to hand-washing practice, but also a positive significant predictor in the last model of hierarchical regression, controlling for demographics and barriers.

Regarding socio-demographic factors, the current study found that better students' hand-washing practice can be attributed to higher parents' education, and household number. Evidence from several studies suggests that there is a significant correlation between parents' level of education and hygiene practice (ALBashtawy, 2017; Okello et al., 2019; Qasass et al., 2023; Sujit Kumar Banik et al., 2024). To the best of our knowledge, no existing literature supports the household number correlation to hand-washing practice in our research.

Moreover, gender in our findings was significantly correlated to; and predicted hand-washing practice in the first, second, and last model in hierarchical regression. This indicates that female students perform handwashing more effectively than their male counterparts. (Hao et al., 2022; Khamaiseh & Leimoon, 2024; Okello et al., 2019). In contrast to this result, findings from Indonesia declined the association between the student's gender and hand-washing behavior (Nazliansyah et al., 2016).

In previous studies, access to hand-washing school facilities, hygiene education campaigns, and trained hygiene staff were found to be significant predictors for students' hand-washing practice (Admasie et al., 2022). In the current study, lack of time, lack of hand-washing facilities, and dirty hand-washing facilities were significant predictors for students' hand-washing practice in the second model and the last model in regression, controlling for demographics.

Strengths and Limitations

As far as we know, this is the first correlational school-based study of its kind in Jordan that assessed, observed, and compared hand-washing practices in public and private schools. Our study has some strengths and limitations. The strengths of our study were the study design that allowed us to investigate correlations between study variables, and the sampling method by using multistage stratified random sampling technique, in which we guaranteed random and equal selection of male and female participants, and equal numbers of students in public and private schools. Moreover, the observation of practical hand-washing was a strength in our study.

Despite its contributions, some constraints should be acknowledged in this study. Due to its cross-sectional nature, this study could not establish causality between the study variables. Moreover, self-reported responses in the demographics and barriers questionnaire are subject to potential overestimation or underestimation by the participants. Furthermore, our study was conducted in selected schools in Amman governorate, which may limit the generalizability of its findings to other regions.

Implications and Recommendations

This study opens a wide range of potential directions for further research, because the identified barriers and hand-washing practices have not yet been tested through intervention studies. Future research should apply an experimental design to test the effectiveness of different interventions in overcoming barriers to handwashing among students, and improve hand-washing practices.

Based on the findings of the present study, the following recommendations are proposed to enhance students' attendance, alleviate the transmission of diseases among students, and enhance their preparedness to handle health crises, like the coronavirus pandemic.

Implications and Recommendations for Government and Policymakers

1. Schools should be monitored more closely, and should have clear guidelines on hand-washing steps, duration, and frequency, particularly in public schools.
2. Ministry of Education jointly with Ministry of Health should conduct regular surveys or observations to identify persistent barriers and adjust strategies accordingly.
3. Allocating sufficient resources is needed to improve infrastructures in public schools, focusing on increasing easily accessible and functional hand-washing stations, supplying hygiene tools, such as soaps and one-use paper towels, and periodically checking water maintenance and preventing water shortages.
4. Utilizing the study findings to inform policy modifications and create interventions tailored to the local cultural and environmental situation.

Implications and Recommendations for Nursing

1. Health education and awareness programs should be included in the curriculum, led by school nurses, and visual posters should be used to support and remind students to wash their hands in all school facilities.
2. Engaging parents, as their involvement is essential to reinforce students' hand hygiene practices at home. Schools should offer guidance for parents on proper hand-washing techniques and the significance of hygiene through meetings or online platforms.
3. Advocating for funding and policies that guarantee access to clean water, soap, and functional hand-washing facilities for students in schools.
4. Serving as a role model by embodying proper hygiene practices and supervising hand-washing practices among students.
5. Conducting periodic assessments of hand-hygiene knowledge and practices for the students and providing feedback on improvements.

Conclusion

In general, the study demonstrated that students have a moderate level of hand-washing practice, indicating the need for improvement, specifically for public school students, according to our comparison between public and private schools. Moreover, hand-washing barriers, gender, parents' education, and household number were significant factors affecting hand-washing practices in public and private schools, and attention to this area at schools is necessary. Students' hand hygiene requires rigorous monitoring at schools, availability of necessary facilities and supplies, integration of health education with visual prompts, and parental participation.

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Conflict of Interests

No conflict of interests has to be declared by the authors.

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Author Contributions

Study Design: **AAA, MA, ME, HH**. Data Collection: **AAA**. Data Analysis: **AAA, MA, ME**. Study Supervision: **MA, ME, AA**. Manuscript Writing: **AAA, AA, MA, MB, HH**. Critical Revisions for Important Intellectual Content: **MA, ME, MB, AA, HH**.

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to institutional copyright issues, but are available from the corresponding author upon reasonable request.

REFERENCES

Aboul-Enein, B.H., Kelly, P.J., Raddi, S., Keller, T., & Almoayad, F. (2024). Effectiveness of hand-hygiene campaigns and interventions across the League of Arab States: A region-wide scoping review. *Journal of Hospital Infection, 147*, 161-179. https://doi.org/10.1016/j.jhin.2024.02.022

ACTED. (2019). *Getting the taps running again in Jordan*. https://www.acted.org/en/getting-the-taps-running-again-in-jordan/

Admasie, A., Guluma, A., & Feleke, F.W. (2022). Handwashing practices and its predictors among primary school children in Damote Woide District, South Ethiopia: An institution based cross-sectional study. *Environmental Health Insights, 16*.

https://doi.org/10.1177/11786302221086795

Afroz, R., Hayet, M., & Bari, N.M. (2024). *Evaluation of sanitation facilities in primary schools: Insights from Rajshahi City Corporation, Bangladesh*. https://doi.org/10.5281/zenodo.14613912

ALBashtawy, M. (2017). Assessment of hand-washing habits among school students aged 6-18 years in Jordan. *British Journal of School Nursing*, *12*(1), 30-36. https://doi.org/10.12968/bjsn.2017.12.1.30

Berhanu, A., Mengistu, D.A., Temesgen, L.M., Mulat, S., Dirirsa, G., Alemu, F.K., Mangasha, A. E., Gobena, T., & Geremew, A. (2022). Hand-washing practice among public primary school children and associated factors in Harar town, eastern Ethiopia: An institution-based cross-sectional study. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.975507

Burton, M., Cobb, E., Donachie, P., Judah, G., Curtis, V., & Schmidt, W.-P. (2011). The effect of handwashing with water or soap on bacterial contamination of hands. *International Journal of Environmental Research and Public Health*, *8*(1), 97-104. https://doi.org/10.3390/ijerph8010097

Carry, M.G., Soelaeman, R.H., Aluko-Estrella, S.K., Garcia-Williams, A.G., West, L.K., Haston, J.C., Besrat, B.N., Aponte, J., Jones, S.L., & Rutt, C.D. (2024). Understanding perceived barriers to and responsibility for implementing recommended hygiene activities in US schools K-12: A needs assessment among caregivers and educators. *Health Behavior and Policy Review*, *11*(6), 1770-1782. https://doi.org/10.14485/HBPR.11.6.3

CDC. (2024a). *School health interventions*. https://www.cdc.gov/children-and-school-preparedness/php/interventions/index.html

CDC. (2024b). *About clean hands*. https://www.cdc.gov/clean-hands/about/index.html

CDC. (2024c). *Clean hands: Facts and stats*. https://www.cdc.gov/clean-hands/data-research/facts-stats/index.html

CDC. (2024d). *About hand hygiene in schools and early care and education settings*. https://www.cdc.gov/clean-hands/prevention/about-hand-hygiene-in-schools-and-early-care-and-education-settings.html

Damani, N., Mehtar, S., & Allegranzi, B. (2017). Hand hygiene in resource-poor settings. In *Hand Hygiene* (pp. 357-366). Wiley. https://doi.org/10.1002/9781118846810.ch43

Douglas Doyle Kebati, Dominic Mogere, & Teresia Ngonjo. (2024). Risk factors associated with hygiene and sanitation practices in public secondary schools in Kitale Municipality Trans Nzoia County, Kenya. *International Journal for Multidisciplinary Research*, *6*(4). https://doi.org/10.36948/ijfmr.2024.v06i04.24030

Engdaw, G. T., Alemu, D., Alemayehu, M., & Tesfaye, A. H. (2024). Handwashing practices among public primary school students in East Dembiya District, Ethiopia. *The American Journal of Tropical Medicine and Hygiene*, *110*(4), 826-834. https://doi.org/10.4269/ajtmh.23-0201

Ezezika, O., Heng, J., Fatima, K., Mohamed, A., & Barrett, K. (2023). What are the barriers and facilitators to community handwashing with water and soap? A systematic review. In *PLOS Global Public Health* (Vol. 3, Issue 4 April). Public Library of Science. https://doi.org/10.1371/journal.pgph.0001720

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149-1160. https://doi.org/10.3758/BRM.41.4.1149

Ghrayeb, F. A., Rusli, A. M., Al Rifai, A., & Ismail, I. M. (2015). Hand-washing behavior and hygiene-related facilities among school adolescents in Palestine. *Indian Journal of Public Health Research & Development*, *6*(3), 22. https://doi.org/10.5958/0976-5506.2015.00132.1

Hao, M., He, J., Zeng, Y., Han, W., Sai, A., & Yamauchi, T. (2022). A comprehensive assessment of hand washing: knowledge, attitudes and practices (KAP) and hand-washing behaviors among primary school students in northeast China. *Sanitation Value Chain*, *6*(1), 13-022. https://doi.org/10.34416/svc.00026

Khamaiseh, A., & Leimoon, H. (2024). *Knowledge, attitude, and practice of personal hygiene among primary school students in southern Jordan: A cross-sectional school-based study*. https://doi.org/10.21203/rs.3.rs-3849230/v1

khan, S., Ashraf, H., Iftikhar, S., & Baig-Ansari, N. (2021). Impact of hand-hygiene intervention on hand-washing ability of school-aged children. *Journal of Family Medicine and Primary Care*, *10*(2), 642-647. https://doi.org/10.4103/jfmpc.jfmpc_1906_20

Kothari, A., Phutane, V.S., Bajaj, S., Mukherjee, R., & Tawar, S. (2023). Impact of health education on knowledge, attitude and practices regarding hand-hygiene amongst school children aged 10-12 years in

pune: An interventional study. *Journal of Marine Medical Society*, *25*(Suppl 1), S36-S40. https://doi.org/10.4103/jmms.jmms_81_22

Kotur, B., Rudić-Grujić, V., Grabež, M., & Petković, V. (2024). Main findings of the Water, Sanitation and Hygiene (WSAH) survey in primary schools in the Republic of Srpska, Bosnia and Herzegovina. *Book of Abstracts - International Congress Public Health – Achievements and Challenges - Zbornik Radova*, 135. https://doi.org/10.5937/BatutPHCO24090K

Loftus, M.J., Guitart, C., Tartari, E., Stewardson, A.J., Amer, F., Bellissimo-Rodrigues, F., Lee, Y. F., Mehtar, S., Sithole, B. L., & Pittet, D. (2019). Hand hygiene in low- and middle-income countries. *International Journal of Infectious Diseases*, *86*, 25-30. https://doi.org/10.1016/j.ijid.2019.06.002

Mekonnen, M., Aga, F., Kinati, T., & Shifera, D. (2018). Assessment of hand-washing practice and associated factors among primary school children in Sebeta Town Oromia Regional State, Ethiopia. *Health Science Journal*, *12*(6). https://doi.org/10.21767/1791-809X.1000605

Melaku, A., & Addis, T. (2023). Handwashing practices and associated factors among school children in Kirkos and Akaki Kality Sub-cities, Addis Ababa, Ethiopia. *Environmental Health Insights*, *17*. https://doi.org/10.1177/11786302231156299

Nazliansyah, N., Wichaikull, S., & Wetasin, K. (2016). Factors affecting hand-washing practice among elementary school students in Indonesia. *Belitung Nursing Journal*, *2*(4), 58-64. https://doi.org/10.33546/bnj.24

Okello, E., Kapiga, S., Grosskurth, H., Makata, K., Mcharo, O., Kinungh'i, S., & Dreibelbis, R. (2019). Factors perceived to facilitate or hinder hand-washing among primary students: A qualitative assessment of the Mikono Safi intervention schools in NW Tanzania. *BMJ Open*, *9*(11), e030947. https://doi.org/10.1136/bmjopen-2019-030947

Parkinson, J., Mkandawire, P. C., Dietrich, T., Badejo, A., Kadir, M., & Tembo, V. (2018). Developing the UNICEF Malawi School Handwashing Program. *Social Marketing Quarterly*, *24*(2), 74-88. https://doi.org/10.1177/1524500418766355

Pieters, M. M., Fahsen, N., Quezada, R., Pratt, C., Craig, C., McDavid, K., Vega Ocasio, D., Hug, C., Cordón-Rosales, C., & Lozier, M. J. (2023). Assessing hand-hygiene knowledge, attitudes, and behaviors among Guatemalan primary school students in the context of the COVID-19 pandemic. *BMC Public Health*, *23*(1), 2252. https://doi.org/10.1186/s12889-023-17168-4

Qasass, Y., Albashtawy, M., Mohammad, K. I., Hamaideh, S. H., Ta'an, W., Rayan, A., Hamadneh, J., Hamadneh, S., Al-Awamreh, K., Ayed, A., Alkhawaldeh, A., Abdalrahim, A., Harb, E.M., Alkharabsheh, M., & Albashtawy, B. (2023). Knowledge and practices of menstrual hygiene among adolescent schoolgirls in Jordanian Badia Region: A field study. *Jordan Journal of Nursing Research*, *2*(3), 219-230. https://doi.org/10.14525/JJNR.v2i3.08

Ramatu Asabe, N., Asiya Salman, Y., & Saadatu Bagiwa, L. (2024). Assessment of post-covid-19 hand hygiene compliance among nigeria certificate in education biology students in Zaria, Nigeria. *International Journal of Advanced Multidisciplinary Research and Studies*, *4*(3), 146-151. https://doi.org/10.62225/2583049X.2024.4.3.2756

Smith, L., Butler, L., Tully, M.A., Jacob, L., Barnett, Y., López-Sánchez, G.F., López-Bueno, R., Shin, J. Il, McDermott, D., Pfeifer, B. A., Pizzol, D., & Koyanagi, A. (2020). Hand-washing practices among adolescents aged 12–15 years from 80 countries. *International Journal of Environmental Research and Public Health*, *18*(1), 138. https://doi.org/10.3390/ ijerph18010138

Steiner-Asiedu, M., Van-Ess, S.E., Papoe, M., Setorglo, J., Asiedu, D.K., & Anderson, A.K. (2011). Hand-washing practices among school children in Ghana. *Current Research Journal of Social Sciences*, *3*(4), 293-300.

Sujit Kumar Banik, Susmita Saha, Munmun Akter, Md Imran Bin Kayes, Moshfequa Rahman Khan, & Abu Ansar Md Rizwan. (2024). Hand-washing practices and associated socio-demographic factors among primary school students in Cox's Bazar, Bangladesh: A cross-sectional study. *International Journal of Science and Research Archive*, *13*(1), 2530-2538. https://doi.org/10.30574/ijsra.2024.13.1.1917

UN. (2023). *Sustainable development goals*. https://www.un.org/sustainabledevelopment/sustainable-development-goals/

UNICEF. (2020). *UNICEF scales up support for water, sanitation and hygiene in schools ahead of reopening*. https://www.unicef.org/jordan/press-releases/unicef-scales-support-water-sanitation-and-hygiene-schools-ahead-reopening

Wada, O. Z., & Oloruntoba, E. O. (2021). Safe reopening of schools during COVID-19: An evaluation of

handwash facilities and students' hand hygiene knowledge and practices. *European Journal of Environment and Public Health*, *5*(2), em0072. https://doi.org/10.21601/ejeph/9704

WHO. (2009). *How to handwash*. https://www.who.int/publications/m/item/how-to-handwash

WHO. (2020, August 13). *2 in 5 schools around the world lacked basic handwashing facilities prior to COVID-19 pandemic — UNICEF and WHO*. https://www.who.int/news/item/13-08-2020-2-in-5-schools-around-the-world-lacked-basic-handwashing-facilities-prior-to-covid-19-pandemic-unicef-who

WHO. (2024). *The top 10 causes of death*. https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death