The importance of hand hygiene education on primary schoolgirls' absence due to upper respiratory infections in Saudi Arabia

A cluster randomized controlled trial

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ABSTRACT

الأهداف: هدفت هذه الدراسة إلى تحديد مقدار التقليل من معدل وأيام الغياب بسبب عدوى المجرى التنفسي العلوي بين طالبات المرحلة الابتدائية في مدارس الرياض على مدى خمسة أسابيع بعد تقديم ورشة نظافة اليدين.

الطريقة: أجريت في الفترة 28/01/2018 إلى 15/03/2018 على مجموعات عشوائية بين طالبات المرحلة الابتدائية في أربع مدارس للبنات. حضرت الطالبات ورشة عمل عن نظافة الأيدي ثم تم جمع غياب الطالبات أسبوعياً على مدى خمسة أسابيع. تم حساب نسبة معدل الغياب ونسبة نسبة أيام الغياب ومعدل الغياب للغياب الكلي والغياب بسبب عدوى المجرى العلوي التنفسي.

النتيجة:العدد الإجمالي للمشاركات كان 496 طالبة. 15.3% من الغياب كان بسبب الإصابة بعدوى المجرى التنفسي العلوي، تغيبت الطالبات 521 يوماً عن المدرسة و19.4% من أيام الغياب كانت بسبب عدوى المجرى التنفسي العلوي. معدل الغياب بسبب عدوى المجرى التنفسي العلوي كان 12.4 و23.4 لطالبات المجموعة التجريبية و 5.62 و 11.72 لطالبات مجموعة التحكم. نسبة أيام الغياب كانت أقل في المجموعة التجريبية (مجموعة التحكم: 0.86% و1.39% مقارنة بالمجموعة التجريبية: 0.39% و0.72%). نسبة معدل الغياب بسبب عدوى المجرى التنفسي العلوي كانت 0.54 و1.02 في مجموعة التحكم مقارنة ب 0.24 و0.51 لكل 100 طالبة لكل يوم.

الخاتمة: قد يكون هنالك انخفاض أكثر في غياب الطالبات لو كان التعليم مصحوبا بتوزيع صابون الايدي. هذه الدراسة قد تخدم كدراسة قائدة لدراسات أكبر في المستقبل. من الممكن دراسة استدامة التدخل في دراسات ذات مدة أطول للمتابعة.

Objectives: To quantify the reduction in absence due to upper respiratory infections (URIs) among primary schoolgirls attending Riyadh's schools after delivering a hand hygiene workshop intervention over a period of 5 weeks.

Methods: A cluster randomized trial was conducted among girls attending 4 primary schools between January and March 2018. The participants attended a hand hygiene workshop. The schoolgirls' absences were followed up for 5 weeks. Incidence rate, percentage of absence days, and absence rate were calculated for total and URIs absences.

Result: Total number of participating schoolgirls was 496. Upper respiratory infections accounted for 15.3% of absence episodes. Schoolgirls lost 521 days of school and 19.4% of them were URIs-related. Absence rate due to URIs were 12.4 and 23.4 as well as 5.62 and 11.72 per 100 schoolgirls in the control (CG) and experimental (EG) groups, respectively. Percentage of absence days were lower in the experimental group (CG: 0.86% and 1.39% versus EG: 0.39% and 0.72%). Incidence rates of absence due to URIs were 0.54 and 1.02 in CG versus 0.24 and 0.51 in EG per 100 schoolgirls per day.

Conclusion: There could be further reduction in school absences if education was accompanied by hand soap dissemination. The study could serve as a pilot for major studies in the future. Sustainability of the intervention can be tested in studies with longer durations.

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Upper respiratory infections (URI) are common diseases observed by physicians in primary health care centers and outpatient clinics.[1] They are also common reasons for school absences as it is estimated that children have an average of 6-8 episodes every year.[2,3] Proper hand hygiene is a recommended control measure to stop the spread of communicable diseases such as respiratory or gastrointestinal infections.[4-6] Hand hygiene intervention using education and soap or sanitizer dissemination was revealed to reduce the risk of respiratory infections by a range of 37% to 72%.[7-9]

Upper respiratory infections are highly infectious among schoolchildren as they spend approximately half of their day in schools. Although URIs are usually self-limited, these infections affect students' attendance, influencing their overall learning performance. Working parents of affected children may require time off to take care of their sick children.[10] In addition, schoolchildren may be responsible for transmitting viruses to their families.[11] Up to date, no publications have been found in literature on the association between school absences and URIs in Saudi Arabia. Appropriate hand hygiene is recommended as a non-pharmacological preventive measure against respiratory infections. However, it remains a controversial issue and research on the association of these measures with URIs in Saudi schools is needed.[12] Therefore, this study aimed to report the rate of episodes and days of absences due to URIs among schoolgirls over a period of 5 weeks and to quantify their reduction after delivering a hand hygiene workshop intervention.

Methods. This study is a cluster randomized controlled trial conducted among schoolgirls between the ages of 6 to 12 years, attending 4 public primary girls' schools in the city of Riyadh, Saudi Arabia. The study was conducted between January and March, 2018.

Sample size and sampling. Assuming a URIs rate of 45% among schoolgirls and a risk ratio of 62% with an alpha level of 0.05 and a power of 80%,[8] the calculated sample size was 123 per group. To adjust for cluster sampling, the sample size was doubled to 246 participants per group and 492 in total. After taking into consideration a 20% refusal rate to participate, loss of follow-up, or withdrawal, the number of students was increased to 308 per group, totaling 616 for the whole study. A multistage cluster sampling was conducted. Riyadh city has 8 educational offices and out of these, 2 were chosen by a simple random method. The selected educational offices were Rawabi and Northern offices. Schools that previously implemented the hygiene program, "My hygiene is the secret to my health" were excluded from the list. Further, 2 primary girls' schools were chosen randomly from each selected educational office. The selection of only 2 schools per educational office is due to lack of human resources in conducting the study. The first selected school per educational office was allocated to the intervention. All schoolgirls attending the selected schools were invited to participate in the study until the targeted sample size was reached. The study was restricted to girls due to the cultural issue of females interacting with boys' schools. A Consolidated Standards of Reporting Trials (CONSORT) flow diagram of the study is described in **Figure 1**.

Intervention. All schoolgirls of randomly assigned schools attended one-hour Arabic handwashing workshop conducted by the principal investigator, one week after submitting all the baseline questionnaires.[13] Workshops included 6-minute video-clip of 2 siblings that attended school-based health education about hand hygiene. One of the siblings washed her hands in required time and the other did not so he ended with having respiratory infection. Short interactive lecture was delivered about common infections in schools, methods of transmission, and a handwashing procedure using soap and water including when to wash hands. Puzzle games related to hand hygiene were distributed among schoolgirls. Posters with cartoon princesses' picture promoting hand washing were also distributed in the schools. Schoolgirls in the control group followed their usual handwashing procedure. At the end of the study, schoolgirls in the control group were exposed to the same intervention by the same investigator.

Absence data collection. The absence reports were collected weekly from the absence observation staff of all participating schools. Parents of absent schoolgirls were called by the principle investigator and asked about the reasons for the absence, symptoms of upper respiratory infections, and duration of illness.

Illness definition. The primary outcome of this study was school absence due to URIs which was defined as a student's failure to attend school due to a URI episode. The episode of URIs was defined as having 2 of the following symptoms for a day or one of the symptoms for 2 or more consecutive days: 1) a runny nose, 2) a stuffy or blocked nose or noisy breathing, 3) sneezing,

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4) a cough, 5) a sore throat, and 6) feeling hot, having a fever or a chill.[14,15]

Outcome measures. The absence rate, incidence rate of absence, and percentage of absent days were calculated for total absences and URIs related absences. The absence rate was calculated by dividing the number of absence episodes by the number of participating schoolgirls. The percentage of absence days was calculated by dividing absence days by the possible days of attendance. The total days of attendance were calculated by multiplying the total number of schoolgirls by the number of weekdays in the study period, which was 23 days (the schools were suspended for 2 days during the follow-up period). The incidence rates of absences were calculated for every 100 schoolgirls per day by dividing the number of absence episodes by the possible days of attendance. Calculation was carried out per cluster due to small number of clusters.

Ethical approval. The proposal was reviewed and approved by the Institution Review Board Committee of King Saud University, Riyadh, Saudi Arabia Agreements from the Ministry of Education, Riyadh Regional Educational Administration; and educational offices were obtained before the beginning of the study. The trial is registered in ClinicalTrials.gov registry with registration number: NCT03535064. Informed consents were obtained from all individual participants included in the study as the parents of the schoolgirls signed consent forms attached to the questionnaires. The consent forms were similar in both the intervention and control groups. The parents of the schoolgirls were unaware of the group that their daughters would be in.

Statistical analysis. The analysis was conducted using Statistical Package for Social Science (SPSS) version 20. The baseline characteristics of both the control and intervention groups were compared using Pearson's Chi-square test (x^2) for categorical variables and Student's t-tests for continuous variables. A p-value of <0.05 was used as a level of significance. Due to a small number of clusters in the study, analysis of the outcome was carried out per school.

Results. One hundred and fifty-one parents of 1,114 schoolgirls did not consent their daughters' participation. A total of 496 parents participating in the study answered and returned the completed baseline questionnaires with 262 from the CG and 234 from EG. None of the schoolgirls was lost during the follow up (**Figure 1**). The age of schoolgirls ranged from 6 to 12

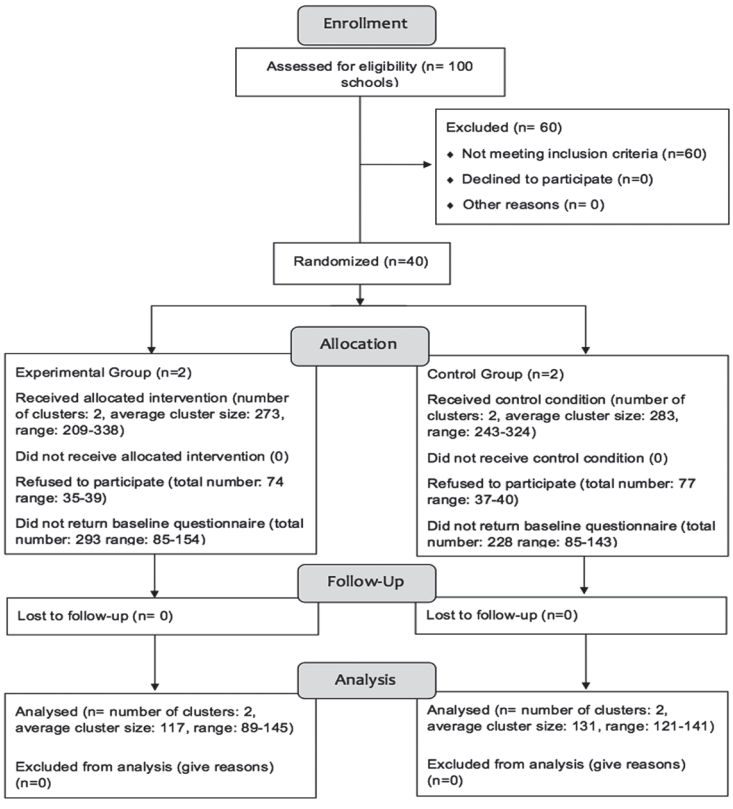

Figure 1 - Consolidated Standards of Reporting Trials flow diagram of the clusters and participants in the study.

Table 1 - Baseline characteristics of students in control and experimental groups.

Variables	CG (n=262) n (%)		EG (n=234) n (%)		*P* value
Schoolgirl's age in years (mean ± SD)	9.7 ± 1.839		9.29 ± 1.779		0.409*
Housing type					
House	120	(45.8)	104	(44.4)	0.917†
Apartment	129	(49.2)	119	(50.9)	
Other*	10	(3.8)	10	(4.3)	
Missed	3	(1.1)	1	(0.4)	
Family members					0.459†
3 members	4	(1.5)	4	(1.7)	
4-5 members	69	(26.3)	76	(32.5)	
6 members or more	178	(67.9)	153	(65.4)	
Missed	11	(4.2)	1	(0.4)	
Shared bedroom	227	(89.7)	210	(90.9)	0.660†
Pets in home	49	(18.9)	33	(14.2)	0.158†
Exposure to smoking at home	43	(16.7)	38	(16.4)	0.917†
Medical conditions					0.404‡
Anemia	1	(0.4)	4	(1.7)	
Bronchial asthma	16	(6.2)	13	(5.6)	
Diabetes	1	(0.4)	1	(0.4)	
Others	21	(8.1)	12	(5.1)	
Flu vaccine	45	(17.2)	39	(16.7)	0.880†

*student t-test, †Chi-square test, ‡Fisher exact test. Baseline hand hygiene score ranged from 0 to 15 and was measured by summing the responses of hand hygiene section questions: (1) before meal, (2) after meal, (3) after toilet use, (4) as soon as they arrive home, and (5) when hands get dirty. Responses were coded as; (0) never; (1) sometimes; (2) often; and (3) always.

Table 2 - Total episodes and days of total absence among the 4 schools during follow-up.

Variables	School 1 in CG	School 2 in CG	School 1 in EG	School 2 in EG	Total
Number of participating schoolgirls	121	141	89	145	496
Total absent episodes	89	205	59	100	453
Total absent days	109	231	68	113	521
Total possible attendance days*	2783	3243	2047	3335	11408
Total absence rate per 100 schoolgirls	73.55	145.39	66.29	68.97	91.33
Total absent days (%)	3.91	7.12	3.32	3.39	4.57
Incidence of episodes/ 100 schoolgirls/day	3.198	6.32	2.88	2.999	3.97

CG - control group, EG - experimental group, *total possible attendance days: The total number of students multiplied by possible days of attendance

Table 3 - Episodes and days of upper respiratory infections (URIs) absence among the four schools during follow-up.

Variables	School 1 in CG	School 2 in CG	School 1 in EG	School 2 in EG	Total
Number of participating schoolgirls	121	141	89	145	**496**
URIs absent episodes	15	33	5	17	**70**
URIs absent days	24	45	8	24	**101**
Total possible attendance days*	2783	3243	2047	3335	**11408**
URIs absence rate per 100 schoolgirls	12.39	23.4	5.62	11.72	**14.11**
URIs absent days (%)	0.86	1.39	0.39	0.72	**0.89**
URIs absence incidence per 100 schoolgirls/day	0.54	1.02	0.24	0.51	**0.61**

CG - control group, EG - experimental group, *Total possible attendance days: The total number of students multiplied by possible days of attendance

years and the mean age was 9.5 years. Ninety percent of the schoolgirls shared their bedrooms with siblings and 17% were vaccinated against influenza. All the baseline characteristics of the schoolgirls were similar in the CG and EG as summarized in **Table 1**. Water was available in all schools but none of the participating schools had soap or paper towels in the restrooms for hand washing, neither in the baseline nor after intervention.

As revealed in **Tables 2 & 3**, there was a total of 453 absence episodes during the study period and 5 weeks of follow-up, 15.3% (70 episodes) of those were absent due to upper respiratory infections. Approximately, two-thirds of the total absence episodes and more than two-thirds of URIs absence episodes were in the control group. Schoolgirls lost 521 days of school, of which 19.4% (101 days) were URIs-related. Schoolgirls in the CG lost 340 days, while schoolgirls in the EG lost 181 days. URIs absence days were 69 and 32 days among schoolgirls in the CG and EG, respectively.

The incidence rate and percentage of absence days for the total absences were lower in the schools in the EG during the study duration. The Incidence rate and percentage of absence days of URIs absences were also lower in the schools in the EG during the study duration. Schoolgirls in the EG had a 40% risk reduction in the absence and lose of school days. The schoolgirls in the EG had a 50% risk reduction in non-URIs absence and 50% reduction of school days lost due to URIs during the study duration. The absence rate, incidence rates, and percentages of absence days for the total absence and absence due to URIs are listed in **Tables 2 & 3**.

Discussion. This study was conducted as a cluster randomized controlled trial to assess the effectiveness of hand hygiene education on school absences due to URIs among primary schoolgirls. A total of 496 schoolgirls and parents participated in the study (CG: 262 and EG: 234). Both the control and experimental groups were significantly similar in baseline data. The schoolgirls in the experimental group were exposed to a one-hour hand hygiene workshop. The incidence rate and percentage of absence days of total absence and URIs absence were lower in the EG during the study duration.

One study examined the seasonal variations of respiratory viruses detected from children with respiratory tract infections in the same area over the years 2013 and 2014. The study found that the number of cases with respiratory syncytial virus (RSV) was high in February and March of the 2 years.[16] Upper respiratory infections incur public costs as parents may lose workdays to take care of their children. Many physicians prescribe antibiotics for common cold patients in their clinics.[1] Upper respiratory infections are self-limiting and cause the sick students to be behind in their studies. Consequently, the other students must wait for them to catch up.[10] This study revealed that URIs were responsible for 15% of absence episodes and approximately 20% of the missed days during the study follow-up duration. These results are slightly higher than those in Egypt, where the proportion of influenza-like illness (ILI) absences to the total absences was 12%.[8]

The schoolgirls in the EG had a 50% risk reduction in absence and 50% reduction in missed days during the study duration. Hand hygiene education alone was weakly productive when studied in one meta-analysis of the effect of hand hygiene education in community settings including schools.[11] The reduction of the URIs absences in the first four weeks of the Egyptian study was 40% as compared to the reduction in our study which is higher by 10%.[8] However, the results of our study correspond with the reduction of upper respiratory infections by providing soap or alcohol-based sanitizers in addition to the education.[7-9,15,17] Bowen et al and Azor-Martínez et al revealed a statistically significant reduction by 38% in the absence rate due to URIs in the intervention group who received education about hand hygiene as well as used hand sanitizers and soap bars that were distributed in the schools, respectively.[7,9,17] The 12-week intensive hand hygiene campaigns reduced the absence due to ILI by 18% among primary school students in Cairo, Egypt, in 2008.[8] Meanwhile, Sandora et al[18] did not reveal a significant reduction in absence due to URIs after providing hand sanitizers and desk disinfection wipes to school students.

Study limitations. The small number of clusters led to the incapability of applying statistical comparison between the groups. The response rate of the participants was only 51.5%, which may mean that the results cannot be generalized to all primary schoolgirls. However, higher reduction could be observed if the response rate was higher. Blinding the schoolgirls to the intervention was not possible in this trial because of the type of intervention. The URIs episodes were measured subjectively by calling the parents to ask about the symptoms and their duration. This method may be less accurate than confirmation by a medical diagnosis. However, it was the only way to collect the outcome data in this study. The short follow-up duration may have

led to an overestimation of the effect as the schoolgirls may have been more likely to follow the new behavior over a brief period.

Strengths of the study. The study was designed as a cluster randomized trial to decrease the risk of contamination that could occur if schoolgirls of the same school were assigned randomly to the intervention or control groups. Poster distributions in schoolyards and restrooms of intervention schools worked as a reminder to schoolgirls to wash their hands. Parents were called within one week of the absence to reduce the chance of recall bias.

This hand hygiene education was successful in reducing absences among primary schoolgirls. Furthermore, the results of our study are essential for school health administration to develop hand hygiene education programs in schools to control the transmission of infections.

In conclusion and recommendation, school absences were reduced when schoolgirls were exposed to a hand hygiene education workshop. This reduction could have been more if the education was accompanied with the provision of soap. The study could serve as pilot for a future study with a higher budget. Sustainability of the intervention could be examined in studies with longer follow-up durations. School health administration is encouraged to adopt hand hygiene education programs by utilizing the available human resources to break the transmission chain of upper respiratory infections and decrease the absences that they cause.

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References

1. Al-Khaldi YM, Diab MMAA, Al-Gelban KS, Al-Asmari AS, Al-Amin S A-SM. Prescribing patterns for acute respiratory infections in primary health care, Aseer Region, Saudi Arabia. ***J Family Community Med*** 2005; 12: 121-126.
2. Simones EAF, Cherian T, Chow J, Shahid-Salles SA, Laxminarayan R, John TJ. Acute respiratory infections in children. ***Dis Control Priorities Dev Ctries*** 2006; 483-497.
3. Cotton M, Innes S, Jaspan H, Madide A, Rabie H. Management of upper respiratory tract infections in children. ***S Afr Fam Pract*** 2008; 50: 6-12.
4. Daryani A, Sharif M, Nasrolahei M, Khalilian A, Mohammadi A, Barzegar G. Epidemiological survey of the prevalence of intestinal parasites among schoolchildren in Sari, northern Iran. ***Trans R Soc Trop Med Hyg*** 2012; 106: 455-459.
5. Freeman MC, Stocks ME, Cumming O, Jeandron A, Higgins JPT, Wolf J, et al. Hygiene and health: Systematic review of handwashing practices worldwide and update of health effects. ***Trop Med Int Heal*** 2014; 19: 906-916.
6. Mahmud MA, Spigt M, Bezabih AM, Pavon IL, Dinant GJ, Velasco RB. Efficacy of handwashing with soap and nail clipping on intestinal parasitic infections in school-aged children: a factorial cluster randomized controlled trial. ***PLoS Med*** 2015; 12: 1-16.
7. Bowen A, Ma H, Ou J, Billhimer W, Long T, Mintz E, et al. A cluster-randomized controlled trial evaluating the effect of a handwashing-promotion program in Chinese primary schools. ***Am J Trop Med Hyg*** 2007; 76: 1166-1173.
8. Talaat M, Afifi S, Dueger E, El-Ashry N, Marfin A, Kandeel A, et al. Effects of hand hygiene campaigns on incidence of laboratory-confirmed influenza and absenteeism in schoolchildren, Cairo, Egypt. ***Emerg Infect Dis*** 2011; 17: 619-625.
9. Azor-Martínez E, Gonzalez-Jimenez Y, Seijas-Vazquez ML, Cobos-Carrascosa E, Santisteban-Martínez J, Martínez-López JM, et al. The impact of common infections on school absenteeism during an academic year. ***Am J Infect Control*** 2014; 42: 632-637.
10. Gottfried MA. Evaluating the relationship between student attendance and achievement in urban elementary and middle schools: an instrumental variables approach. ***Am Educ Res J*** 2010; (47): 434-465.
11. Aiello AE, Coulborn RM, Perez V, Larson EL. Effect of hand hygiene on infectious disease risk in the community setting: A meta-analysis. ***Am J Public Health*** 2008; 98: 1372-1381.
12. Willmott M, Nicholson A, Busse H, Macarthur GJ, Brookes S, Campbell R. Effectiveness of hand hygiene interventions in reducing illness absence among children in educational settings: a systematic review and meta-analysis. ***Arch Dis Child*** 2016; 101: 42-50.
13. Morton JL, Schultz AA. Healthy hands: Use of alcohol gel as an adjunct to handwashing in elementary school children. ***J Sch Nurs*** 2004; 20: 161-167.
14. Lee GM, Salomon JA FJ et al. Illness transmission in the home: a possible role for alcohol-based hand gels. ***Pediatrics*** 2005; 115: 852-860.
15. Sandora TJ, Taveras EL, Shih MC, Resnick EA, Lee GM, Ross-Degnan D, et al. A randomized, controlled trial of a multifaceted intervention including alcohol-based hand-hygiene education to reduce illness transmission in the home. ***Pediatrics*** 2005; 116: 587-594.
16. Albogami SS, Alotaibi MR, Alsahli SA, Masuadi E, Alshaalan M. Seasonal variations of respiratory viruses detected from children with respiratory tract infections in Riyadh, Saudi Arabia. ***J Infect Public Health*** 2018; 11: 183-186.
17. Azor-Martinez E, Cobos-Carrascosa E, Seijas-Vazquez M, Fernández-Sánchez C, Strizzi J T-AP, Torres-Alegre P, et al. Hand hygiene program decreases school absenteeism due to upper respiratory infections. ***J Sch Health*** 2016; 86: 873-881.
18. Sandora TJ, Shih M-C, Goldmann DA. Reducing absenteeism from gastrointestinal and respiratory illness in elementary school students: a randomized, controlled trial of an infection-control intervention. ***Pediatrics*** 2008; 121: e1555-e1562.