

Comparing the Effects of Menthol-cold Water and Psyllium on Thirst and Xerostomia among Patients in Intensive Care Unit

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ABSTRACT

Background: Thirst is a prevalent problem among patients in intensive care unit. This study aimed to compare the effects of menthol-cold water and psyllium on thirst and xerostomia among patients in intensive care unit.

Methods: This randomized controlled trial was conducted in 2018–2019. Participants were 132 patients consecutively recruited from the intensive care units of two teaching hospitals, Tehran, Iran. They were randomly allocated to either a menthol-cold water, a psyllium, or a control group (44 patients in each group). Participants in the menthol-cold water and the psyllium groups received mouth wash with respectively menthol-cold water and psyllium in two fifteen-minute rounds with a thirty-minute interval. A visual analogue scale was used to assess thirst severity, distress, and xerostomia before and after each round of mouth wash. Data were analyzed through non-parametric statistical tests.

Results: There were no significant differences among the groups respecting baseline characteristics, thirst severity and distress, and xerostomia. However, among-group differences respecting thirst severity, distress, and xerostomia were statistically significant after the intervention ($P < 0.001$). Mouth wash with psyllium was associated with significantly greater reduction in thirst severity, distress, and xerostomia compared with mouth wash with menthol-cold water ($P < 0.001$).

Conclusion: Both menthol-cold water and psyllium are effective in reducing thirst and xerostomia among patients in intensive care unit, though the effectiveness of psyllium is significantly greater than menthol-cold water. Educating nurses about thirst and xerostomia assessment and herbal remedies for their management may help them effectively manage their patients' thirst and xerostomia.

Thirst and xerostomia are among the most prevalent problems experienced by patients in intensive care unit (ICU)[1]. By definition, thirst is a feeling of dryness in the mouth and throat [2]. It is caused by a wide range of internal and external factors such as hormones, nervous system activities, dietary habits and regimen, inadequate fluid intake, pathologic conditions, reduced saliva production, and medications [2-3]. Patients in ICU are exposed to thirst while they are unable to communicate their thirst due to reduced consciousness, long-term endotracheal intubation,

tracheostomy, facial mask, or oxygen therapy. Hypoxia-induced mouth breathing and mechanical ventilation are among the other causes of thirst among patients in ICU [2]. Moreover, they receive medications such as analgesics, diuretics, opioids, and anticholinergic agents which predispose them to fluid balance impairments and thirst [1]. A study reported thirst as the second most common problem in ICU with a prevalence of 70.8% [2]. Another study reported thirst and xerostomia as fundamental problems among patients in ICU [4].

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Thirst among patients in ICU is associated with different physical problems, ranging from xerostomia, speech impairment, and dysphagia to aspiration pneumonia and respiratory infection [2]. Besides physical problems, unmanaged thirst can cause mental distress, anxiety, fear, despair, and powerlessness and thereby, may negatively affect psychological well-being [2, 5].

Because of its high prevalence and significant health-related effects, effective thirst management is of paramount importance [4]. Patient assessment for thirst and xerostomia is among the main responsibilities of nurses [5]. These problems raise some nursing diagnoses such as impaired oral mucus membrane and deficient fluid volume. Moreover, thirst can result in nursing diagnoses such as infection and damage. Therefore, nurses need to use effective strategies to compensate deficient fluid volume and manage thirst and xerostomia among patients in ICU [6].

Thirst assessment, oral care, and mouth wash are among the strategies nurses use for alleviating thirst and xerostomia. Studies reported a wide range of preparations for mouth wash, including olive oil, artificial saliva, saliva stimulants [7-8], ice, frozen gauze [9-10], cold sterile water, lip and mouth moisturizers [11], chewing gums, cold water gargle, acupuncture, and wet gauze [3]. However, some of these preparations cannot be used for patients in ICU due to their specific conditions such as altered consciousness.

Menthol-cold water (MCW) combination is among the interventions for thirst and xerostomia management. Menthol is a ten-carbon alcohol extracted from peppermint essential oil. Its use produces cooling and refreshment sensations and hence, it is widely used in candies, chocolates, gums, toothbrushes, common cold medicines, cigarettes, and makeup products [12-13]. A study reported that MCW significantly alleviated thirst severity and distress but did not completely eliminate them [1].

Another strategy for thirst management is the use of mucilage. Psyllium is among the plants with mucilage which can be used for thirst management. It is scientifically known as *Plantago psyllium* or *Plantago ovate* Forsk and belongs to the Plantaginaceae family. Psyllium mucilage entitled "Esfarzeh" has traditionally been used in Iran for thirst management. According to the Iranian Traditional Medicine, psyllium has a cold and wet temperament and hence, alleviates bodily warmth and thirst [14]. However, there are limited empirical studies into the effectiveness of psyllium and MCW in alleviating thirst, particularly among patients in ICU [1, 15-16] and hence, more studies are still needed to produce firmer evidence in this area. The present study was conducted to address this gap. The aim of the study was to compare the effects of MCW and psyllium on thirst and xerostomia among patients in ICU.

Methods

This three-group randomized controlled trial was conducted from December 2018 to March 2019.

Participants were 132 patients recruited from the ICUs of Shariati and Imam teaching hospitals, Tehran, Iran. Eligibility criteria were an age of more than eighteen, ICU stay for more than 24 hours, ability to understand, read, and speak Persian, no intake of opioids or consciousness suppressants, no history of allergy, no open wounds in the mouth and the lips, no history of dementia or Alzheimer's disease, a Richmond Agitation-Sedation Scale score of -1 to +1 [17], a thirst severity score of greater than 3, compatibility of the study intervention with patient's medical conditions (for example no oral cavity surgeries), and agreement for participation. Exclusion criterion was allergic reaction to psyllium or menthol which was observed among none of the participants.

Sample size was calculated based on the method proposed by Cohen [18]. Accordingly, with a large effect size of 0.70, a type I error of 0.05, and a type II error of 0.90, sample size for each group was determined to be 44. In other words, 132 patients were needed for the three groups of the study.

Sampling was done consecutively and participants were randomly allocated to groups through permuted block randomization. The R software and the Block and command were used to generate the randomization sequence.

Study interventions were mouth wash with MCW for patients in the MCW group and mouth wash with psyllium for patients in the psyllium group. In the MCW group, cold water was used for mouth wash and menthol was used for lip moisturizing. In the psyllium group, psyllium mucilage was used for both mouth wash and lip moisturizing. Menthol was prepared and used as a 0.1% solution through diluting peppermint essential oil in water. Peppermint essential oil was bought from pharmacy. Psyllium was also prepared as 0.5% solution through soaking 0.5 grams of psyllium seed coat in 100 milliliter of water. The solution was then sieved and autoclaved at a temperature of 121°C. Both menthol, water and psyllium mucilage solutions were kept in the refrigerator at a temperature of 7°C to 15°C. Mouth wash in both groups was performed in two fifteen-minute rounds with a thirty-minute interval. Initially, ten milliliters of the intended solution was sprayed in the oral cavity and then, a piece of sterile gauze was used for mouth wash. Patients in all three groups received routine oral care provided to all patients in ICUs in the study setting which consisted of mouth wash using a cotton swab and chlorhexidine solution.

The primary outcomes in this study were thirst severity and distress, while the secondary outcome was

xerostomia. Thirst distress refers to the degree of suffering due to thirst or its associated discomfort [19].

Study data were collected using a demographic and clinical characteristics questionnaire, the Simplified Acute Physiology Score II, and a visual analogue scale for thirst assessment. Data on participants' demographic and clinical characteristics were collected from their medical records. The Simplified Acute Physiology Score II (SAPS II) was used to predict mortality based on patients' conditions in the first 24 hours of their ICU hospitalization [20]. Serum osmolality was calculated using the osmolality formula and the results of patients' laboratory tests.

As thirst is a subjective feeling, a 0–10 visual analogue scale was used for its assessment [21]. Points 0 and 10 on the scale respectively stood for “No thirst” and “Most severe thirst”. The scale was printed in color on a large paper and was shown to patients while they were asked to answer our questions verbally. Patients with tracheostomy or endotracheal tube were trained to answer our questions using their fingers. Patients who could not answer the questions verbally or with fingers were assisted by the first author who placed her own finger on the scale and asked the intended patient to confirm the accuracy of the selected point by firmly closing his/her eyes. Questions for thirst severity and distress assessment were respectively, “How severe is your thirst at the present moment?” and “How much does thirst cause you discomfort at the present moment?” Xerostomia was also assessed using the following Yes/No question, “Do you have xerostomia?” Data on thirst severity, thirst distress, and xerostomia were collected at four measurement time-points, namely immediately before and after each fifteen-minute mouth wash.

The content validity of the data collection instruments was approved by ten lecturers of the Faculty of Nursing and Midwifery of Tehran University of Medical Sciences, Tehran, Iran. For reliability assessment, the visual analogue scale was simultaneously used for five patients by the first author and a trained critical care nurse. Inter-rater Kappa agreement coefficient was 1.

Statistical analysis

Given the non-normal distribution of the study data, among-group comparisons respecting participants' demographic and clinical characteristics were made through the Kruskal-Wallis and the Chi-square tests. The Kruskal-Wallis test was also used for among-group comparisons respecting thirst severity and thirst distress. To compare xerostomia among three group Chi-square test was used. Pairwise between-group comparisons were also made through the Mann-Whitney U test. Moreover, within-group comparisons were performed using the Wilcoxon and the McNemar tests. As there was a statistically significant difference between the

intervention groups respecting the time interval between the first and the second rounds of mouth wash, logistic and linear regression analyses were performed to remove the effects of this confounder. All analyses were performed at a significance level of less than 0.05.

Ethical considerations

This study was approved by the Institutional research ethics committee school of nursing and midwifery & rehabilitation of Tehran University of Medical Sciences, Tehran, Iran (code: IR.TUMS.FNM.REC.1397.115). It was also registered in the Iranian Registry of Clinical Trials (code: IRCT20170803035479N2). Participants were allocated to groups after securing their agreement and written informed consent. Thirst among patients in the control group was one of our major concerns. Therefore, at the end of the intervention in each day during the study, we asked critical care nurses to take measures for thirst management in the control group.

Results

During the course of the study, 221 patients were assessed for eligibility. Eighty-nine patients were not eligible. The remaining 132 patients were eligible and were allocated to the MCW (n = 44), psyllium (n = 44), and control (n = 44) groups. None of the patients were excluded (Figure 1).

The Kruskal-Wallis and the Chi-square tests showed no statistically significant differences among the groups respecting participants' baseline demographic and clinical characteristics, namely age, gender, body mass index(BMI), systolic and diastolic blood pressures, body temperature, Peripheral oxygen saturation (SpO₂), daily fluid intake and output, ICU stay, ICU environmental temperature, SAPS II, airway status, prescribed medications, and serum levels of sodium, glucose, blood urea nitrogen(BUN), and osmolality ($P > 0.05$; Table 1). However, the time interval between the first and the second rounds of mouth wash in the psyllium group was significantly longer than the MCW group ($P = 0.006$; Table 1).

Thirst severity in the control group did not change significantly ($P > 0.05$), while thirst severity in the psyllium and the MCW groups significantly reduced from 8.45 ± 2.01 to 4.95 ± 2.01 and from 8.35 ± 1.19 to 6.61 ± 1.63 , respectively ($P < 0.001$). Thirst distress also showed no significant change in the control group ($P > 0.05$), while it significantly reduced in the psyllium and the MCW groups from 8.43 ± 2.01 to 4.95 ± 2.01 and from 8.41 ± 1.94 to 6.65 ± 1.61 , respectively ($P < 0.001$). Moreover, while xerostomia did not significantly change in the control group, it was completely managed in both intervention groups so that its rate in these groups reached from 100% at pretest to zero after the intervention ($P < 0.001$; Table 2).

There were no significant among-group differences respecting baseline thirst severity, thirst distress, and xerostomia ($P > 0.05$; Table 2). However, among-group differences respecting these outcomes were statistically significant at all the other measurement time-points, namely after the first mouth wash and before and after the second mouth wash ($P < 0.001$). Pairwise between-group comparisons indicated that the means of thirst severity and distress and the rate of xerostomia in both intervention groups were significantly less than the control group at the second, third, and fourth measurement time-points ($P < 0.05$), except for the difference between the MCW and the control group respecting xerostomia at the third measurement time-point ($P = 0.241$). Moreover, the means of thirst severity and distress in the psyllium group were significantly less than the MCW group at the second, third, and fourth measurement time-points ($P < 0.05$). The rate of xerostomia in the psyllium group was also significantly less than the MCW group only at the second and the third measurement time-points ($P < 0.001$).

There was a significant difference between the psyllium and the MCW groups respecting the time interval

between the first and the second mouth wash rounds ($P = 0.006$; Table 1). This difference could affect the study results and hence, regression analyses were performed to remove its effects. The results of linear regression analysis showed that after removing the effects of this confounder, the means of thirst severity and distress in the psyllium group were significantly less than the MCW group ($P < 0.05$; Table 3). Further analysis indicated that the first and the second mouth wash with psyllium significantly reduced thirst severity by respectively 0.534 and 0.325 times more than mouth wash with MCW (Table 3). Similarly, the amount of decrease in thirst distress in the psyllium group after the first and the second mouth wash was respectively 0.536 and 0.329 times greater than the MCW group (Table 3).

Logistic regression analysis also showed that though there was no statistically significant difference between the intervention groups respecting xerostomia rate after the first mouth wash ($P = 0.317$), the decrease in xerostomia rate after the second mouth wash with psyllium was 0.09 times greater than mouth wash with MCW (odds ratio = 0.09; $P = 0.006$; Table 4).

Figure 1. CONSORT flow diagram

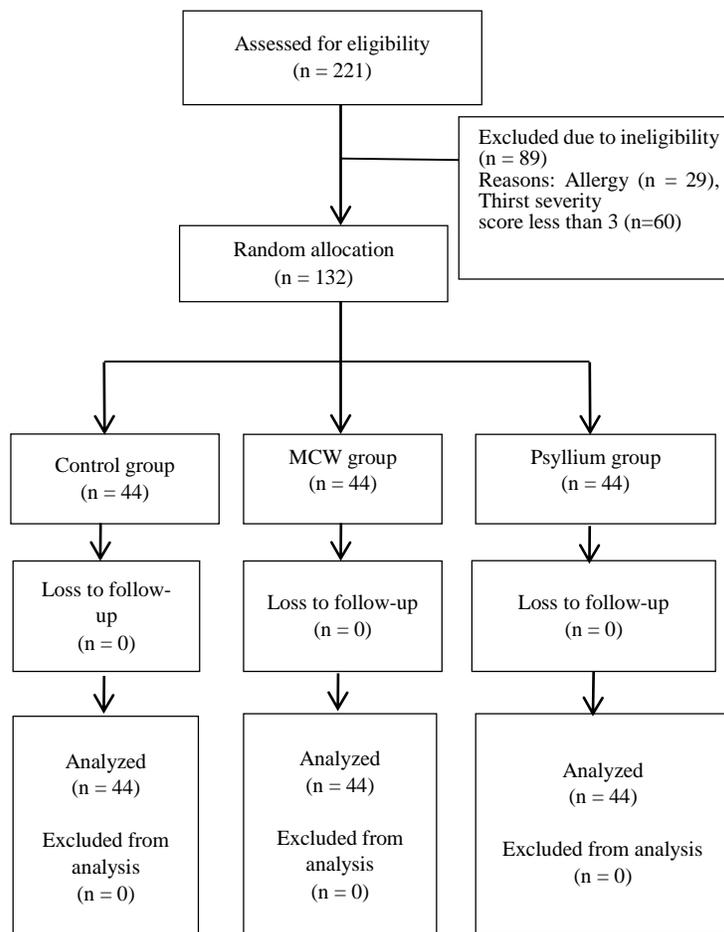


Table 1- Participants' demographic and clinical characteristics

Characteristics	Psyllium (n = 44)	MCW (n = 44)	Control (n = 44)	P value
Age(Years) *	55.27±16.72 (59.5)	53.36±17.94 (54.5)	57.65±15.054 (59)	0.516
Gender^				0.557
Male	22 (50)	25 (56.8)	27 (61.4)	
Female	22 (50)	19 (43.2)	17 (38.6)	
BMI	26.07±4.4 (26.1)	25.10±5.5 (24.3)	24.51±4.3 (24.01)	0.234
Systolic blood pressure (mm Hg)	128.2±17.94 (129)	129.7±22.56 (122)	131.09±21.64 (134.5)	0.670
Diastolic blood pressure (mm Hg)	75.39±16.22 (76.5)	78.45±17.69 (73.5)	76.64±13.12 (77)	0.968
Body Temperature (°C)	37.13±0.362 (37.1)	37.18±0.363 (37.1)	37.19±0.313 (37.2)	0.663
Spo2 (%)	97±1.97 (96)	96.7±2.11 (96)	96.5±2.47 (96)	0.537
Fluid intake (Liter/24 hours)	3.23±1.3 (3)	3.34±1.2 (3.1)	3.4±1.5 (3.1)	0.835
Fluid output (Liter/24 hours)	2.80±1.36 (2.5)	2.78±1.4 (2.5)	2.81±1.2 (2.5)	0.994
Serum sodium (mEq/L)	139.23±3.96 (140)	138.07±4.98 (138.5)	140±4.64 (140)	0.288
Blood sugar (mg/dL)	149.02±52.39 (142.5)	157.89±61.67 (144)	158.32±37.56 (146)	0.447
BUN (mg/dL)	30.48±26.85 (27)	33.82±27.13 (25.5)	25.47±18.83 (20)	0.374
Serum osmolality (mOsm/kg)	297±12.65 (295.55)	297±11.89 (297.75)	298±9.75 (296.77)	0.609
ICU stay (Days)	2.58±1.59 (2)	4.9±8.57 (2)	2.3±0.795 (2)	0.418
ICU environmental temperature (°C)	24.26±2.07 (25)	24.09±2.15 (25)	24.23±1.7 (25)	0.663
Simplified Acute Physiology Score II	22.2±8.4 (21)	21.55±9.5 (22)	21.16±8.5 (22)	0.887
Time interval between chlorhexidine mouth wash and the intervention	10.26±2.91 (10)	9.72±2.44 (10)	9.44±2.48 (10)	0.619
Time interval between the first and the second rounds of the intervention	37.18±5.84 (40)	33.84±4.6 (30)	—	0.006
Airway status^				0.242
Endotracheal tube or tracheostomy	4 (9.1)	9 (20.5)	3 (6.8)	
Oxygen therapy with nasal mask	19 (43.2)	18 (40.9)	24 (54.6)	
normal	21 (47.7)	17 (38.6)	17 (38.6)	
Medications^				0.277
Diuretics	3 (2.3)	6 (4.5)	8 (6.1)	
Sedatives	31 (23.5)	36 (27.3)	35 (26.5)	0.404
Antihypertensive agents	16 (12.1)	17 (12.9)	21 (15.9)	0.518
Steroids	3 (2.3)	5 (3.8)	4 (3)	0.760
Diabetes medications	3 (2.3)	2 (1.5)	1 (0.8)	0.605
Insulin	2 (1.5)	1 (0.8)	1 (0.8)	0.773

*: Values are reported as Mean±SD (Median) except for variables labeled with “^” which are reported as N (%)

Table 2- Within- and between-group comparisons respecting the mean scores of thirst severity and distress and the rate of xerostomia

		Psyllium [1] (n = 44)	MCW [2] (n = 44)	Control [3] (n = 44)	P value^
Thirst severity Mean±SD (Median)	Before the first mouth wash	8.45±2.01(10)	8.35±1.19 (9)	8.52±2 (10)	0.823
	After the first mouth wash	6.23±1.89(7)	7.02±1.71(8)	8.52±2(10)	< 0.001
	Before the second mouth wash	6.93±1.88(7.5)	7.73±1.75(9)	8.52±2(10)	< 0.001
	After the second mouth wash	4.95±2.01(5.5)	6.61±1.63(7)	8.52±2 (10)	< 0.001
	P value*	< 0.001	< 0.001	1	—
Thirst distress Mean±SD (Median)	Before the first mouth wash	8.43±2.01(10)	8.41±1.94 (9.5)	8.48±2.08 (10)	0.960
	After the first mouth wash	6.16±1.87(7)	7.09±1.72(8)	8.48±2.08 (10)	< 0.001
	Before the second mouth wash	6.89±1.95(7.5)	7.68±1.82(9)	8.48±2.08 (10)	< 0.001
	After the second mouth wash	4.95±2.01(5.5)	6.65±1.61(7)	8.48±2.08 (10)	< 0.001
	P value*	< 0.001	< 0.001	1	—

Xerostomia N (%)	Before the first mouth wash	44 (100)	44 (100)	44 (100)	1
	After the first mouth wash	5 (38.5)	8 (61.5)	44 (100)	< 0.001
	Before the second mouth wash	32 (72.7)	42 (95.3)	44 (100)	< 0.001
	After the second mouth wash	0 (0)	0 (0)	44 (100)	< 0.001
	P value*	< 0.001	< 0.001	1	—

Table 3- The results of the linear regression analysis to compare the psyllium and the MCW groups respecting thirst severity and distress

Parameters	Coefficient	Std.Error	Beta	t	P value
Thirst Intensity (First time-point)	-0.966	0.179	-0.534	5.384	< 0.001
Thirst Intensity (Second time-point)	-0.583	0.201	-0.325	2.905	0.005
Mean difference between the first and the second time-points	-0.306	0.106	-0.309	2.897	0.005
Thirst Distress (First time-point)	-0.993	0.182	-0.536	5.455	< 0.001
Thirst Distress (Second time-point)	-0.602	0.212	-0.329	2.838	0.006
The difference between the first and the second time-points	-0.275	0.112	-0.273	2.457	0.016

Table 4- The results of the logistic regression analysis to compare the psyllium and the MCW groups respecting xerostomia

Parameters	Coefficient B	S.E	df	Odds ratio	P value
First time-point	0.651	0.651	1	0.522	0.317
Scnd time-point	-2.478	0.906	1	0.09	0.006
The difference between the first and the second time-points	1.648	0.828	1	5.195	0.047

Discussion

This study compared the effects of MCW and psyllium on thirst and xerostomia among patients in ICU. Findings showed that both MCW and psyllium were effective in significantly reducing thirst severity, thirst distress, and xerostomia. Psyllium was also found to be more effective than MCW in reducing thirst severity, thirst distress, and xerostomia.

Because of the strong odor of menthol and the necessity of applying menthol only on lips, the blinding of the first author, who implemented the study intervention, was impossible. Moreover, study intervention and data collection were performed by one person (L.E). Intervention performance and data collection by one person can affect outcomes. In addition, sample size was calculated with a large effect size.

Our findings indicated significant reduction in thirst severity and distress after using both MCW and psyllium. In line with these findings, a study found that MCW significantly reduced thirst severity and distress by respectively 2.3 and 1.8 points, while thirst severity and distress reduction in the control group was as low as respectively 0.6 and 0.4[1]. Another study found that cold water gargling and the use of wet gauze significantly reduced thirst and improved oral cavity conditions among patients with orthopedic surgeries under general

anaesthesia [22]. Similarly, a study reported that scheduled use of MCW for patients in ICU significantly reduced thirst severity and xerostomia but did not significantly affect thirst distress [15]. The effectiveness of our interventions in reducing thirst is attributable to the facts that coldness significantly reduces thirst [3] and menthol produces coldness and refreshment sensations [1].

Before the study intervention, all patients in all groups had xerostomia. After the intervention, none of the patients in the MCW and the psyllium groups had xerostomia, while xerostomia rate did not significantly change in the control group. These findings denote the effectiveness of both MCW and psyllium in completely eliminating xerostomia. Similarly, a study on patients in ICU found that after using MCW, xerostomia rate in the MCW group was 1.9 times less than the control group [1]. Another study also found that oral care (combined of brushing and mouth wash with cold water and chlorhexidine) was effective in significantly reducing xerostomia among patients with endotracheal tube [16].

We repeated both MCW and psyllium mouth wash interventions for two times. Such repetition helped further reduce thirst severity, thirst distress, and xerostomia. Similarly, a study reported that scheduled hourly mouth wash with MCW for seven consecutive hours was more effective than unscheduled mouth wash

with MCW in reducing xerostomia among patients in ICU [15]. Another study also compared the effects of wet gauze with cold normal saline and wet gauze with cold water applied for fifteen minutes for three times and found that the greater number of wet gauzes used for oral care was associated with lower thirst severity [23].

The present study showed that psyllium was more effective than MCW in reducing thirst severity. We did not find any study into the effects of psyllium on thirst and xerostomia. In the Iranian Traditional Medicine, psyllium mucilage is used to reduce thirst and xerostomia [24]. Psyllium has a cold and wet temperament and has a high water absorption and maintenance capacity [25]. Our findings showed no significant change in thirst and xerostomia in the control group. This finding denotes that no serious measure is taken for thirst and xerostomia management in the study setting. Developing and using clear oral care guidelines are recommended for assessing and managing thirst and xerostomia in ICUs.

Conclusion

MCW and psyllium for mouth wash are effective in significantly reducing thirst and xerostomia among patients in ICU. Therefore, nurse managers need to develop strategies to promote the use of these interventions for thirst and xerostomia management in ICU and other hospital settings. In-service education for critical care nurses about thirst assessment and management can be an effective strategy in this area.

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