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Impact of School Nurse Asthma Education Program on School Nurses' Asthma Knowledge and Self-Efficacy Levels: A Quasi-Experimental Study

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Introduction

Asthma is a chronic respiratory condition that affects millions of people worldwide, including school-aged children. School nurses are the first point of contact for students with asthma and play a crucial role in the management of asthma in schools. The prevalence of asthma in schoolchildren has increased in recent years, highlighting the need for effective asthma management strategies in schools. One such strategy is asthma education programs that are designed to educate patients and healthcare providers about asthma, its management, and prevention. These programs aim to promote knowledge and skills necessary to manage asthma symptoms, including proper use of medications, avoiding asthma triggers, and recognizing the signs of asthma exacerbation.

According to the Global Asthma Report, the prevalence of asthma in Oman is 11.5% among school-age children (aged 6-7years) [1]. With the high childhood asthma prevalence, studies reported unacceptably low use of preventive ICSs among children with asthma in Oman which implies an immediate need to promote education and awareness for these children, their caregivers and healthcare providers [2]. The current disease burden in Oman shows epidemiological transition from acute infections to non-communicable diseases. Efforts within schools are emphasized as strategic investments to tackle non-communicable diseases. In line with the World Health Organization (WHO) Country Cooperation Strategy for the WHO and Oman (2018- 2025), addressing the needs of children and adolescents through school health is useful not only for preparedness and response in emergencies, but in addressing priority health issues, including asthma [3].

While school nursing is often overlooked, the need for adequately trained school nurses is undebatable in light of the high prevalence of asthma among schoolchildren in Oman and the inability of this age group to self-manage asthma exacerbation. The school nursing profession plays an important role in Oman due to the sizable number of school-aged children. School aged children and youth aged 5–24 years old comprise 39% of the Omani population [4,5]. School nurses can significantly contribute to reducing the asthma

burden [2,6]. Data on the workforce profile of school nurses in Oman are required to build a body of research on their role in the management of chronic conditions, particularly asthma, in the school setting. The lack of literature examining the role of school nurses in Oman influences the visibility of the school nursing field. An empirical clarification of the role of school nurses can assist with the establishment and promotion of the school nursing field. This study is significant as it seeks to establish a baseline data about the role, responsibilities and asthma educational needs of school nurses as well evaluate the impact of a School Nurse Asthma Education Program (SNAEP) on the knowledge and self-efficacy levels of school nurses.

Methods

We conducted a two-phase quasi-experimental study among all school nurses (N = 80) covering 153 governmental schools (primary, middle, and secondary) in the Muscat Governorate enrolling 94,250 students [7]. Phase 1 consisted of a quantitative needs assessment survey that was conducted to identify asthma educational needs of school nurses. Data were collected once-off during this phase using needs assessment survey to explore school nurse's role, function and asthma educational needs. In phase 2, a School Nurse Asthma Educational Program (SNAEP) was implemented incorporating findings from phase 1. Data were collected at four data collection time points during this phase: before the intervention, immediately after, 3 months post-intervention, and 6 months post-intervention. The multiple data collection time points in phase 2 allowed for the examination of the intervention's short-term and long-term effects.

The allocation of nurses to schools is done by Ministry of Health and depends on the number of students on each school. The nurse is responsible for one school when the number of students enrolled is $\geq 1,000$ and covers two schools if the number of students enrolled is $< 1,000$. A school nurse's normal duty is to visit each school for which they are responsible two days a week and to work one day in the primary healthcare centre in the same school area. A primary healthcare center typically offers outpatient clinics in various specialties, one of which is the asthma clinic.

Participants

The target population of phase 1 of this study was all school nurses working in governmental schools in Muscat Governorate. Nurses working in Private school were excluded as private school nurses are outside the umbrella of the Ministry of Health in Oman. Only a few private schools have a school nurse, and of those schools, all nurses are from overseas. Their working environment and access to educational programs is different from the rest of school nurses working in governmental schools.

For Phase (2) the interventional Phase, it was not feasible to include all of the target population; therefore, a sample of this population was selected. This sample includes nurses working in Al Seeb and Bawsher counties. There was greater confidence that the selection of these counties would lead to a more representative sample that had key characteristics of the target population.

The Following Criteria Assisted with The Sample-Size Calculation

Location: The preliminary data collected through the field assessment indicated that there two counties in the Muscat region has the highest schoolchildren density and the highest enrolment of primary schoolchildren, therefore, a higher number of school nurses are allocated to schools in these counties. These two counties are Al Seeb and Bawsher counties, with an average nurse-to-student ratio of 1:616. Forty-five school nurses out of a total of 70 school nurses in the Muscat regions work in Al Seeb and Bawsher counties, covering 78 schools.

The number of nurses that were available in Al Seeb and Bawsher counties was 45 nurses covering 78 schools, all were invited to attend the intervention program. These 45 nurses cover primary, middle, and secondary schools.

Instrumentation

Phase 1 of this study used a validated instrument developed by researchers at Johns Hopkins University in Baltimore, Maryland, to investigate the role, functions and educational needs of school nurses. The survey instrument (Appendix 1) was developed according to the U.S. National Heart, Lung, and Blood Institute guidelines. It was deemed appropriate to achieve the study objectives [8].

Asthma knowledge and self-efficacy in providing asthma care was measured using the asthma knowledge and self-efficacy questionnaire, a more recent tool developed by to assess school nurses' knowledge and self-efficacy in providing asthma care at school setting [9]. It is a 4-point Likert-type scale (Appendix 2) to assess self-efficacy. A higher score reflects a higher self-efficacy. Asthma knowledge questionnaire (Appendix 3). Permission to use this tool was obtained from the tool developer (Appendix 4). Instrument's reliability and validity were established. The tools were pretested in a separative pilot study.

Data Collection

There were four data collection points: Time 1 (preintervention data), Time 2 (immediately postintervention data), Time 3 (three months postintervention), and Time 4 (six months postintervention). Time 1 data collection was conducted on the day of the program, immediately before the session began by administering a paper form of the asthma knowledge questionnaire and the asthma self-efficacy questionnaires and was repeated at the end of the program on the same day, which was Time 2. Both questionnaires were readministered further on two different occasions, three months and six months after delivery of the program, by sending the questionnaires to the school nurses at their designated areas.

Doing so maintained the consistency of the data collection process.

School Nurse Asthma Education Program (Snaep)

The study utilized the content of the education program prepared for community health workers by the Association of Asthma Educators. The program was selected as it included all of the elements identified as learning gaps by the school nurses. The program supports the asthma educational needs of school nurses by providing training based on international asthma guidelines. It covers five basic areas: pathophysiology, triggers and environmental control, medications, medication delivery devices, and assessment and monitoring. A practical demonstration follows the theoretical part. Delivery of the program was divided into a theoretical part (120 minutes) and a practical part (90 minutes) for a demonstration and a return demonstration of peak-flow meter measurement and the use of medication delivery devices (a dry-powder inhaler and a metered-dose inhaler). The session was designed to maximize nurses' active participation by including instructional content and interactive learning activities to reinforce the learning objectives.

Data Analysis

In order to explore school nurses' asthma roles, functions, and educational needs in Phase I of the study, descriptive statistics were used. For Phase 2 of the study, in order to detect and analyze changes over time, a t-test was considered. This study used the same sample across the four data collection times. Paired sample t-tests can detect the changes in school nurses' knowledge and self-efficacy levels across time. Overall, the total number of respondents in phase 1 was 49 and the number of school nurses who attended the educational program and returned the completed forms was.

Results

Phase 1

Demographics. The majority of school nurses were female (87.8%, n = 43), and 12.2% were male (n = 6). The mean age was 37.7 years old (SD = 5.036), with ages ranging from 30–60 years. School nurses aged 35–39 years comprised more than half of the participants (51%, n = 25). Table (1)

Table 1: Demographics

Demographics (N = 49) Age (years)	Frequency	Percentage
30–34	9	18.4%
35–39	25	51.0%
40–44	10	20.4%
45–49	4	8.2%
60–64	1	2.0%
Mean Age (SD*)	37.73 (5.04) years	
Educational level	Frequency	Percentage
Diploma in nursing	44	89.8%
Bachelor's degree in nursing	4	8.2%
Other	1	2.0%
Years of nursing experience	Frequency	Percentage
6–10	7	14.29%
11–15	16	32.65%
16–20	22	44.90%

21–25	3	6.12%
31–35	1	2.04%
Mean (SD)	15.76 (4.76) years	
Years of Experience in School Nursing	Frequency	Percentage
1–5	21	42.86%
6–10	25	51.02%
11–15	1	2.04%
16–20	1	2.04%
31–35	1	2.04%
Mean (SD)	6.59 (5.22) years	

*SD = Standard Deviation

Role of School Nurse: The top nursing activities reported by the majority of school nurses were first aid (81.63%, n = 40), administration of immunization (79.59%, n = 39), individual health teaching (71.43%, n = 35) and medication administration (71.43%, n = 35). Table (2).

Table 2: Types of Activities Performed by School Nurses in A School Setting

Item	Type	n	%
1	First aid	40	81.63%
2	Immunization administration	39	79.59%
3	Individual health teaching	35	71.43%
4	Medication administration	35	71.43%
5	Classroom teaching	34	69.39%
6	School-wide wellness promotion	34	69.39%
7	Contacting of parents to collect a sick child	34	69.39%
8	Support groups	33	67.35%
9	Education of students on asthma management or exacerbation prevention	32	65.31%
10	Transport of sick child to home or emergency department	31	63.27%
11	Education of students on the use of asthma medication delivery devices	29	59.18%
12	Development of emergency plans	27	55.10%
13	Development of classroom modifications for students with health problems	25	51%
14	Education of teachers on asthma management or attack prevention	24	48.98%
15	Development of a fire evacuation plan for impaired students	22	44.90%
16	Education of parents on asthma management or attack prevention	20	40.82%
17	Individualized health plan development/ implementation	17	34.70%
18	Education of teachers on the use of asthma medication delivery devices	15	30.61%
19	In-service presentations for staff	14	28.57%
20	In-service presentations for family	9	18.37%
21	Education of parents on the use of asthma medication delivery devices	5	10.20%

Other (please specify)			
22	Assessment of playfield	2	4.1%
23	Drinking water safety check-up	2	4.1%
24	Cafeteria check-up and assessment	3	6.1%
25	Arrangement of health-related roleplay performances in front of an audience	3	6.1%

Medication Administration Policy. More than half of school nurses (55.1%, n = 27) reported that their school region had a medication administration policy, whereas 30.6% (n = 15) were not sure whether one existed. Twenty-three school nurses (46.9%) reported that students were permitted to self-administer their oral asthma medication. However, more than half of the school nurses (53.1%, n = 26) reported that students were not permitted to do so.

The majority of school nurses (87.8%, n = 43) believed that students were permitted to have their inhaled medication self-administered at school, whereas 12.2% (n = 6) responded that students were not permitted to do so. Most respondents (83.7%, n = 41) supervise students who are self-administering asthma medication, while eight (16.3 %) do not.

Task Delegation. Most school nurses (67.3%; n = 33) did not delegate nursing actions to unlicensed personnel such as schoolteachers. Moreover, 65.3% (n = 32) of school nurses did not have a health assistant.

Exacerbation management. Nine (18.4%) school nurses in the Muscat Governorate estimated that they encountered students with an asthma exacerbation at least 2–3 times a week, with 11 (22.4%) nurses reporting a frequency of once a week. In contrast, 26.5% (n = 13) and 12.2% (n = 6) of school nurses reported that an asthma attack occurred once a month and once every other month, respectively. Only three school nurses reported having never seen students with asthma in a school setting.

Education and Training. More than half of school nurses (55%, n = 27) reported that no asthma-related educational training was offered in their schools, with just under half (44.9%, n = 22) indicating that such training programs were available in their schools. The results revealed that 55.1% (n = 27) and 18.4% (n = 9) of school nurses attended an asthma education program either over a year ago or in the past year. Nearly a quarter of nurses (20.4%, n = 10) never attended such programs. More importantly, of those school nurses who never attended an asthma program, four (8.16%) encountered a student once a month with an asthma exacerbation. In addition, of those who had attended an asthma education training program more than a year ago, eight (16.33%) encountered a student once a week with an asthma exacerbation, and five (10.20%) encountered a student with asthma exacerbation 2–3 times a week.

Use of Peak flow meter. The majority of school nurses (89.8%, n = 44) reported that they did not use a PFM to assess asthma in the school setting, including nurses who encountered a student with asthma exacerbation daily (4.08%, n = 2), 2–3 times a week (14.29%, n = 7) or once a week (n = 10; 20.41%).

School Nurse Association Membership and the Use of Asthma Guidelines. None of the school nurses were members of any school nurse association. The majority of school nurses (83.7%; n = 41) did not use asthma guidelines when caring for students with asthma.

Phase 2 (Asthma Knowledge)

Comparison Between School Nurses' Asthma Knowledge Scores at Time 1 and Time 2. The mean asthma knowledge score was 1.48 (SD = 0.17) at Time 1 and 1.56 (SD = 0.07) at Time 2. On average, school nurses showed statically significant asthma knowledge gain at Time 2 compared to Time 1: $t(36) = 2.118$; $p = .041$; effect size $[d] = 0.4$. Table (3) shows a comparison of knowledge scores across time points.

Table 3: Comparison of Asthma Knowledge Scores Across Time Points

Comparison	Time Points	*Mean (SD)	P-Value	t-test
1	Time 1 Time 2	0.07 (0.19)	.04**	2.12
2	Time 1 Time 3	0.14 (0.15)	0.00**	5.37
3	Time 1 Time 4	0.12 (0.17)	.00**	4.37
4	Time 2 Time 3	0.06 (0.11)	.00**	4.24

Comparison Between School Nurses' Asthma Knowledge Scores at Time 1 and Time 3. The mean asthma knowledge scores at Time 1 and Time 3 were ($M = 1.48, SD = 0.17$) and ($M = 1.62, SD = 0.07$), respectively. The difference was statistically significant: $t(35) = 5.37, p = .000$, effect size $[d] = 0.89$.

Comparison Between School Nurses' Asthma Knowledge Scores at Time 1 and Time 4. A paired sample t-test showed that school nurses scored significantly higher on asthma knowledge at Time 4 ($M = 1.60, SD = 0.09$) compared with Time 1 ($M = 1.48, SD = 0.17$), $t(35) = 4.37, p = .000$; effect size $[d] = 0.73$.

Comparison Between School Nurses' Asthma Knowledge Scores at Time 2 and Time 4. The results of the paired sample t-test showed that school nurses had a higher asthma mean knowledge score at Time 4 ($M = 1.60, SD = 0.09$) compared with Time 2 ($M = 1.56, SD = .07$); $t(35) = 2.436, p = 0.02$; effect size $[d] = 0.4$.

Table (6) shows mean, SD and the percentage of correct responses to the 24-item asthma knowledge questionnaire at the four data collection time points.

Table 6: The Mean, Standard Deviation (SD) and, Percentage of Correct Responses to the 24-Item Asthma Knowledge Questionnaire

	Item	Time (1)		Time (2)		Time (3)		Time (4)	
		N* (%)	Mean (SD)	N*(%)	Mean (SD)	N*(%)	Mean (SD)	N* (%)	Mean (SD)
1	Peak flow meters are used to determine if someone has asthma.	5 (13.9)	1.86 (0.35)	20(55.6)	1.44 (0.50)	20(55.6)	1.44 (0.50)	15(41.7)	1.58 (0.50)
2	Uncontrolled asthma can impair lung growth in children.	6 (16.7)	1.17 (0.37)	34(94.4)	1.94 (0.23)	33(91.7)	1.92 (0.28)	31(86.1)	1.86 (0.35)
3	The four classifications of asthma according to the most recent asthma guidelines are: mild intermittent, mild persistent, moderate persistent and severe persistent.	3 (8.3)	1.08 (0.28)	35(97.2)	1.97 (0.17)	35(97.2)	1.97 (0.17)	34(94.4)	1.94 (0.23)
4	A child who has asthma whose age is from 5-11 years old who needs to use a rescue inhaler two times a week and oral steroids once a year is considered well controlled.	15(41.7)	1.58 (0.50)	28(77.8)	1.22 (0.42)	20(55.6)	1.44 (0.50)	17(47.2)	1.53 (0.51)
5	A child with asthma with a peak flow reading of 85% is considered in the yellow zone and should initiate their asthma action plan.	15(41.7)	1.58 (0.50)	25(69.4)	1.31 (0.47)	10(27.8)	1.72 (0.45)	26(72.2)	1.28 (0.45)
6	Children should use a spacer or valved holding chamber when taking their dry powder inhalers.	6 (16.7)	1.83 (0.38)	35(97.2)	1.03 (0.17)	26(72.2)	1.28 (0.45)	18(50.0)	1.50 (0.51)
7	Asthma is an emotional disease.	29(80.6)	1.81 (0.40)	36(100)	1.00 (0.00)	36(100)	1.00 (0.00)	36(100)	1.00 (0.00)
8	Asthma, regardless of its severity, is a chronic inflammatory disorder of the airways.	28(77.8)	1.78 (0.42)	35(97.2)	1.97 (0.17)	34(94.4)	1.94 (0.23)	35(97.2)	1.97 (0.17)
9	If asthma symptoms such as tightness or wheezing do not occur for several years, a child has outgrown his/her asthma.	12(33.3)	1.67 (0.48)	36(100)	1.00 (0.00)	34(94.4)	1.94 (0.232)	25(69.4)	1.31(0.47)
10	Airway inflammation is present in almost all children with asthma, even when asthma symptoms are well-controlled.	13(36.1)	1.36 (0.48)	28(77.8)	1.78 (0.42)	31(86.1)	1.86 (0.35)	20(55.6)	1.56(0.50)

11	People with asthma can usually control their symptoms by taking medicine and avoiding things that make their asthma worse.	32(88.9)	1.89 (0.32)	36(100)	2.00 (0.00)	36(100)	2.00 (0.00)	36(100)	2.00(0.00)
12	Children with asthma can be cured with medication.	10(27.8)	1.72 (0.45)	33(91.7)	1.08 (0.28)	27(75.0)	1.25 (0.44)	22(61.1)	1.39(0.49)
13	It is possible for your asthma to become worse without noticing a change in breathing.	3 (8.3)	1.08 (0.28)	29(80.6)	1.81 (0.40)	26(72.2)	1.72 (0.45)	24(66.7)	1.67(0.47)
14	Untreated asthma can cause death.	30(83.3)	1.83 (0.38)	36(100)	2.00 (0.00)	34(94.4)	1.94 (0.23)	36(100)	2.00(0.00)
15	An early warning sign of asthma may be a chronic cough, especially at night.	27(75.0)	1.75 (0.43)	33(91.7)	1.92(0.28)	34(94.4)	1.94 (0.23)	31(86.1)	1.86(0.35)
16	Children with asthma should not participate in activities where they run a lot.	29(80.6)	1.81 (0.40)	30(83.3)	1.83 (0.38)	33(91.7)	1.92(0.28)	27(75.0)	1.75(0.44)
17	Fish and birds are both good pets for a child with asthma.	30(83.3)	1.17 (0.38)	32(88.9)	1.22 (0.422)	32(88.9)	1.11 (0.32)	28(77.8)	1.22(0.42)
18	Keeping the bedroom windows open at night will help prevent asthma symptoms.	26(72.2)	1.28 (0.45)	33(91.7)	1.08 (0.28)	29(80.6)	1.19(0.40)	29(80.6)	1.08(0.28)
19	A rescue inhaler (i.e., bronchodilator) is taken to reduce inflammation in the lungs.	13(36.1)	1.64 (0.49)	21(58.3)	1.42 (0.50)	25(69.4)	1.31(0.47)	13(36.1)	1.64(0.49)
20	The purpose of steroid medication inhalers is to stop an asthma attack when it occurs.	5 (13.9)	1.86 (0.35)	16(44.4)	1.56 (0.50)	13(36.1)	1.64(0.48)	17(47.2)	1.53(0.51)
21	Children with asthma do not need to take medicine if they feel normal.	28(83.3)	1.22 (0.42)	35(97.2)	1.03 (0.17)	36 (100)	1.00(0.00)	29(80.6)	1.19(0.40)
22	It may take 1-4 weeks to notice improvement in breathing when a child with asthma starts using an inhaled steroid medication.	3 (8.3)	1.08 (0.28)	34(94.4)	1.94 (0.23)	34 (94.4)	1.94(0.23)	33(91.7)	1.92(0.28)
23	When using a dry powder inhaler, the powder needs to be inhaled by taking a slow and deep breath.	12(33.3)	1.33 (0.48)	35(97.2)	1.97 (0.17)	35(97.2)	1.97(0.17)	35(97.2)	1.97(0.17)
24	After taking a quick acting inhaler, the child should hold his/her breath for 10 seconds after each puff and wait one minute between puffs.	5 (13.9)	1.14 (0.35)	33(91.7)	1.92 (0.28)	36(100)	2.00(0.00)	33(91.7)	1.92(0.28)
	Overall	44.6%	1.48 (0.17)	86.6%	1.56 (0.07)	82.1%	1.62 (0.07)	75.2%	1.60 (0.09)

N* = the number and percentage of participants who provided a correct response to this statement.

Phase (2) Asthma Self-efficacy

Table (4) illustrates self-efficacy scores across the 4 data collection times. Differences in Asthma Self-Efficacy Scores Between Time 1 and Time 2. Overall, there was statistically significant improvement in all items at Time 2 when compared to Time 1. A paired *t*-test showed that the school nurses exhibited a significantly higher mean self-efficacy score at Time 2 (3.54 ± 0.31) compared with Time 1: (2.88 ± 0.299), $t(35) = 10.687$, $p = .000$; effect size [d] = 1.78.

Table 4: School Nurses' Asthma Self-Efficacy Mean Scores and Standard Deviation (SD)

Table 7.15.	Time 1 (N = 36)	Time 2 (N = 36)	Time 3 (N = 36)	Time 4 (N = 36)	Overall
Minimum Score	41	57	55	54	41
Maximum Score	64	76	73	69	76
Mean Score	54.78	67.19	64.64	63.22	62.46
SD	5.698	5.874	5.145	4.072	6.983

Differences in Asthma Self-Efficacy Scores Between Time 1 and Time 3. A paired *t*-test showed that school nurses exhibited a significantly higher mean asthma self-efficacy score at Time 3 (3.40 ± 0.27) than at Time 1: (2.88 ± 0.29), $t(35) = 8.884$, $p = .000$; effect size [d] = 1.48.

Differences in Asthma Self-Efficacy Scores Between Time 1 and Time 4. The mean asthma self-efficacy score at Time 4 (3.32 ± 0.21) was significantly higher than that at Time 1 (2.88 ± 0.29). School nurses showed a significantly higher self-efficacy score at Time 4 compared with Time 1, $t(35) = 7.696$

Differences in Asthma Self-Efficacy Scores Between Time 2 and Time 4. The mean asthma self-efficacy score at Time 2 (3.54 ± 0.31) was slightly and significantly higher than that at Time 4 (3.32 ± 0.21). According to a paired t -test, school nurses exhibited a higher self-efficacy score at Time 2 compared with Time 4: $t(25) = 5.790$, $p = .000$; effect size[d] = 0.97.

Table (5) shows the number and percentage of school nurses' responses to the 19-item asthma self-efficacy questionnaire in the four data collection time points.

Table 5: School Nurses' Asthma Self-Efficacy Responses at Time1, Time 2, Time 3, and Time 4

Asthma Self-Efficacy items	N*(%)	N* (%)	N*(%)	N*(%)	N*(%)	N* (%)	N*(%)	N*(%)	N*(%)	N* (%)	N*(%)	N*(%)	N*(%)	N* (%)	N*(%)	N*(%)
	True	Mostly true	Mostly false	False	True	Mostly true	Mostly false	False	True	Mostly true	Mostly false	False	True	Mostly true	Mostly false	False
When I have concerns, I feel comfortable contacting the primary health care provider	80.6%	19.4%	0.0%	0.0%	91.7%	8.3%	0.0%	0.0%	83.3%	16.7%	0.0%	0.0%	86.1%	13.9%	0.0%	0.0%
When I have concerns, I feel comfortable contacting the child's parents	52.8%	47.2%	0.0%	0.0%	66.7%	33.3%	0.0%	0.0%	61.1%	38.9%	0.0%	0.0%	44.4%	55.6%	0.0%	0.0%
I can correctly assess the needs of students with asthma.	11.1%	69.4%	8.3%	11.1%	47.2%	50.0%	2.8%	0.0%	47.2%	47.2%	5.6%	0.0%	38.9%	52.8%	8.3%	0.0%
I can correctly demonstrate how to use a dry powder inhaler.	8.3%	41.7%	19.4%	30.6%	41.7%	30.6%	16.7%	11.1%	16.7%	58.3%	13.9%	11.1%	5.6%	52.8%	33.3%	8.3%
I can correctly demonstrate how to use a peak flow meter.	19.4%	52.8%	19.4%	8.3%	44.4%	55.6%	0.0%	0.0%	33.3%	58.3%	8.3%	0.0%	30.6%	58.3%	11.1%	0.0%
I have the ability to evaluate the effectiveness of the self-management efforts of the student with asthma.	38.9%	44.4%	8.3%	8.3%	52.8%	47.2%	0.0%	0.0%	55.6%	41.7%	2.8%	0.0%	36.1%	55.6%	8.3%	0.0%
I can correctly choose which asthma medication	0.0%	25.0%	27.8%	47.2%	38.9%	61.1%	0.0%	0.0%	16.7%	63.9%	11.1%	8.3%	8.3%	50.0%	30.6%	11.1%

Discussion

The results of this study indicate that first aid, immunization administration, health education and medication administration were the most commonly identified functions of school nurses. These functions also match the roles of school nurses as reported by Lineberry and Ickes [10]. The purpose of this systematic review (33 studies) was to examine the literature on the role and impact of school nurses in American elementary schools. The authors aimed to identify the ways in which nurses contribute to the health and wellbeing of students, as well as the challenges and limitations of their role. They reported that the role of school nurses can be categorized into four main areas: 1) health promotion and disease prevention, 2) management of acute issues like injuries, 3) management of chronic conditions and 4) psychological support [11]. In a qualitative study school nurses describe their role as a multitude of duties, including the management of acute injuries and chronic conditions, medication administration, health promotion and prevention activities for both staff and students, coordination of care and resources and provision of emotional support [10]. These studies concur with findings from a 24-year-old study concerning the top nursing activities performed by school nurses [8]. The implication of having the same results as those from 24 years ago concerning the role of performing first aid tasks is that this remains a critical role for school nurses in promoting the health and safety of students.

An important finding in this study is that school nurses recognize themselves as the main person managing asthma-related emergencies. More importantly, similar to the US data that indicated that over 3.2 million children had at least one documented asthma attack in 2016, this current study found that asthma exacerbation is encountered by school nurses on a weekly base [12]. The fact that school

nurses are the only health care professional available at schools, where children spend most of their time, suggests the necessity of preparing school nurses to act in medical emergencies. Owing to their age, schoolchildren cannot be expected to independently self-manage asthma exacerbations. Therefore, the ability of school nurses to respond and treat these exacerbations is critical. Thus, more education might be needed for school nurses regarding how to manage an exacerbation.

Interestingly, this study indicated that the vast majority of school nurses did not use a PFM to monitor asthma, including nurses who encountered asthma exacerbation on a daily basis. One possible explanation for this lack of PFM use by school nurses might be a lack of knowledge regarding its use. Quaranta and Spencer examined the barriers that school nurses face in managing asthma among school-aged children [13]. The study was conducted using a qualitative research design and employed focus group interviews with school nurses in the US. The study reported a significant correlation between obtaining PFM measurements and the lack of knowledgeable school nurses. GINA guidelines have clearly stated that schoolchildren with asthma need to receive education on the proper use of PFM [14]. Without a peak flow assessment prior to physical activity, school nurses have no perception of whether a student may be vulnerable to an asthma exacerbation or not. Studies highlighted the importance of using a PFM as a monitoring tool to prevent exacerbation among school-aged children with asthma [6,15].

The results of this study also indicate that, as a form of health promotion and disease prevention, immunisation administration is the second-most reported function of school nurses. The reason for this is that school nurses in Oman are responsible for immunisation administration for all students, unlike school nurses in Scotland, where they progressively delegated immunisation of all school children to a specialized team in an effort to standardize the role of school nurses [16]. In the US, school nurses are expected to enhance vaccine uptake by reminding students, families and staff of immunisation schedules and to update immunisation records [17]. Previous literature suggests that immunisation administration in school settings promotes adherence among school students and emphasizes the leadership role of school nurses in coordinating and administering immunization [10,18,19].

The current study indicates the existence of uncertainty regarding medication administration policy, with more than 30% of school nurses unsure of whether one existed and 50% reporting that students are not permitted to self-administer oral asthma medication. It is worth mentioning that the vast majority of school nurses in this study (83.7 %, n = 41) indicated that they supervise students who are self-administering asthma medication. This finding further supports the idea of applying directly observed therapy (DOT) of asthma medication by school nurses which suggests that medication administration by school nurses will promote medication adherence and reduce health care service use [20,21]. The various responses related to medication administration suggest that efforts are needed to familiarize school nurses with local medication administration policies. However, our findings are not surprising, as a structured school medication administration policy does not exist in Oman. A possible explanation for the lack of a medication administration policy is the fact that each student has a school health record stating their condition and the type and frequency of administered medication. However, it is important to bear in mind that medication administration practice in schools undergo constant change, and school nurses are not present in schools five days a week. It is interesting to note that this finding

is similar to findings from a recent study in the US. A systematic review and meta-analysis to investigate medication administration practices in U.S schools and identified 17 relevant studies [22]. The study found that medication administration practices in U.S. schools varied widely, with variability in policies, procedures and training across different states, school districts and at individual schools. Additionally, there was a lack of standardization and consistency in medication administration practices, with many schools lacking clear policies and procedures for medication administration [22]. Another American qualitative study describes the administration of authorized asthma medication such as albuterol as a function of school nurses. It is worth noting that schools in Oman have stock asthma rescue medication in the form of a nebulizer puff, yet no written policies on its administration exist [10]. Administering medication in a non-hospital setting raises issues that need to be addressed with written policies and procedures [23]. Delegation of tasks when school nurses are not available is an important issue regarding medication administration policy. It should be pointed out that delegation does not preclude the need for full-time school nurses in each school [17]. Delegation of health services means providing health services by school personnel other than a registered nurse. It is noteworthy that almost all school nurses in this study did not delegate nursing actions like medication administration to unlicensed personnel. The NASN advises that delegation is beneficial when the five rights of delegation exist: the right task, the right circumstances, to the right person, with the right directions and communication and under the right supervision and evaluation [24]. An US qualitative study explored the role of school nurses in medication administration and the challenges they face with delegation legislation using focus group interviews [10]. The study concluded that delegating school health service delivery to school staff is an important part of the role of school nurses, and having a national standard regarding delegation can provide more visibility to the role of school nurses. The role of a school nurse in delegation can vary depending on the specific school and its policies. However, in general, a school nurse may be responsible for delegating certain tasks to other staff members, such as trained health assistants or schoolteachers. The school nurse must ensure that staff members are knowledgeable about the student's specific asthma medications, dosages and administration procedures [24]. The role of school nurses in delegation is likened with their role in health education. When delegating tasks related to asthma care, the school nurse should educate the delegate about the assigned task to ensure that the delegate is properly trained and competent.

About half the nurses in this study reported attending an asthma education program either over a year ago or in the past year. Alarming, some school nurses who never attended an asthma education program reported encountering a student with asthma exacerbation once a month, and those who attended an asthma education program over a year ago reported encountering a student with an exacerbation on a weekly basis. In response to this identified gap, actively seeking educational opportunities to advance their knowledge is a pressing need among school nurses. The lack of continuing education for school nurses is a significant issue that can impact the quality of asthma care provided to students. In their a qualitative study using semi-structured interviews with school nurses in the US, Quaranta and Spencer (2016) found that inadequate training and education, particularly the training related to asthma emergency situations, was a barrier to effective asthma management at schools [13].

In order for school nurses in Oman to be a valuable source for children's health and well-being, they must continue developing their skills and direct their efforts appropriately. It is unfortunate

that none of the school nurses in this study are members of any school nurse association. To promote themselves as professionals in the field of school nursing, school nurses should consider joining national and international school nursing organizations [25]. Similar to school nurses in other parts of the world, the nurses in this study need to stay up to date with current practices in asthma care, particularly with the vast majority of them reporting that they do not follow any specific asthma guidelines when caring for a child with asthma. Previous studies in the US suggested that school nurses may not follow or be aware of some of the asthma care guidelines indicating a possible lack of knowledge regarding current guidelines [26]. Despite changes in the healthcare system and advancements in technology, the need for immediate first aid attention for acute illnesses and injuries among students persists [13,25]. Overall, the finding that first aid remains a key task for school nurses highlights the ongoing need for school nursing services in promoting student health and wellbeing. Asthma exacerbation is one such medical emergency that school nurses are expected to handle and respond to. Exacerbation can occur at any time due to potential exposure to triggers that vary from child to child. Every child with asthma has specific triggers and should receive education about them [27].

The study findings indicate that the knowledge level of school nurses at the three data collection time points after SNAEP is higher than their knowledge level prior to administration of the program. Prior to SNAEP, questionnaire items related to medication and medication delivery devices, particularly those regarding inhaled steroid medication and PFM use, were the items with the fewest correct responses. It has been observed that school nurses do not recognize the main purpose of PFM as a monitoring device for asthma symptoms rather than as a diagnostic device. Therefore, it is not surprising to observe such responses, as almost all school nurses in Phase 1 reported that they do not use PFM at their schools. Although the use of PFM by school nurses is not widely examined in the context of school nurses' knowledge, its use by schoolchildren has been emphasized extensively, with research indicating the need to adopt PMF as a self-management skill for schoolchildren with asthma [28].

Immediately after the administration of SNAEP, there was observed improvement in responses to almost all questionnaire items, with noticeable improvement regarding the dry powder inhaler technique, reflecting that skill demonstration was beneficial. However, items related to inhaled steroid medication and PFM use netted the greatest number of incorrect responses, even though scores were better than those before the administration of SNAEP. It was observed that it is common for school nurses to be confused when distinguishing between steroid and bronchodilator indications. The lack of knowledge regarding this aspect of medication and PFM remained constant at Time 3 and Time 4. A possible explanation for this may be the lack of adequate supplies of PFMs, inhalers, spacers and medications. The literature reported a lack of resources as one of the top barriers to effective asthma management [13,25,29,30].

While there is increasing evidence that education improves asthma knowledge among adults, this theoretical information may not be easily retained, indicating the need for ongoing continuing education. In addition, the lack of knowledge acquisition and retention related to medication could be attributed to the didactic lectures. Previous studies reported lectures with or without visual demonstration as common teaching methods to educate school nurses about asthma [31-33].

The intervention phase of the current study included a demonstration and a return demonstration of medication delivery devices, but the types of medication and their indications were explained to school nurses in lecture form, which may explain the lack of retention of pharmaceutical information. In an RCT, authors argued that learning through a game-based approach had a greater potential to transfer information from short-term to long-term memory among nursing students who were learning about medication indications and mechanisms for action [34].

By the end of this study, school nurses' knowledge of quick-acting inhaler and dry-powder inhaler use had declined, alongside deteriorated recall of skills. Common reasons for incorrect inhaler use is confusion about proper use due to lack of exposure to inhaler devices and the various technical changes in inhaler designs have made it challenging even for health care professionals to keep up with the correct inhaler techniques [35]. Another possible explanation for incorrect inhaler use could be the unavailability of the device as a result of their relatively high cost, alongside health care professionals' lack of knowledge regarding the correct technique for inhaler use. These conditions may justify the lack of retention of medication delivery device skills among school nurses.

The results of this study revealed higher self-efficacy scores for school nurses post-SNAEP at all four data collection time points, reflecting the significant positive impact of the program on school nurses' self-efficacy. This study found that self-efficacy diminishes over time, but, by the end of the study, all mean scores on questionnaire items were significantly higher than the respective baseline mean scores, indicating that SNAEP was effective in improving school nurses' self-efficacy up to six months post-intervention. These findings are similar to a previous study that reported increased self-efficacy among school nurses and improvement in PFM, medication delivery devices, medication administration and communication after their attendance at an asthma education workshop [33].

The questionnaire items related to communication between the school nurse and the student's health care provider revealed the greatest self-efficacy throughout the study period. School nurses reported feeling comfortable contacting health care providers to discuss any concerns. However, their confidence in contacting the child's parent diminished over time. Previous studies found a lack of communication between the school nurse and the health care provider to be a challenge to effective asthma management [13,30].

The questionnaire items with the lowest self-efficacy at the four data collection time points were items related to medication administration, PFM use and dry powder inhaler technique, mirroring those items from the knowledge questionnaire. This finding supports previous research that found that, despite education and instruction in the use of PFM, school nurses reported a lack of self-efficacy in the use of PFM and medication delivery devices [31]. The finding further highlights the need for continuing education and training to refresh and enhance the school nurses' knowledge and skills in asthma medication and delivery devices.

This study found a strong positive correlation between school nurses' asthma knowledge and self-efficacy levels at Time 1 before the SNAEP intervention and a moderate positive correlation immediately after SNAEP. Additionally, school nurses with greater knowledge demonstrated a higher level of self-efficacy. This result is in agreement with previous studies, which revealed a moderate positive correlation between knowledge and self-efficacy among school nurses [9,26].

Another important finding is that school nurses exhibited lower self-efficacy in managing asthma exacerbation without the need to send the child to the emergency room. This was evident at the four data collection time points. Even with the presence of basic asthma knowledge, school nurses reported low self-efficacy when independently responding to children with an exacerbation. School nurses may have not experienced an opportunity to independently manage asthma exacerbation symptoms, which may be beyond their scope of practice as school nurses. However, as the first line of defense in addressing the health needs of students, school nurses have a critical role in managing exacerbation, and these nurses should be able to identify exacerbation signs and symptoms at an early stage. A similarly low level of self-efficacy was identified in a previous study, whose cross-sectional study aimed to assess the emergency preparedness of school nurses in the United States. Most school nurses in the study (77 %, n =154) reported having students with severe asthma, but only 25% reported having confidence in their ability to manage asthma exacerbation despite the presence of an asthma emergency plan in the school [36]. The presence of an asthma emergency plan is a positive step towards improving asthma management in schools. However, the low level of confidence among school nurses in managing asthma exacerbations despite the presence of these plans suggests that there may be gaps in training and education for school nurses that needs to be addressed.

It is important to note that if the student experiencing severe asthma exacerbation is suffering from chronic respiratory failure that requires ongoing treatment and monitoring or is having uncontrolled asthma with frequent exacerbation, it may be beyond the scope of practice for the school nurse to manage their exacerbation care at school. Therefore, it is essential to train school nurses to recognize when students' symptoms are beyond their scope of practice and when it is necessary to seek medical assistance. This is a clear and compelling indication of the importance of having a clear scope of practice for school nurses. As findings suggested, Oman lacks any written documents regarding school nurses' scope of practice. A clear scope of practice ensures that school nurses are aware of their areas of expertise and where they need further education and understand when to seek assistance. This knowledge ensures that students with asthma receive consistent, safe care and support. In addition to a clear scope of practice, various strategies can be adopted to increase school nurses' self-efficacy in asthma exacerbation management, such as providing easy access to resources, ensuring ongoing education and training and collaborating with other health care professionals.

Implications

Findings from this study have highlighted that the role of school nurses is not clearly defined. There is an absence of a well-stated scope of practice, and the multiple non-nursing tasks are being assigned to school nurses. Additionally, school nursing policies are not clearly formulated, with no clearly defined medication administration policy. Findings also highlighted the need for a well-formulated policy regarding asthma exacerbation management which addresses the following issues:

- Developing and implementing clear policies and guidelines (job description) outlining the roles and responsibilities of school nurses in collaboration with stakeholders (e.g., school administrators, healthcare providers, policymakers, educators, parents).
- Developing and implementing a clear medication administration policy outlining school nurses' role in

medication administration and delegation.

- Developing and implementing a comprehensive training program for new school nurses that covers the scope of their responsibilities, relevant policies and regulations and protocols for communication and collaboration with other healthcare providers and educators.
- Developing and implementing school-specific asthma exacerbation management guidelines.
- Developing and implementing a system for monitoring and evaluating the performance of school nurses and ensuring accountability for meeting established standards and expectations.

Limitations

School nurses' needs assessment relied on self-reported data that reflected their personal experiences and needs. They may not have accurately recalled their educational needs particularly if they had not recently encountered a student with asthma or have not previously managed an exacerbation. Additionally, the lack of direct observation during the data collection process made it challenging to assess the extent to which school nurses may have sought assistance or additional resources when completing the questionnaire.

Another limitation of this quasi-experimental study was the lack of a control group due to the risk of contamination between the intervention and control groups. The nature of the intervention made it difficult to prevent school nurses in the control group from receiving some exposure to the intervention.

Conclusion

The originality of this study lies in its dual focus on identifying educational needs and evaluating the impact of an intervention, making it a valuable contribution to the literature on asthma management. Additionally, this study contributed to the development of evidence-based practices for managing asthma in school settings.

The findings may help nursing educators and administrators to design and implement effective educational programs that meet the specific needs of school nurses, informing the content and delivery of education programs. Finally, this study can serve as a baseline model for future research conducted in nursing education in Oman and Middle East, specifically in the area of chronic disease management at school setting.

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