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RESEARCH ARTICLE

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New Dimension in Inhaler Technical Training: Puzzle

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ABSTRACT

Objective: To evaluate the effectiveness of group trainings for using inhaler drugs with a spacer with a game (puzzle) after face-to-face training and the satisfaction of health care professionals in a second-line hospital.

Materials and Methods: Participants completed the post-training satisfaction questionnaire after both face-to-face and practical training. A cross-sectional, quasi-experimental study was performed.

Results: A total of 102 participants were included in the study. After the face-to-face training, the most common inhaler error was not shaking the inhaler tube before inhalation. The rate of participants who received a full score after face-to-face training (total 7 points) increased to 91.2% from 49% after puzzle practice ($p < 0.001$). In addition, the increase in the total score after the face-to-face training was statistically significant ($p<0.001$). The majority of the participants (> 90%) assessed themselves as providing adequate inhaler training with a spacer and treatment to the patients. In addition, the participants thought that the puzzle was highly instructive, interesting, and a facilitator for learning.

Conclusion: The puzzle can be used as a complementary tool for face-to-face training and it seems to be useful as a visual education material. Large-scale and multicenter studies are needed to determine the effectiveness of puzzles in other disciplines.

Keywords: Spacer, inhaler training, puzzle

INTRODUCTION

Due to their local effects, inhaler drugs are the basis of the treatment in obstructive pulmonary diseases such as asthma (1). According to the guidelines, using inhaler drugs with a spacer (a mask or mouth piece) is the preferred treatment method in children (1, 2). Using inhaler medications with a spacer reduces the technical coordination problems at the beginning of inhalation. Inhaler drugs then accumulate less in the upper airways and reach the lungs more effectively (3, 4). Errors in inhaler techniques result in an increase in health care costs, lack of disease control and hospitalization (5). Healthcare professionals are often the first people to teach patients how to use an inhaler drug with spacer. In addition, they have opportunity to evaluate the accuracy of the inhaler technique (6). In spite of the importance of inhaler drugs in the treatment of obstructive pulmonary diseases, healthcare professionals often learn inhaler technical skills with a spacer on their own and inaccurately (4). After evaluating 20 studies conducted in the last 30 years, Self et al. have reported that inhaler technical skills of health care professionals were insufficient (5). In spite of these problems related to inhaler technical knowledge in healthcare professionals, an adequate and effective solution for this important issue could not be produced. However, studies have shown that the inhaler technique can be easily taught and sufficient knowledge can be provided for healthcare professionals (7, 8).

The word 'game' is a general term and includes integrative content and educational activities (9, 10). Many different types of instructional games have been used in medical and health care education courses such as crossword jigsaw, lego pieces, game boards, skeletal-muscle models, jigsaws, and playing cards (11-16). The

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puzzle was found to be a useful learning tool for various medical and health care educational objectives (16). Group work with a puzzle provides better inter-group interaction (17). In addition to theoretical courses, education via puzzles improves the students' performance (18). Students have reported that using a puzzle was less stressful and more useful than classical lessons in electrocardiogram (ECG) studies (19).

The rate of knowing the correct inhaler technique with a spacer should be increased in health professionals (5). Current guidelines suggest that health care professionals should also increase patients' knowledge about adequate inhalation techniques. Therefore, asthma specialists should provide local or regional training about inhaler drug techniques to health care professionals (7, 20). Evaluation of inhaler technique should always be done after such training. In addition, trained health care professionals should be encouraged to control patients' inhaler technique and educate them (21).

It has been shown that spacers were cost-effective and an alternative to nebulizers in acute severe asthma attacks (22, 23). In large randomized trials comparing spacers and nebulizer therapies, the spacers were found to be as effective as nebulizer therapy as regards the clinical score, respiratory rate, and oxygen saturation in acute moderate-severe asthma attacks in children (24). Metered dose inhalers with spacers can frequently be administered to children in the emergency department. Asthma treatment could therefore be accelerated and was more beneficial and effective (25, 26).

Asthmatic patients can be hospitalized in the emergency room, intensive care unit, or pediatric services, or followed up at the outpatient clinics in our second-line hospital. In our pediatric allergy clinic, patients diagnosed with asthma are educated on using inhaler drugs with spacers for asthma attacks. Using a salbutamol metered dose inhaler with spacers may be advantageous because of fewer side effects and more effective treatment. When the patients are being discharged, the patients' inhaler technique can be checked. They can be trained by the medical personnel (nurse, doctor) adequately trained about inhaler techniques. The aim of this study was to evaluate the effectiveness of group training with a game (puzzle) after face-to-face training and the satisfaction of health care professionals in a second-line hospital.

MATERIALS and METHODS

Informed written consent was obtained from the participants. After completing the face-to-face and practical training sessions, they completed the post-training satisfaction questionnaire. A cross-sectional, quasi-experimental study design was used. The study was performed in two months.

The training was given in two stages.

Face-to-Face Training

In the first stage, face-to-face training on using the inhaler with a spacer was given for about three minutes. In addition, the participants were educated on oral hygiene and spacer care. The questions were answered and individual inhaler technique scoring was performed at the end of the training. The maximum inhaler technical score was accepted as seven points.

Evaluation of Oral Hygiene and Spacer Care After Using a Metered Dose Inhaler

The participants were asked questions on oral hygiene and spacer care and these were scored separately. Total hygiene score was accepted as two points with one point for spacer care and one point for oral hygiene care.

Practical Training

In the second stage, a visual puzzle practice was completed by each group. At the end of the puzzle, questions were received and answered. After the visual puzzle was finished, individual inhaler technique scoring was performed again. The score was then compared with the face-to-face inhaler technical training score. The maximum score was accepted as seven points. Fully adequate training was defined as getting full scores.

Evaluation of Inhaler Technical Skills (Scoring)

Inhaler technical skill scores were performed after both face-to-face training and puzzle practice (Table I). Various scoring systems have been used for using inhaler drugs with a spacer in children. In our study, the five-step seven-item scoring system was used for assessment of the adequacy of inhaler technique. Each step was scored as one point (24, 27). The maximum inhaler technique score was accepted as seven points.

Table I. Scoring Criteria*.

Steps	Inhaler Technique
1	Removing the cap of the inhaler tube (removing cap).
2	Shaking the inhaler before use (shaking the inhaler).
3	Placing the inhaler tube into the spacer correctly (placing).
4	Placing the spacer to the mouth properly (> 5 years, spacer with mouthpiece) or to the mouth-nose (mask) (<5 years, spacer with mask) (placing the spacer to mouth).
5	Correct delivery of single dose salbutamol by pressing the salbutamol inhaler tube (activation).
6	Inhaling deeply and slowly from the spacer 5 times (breathing).
7	Accurate number of doses (correct number of doses).

*A numbered system was developed for each criterion. One point was given when each step was done correctly and 0 points otherwise. The maximum total score after face-to-face and puzzle training was seven.

Table II. Demographic characteristics of the participants.

Total number of participants, n	102
Gender, n (%)	
Male	30 (29.4)
Female	72 (70.6)
Age, median (min-max) years	31.5 (18-67)
Jobs, n (%)	
Doctor	14 (13.7)
Nurse	88 (86.3)
Department, n (%)	
Emergency	1 (0.98)
Intensive care	36 (35.3)
Service	55 (53.92)
Outpatient clinic	10 (9.8)
Previous inhaler training, n (%)	
Yes	16 (15.7)
No	86 (84.3)

Questionnaire

Questionnaires, prepared by referring to previous studies, were administered after puzzle practice and the participants' satisfaction was evaluated (28-30). There were 15 questions in total. Six of them were related to the personal history and sociodemographic status. The following four questions were included to evaluate the individual capability of the participants after the training. The last five questions were related to adequate teaching of the puzzle.

Statistical Method

Statistical analyses were performed using the SPSS version 18 software. The suitability of the variables to a normal distribution was evaluated with visual (histogram and probability graphs) and analytical (Kolmogorov-Smirov/Shapiro-Wilk tests) methods. Descriptive statistics were determined with the median for numerical non-normally distributed variables and the mean for normally distributed variables. Since the increase in scores did not show a normal distribution before or after practical training, these were compared with the Wilcoxon test. After face-to-face training and puzzle practice training, the rates of the inhaler technical steps were reported as percentages and the change in training steps was compared by McNemar test. A p value of less than 0.05 was accepted as statistically significant.

RESULTS

One hundred two health care professionals were included in the study. Demographic characteristics of the participants are shown in Table II. The rate of participants who performed the inhaler technical steps correctly after two training steps are shown in Table III. The most common error (26.5%) after face-to-face training was not shaking the inhaler tube. This error was statistically significantly decreased after puzzle training (2.9%) ($p<0.001$). In addition, after the puzzle practice, the accuracy rate of placing the spacer to the mouth, activating the inhaler tube and giving a single dose and the accurate number of drug doses increased in a statistically significant manner (Table III).

Table III. Proportion of correct inhaler training steps*.

Steps	Face to face training (%)	Puzzle training (%)	p**
Removing the cap of the inhaler tube (removing cap)	93.1	100	0.16
Shaking the inhaler before use (shaking the inhaler)	73.5	97.1	**<0.001**
Placing the inhaler tube into the spacer correctly (placing)	94.1	100	0.31
Placing the spacer to the mouth properly	87.3	98	**0.01**
Correct delivery of single dose salbutamol by pressing the salbutamol inhaler tube (activation)	87.3	99	**<0.001**
Accurate number of doses (correct number of doses)	86.3	98	**<0.001**
Inhaling deeply and slowly from the spacer 5 times (breathing)	91.2	97.1	0.70
Full score	49	91.2	**<0.001**

* The results are given as a percentage.
** After the face-to-face and practical training, the change in training steps was compared by using the McNemar test.

Table IV. Survey questions for assessing professional competence after face-to-face and puzzle training.

Survey Questions	Low adequate	Full adequate	Inadequate
Learning spacer care, n (%)	4 (3.92)	97 (95.1)	1 (0.98)
Learning oral hygiene, n (%)	1 (0.98)	96 (94.12)	5 (4.9)
Feeling adequate to prescribe inhaler drugs with spacers for patient treatment, n (%)	8 (7.8)	94 (92.2)	0
Feeling adequate to give inhaler training to the patients, n (%)	5 (4.9)	97 (95.1)	0

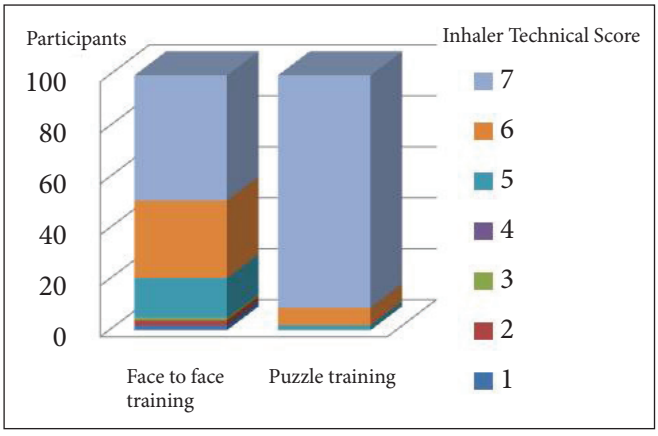

Figure 1. Total score after face-to-face and puzzle training.

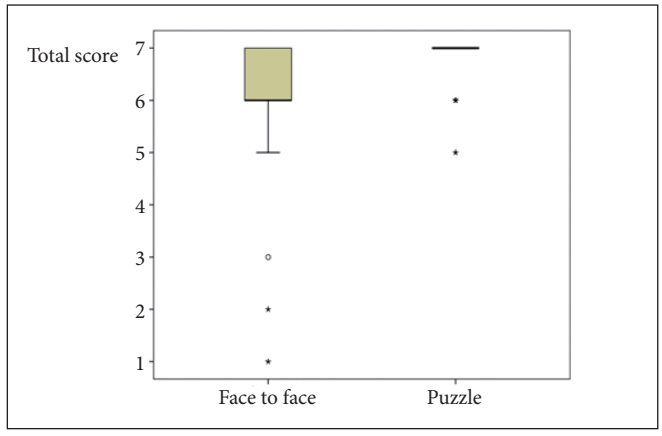

Figure 2: The effect of puzzle training on total scoring. Total scores after face-to-face and puzzle training are seen. The Wilcoxon test shows that the score of the participants after the puzzle training was significantly higher than after the face-to-face training ($p < 0.01$, n=102). The data are given as box plot.

The scores after face-to-face and puzzle practices are shown in Figure 1. While the rate of participants who received a full score after face-to-face training (total seven points) was 49%, it increased to 91.2% after puzzle practice. This increase was statistically significant ($p<0.001$). In addition, the participants' inhaler technique scores were increased statistically significantly after the puzzle practice ($p <0.001$) (Figure 2). A significant proportion of participants (91.2%) achieved a full score in oral hygiene and spacer care. Two percent of the participants did not score any points.

A high percentage of the participants assessed themselves as adequate to provide inhaler training and to administer inhaler therapy with a spacer to the patients.

Table V. Survey questions about teaching of the puzzle.

Survey questions	Yes	No	No idea
Facilitate understanding, n (%)	100 (98.2)	1 (0.9)	1 (0.9)
Tutorial game, n (%)	95 (93.3)	6 (5.8)	1 (0.9)
Tutorial material in other scientific fields, n (%)	100 (98.2)	1 (0.9)	1 (0.9)

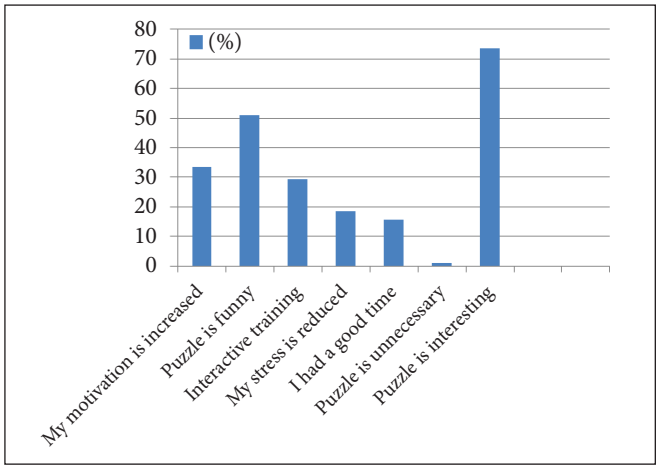

Figure 3: Free questions about the puzzle training answered by the participants.

In addition, a high percentage of participants learned oral hygiene and spacer care (Table IV). Although the participants thought the puzzle was funny and interesting, a small number of them thought that it was unnecessary. The survey results are summarized in Table V and Figure 3.

DISCUSSION

Tratto et al.'s study showed that 43% of nurses and 65-100% of doctors working in different specialties has previously received inhaler drug use training (31). Another study revealed that 13% of 23 nurses had never received inhaler drug training (32). In the current study, 28.5% of the physicians and 13.5% of the nurses had received inhaler medication training previously. These rates are unfortunately lower than the ones reported in the literature.

Oral hygiene and spacer care are also important, because they can reduce local (oral candidiasis) and long-term (growth retardation, reduction in bone mineralization) side effects of inhaler drugs (1). In our study, 93% of the participants had a full score for oral hygiene and spacer care after the face-to-face training. These results showed that the healthcare professionals should be educated by face-to-face training for adequate oral hygiene and spacer care knowledge. Inadequate knowledge of spacer use causes more nebulizer drugs to be prescribed than metered dose inhalers. The patients spend more time in the emergency department with the nebulizer treatment. For example, the average time for each nebulizer drug administration is about 15 to 20 minutes and the total time will be approximately 45 minutes to one hour. In addition, conventional nebulizers are more expensive than spacers. They also require periodic maintenance and electricity. However, the average time needed for using metered dose inhalers with spacers does not exceed 5 minutes. In addition, heart-related side effects occur rarely with spacers (26). Health professionals should be encouraged to use metered dose inhalers with spacers (22, 23, 25).

In Amirav et al.'s study, the group that received both theoretical and practical training showed better performance than the group with only theoretical training (21). Providing both theoretical and practical training programs to all healthcare professionals (doctors, nurses, etc.) is recommended to increase inhaler technical skills. After these programs, written and practical objective evaluation should be done to show the effectiveness (33). In our study, 49% of the participants achieved a full score after face-to-face training. This rate increased to 91.2% after puzzle practice, and this difference was statistically significant ($p<0.001$). Our study supports the fact that only face-to-face inhaler technical training may be insufficient and it should be supported with practical training. Puzzle tools may therefore be a new alternative in practical training.

Not shaking the inhaler tube and not breath holding after inhalation are reported to be the most common mistakes of healthcare professionals' (including nurses, doctors and pharmacists) inhaler technique in the literature (34, 35). Similarly, not shaking the inhaler tube (26.5%) was the most common mistake after the face-to-face training but the rate decreased statistically significantly (2.1%) after the practical puzzle in our study ($p<0.001$). It is therefore useful to pay attention to shaking the inhaler tube before use, especially during face-to-face training.

Although there is no data on the use of the puzzle practice for inhaler medication technique training, there are many studies related to other medical disciplines in the literature. Marcondes et al. used the visual puzzle game to

teach cardiac cycles to 327 students. Most of them thought that it was highly instructional material. Only 4.6% of the students found the puzzle unnecessary in understanding the lesson (16). Machado et al. used the puzzle to teach the membrane potential to 45 students who then stated that the puzzle was instructive (29). In many studies, the puzzle practice increased the students' performance, interest, curiosity, and teamwork, together with a desire to learn (15, 18, 36, 37). In our study, group work was allowed during the puzzle practice. The majority of the participants (> 90%) assessed themselves as able to provide adequate inhaler training with a spacer and treatment to patients. In addition, the participants thought that the puzzle was highly instructive, interesting, and a facilitator for learning (Table V and Figure 3). According to the study, the total inhaler score increased after the practice training and the participants reported that the puzzle was a good method for inhaler practice. Thus, a puzzle can be a complementary model for face-to-face education for healthcare professionals and it can facilitate teaching inhaler skills with a spacer.

There are some limitations of our study. Our study was cross-sectional and the effect of puzzle training on long-term memory was not evaluated. It was therefore not possible to obtain the long-term results of puzzle training. In addition, not all healthcare professionals were included in the study. The adequacy of the training has not been evaluated, especially in the emergency room and with other medical professionals due to time constraints and workload.

In conclusion, puzzles can be used as a complementary tool for face-to-face training and visual education materials in inhaler technique trainings. Large-scale and multicenter studies are needed to determine the effectiveness of puzzles in other disciplines. Patient education may be facilitated with both puzzles and face-to-face practice, especially in healthcare clinics. Further studies are needed to evaluate the effect of puzzle training on long-term retention.

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