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Impact of oral care on thirst perception and dry mouth assessments in intensive care patients: An observational study

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Author Contributions

SD and YK contributed to study design, acquisition and interpretation of the data, and drafting of the manuscript. NN took part in the critical revision of the manuscript. SN took part in study concept and design. All authors read and approved the final manuscript.

Competing interests None declared.

Clinical Trial Registration

Trial registration: UMIN000043412

Ethics approval Ethics approval was obtained from the clinical research ethics committees of nursing department in Tokushima University Hospital (#201801).

Data sharing statement Data are available upon reasonable request for academic, non-commercial research purpose.

Figure: color was not used fir any figures in print.

ABSTRACT

Objectives: To investigate the impact of oral care on thirst perception and dry mouth assessments.

Research design: Single-center observational study

Setting: Intensive care unit in a university hospital

Main Outcome: We assessed thirst perception and dry mouth in adult patients before and after oral care. Thirst perception was assessed using a numerical rating scale (NRS), and dry mouth was assessed using an oral moisture checking device and the modified Revised Oral Assessment Guide (mROAG) including tongue, mucous membranes, and saliva.

Results: Eighty-six patients were included. After oral care, thirst NRS scores decreased by 1 (0 to 3, $p < 0.01$) and remained low only for 1 hour. Oral moisture was maintained in a normal level ≥ 27.0%, and mROAG was in a low level ≤ 4 before and after the oral care. NRS score did not correlate with oral moisture ($\rho = -0.01$, $p = 0.96$) or mROAG ($\rho = 0.09$, $p = 0.42$). Among patients with thirst, 60 (70%) patients complained of thirst at the assessment timepoints, but only 17 (20%) patients complained independently.

Conclusion: Thirst perception was dissociated from dry mouth before and after oral care. Thirst must be frequently assessed and treated.

Key words:

Oral care, Thirst, Dry mouth, Critical illness

Implications for Clinical Practice:

- Thirst and dry mouth are common among critically ill patients.
- Oral care impacts on thirst perception only for 1 hour.
- Dry mouth assessments do not reflect thirst perception.
- Thirst and dry mouth should be frequently assessed and treated by the ICU staff.

INTRODUCTION

Thirst and dry mouth are common problem in the Intensive Care Unit (ICU), and these are associated with physical discomfort (Schittek et al., 2020). In a previous study, thirst has been observed in 70.8% of critically ill patients as the most intense and the second most common symptom among ten symptoms (Puntillo et al., 2010). However, thirst is often undetected and remains untreated (Landström et al., 2009). Particularly in critically ill patients, it is difficult to detect patient's thirst perception because they cannot express their thirst under sedation or intubation (Kawahara et al., 2020).

Thirst is perceived by brain stimuli, which is caused by increased plasma osmolality and hypovolemia (Arai et al., 2013). Increased osmolality releases antidiuretic hormone, while hypovolemia activates renin-angiotensin aldosterone system. Unsuccessful compensation leads to thirst perception. On the other hand, dry mouth is the result of inadequate saliva secretion, which may reflect hypovolemia. Although thirst perception and dry mouth may be associated, these relationships have not been clearly investigated yet.

Thirst should be treated because thirst persisting for more than 24 hours is associated with delirium (Sato et al., 2019). Furthermore, thirst experience leads to posttraumatic stress disorder (PTSD) (Chanques et al., 2015), which is experienced by 25% of patients a year after discharge (Parker et al., 2015). Thirst perception must be recognized in nursing care because relieving thirst is an important part of humanized care. Proper management of thirst will mitigate patients' stress and prevent delirium and PTSD.

In general, treatment of thirst requires oral drinking (Obika et al., 2009), but it is often difficult in critical situations. In critical illness, oral care is an important to preserve oral moisture (Atay and Karabacak, 2017) as well as prevent ventilator-associated pneumonia (Mori et al., 2006). Therefore, patients are treated by oral care, but thirst is commonly experienced by patients. It is important to find some features to detect thirst. We hypothesized that dry mouth assessment could help detect thirst perception. Therefore, we conducted a prospective observational study to evaluate the impact of oral care on thirst perception and dry mouth assessments in intensive care patients.

METHODS

Objectives

We investigated the impact of oral care on thirst perception and dry mouth assessments in intensive care patients.

Setting

This single-center observational study was conducted in the mixed medical-surgical ICU of Tokushima University Hospital between July 2018 and July 2019. This study was registered in University Hospital Medical Information Network Clinical Trials Registry (UMIN000043412).

Ethical approval

This study was approved by the clinical research ethics committees of the nursing department in Tokushima University Hospital (#201801). Written informed consent was obtained from patients at the time of enrollment.

Participants

We included adult patients who were aged ≥20 years old. Subject recruitment was conducted when trained research nurses (S.D. or Y.K.) were present during the day shift (7 am to 5 pm). We excluded patients who could not communicate due to disorientation or delirium, which were assessed using the verbal Glasgow Coma Scale ≤ 4 and confusion assessment method for the ICU (CAM-ICU), respectively.

Data collection

Nurses assessed thirst perception using the following protocol (Figure 1). The intensity of thirst perception was assessed using a thirst numerical rating scale (NRS) ranging from 0 to 10, in which 0 was no thirst and 10 was worst thirst ever. Objective dry mouth was assessed by an oral moisture-checking device (Moisture Checker for Mucus; Scalar, Tokyo, Japan) and modified Revised Oral Assessment Guide (ROAG). The moisture-checking device measures the percentage of water content in the oral mucosa (Yamada et al., 2005). We used the device to assess the buccal mucosa as previously reported (Takahashi et al., 2005). We did not measure the surface of the tongue because the measurement was inconsistent in our preliminary tests. Normal and dry mouth were defined as ≥27.0% and <27.0, respectively (Minakuchi et al., 2018). ROAG is a tool used to assess oral health with a high sensitivity and specificity (Ribeiro et al., 2014). To assess dry mouth, we used the original modified ROAG, which included only tongue, mucous membrane, and saliva assessments. The median of three modified ROAG scores was used for the assessments. The modified ROAG score ranges from 3 to 9, in which a higher score indicates dry mouth.

Nurses conducted thirst perception and dry mouth assessments before and after oral care, and then hourly until 4 hours after oral care. We used this time period because routine oral care is recommended every 4 hours (Hua et al., 2016). At each timepoint, nurses assessed whether thirst was present and if oral care was required. The assessments were halted if patients desired oral care or oral intake in patients who are permitted to drink. The permission of oral intake was based on clinical practice. When patients required oral care or oral intake, a final assessment was conducted. Oral care included brushing teeth with water followed by cleaning with foam swabs. We did not use antiseptic mouthwash because of the safety concerns (Blot, 2021). In our facility, oral care is usually conducted every 8 hours on all patients admitted to the ICU.

The primary outcome of this study was the change of thirst perception and dry mouth assessments before and after oral care. Secondary outcomes included the correlation between thirst perception and dry mouth assessments before oral care. Another secondary outcome is the potential risk factors for thirst perception in patients with the following score ranges: Thirst NRS < 4, 4–7, and ≥ 7. Risk factors included sex, age, the Acute Physiology and Chronic Health Evaluation (APACHE) II score, plasma osmolality (calculated as 2 × sodium + glucose/18 + blood urea nitrogen/2.8), blood urea nitrogen, sodium, permitted oral intake, and respiratory managements (mechanical ventilation, high flow nasal cannula, and nasal cannula or mask). Furthermore, we conducted multiple regression analysis to identify the risk factors for thirst perception. The eight risk factors were included in the analysis.

Data analysis

Categorical data were presented as numbers (%). Continuous data were presented as mean ± standard deviation or median (interquartile range). Correlation was assessed using the Spearman rank correlation coefficient. The Wilcox signed-rank test was used to examine the longitudinal changes over time, and the Kruskal-Wallis test and multiple regression analysis were used to determine the risk factors for thirst perception. Sample size was not determined a priori due to the exploratory nature of this study. Data analyses were conducted using JMP version 13.1.0 (SAS Institute Inc., Cary, NC). A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 86 patients were included. The average age was 70 (62–77) years, and 54 (63%) were male (Table 1). The APACHE II score was 20 (14–29), and the median length of ICU stay was 4 (2–9) days. The examination was conducted at 2 (2–5) days after ICU admission. Eighteen (21%) patients were mechanically ventilated. The reasons for admission were cardiovascular disease (31%), digestive disease (27%), and respiratory disease (14%). Oral intake was permitted in 24 (28%) of patients, but patients did not drink until withdrawal from the study.

After oral care, all 86 patients remained immediately after oral care, 70 at 1 hr, and 29 at

2 hr, 10 at 3 hr, 9 at 4 hr. During the study, 77 (90%) patients withdrew within 4 hours due to thirst. Among them, 60 (70%) complained of thirst at the observational timepoints, but only 17 (20%) patients complained independently.

Before oral care, the median thirst NRS score was 6 (IQR, 5–8). Immediately after oral care, thirst NRS scores significantly changed by −1 (−3 to 0, $p < 0.01$, n = 86) and remained low until the 1-hour timepoint (0 [−1.25 to 1], p = 0.04, n = 70, Figure 2, Figure S1, Table S4). The change of thirst NRS score was 0 (−1 to 0.5, p = 0.32, n = 29) at 2 hr, −0.5 (−3.5 to 1.25, p = 0.41, n = 10) at 3 hr, 0 (−4.5 to 1.5, p = 0.34, n = 9) at 4 hr. All data were presented in supplemental file (Table S1–S3).

Contrary to thirst NRS, oral moisture was maintained at a normal level before and after oral care (Figure 3, Figure S2). Before oral care, oral moisture was 28.9% (27.7%–30.2%), and the change was 0.1 (−0.7 to 1.1), p = 0.43, n = 86 immediately after oral care, −0.25 (−1.1 to 1.0), p = 0.79, n = 70 at 1 hr, −0.6 (−1.3 to 0.9), p = 0.35, n = 29 at 2 hr, 0.4 (−0.6 to 1.9), p = 0.34, n = 10 at 3 hr, and 0.3 (−1.5 to 2.8), p = 0.73, n = 9 at 4 hr.

The median modified ROAG score was 4 (3–5) before oral care, and the score changed by −1 (−1 to 0), $p < 0.01$, n = 86 immediately after oral care, and 0 (−1 to 0), $p < 0.01$, n = 86 at the last evaluation (Figure 4, Figure S3). Before oral care, the tongue, mucous membrane, and saliva were 1 (1–2), 1 (1–1), and 2 (1–2). Immediately after oral care, tongue, mucous membrane, and saliva changed by 0 (0 to 0, $p < 0.01$, n = 86), 0 (0 to 0, $p < 0.01$, n = 86), −1 (−1 to 0, $p < 0.01$, n = 86), respectively. At the last evaluation, these changed by 0 (0 to 0, p = 0.03, n = 86), 0 (0 to 0, p = 0.01, n = 86), 0 (−1 to 0, $p < 0.01$, n = 86), respectively.

Thirst perception did not correlate with objective dry mouth assessments (Figure 5). Thirst NRS score was not correlated with oral moisture ($\rho = -0.01$, p = 0.96) or modified ROAG ($\rho = 0.09$, p = 0.42). However in the objective assessments, modified ROAG and oral moisture were correlated ($\rho = -0.22$, p = 0.04).

There was no significant difference in the risk factors investigated in our study (Table

2). In multiple regression analysis, all risk factors were not significantly associated with thirst NRS score: sex (p = 0.17), age (p = 0.48), APACHE II score (p = 0.54), plasma osmolality (p = 0.81), blood urea nitrogen (p = 0.11), sodium (p = 0.48), permitted oral intake (p = 0.60), and respiratory managements (p = 0.19).

DISCUSSION

In this study, contrary to our hypothesis, we found a disparity between thirst perception and dry mouth assessments before and after the oral care in intensive care patients. Although mouth moisture was in normal level, thirst was observed before oral care. After oral care, thirst perception was relieved only for 1 hour. Despite the common thirst prevalence, only 20% of patients complained of thirst independent of the set timepoints. It is important to note that nursing staff need to actively assess for thirst in critically ill patients without depending on objective assessments.

In our study, oral care slightly decreased thirst perception by NRS 1 (0 to 3) immediately after oral care. This result was consistent with a previous study, which reported bundle intervention including oral swab wipe, sterile ice-cold water sprays, and a lip moisturizer, improved thirst perception by the thirst NRS 2.3 (Puntillo et al., 2014). However, the previous study did not investigate the sustained effect of the intervention. In our study, oral care contributed to relieving thirst perception only for 1 hour. Because oral care does not have a sustained effect on thirst perception, the frequent nursing care is needed to treat thirst perception. Indeed, VonStein et al. found that treating thirst hourly relieved thirst perception (VonStein et al., 2019). The previous study used ice water oral swabs and lip moisturizer with menthol hourly during a 7-hour period, and this intervention lessened thirst perception. These results are reasonable because thirst perception is elevated in dehydrated patients and complete modulation is difficult without drinking (Obika, Idu, 2009).

It is important to note there is a disparity between thirst perception and objective dry mouth assessments. Before oral care, the median thirst NRS score was 6 (5–8), which means patients had thirst perception. In contrast, the objective dry mouth assessment appeared to be normal because the oral moisture measurement was at a normal level ≥ 27.0% and the median modified ROAG score (normal range: 3–9) was limited to 4 (3–5). This thirst perception was not correlated with oral moisture and modified ROAG. Furthermore, the impact of oral care was different between thirst perception and oral moisture. We found the objective dry mouth assessment contributes to assessing oral moisture but did not contribute to assessing patients' thirst perception. This finding is reasonable because thirst perception is caused by various brain stimuli. It is difficult to assess the existence of thirst objectively by solely depending on oral observation. Therefore, frequent assessment of thirst perception is important. Especially, critically ill patients often experience difficulty communicating and expressing their desires (Ten Hoorn et al., 2016). Indeed, in our study, only 20% of patients in the ICU complained of thirst independently in this study. In many facilities, nurses practice oral care every 4 hours (Collins et al., 2020), but oral care can relief thirst only for 1 hour. Therefore, nursing staff need to assess thirst perception more frequently in critically ill patients.

In our secondary analysis including multivariate analysis, there were no significant risk factors related to thirst perception. In contrast, previous studies have reported that increased plasma osmolality, hypovolemia, and mechanical ventilation were associated with thirst (Arai, Stotts, 2013, Hua, Xie, 2016). Our study was primally conducted to assess the disparity between thirst perception and dry mouth assessments. Therefore, the sample size was not sufficient to statistically analyze the risk factors. Indeed, plasma osmolality, blood urea nitrogen, sodium, and the degree of mechanical ventilation increased in those patients with mild to severe thirst NRS scores, but there was no statistical difference. A large study is needed to clarify this observation because critically ill patients have numerous risk factors related to thirst.

Limitations

There are several limitations in this study. First, this study was based on a small sample size in a single center. Therefore, a large study should be conducted. Second, most patients (90%) were withdrawn from the observation within 4 hours. Therefore, the study population is different through observation time. Third, we used our original modified ROAG score. The validity of the modified ROAG needs further study. Fourth, patient recruitment was limited to when the research nurses were present.

CONCLUSION

In this study, we found a disparity between thirst perception and dry mouth assessments before and after oral care. Oral care decreased thirst perception for only 1 hour, while oral moisture was in a normal level through the study. Despite the common thirst prevalence, most patients did not independently complain of thirst. Therefore, it is important for nursing staff to actively communicate and assess for thirst in critically ill patients without depending on objective dry mouth assessments. Thirst must be frequently treated for patients’ wellbeing.

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Figure legends

Figure 1. Protocol of our observational study

Thirst NRS, oral moisture, and modified ROAG were evaluated before and after the oral care. The arrows show the timing of assessments.

NRS = numerical rating scale, ROAG = revised oral assessment guide

Figure 2. Thirst numerical rating scale before and after the oral care

We showed the thirst numerical rating scale after the oral care. Before oral care, numerical rating scale was 6 (5–8), and it significantly decreased 0 and 1 hour after the oral care. Data were presented as median (interquartile range), and compared using the Wilcoxon signed-rank test.

* Significant at $p = 0.04$, ** Significant at $p < 0.01$

NRS = numerical rating scale

Figure 3. Oral moisture before and after the oral care

We showed oral moisture after the oral care. Before oral care, oral moisture was 28.9% (27.2%–30.3%), and it did not change significantly after the oral care. During the study period, the median oral moisture was maintained in a normal level ≥ 27.0%. Data were presented as median (interquartile range), and compared using the Wilcoxon signed-rank test.

Figure 4. Modified Revised Oral Assessment Guide before and after the oral care

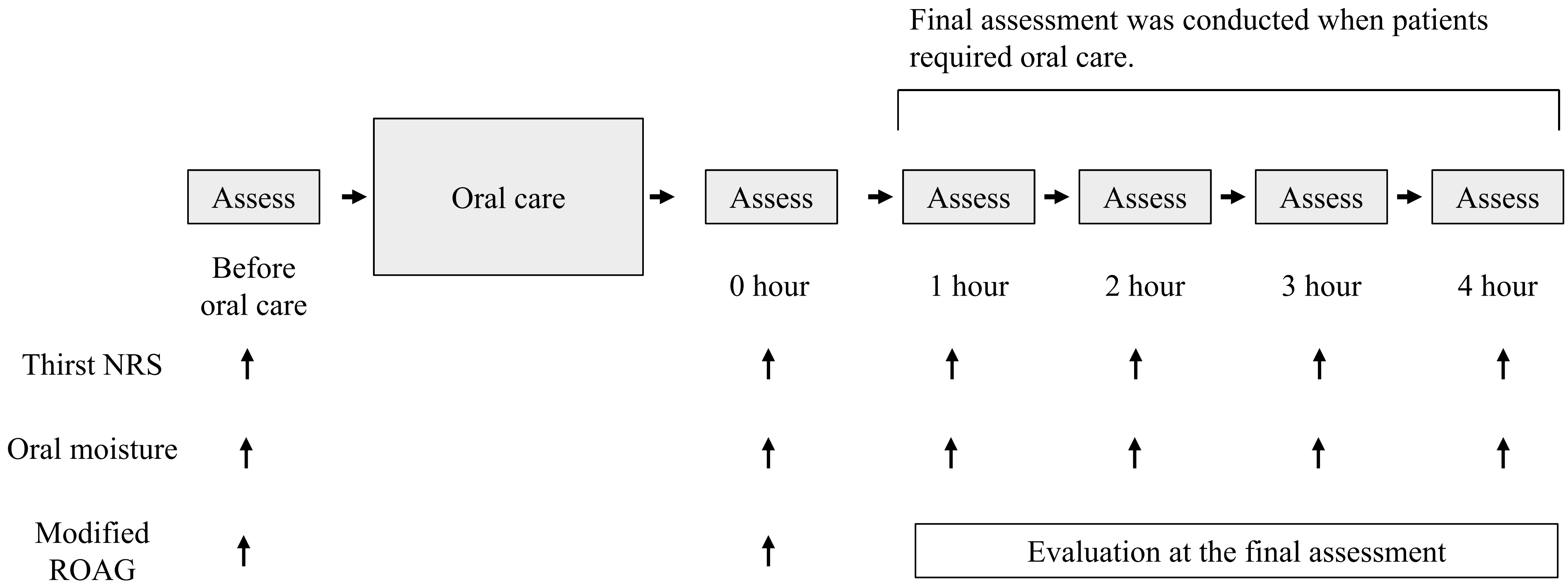
We showed modified ROAG before and after the oral care. Modified ROAG included only tongue, mucous membrane, and saliva. Before oral care, the modified ROAG was limited to 4 (3–5),1 (1–2), 1 (1–1), and 2 (1–2) at sum, tongue, mucous membrane, and saliva. These low scores further decreased immediately after oral care and at the last evaluation.

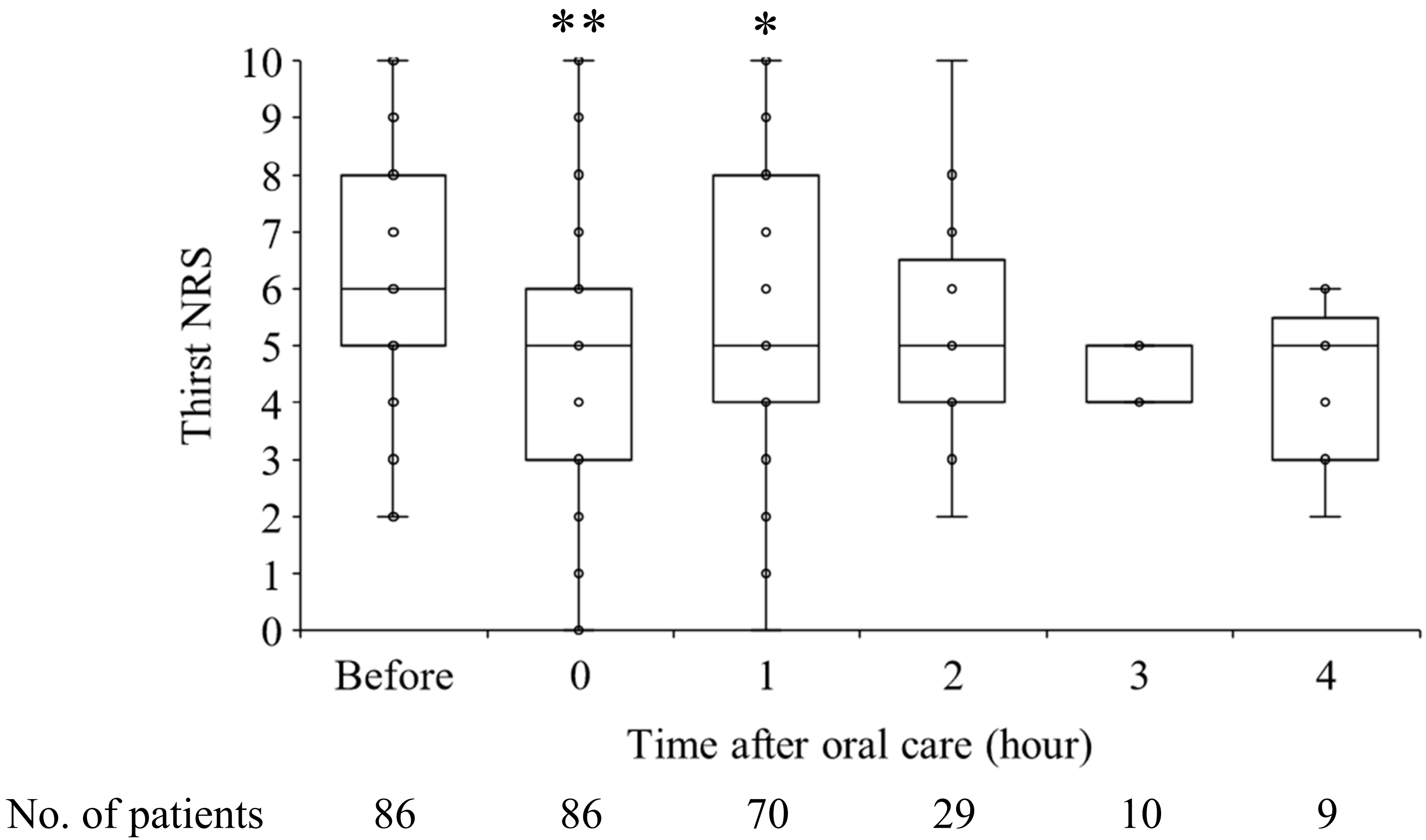
Data were presented as median, and the changes were compared using the Wilcoxon signed-rank test.

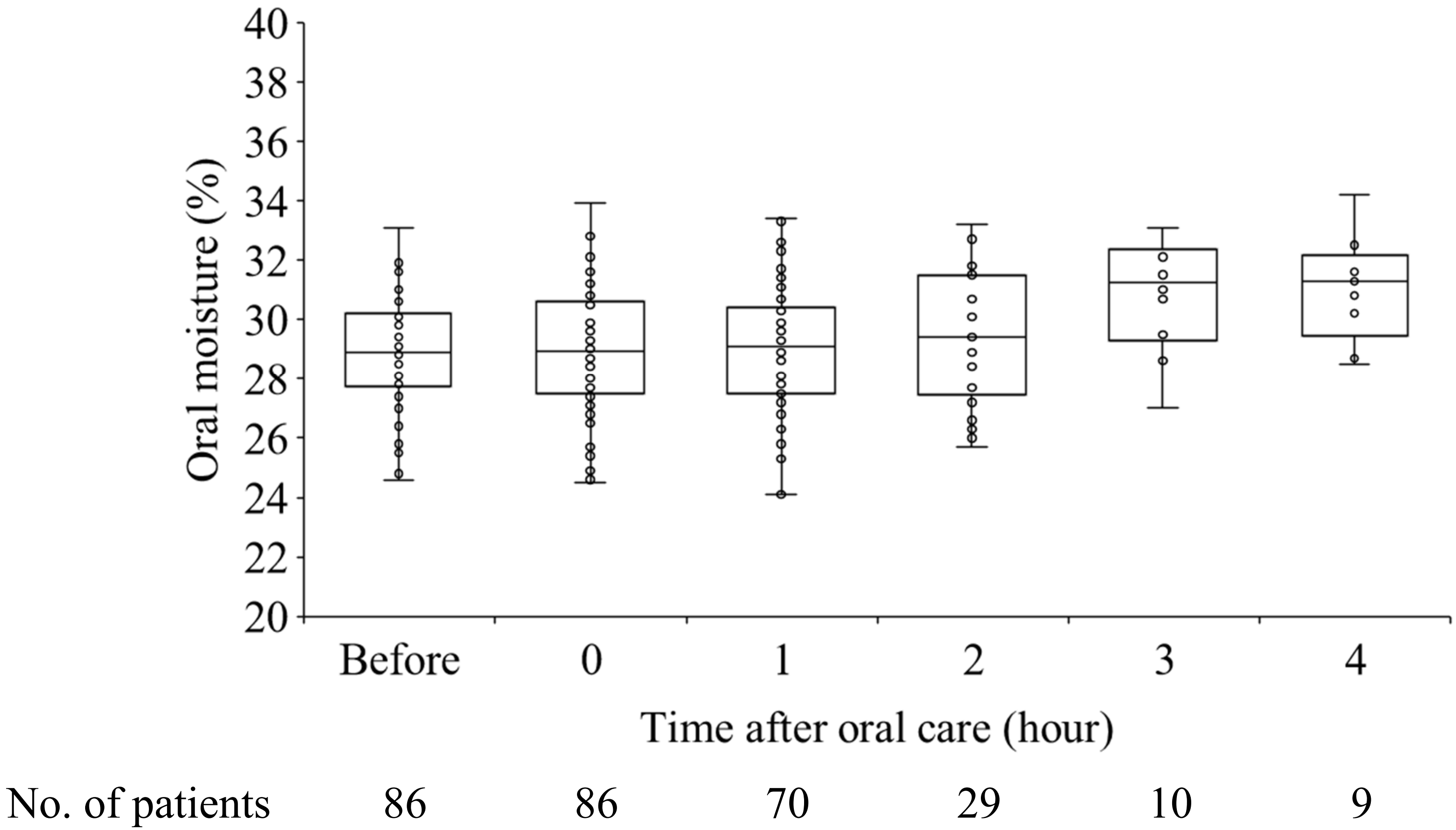
ROAG = revised oral assessment guide

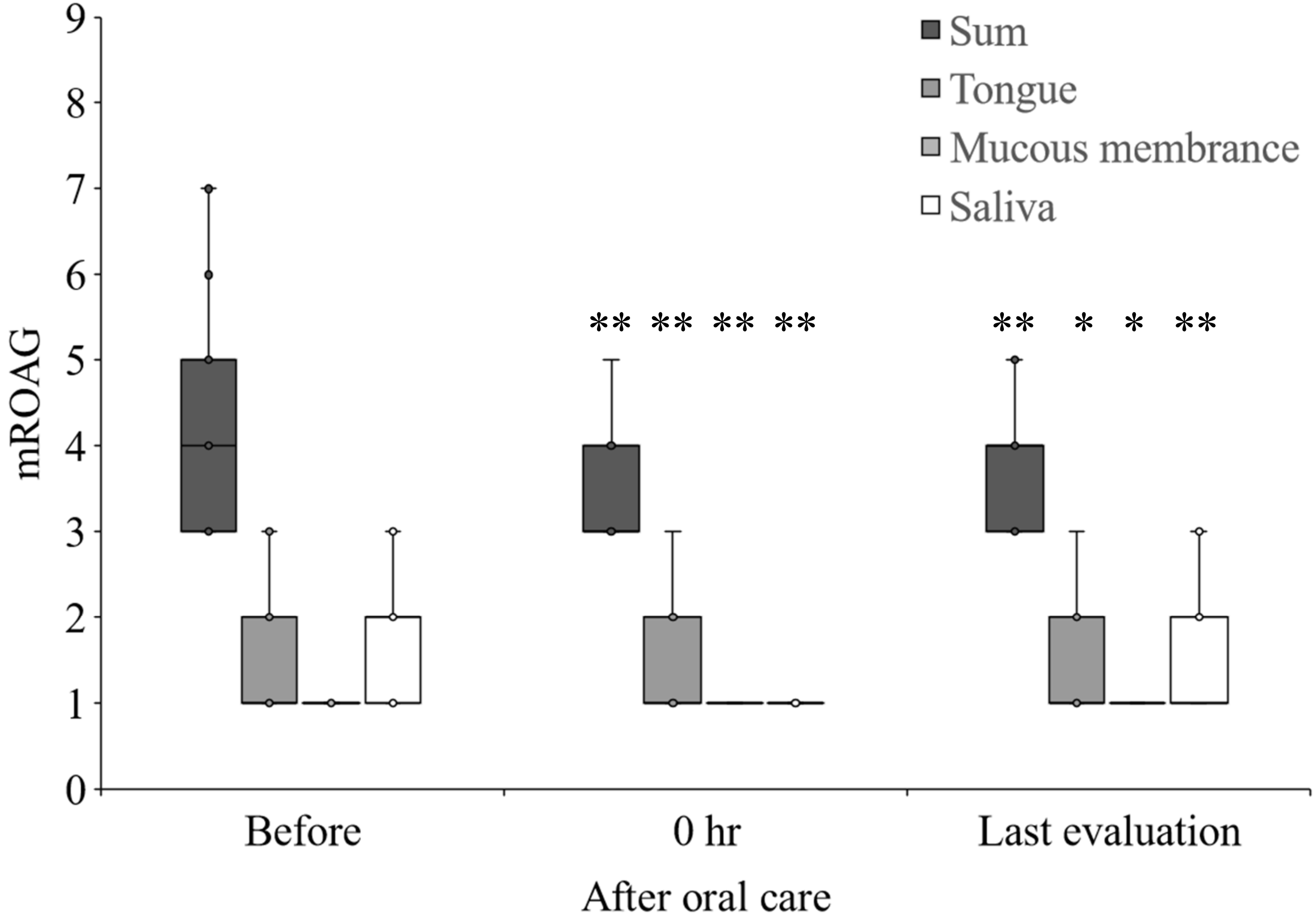
Figure 5. The correlation among numerical rating scale, oral moisture, and modified ROAG. There was no significant correlation between numerical rating scale and oral moisture or modified ROAG, while there was a negative correlation between modified ROAG and oral moisture.

ROAG = revised oral assessment guide

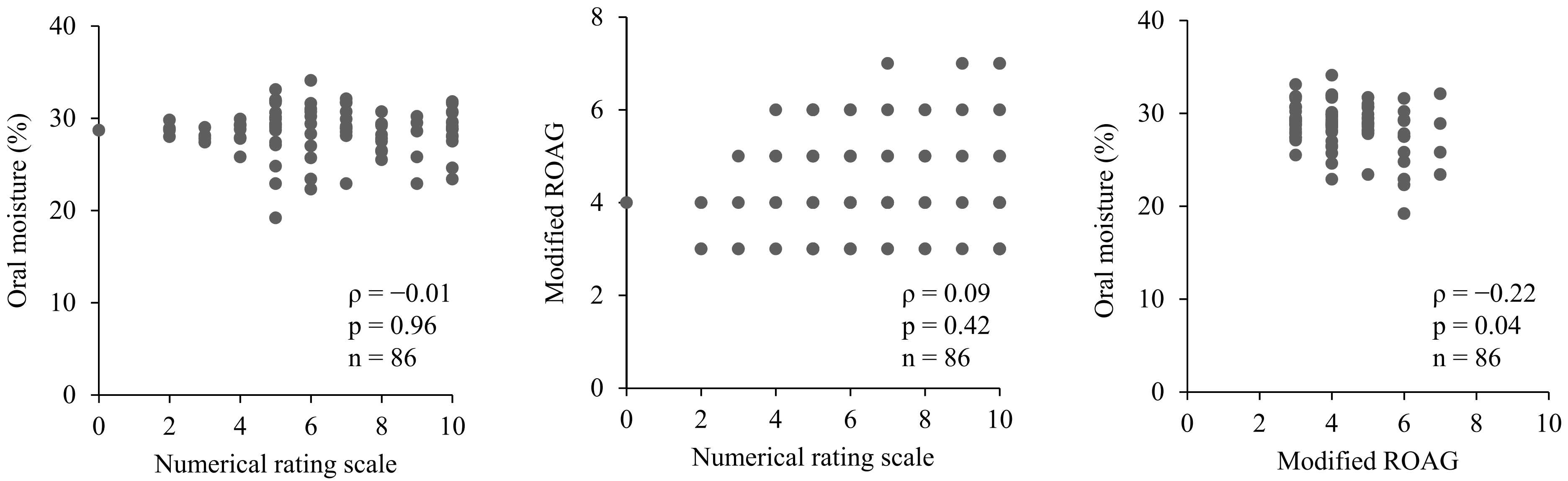

Final assessment was conducted when patients required oral care.
Assess
Oral care
Assess
Assess
Assess
Assess
Assess
Before oral care
0 hour
1 hour
2 hour
3 hour
4 hour
Thirst NRS
Oral moisture
Modified ROAG
Evaluation at the final assessment


**
*
10
9
8
7
6
5
4
3
2
1
0
Thirst NRS
Before
0
1
2
3
4
Time after oral care (hour)
No. of patients
86
86
70
29
10
9


40
38
36
34
32
30
28
26
24
22
20
Oral moisture (%)
Before
0
1
2
3
4
Time after oral care (hour)
No. of patients
86
86
70
29
10
9



No. of patients 86 86 86



Oral moisture (%)
Numerical rating scale
ρ = −0.01
p = 0.96
n = 86
Modified ROAG
Numerical rating scale
ρ = 0.09
p = 0.42
n = 86
Oral moisture (%)
Modified ROAG
ρ = −0.22
p = 0.04
n = 86

Table 1 Patient characteristics

Variables	Overall (n = 86)
Age, years	70 (62–77)
Sex (Men), n (%)	54 (63)
APACHE II score	20 (14–29)
Length of ICU stay, days	4 (2–9)
Examination day after ICU admission	2 (2–5)
ICU admission reasons, n (%)	
Cardiovascular	27 (31)
Digestive	23 (27)
Respiratory	12 (14)
Sepsis	7 (11)
Cerebrovascular	5 (6)
Other	12 (14)
Postoperative admission, n (%)	51 (61)
Mechanically ventilation, n (%)	18 (21)
High flow nasal cannula, n (%)	13 (15)
Permitted oral intake state, n (%)	24 (28)
Plasma osmolality, mosmol/kg	297 (290–305)

APACHE II = Acute Physiology and Chronic Health Evaluation II, ICU = intensive care unit

Data were presented as median (interquartile range) unless otherwise indicated.

Table 2 Risk factor of thirst perception

Variables	Mild NRS = 0–3 (n = 9)	Moderate NRS = 4–6 (n = 37)	Severe NRS = 7–10 (n = 40)	p value
Sex (Male), n (%)	5 (56)	21 (57)	28 (70)	0.43
Age, years	61 (60–76)	73 (64–80)	69 (56–75)	0.12
APACHE II score	21 (16–26)	20 (16–28)	18 (12–32)	0.85
Plasma osmolality, mosmol/kg	291 (283–295)	296 (290–304)	300 (290–310)	0.12
Blood urea nitrogen, mg/dL	15 (11–23)	21 (15–40)	22 (13–39)	0.19
Sodium, mmol/L	138 (136–140)	139 (137–143)	140 (138–144)	0.10
Permitted oral intake, n (%)	3 (33)	14 (38)	7 (18)	0.15
Mechanical ventilation, n (%)	1 (11)	6 (16)	11 (28)	
High flow nasal cannula, n (%)	3 (33)	7 (19)	3 (8)	0.29
Nasal cannula or mask, n (%)	4 (44)	13 (35)	18 (45)	

APACHE II = Acute Physiology and Chronic Health Evaluation II

Data were presented as median, and the data were compared using the Kruskal-Wallis test.