



## Hand Hygiene Education Decreased School Absenteeism among Saudi Female Primary Students in Saudi Arabia, 2018

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### ABSTRACT

**Background:** Upper Respiratory Infection (URI) frequently results in students' absence. Proper hand hygiene is an important preventative measure to control transmission infections. The study aimed to determine if there was an association between the education of hand hygiene and reduction in school absences due to URIs among primary students in Riyadh, Saudi Arabia. **Methodology:** A clustered randomized controlled trial was conducted. After completion of baseline data questionnaires, students in the experimental group attended hand hygiene workshops. Parents of absent students were phoned to uncover the reason for absence. **Result:** The multivariate analysis revealed that students in the experimental group were at significantly lower risk of URIs absenteeism (Incidence Rate Ratio (IRR): 0.508, 95% CI: 0.292-0.882, p-value: 0.016). Family size was related to URI absences, as students in families with 4-5 members and 6 or more members were at significantly lower risk for absence due to URIs when compared to students in families with 3 members (IRR: 0.191, 95% CI: 0.050-0.727, p-value: 0.015) and (IRR: 0.157, 95% CI: 0.041-0.595, p-value=0.006), respectively. Students exposed to passive cigarette smoking were twice as likely to be absent due to URI compared to those who were not exposed (IRR: 1.926, 95% CI: 1.095-3.389, p-value: 0.023). **Conclusion:** School absenteeism was lower among students who participated in the hand hygiene workshop. Hand hygiene education programs are encouraged for adoption by stakeholders to break the transmission of URIs through utilizing available human resources.

**Keywords:** Students, URIs, Hand hygiene, Saudi Arabia, School absence, School absenteeism

### INTRODUCTION

#### Background

Upper Respiratory Infections (URIs) are common diseases seen by physicians in primary health care centers and outpatient clinics [1]. Previous studies have indicated that children experience an average of six to eight URIs episodes every year and frequently result in school absenteeism [2,3]. Children are more prone to develop URIs during the fall and winter seasons [2]. URIs' viruses can be transmitted through inhalation of airborne respiratory droplets from an infected person or by direct contact with secretions on the hands of an infected person or on objects or surfaces that were touched by an infected person [2-4]. Hand hygiene practices should be taught to children from a young age in both the home and school environments as a method to prevent the spread of infectious diseases such as respiratory infections and gastrointestinal infections [5-9].

Several studies related to school absenteeism conducted in Saudi Arabia investigated school absences due to menstruation, toothaches, hemophilia, and bronchial asthma [10-13]. URIs are self-limiting, but their complications may be more dangerous than the primary infections [2,3]. Upper respiratory infections have a significant impact on students' absence from school and contribute to lowering their overall academic performance with parents' needing to take leave from work to take care of their sick children [14]. Furthermore, URIs and associated viruses may be transmitted to other family members [15]. As handwashing is an important and effective measure to prevent transmission of infections, this study may help to develop a hand hygiene education program in schools to control the transmission of infections.

The study aimed to determine whether there is an association between education regarding hand hygiene practices and reduction of school absence due to URIs among primary school-aged girls in Riyadh, Saudi Arabia.

## METHODOLOGY

### Design and Sampling

This article is a part of a larger study titled "Education of Hand Hygiene Practice and its Association with School Absence due to Upper Respiratory Infections among Primary Schoolgirls. Riyadh, 2018." which was conducted as clustered randomized controlled trial among students attending four public primary schools of girls in Riyadh city for a period of seven weeks (from January 28, 2018, through March 15, 2018). A multistage cluster sampling method, consisting of three stages, was followed, yielding four schools. First stage: Two of the eight educational offices were selected by simple random method. Second stage: Two primary girls' schools were selected randomly from each of the selected educational offices. The first selected school in each educational office was assigned to the Experimental Group (EG). Third stage: All students attending the selected schools (1<sup>st</sup>-6<sup>th</sup> grade students) were invited to participate in the study. All students attending the first selected school from each educational office were assigned to the intervention and all students in the second selected school from the education office were in the control group. The rate of URIs was assumed to be 44.86% according to the previous study in the neighboring country, a risk ratio of 62% was assumed with an alpha level of 0.05 and power of 80% [16,17]. The calculated sample size was 123 students per group. To adjust for cluster sampling, it was doubled to become 246 participants per group and 492 total. After taking into consideration a 20% rate of refusal to participate, loss of follow-up, or withdrawal, and the number of students in each study group was increased to 308 with a total of 616 students in the whole study.

### Study Procedures

**The baseline phase:** Observation forms about the classes were completed by the principal investigator for all participating classes in both the Experimental Groups (EG) and Control Groups (CG). The observation form included the number of students per class and classroom area. A class crowdedness indicator was calculated by dividing the area of the classroom by the number of students in the class, yielding the area per student in square meter squares, as calculated and approved square meterage per child by the Saudi Ministry of Health is (1-1.5) m per student in the class [18]. A self-administered questionnaire in Arabic was designed for the study and validated by a panel of experts in the field of public health and epidemiology as they evaluated the content validity of the questionnaire. The questionnaires were disseminated to the students along with the consent form and were completed by the parents of the students in both groups. The questionnaire included three sections: socio-demographic; health; and hand hygiene practices at home. The socio-demographic section of the questionnaire included name, age of the student, parents' age, parents' level of education, monthly income of the family, type of residence, number of family members, sharing a bedroom with siblings, exposure to smoking at home, and raising a pet in the home. The health section of the baseline questionnaire included medical conditions that the student may have and the students' influenza vaccine status. Parents were asked about the hand hygiene practices of the student at home, including whether they wash their hands before eating; after eating; after using the toilet; after coming home, and whenever the hands were dirty. Response options were "never" (scored as 0), "sometimes" (scored as 1), "often" (scored as 2), or "always" (scored as 3) [17,19]. The sum of the responses scores provided the baseline hand hygiene score.

**The intervention phase:** Following the completion of the baseline questionnaires, students of the schools randomly assigned as the experimental group attended one-hour workshops in Arabic on hand-washing. The workshops were conducted by the investigator only. The workshops included video clips, interactive lectures about common infections

in schools, methods of transmission, means of prevention, hand washing procedures, and when to wash hands [6]. Puzzle game papers linked to hand hygiene were disseminated between students according to their grades. Posters promoting hand hygiene were placed in the schoolyard and in restrooms as reminders for hand hygiene to confirm the continuation of the message.

**Post-intervention phase:** Data on students' absenteeism were collected weekly from observation staff of all participating schools. Parents of students who were absent were phoned within a week of absence and asked the reason for the absence, whether the students exhibited symptoms of URIs and the duration of the students' sickness. The duration of the follow-up was five weeks.

**Illness definition:** Absence due to URI episode was meant to be when the student was absent because of having two of the following symptoms for one day or one of the symptoms for two or more consecutive days: a runny nose; stuffy or blocked nose or noisy breathing; sneezing; a cough; a sore throat and feeling hot, having a fever or having chills [20,21].

### **Data Analysis**

Entry and analysis of data were performed using Software Package for Social Science (SPSS) version 20. The baseline characteristics were described using means and standard deviation for normally distributed continuous variables, median, minimum, and maximum for continuous variables with abnormal distribution, and numbers with proportions for categorical variables. The baseline characteristics of both CG and EG were compared using Pearson's chi-square test for categorical variables, students' t-tests for continuous variables with normal distribution, and Mann-Whitney test for variables with the abnormal distribution. A p-value of less than 0.05 was used as the level of significance. Intention to treat analysis was conducted in this trial.

Bivariate Poisson regression was used to explore the IRR for the intervention and other factors. A p-value of less than 0.05 was considered significant and the 95% confidence intervals of IRR were reported. Covariates were adjusted using multivariate Poisson regression. A p-value of less than 0.05 was considered significant and the 95% confidence intervals were reported.

### **Ethical Considerations**

The study proposal was reviewed and approved by the institutional review board committee of King Saud University. The trial was registered in [clinicaltrials.org](https://clinicaltrials.org) with registration number NCT03535064. The confidentiality and anonymity of the participants' data were preserved. A consent form was signed by the parents before data collection. When the study ended, students of the control schools were exposed to the same intervention by the principal investigator.

## **RESULTS**

Among the invited 1,114 students, 151 parents refused to participate. The number of baseline questionnaires completed by parents who agreed to participate in the study was 496. Most of the baseline characteristics of the participants were not different between the two groups, except parents' level of education, family monthly income, and classroom crowdedness index (Table 1). Although the two groups were statistically different for some variables, all of them were controlled by including them in the regression model.

Table 1 Baseline characteristics of primary female students in control and experimental groups (Feb-March, 2018)

Variables		Total (N=496)	CG (N=262)	EG (N=234)	p-value
		N (%)	N (%)	N (%)	
Mother's Age: mean (SD)		37.02 (5.589)	37.24 (5.382)	36.79 (5.806)	0.755*
Educational attainment of the mother	Did not attend school	10 (2.1%)	8 (3.2%)	2 (0.9%)	0.000†
	Uncompleted Primary school	23 (4.8%)	15 (5.9%)	8 (3.5%)	
	Completed Primary school	25 (5.2%)	20 (7.9%)	5 (2.2%)	
	Intermediate school	47 (9.7%)	37 (14.6%)	10 (4.3%)	
	Secondary school	126 (26.0%)	55 (21.7%)	71 (30.7%)	
	University degree or higher	253 (52.3%)	118 (46.6%)	135 (58.4%)	
Father's age: mean (SD)		44.31 (8.010)	44.60 (8.014)	43.99 (8.015)	0.809*
Educational attainment of the father	Did not attend school	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.000†
	Uncompleted Primary school	20 (4.2%)	16 (6.5%)	4 (1.8%)	
	Completed Primary school	13 (2.7%)	9 (3.7%)	4 (1.8%)	
	Intermediate school	36 (7.6%)	26 (10.6%)	10 (4.4%)	
	Secondary school	122 (25.8%)	68 (27.8%)	54 (23.7%)	
	University degree or higher	282 (59.6%)	126 (51.4%)	156 (68.4%)	
Monthly income by SR	<5,000	122 (24.6%)	81 (29.3%)	51 (24.4%)	0.006‡
	From 5,000 to less than 10,000	166 (33.5%)	102 (42.1%)	64 (30.6%)	
	From 10,000 to less than 15,000	69 (15.9%)	33 (13.6%)	46 (22.0%)	
	From 15,000 to less than 20,000	49 (9.9%)	19 (7.9%)	30 (14.4%)	
	≥ 20.000	35 (7.1%)	17 (7.0%)	18 (8.6%)	
Class crowdedness in Student/m <sup>2</sup> : mean (SD)		1.747 (0.432)	1.894 (0.175)	1.695 (0.598)	0.000*

SD: Standard Deviation; \*student t-test, †chi-square test, ‡ Fisher exact test

During the five weeks of follow-up, there were 453 absence episodes. Of these, 15.34% (70 episodes) were due to URIs. Students missed a total of 521 days of school, of which 19.39% (101 days) were URI-related. Students in the CG missed 69 days due to URIs while students in the EG missed 32 days due to the same reason (Figure 1).

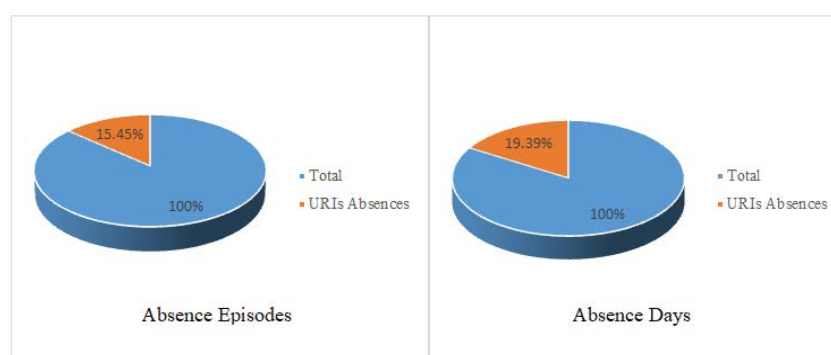


Figure 1 Proportion of URIs absence episodes and absence days from the total absence episodes and absence days among both groups during follow-up (Feb-March, 2018)

Bivariate analysis (Table 2) showed that; students who attended the hand hygiene workshop were at a significantly lower risk of being absent due to URIs (IRR EG: 0.519, 95% CI: 0.341-0.790, p-value=0.002). The older the student's mother, the lower the chance of the student being absent due to URIs, and this association was significant (IRR: 0.956, 95 CI: 0.916-0.998, p-value=0.038). Family size played a role in preventing absence due to URIs. Being a member in

a family with six or more members has a significant reduction when compared to a student in a family with only three members (IRR: 0.285, 95% CI: 0.114-0.711, p-value=0.007). Being vaccinated against influenza was a significant risk factor for students' URI-related absences (IRR: 1.613, 95% CI: 1.027-2.535, p-value=0.038). After applying multivariate analysis (Table 2), students who attended hand hygiene workshops were at significantly lower risk for URI-related absences (IRR: 0.508, 95% CI: 0.292-0.882, p-value: 0.016). Mother's age and vaccination against influenza lost their effect after applying the multivariate analysis. Family size was found to be a factor affecting students' URI-related absences, as students in families with four or five members were significantly 80% less prone to be absent due to URIs and those in families with six or more members were significantly 84% less likely to be absent due to URIs when compared to students in families with three members. Students exposed to passive smoking at home were twice as likely to be absent due to URIs when compared with students who were not exposed to smoking at home (IRR: 1.926, 95% CI: 1.095-3.389, p-value=0.023).

**Table 2 Factors Associated with School Absence Due to Upper Respiratory Infections**

Variables	Bivariate Analysis			Multivariate Analysis			
	URI Absences (IRR)	95% CI	p-value	URI Absences (AIRR)	95% CI	p-value	
<b>Intervention</b>	0.519	0.341-0.790	0.002*	0.508	0.292-0.882	0.016*	
<b>Age of student (years)</b>	0.938	0.843-0.1.045	0.244	0.873	0.755-1.009	0.067	
<b>Mother's age (years)</b>	0.956	0.916-0.998	0.038*	0.939	0.872-1.010	0.092	
<b>Mother's Education</b>	Not attended school (Reference)	1	-	1	-	-	
	Incomplete primary school	1.063	0.700-1.612	0.775	0.899	0.161-5.001	0.903
	Completed primary school	1.083	0.718-1.635	0.703	0.828	0.132-5.190	0.84
	Intermediate school	1.013	0.690-1.486	0.948	0.363	0.060-2.187	0.269
	Secondary school	1.006	0.701-1.445	0.973	0.657	0.131-3.302	0.611
University degree or higher	0.978	0.686-1.395	0.903	0.499	0.097-2.557	0.404	
<b>Father's age (years)</b>	0.989	0.961-1.017	0.429	1.023	0.975-1.073	0.353	
<b>Father's Education</b>	Incomplete primary school (Reference)	1	-	1	-	-	
	Completed primary school	0.724	0.490-1.069	0.104	0.166	0.017-1.648	0.125
	Intermediate school	0.861	0.634-1.168	0.335	0.413	0.112-1.517	0.183
	Secondary school	0.843	0.648-1.098	0.205	0.492	0.162-1.497	0.212
University degree or higher	0.792	0.615-1.020	0.071	0.5	0.167-1.502	0.217	
<b>Housing type</b>	House (Reference)	1	-	1	-	-	
	Flat	0.98	0.659-1.457	0.921	0.695	0.386-1.250	0.224
	Other	0.477	0.116-1.962	0.305	0.485	0.094-2.495	0.386
<b>Family size</b>	(Reference: 3)	1	-	1	-	-	
	4-5	0.408	0.160-1.039	0.06	0.191	0.050-0.727	0.015*
	6 or more	0.285	0.114-0.711	0.007*	0.157	0.041-0.595	0.006*
<b>Shared bedroom</b>	1.06	0.486-2.314	0.883	1.944	0.688-5.488	0.808	
<b>Monthly income in SR</b>	<5,000 (Reference)	1	-	1	-	-	
	From 5,000 to less than 10,000	0.898	0.540-1.494	0.679	1.105	0.557-2.191	0.776
	From 10,000 to less than 15,000	0.801	0.420-1.527	0.5	1.134	0.482-2.668	0.774
	From 15,000 to less than 20,000	1.291	0.677-2.462	0.438	1.864	0.731-4.752	0.192
≥ 20.000	0.516	0.181-1.476	0.217	1.216	0.368-4.016	0.748	
<b>Pet at home</b>	0.941	0.552-1.606	0.824	1.926	1.095-3.389	0.023*	
<b>Smoking at home</b>	1.746	1.118-2.728	0.014*	0.909	0.445-1.855	0.793	
<b>Asthma</b>	1.575	0.794-3.124	0.193	1.126	0.433-2.930	0.808	
<b>Flu vaccine</b>	1.613	1.027-2.535	0.038*	1.53	0.808-2.899	0.192	
<b>Baseline hand hygiene score</b>	1.01	0.920-1.109	0.837	0.982	0.877-1.098	0.747	
<b>Classroom Crowdedness (Student/m<sup>2</sup>)</b>	1.029	0.656-1.614	0.901	0.808	0.392-1.663	0.562	

\*Statistically significant

## DISCUSSION

To accomplish the study objective, 496 female primary school students were enrolled (CG: 262 and EG: 234). Students in the experimental group were exposed to hand hygiene workshops. Following the workshop, the school absences were collected for five weeks. Parents of absent students were phoned within one week to uncover the cause of absence, symptoms of URIs, and duration of sickness. The EG and CG were similar in most of the baseline data.

After adjusting for covariates using multivariate Poisson regression, exposure to a hand hygiene education workshop was found to be responsible for a significant decrease in absence due to URIs. This significant association after adjustment is similar to the previous findings of a study in Spain in which hand hygiene education was supplemented with hand sanitizers among primary school students with no difference between both genders [22]. Another study conducted among primary school students in the USA, which adjusted for covariates, did not discover a significant association between the intervention (provision of hand sanitizers and desk disinfection wipes) and reduction of school absence due to URIs [23]. Furthermore, hand hygiene education alone was found to be a weak protective measure when pooled in one meta-analysis of the effect of hand hygiene education in community settings including schools and one Chinese study [15,24].

The multivariate analysis revealed that students in families with at least four members had lower rates of absence due to URIs. These results differ from those attained in previous studies, which did not find any significant association between family size and decrease in school absences [22,23]. This could be because the lowest percentage of study participants was in families with three members.

Students exposed to smoking at home were at a significantly higher risk for absence due to URIs. Previous studies that addressed the association between smoking and absence due to URIs did not find a significant association [22]. However, passive exposure to smoke is a well-known risk factor for developing respiratory infections and their recurrence [25].

The influenza vaccine was not found to be an effective measure in the prevention of absences due to URIs in this study. Although several previous studies found the influenza vaccine to be effective in preventing respiratory infections among schoolchildren, one previous study did not find the influenza vaccine to be effective in preventing school absences due to URIs [22,26-30]. The ineffectiveness of the vaccine found in this study could be attributed either to the self-reported vaccine status or to students receiving only one annual dose since some studies have found that two doses of the influenza vaccine are more effective in preventing respiratory infections [31].

The relatively low response rate of the participants, at 51.5%, makes it difficult to generalize the results to all primary school-aged girls. Additionally, the study was conducted among females, and generalizing the results to both male and female primary students is a bit difficult, though previously similar published researches did not reveal any difference between males and females [22,23]. Blinding the students to the intervention was not possible because of the type of intervention. Data collection was conducted using self-administered questionnaires completed by parents, so some data may not be accurate, such as influenza vaccine status. URI-related absence episodes were measured subjectively by calling the parents to ask about symptoms and duration of symptoms. This may be less accurate than confirmation by medical diagnosis, but it was the only feasible method for collecting outcome data in this study. The follow-up period of five weeks was short due to the time limit for submitting this thesis. The short period of follow-up may be led to overestimation of the result, as students may have been more likely to follow the new hand hygiene behaviors during this short time.

The study was designed as a cluster-randomized trial to decrease the risk of contamination that could occur if students in the same school were assigned randomly to the experimental or control groups. Distribution of posters in schoolyards and restrooms of the schools where the intervention took place served as a continuous reminder to students to wash their hands. Parents were called within one week of any absence to reduce the chance of recall bias. The study is one of the few studies that reported adjusted relative risk, as this was reported previously in only two studies [25,26].

In addition, although there have been similar international studies, the study is the first study to reveal the effect of hand hygiene education on school absences in this country [15,22-24]. This hand hygiene education was successful in reducing the absence among primary school-aged girls. Furthermore, the results of our study are important for the school health department to develop hand hygiene education programs in schools to control infection transmission.

## CONCLUSION AND RECOMMENDATIONS

School absence due to URIs decreased when students were exposed to hand hygiene education workshops. In addition, the larger the students' family, the lower chance that they would be absent due to URIs. Furthermore, students who were exposed to passive smoking at home were at higher risk of absence due to URIs. School health departments are encouraged to adopt hand hygiene education programs to break the transmission of URIs by utilizing available human resources.

## DECLARATIONS

### Acknowledgment

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### Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Contribution Statement

#### Alzaher Abrar

- The responsible for conception and design of the work, analysis, and interpretation of data for the work
- Drafting the work
- approved the version to be published
- Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

#### Gosadi, Ibrahim

- Substantially contributed to the conception and design of the work, and interpretation of data for the work
- Revised the work critically for important intellectual content
- Approved the final version to be published
- Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

#### Mustafa, Muna

- Substantially contributed to the conception and design of the work, and interpretation of data for the work
- Revised the work critically for important intellectual content
- Approved the final version to be published
- Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

#### Almударra, Sami

- Substantially contributed to the conception and design of the work, and interpretation of data for the work
- Revised the work critically for important intellectual content
- Approved the final version to be published
- Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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