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Effects of menthol gum chewing on postoperative nausea, vomiting, and length of hospital stay in children undergoing appendectomy: A randomized controlled trial☆

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ABSTRACT

Purpose: This study aimed to determine the effects of menthol gum chewing on nausea, vomiting, and length of hospital stay after appendectomy in children.

Background: Postoperative nausea and vomiting (PONV) can be induced by general anesthesia. Several drugs are available to reduce the risk of PONV; however, their cost and side effects limit their clinical use.

Method: This was a randomized controlled clinical trial that included 60 children aged 7–18 years who underwent an appendectomy at the Pediatric Surgery Clinic of a tertiary hospital between April and June 2022. Data for this study were collected via the developed information form, which included participants' descriptive characteristics and bowel function parameters, and the Baxter Retching Faces (BARF) nausea scale. Children in the study group who underwent an appendectomy were given chewing gum and asked to chew it for an average of 15 min, whereas those in the control group received no intervention.

Results: The BARF nausea score measured during the menthol gum chewing period was lower in the study group and the difference score value calculated after pretest time was higher in the study group, as expected ($p < 0.001$). Moreover, menthol gum chewing was found to shorten hospital stay by 1 day ($p < 0.05$).

Conclusion: Menthol gum chewing reduced the severity of postoperative nausea and length of hospital stay.

Practice implication: Chewing gum can be used as a nonpharmacological method by pediatric nurses in clinical practice to reduce the severity of postoperative nausea and length of hospital stay.

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Introduction

Appendicitis is defined as an inflammation of the appendix vermiformis (Jones et al., 2021). It is the most common surgical emergency reported in children (Gadiparthi & Wasim, 2021; Howell et al., 2018). The standard treatment for appendicitis is surgery (Mosuka et al., 2021). Appendectomy involves the removal of the appendix for appendicitis or during other surgical procedures unrelated to the appendix (Buzatti & Da Silva, 2017). Delay of appendectomy for appendicitis can result in perforation, peritonitis, and sepsis, all of which can lead to life-threatening conditions (Koyuncu et al., 2016).

Appendectomy is abdominal surgery that requires general anesthesia and is associated with some risks and potential complications. Complications related to surgery or anesthesia occur in >10% of children within 30 days of surgery (Hall & Eaton, 2018). In particular, postoperative nausea and vomiting (PONV) is one of the most common early complications induced by general anesthesia and irritation of the peritoneum (Becker, 2010; Canakci & Catak, 2019).

Postoperative nausea and vomiting typically refers to nausea and vomiting that begins to manifest in the post-anesthesia care unit (PACU) and continues for 24 h after surgery (Urits et al., 2020). Appendectomy has been reported to be associated with a high risk of PONV (Höhne, 2014). Notably, PONV is two times more common in children than in adults (Urits et al., 2020). Severe nausea and vomiting during the postoperative period may cause several complications, such as aspiration of gastric contents, pneumothorax, electrolyte imbalance, and dehydration (Hooper, 2016; Martin et al., 2016). In addition, PONV may prolong PACU and hospital stays and cause unplanned readmission (Urits et al., 2020).

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Chewing gum stimulates the cephalic phase of digestion and increases the release of neurohormonal mediators and secretion from glands (e.g., salivary, gastric, and biliopancreatic glands), thereby leading to a faster recovery of bowel function (Vasquez et al., 2009). Some studies have reported that chewing gum helps in the reduction of nausea and vomiting and the duration of hospitalization in both pediatric and adult patients (Darvall et al., 2017; Keenahan, 2014; Lopez-Jaimes & Cuello-García, 2016; Vasquez et al., 2009). Menthol is the main component of peppermint oil, which is used to treat various gastrointestinal disorders, such as nausea and vomiting (Amato et al., 2014).

Chewing gum can help prevent the problems experienced by patients who start feeding early after surgery (Riad et al., 2019). Encouraging patients to chew gum after abdominal surgery has many benefits. Chewing gum accelerated return of intestinal functions (Keenahan, 2014). It has been reported to reduce the rate of postoperative ileus in children (Lopez-Jaimes & Cuello-García, 2016), shortens the time to first flatus and length of hospital stay in adult patients (Ngowe et al., 2010).

Postoperative nausea and vomiting is one of the nursing diagnoses proposed by the North American Nursing Diagnosis Association-International (Carpenito, 2023). Therefore, nurses should be aware of the risk factors associated with PONV and be able to apply treatment approaches, including nonpharmacological interventions, in PONV management (Mamaril et al., 2006) because pharmacological treatment of postoperative nausea and vomiting has economic implications and side effects (Farhadi et al., 2016). Nonpharmacological treatment is known to be effective for PONV (Gan et al., 2019). Moreover, nonpharmacological prophylaxis has been reported in the relevant literature as a possible additional treatment option to antiemetic drugs (Von Peltz et al., 2021).

To the best of our knowledge, there is no study in the relevant literature on the effect of gum chewing on PONV in children. Accordingly, it was determined that there is a need for further research on this topic.

The present study aimed to determine the effect of menthol gum chewing on nausea, vomiting, and length of hospital stay after appendectomy in children.

Materials and methods

Study design

This prospective randomized controlled clinical trial was conducted between April and June 2022 at the pediatric surgery clinic of a tertiary hospital. Owing to the nature of the surgical procedure, neither participants nor the researcher could be blinded, as it is difficult to blind participants and staff during the procedure and outcome assessment phase.

Participants

The selection criteria for the study sample were as follows: patients aged 7–18 years who underwent appendectomy and had postoperative nausea and vomiting, those who received general anesthesia, those without intellectual disability and cognitive problems, those who tolerated chewing gum after surgery, and those whose parents had consented to participate in the study. Exclusion criteria were as follows: patients with diabetes, patients with dental and jaw problems, patients with menthol allergy, patients with postoperative complications, patients with irritable bowel syndrome, patients with a history of reflux, patients with cognitive impairment, and patients receiving management via nasogastric tubes. Overall, 60 children (30 each in study and control groups) who agreed to participate in the study and met the eligibility criteria were enrolled in the study.

Data collection and instruments

Patient Information Form: This form was prepared by the researcher in accordance with the findings in relevant literature, and it included

questions about the descriptive characteristics, postoperative nausea and vomiting status, length of hospital stay, and bowel function of the participants. The study and control groups were compared in terms of their descriptive characteristics. Demographic variables, such as sex, age, and body mass index (BMI), of the study and control groups were compared. Moreover, with this form, clinical characteristics of the patients such as the type of surgery, family history of PONV, duration of the surgery, time to first flatus, time to first defecation, and length of hospital stay were also evaluated.

Baxter Animated Retching Face Scale (BARF Scale): The scale was developed by Amy L. Baxter et al. in 2011 (Baxter et al., 2011).

The BARF scale was developed to assess the severity of nausea in children. This scale comprises six facial expressions, with a 2-point difference between the scores of each expression. The scores of the scale range between 0 and 10 (Baxter et al., 2011; Watcha et al., 2019).

This scale is scored individually by pediatric patients. The validity and reliability of the BARF scale was established in pediatric patients with nausea and vomiting in the emergency department and in healthy patients who underwent day surgery (Baxter et al., 2011). The validity and reliability study of the Turkish version of the BARF Scale was performed by Şişman et al. in 82 pediatric surgery patients aged 7–18 years in 2016 (Sisman et al., 2016).

Verbal Descriptive Scale: Level of relaxation among children after gum chewing was assessed using a four-item verbal descriptive scale. This scale is evaluated individually by children. The items of the scale were as follows:

- I) Worse.
- II) No change.
- III) Partial well-being.
- IV) Complete well-being (Darvall et al., 2017).

Menthol Gum: In the present study, each patient was given a soft and easily chewable mint-flavored sugar-free gum of the same brand. This gum contained gum yeast, flavoring agents, antioxidants, and coloring agents.

Randomization

Nurses working at the pediatric surgery clinic informed the researcher about every case of appendicitis referred to the clinic, and the researcher was present at the clinic for every case of appendicitis. Patients were assigned numbers from 1 to 60 according to the order of their arrival at the clinic; those with odd numbers were included in the study group and those with even numbers were included the control group.

Intervention

Written informed consent was obtained from parents before the study was conducted. The children were asked a question about chewing gum whether they would like to in their own patient room, in the presence of the parent, without compromising their comfort. Who accepted were included in the study. Written informed consent was obtained from their parents. The data was collected through the face-to-face interviews by same researcher. First, the severity of the postoperative nausea was assessed using the BARF nausea scale, and the patient information sheet was filled out. Subsequently, from the second hour after the child was brought to the clinic for appendectomy, in addition to following the clinical nursing care protocol, those with nausea and vomiting were, alert and oriented asked to chew menthol gum for an average of 15 min as soon as they could chew gum and follow the instructions. They were then reassessed for severity of nausea, during chewing at 5–10 min and at 30, 60, and 120 min after the procedure. Furthermore, vomiting episodes of patients who experienced vomiting were recorded. After the quantitative steps of the study were

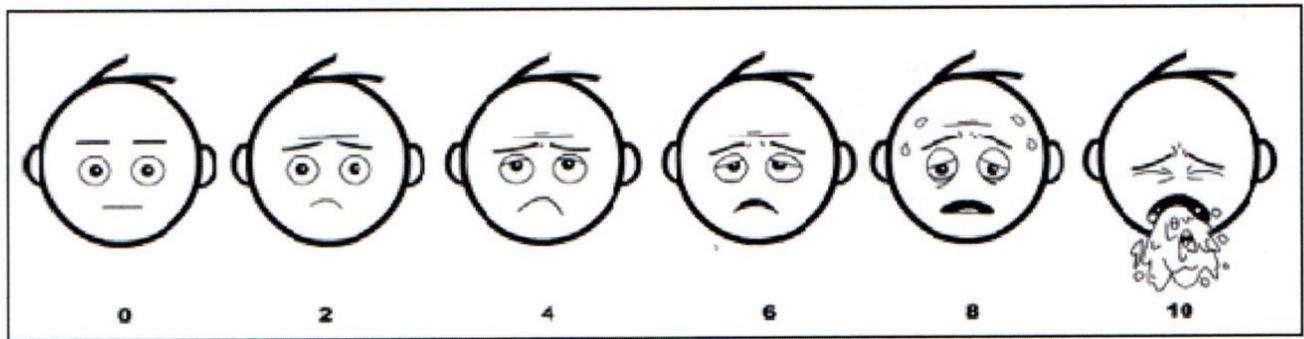


Fig. 1. BARF Scale.

completed, the patient's level of relaxation was rated using a verbal description scale. Nausea and vomiting were evaluated before patient discharge. Children in the control group who met study criteria underwent no procedure other than those in the routine clinical nursing care protocol. The severity of nausea was assessed at 5–10 min and at 30, 60, and 120 min after the onset of nausea (Fig. 2). All patients were asked to notify the nurses when their first flatus and defecation occurred. The first flatus and defecation times were also noted carefully by nurses. The length of hospital stay was counted from admission of patient until his or her discharge. (See Fig. 1.)

Sample size

To calculate power based on the study results, a posterior performance analysis was performed. In the study group (n = 30), the mean score change calculated by comparing the scores obtained during the gum chewing and pretest periods was -2.70 ± 1.95, and in the control group the mean score change was -0.67 ± 1.95; in addition, the related effect size (d) was determined to be 1.07. Based on the calculated effect size, the power value obtained from our study, in which the error of the 1st type was accepted at the 5% level, was determined to be 98%, and the evaluation was carried out using the G*Power program (Faul et al., 2007).

Statistical analysis of data

In the present study, the conformity of continuous variables to the normal distribution was examined using the Shapiro–Wilk test. According to the normality test results, the variables in this study were expressed as median (minimum–maximum) and mean ± standard deviation. In contrast, categorical variables were expressed as numbers and associated percentages. The Mann–Whitney U test was used for comparisons of continuous variables between two groups, and the Kruskal–Wallis test was used for comparisons among three groups. The chi-square and Fisher's exact tests were used for comparisons between categorical groups. The relationships between continuous and discrete variables were analyzed using correlation analysis, and Spearman's correlation coefficient was calculated. Furthermore, all study analyses were performed using the SPSS program (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.), and the type I error rate was accepted as 5% for statistical comparisons.

Ethics approval

The study was examined and approved by the Bursa Yuksek Ihtisas Training and Research Hospital Ethics Committee with the decision dated 12.01.2022 and numbered 2011-KAEK-252022701-05. Institutional permission was obtained Bursa Yuksek Ihtisas Training and Research Hospital Pediatric Surgery Department. Confidentiality and anonymity of the survey data was protected by coding the participants' data and assigning each participant a number to code the survey

questionnaire. The study numbers were stored separately from the questionnaires in a restricted-access database accessible only to the researchers. The clinical trial number was NCT05679531.

Results

Demographic and clinical characteristics of the patients who underwent appendectomy are presented in Table 1.

The study and control groups were compared in terms of their descriptive characteristics. When the variables, such as sex, age, and body mass index (BMI), of the study and control groups were compared it was found that there was no statistically significant difference between the groups and that the groups were similar in terms of these variables (p > 0.05). Moreover, no significant difference was found between the groups in variables, such as the type of surgery, family history of PONV, and duration of surgery (p > 0.05).

The comparison of the BARF score results between study groups is shown in Table 2. The BARF scores obtained during gum chewing were not compared between the groups; the difference between the BARF scores obtained in the gum chewing and pretest periods was taken into account, and the difference values (Δ_{During Gum Chewing→pretest}) were calculated. Table 2 shows that the BARF score measured during the gum chewing period was lower in the study group, and the difference score calculated based on the pretest period was higher in the study group, as expected (p < 0.001).

Table 3 shows the postoperative findings and length of hospital stay between the groups. Notably, time to first flatus was shorter in the study

Table 1 Comparison of the study groups according to the descriptive characteristics of the patients.

Parameters	Study group (n = 30)	Control group (n = 30)	p value
Gender			
Female	12 (40%)	15 (50%)	0.436 ^a
Male	18 (60%)	15 (50%)	
Age (years)			
7–11 years	10 (33.30%)	12 (40%)	0.592 ^c
12–18 years	20 (66.70%)	18 (60%)	
Body mass index			
<5	3 (10%)	5 (16.7%)	0.809 ^c
5–85	23 (76.7%)	20 (66.7%)	
>85–95	3 (10%)	3 (10%)	
>95	1 (3.3%)	2 (6.7%)	
Type of surgery			
Open	17 (56.7%)	19 (63.3%)	0.598 ^a
Laparoscopic	13 (43.3%)	11 (36.7%)	
Family history of postoperative nausea and vomiting			
Yes	4 (13.3%)	8 (26.7%)	0.197 ^a
Duration of surgery (minutes)			
0–120	21 (70%)	17 (56.70%)	0.284 ^c
>120–180	9 (30%)	13 (43.30%)	

Data are expressed as median (minimum–maximum) and n (%). a: Chi-square Test, b: Mann–Whitney U Test, c: Fisher–Freeman–Halton Test.

Table 2
Comparisons of BARF score between groups.

	Study group (n = 30)	Control group (n = 30)	p value ^b
	Median (Minimum–Maximum) Mean ± SD	Median (Minimum–Maximum) Mean ± SD	
Pretest	4 (2:10) 5.06 ± 2.01	6 (2:8) 5.33 ± 1.21	0.349
During Gum Chewing	2 (0:10) 2.36 ± 2.26	4 (2:10) 4.66 ± 1.91	–
Δ _{During Gum Chewing→pretest}	–4 (–6:2) –2.70 ± 1.95	0 (–4:4) –0.66 ± 1.84	<0.001
After Gum Chewing 30 min	0 (0:6) 0.93 ± 1.55	2 (0:6) 2.33 ± 1.89	–
Δ _{After Gum Chewing 30 min→pretest}	–4 (–10:2) –4.13 ± 2.62	–2 (–6:0) –3 ± 2.21	0.74
After Gum Chewing 60 min	0 (0:6) 0.63 ± 1.40	0 (0:6) 1.13 ± 1.79	–
Δ _{During Gum Chewing 60 min→pretest}	–4 (–10:0) –4.43 ± 2.54	–4 (–8:2) –4.2 ± 2.24	0.853
After Gum Chewing 120 min	0 (0:4) 0.36 ± 0.92	0 (0:4) 0.93 ± 1.55	–
Δ _{After Gum Chewing 120 min→pretest}	–4 (–10:0) –4.70 ± 2.42	–6 (–8:0) –4.40 ± 2.12	0.793

Data are expressed as median (minimum–maximum) and mean ± standard deviation. b: Mann-Whitney U Test.

group ($p < 0.001$). Moreover, median time to first flatus in the study group was 7.5 (4–14) hours, and it was 10 (5–24) hours in the control group. Furthermore, time to first defecation was shorter in the study group (12 [7–32] hours) than in the control group (15 [10–32] hours) ($p = 0.00$).

When the length of hospital stay of the children included in the study was analyzed, it was found that the length was shorter in the study group. Median length of hospital stay in the study group was 3 (2–6) days, whereas in the control group, it was 4 (2–6) days. The results of the analysis indicated a significant difference between the groups in terms of the length of hospital stay ($p = 0.019$).

After the completion of gum-chewing intervention, a four-point verbal description scale was used to assess the patient's level of relaxation. The results of this assessment showed that 73.7% of patients reported the level of relaxation as complete well-being, 20% as no change, and 6.7% as partial well-being (Fig. 3).

Discussion

This study aimed to determine the effect of menthol gum chewing on nausea, vomiting, and length of hospital stay after appendectomy in children. No statistically significant difference was found in the studied variables, including sex, age, BMI, type of surgery, family history of PONV, and the duration of surgery, between the study and control groups.

In the present study, the BARF score measured during gum chewing (at 5–10 min) was lower in the study group, and the difference score calculated based on the pretest period was higher in the

study group. Darvall et al. (2017) compared sugar-free mint-flavored chewing gum and the antiemetic ondansetron in a study involving women undergoing laparoscopic and breast surgery, and they reported that chewing gum was not inferior to ondansetron in relieving PONV (Darvall et al., 2017). Similar to our study results, Jernigan et al. (2014) conducted a study of patients undergoing gynecologic surgery and found that the postoperative nausea symptoms were less common in those who chewed mint-flavored gum than in those who did not chew the gum, and the difference between the two groups was statistically significant (Jernigan et al., 2014). Park and Choi (2018), Ciardulli et al. (2018), and Xu et al. (2018) reported fewer episodes of nausea and vomiting in the gum chewing group in their study of patients undergoing gynecologic surgery and cesarean section (Ciardulli et al., 2018; Park & Choi, 2018; Xu et al., 2018). In contrast to our study results, Mei et al. (2017) studied the incidence of nausea in adult patients undergoing colorectal cancer surgery, and they reported that the chewing gum had no effect (Mei et al., 2017). This difference between the results of the studies may be due to the difference in the mean age of the participants, the type of surgery, and the duration of gum chewing in these studies.

In our study, chewing gum use was found to reduce the time to first flatus by 2.5 h (Table 3). Similar to our study results, studies conducted on adult patients undergoing bowel surgery in Turkey (Duluklu & Çelik, 2020; Topcu & Öztekin, 2016), a study conducted on adult patients undergoing abdominal surgery in India (Kumar et al., 2018), a study involving 46 adult patients who underwent open appendectomy in Cameroon (Ngowe et al., 2010), and a study involving patients who

Table 3
Comparison of the postoperative characteristics between the study and control groups.

	Study group (n = 30)	Control group (n = 30)	p value ^b
	Median (Minimum–Maximum) Mean ± SD	Median (Minimum–Maximum) Mean ± SD	
Time to first flatus (hours)	7.5 (4:14) 7.46 ± 2.60	10 (5:24) 10.93 ± 3.54	<0.001
Time to first defecation (hours)	12 (7:32) 12.80 ± 5.51	15 (10:32) 15.83 ± 4.06	0.00
Length of hospital stay (days)	3 (2:6) 3.03 ± 1.12	4 (2:6) 3.83 ± 1.34	0.019

Data are expressed as median (minimum–maximum) and mean ± standard deviation. b: Mann-Whitney U Test.

underwent radical cystectomy in the United States (Atkins et al., 2022) reported that time to first flatus was shorter in the gum chewing groups. In contrast, in a study examining the effect of sugar-free chewing gum in reducing postoperative ileus and oral tolerance time in children undergoing appendectomy, it was reported that time to first flatus decreased in the gum chewing group, but there was no statistically significant difference between the groups (Lopez-Jaimes & Cuello-García, 2016). Similarly, Cavusoglu et al. (2009) examined the effect of chewing sugar-free gum on ileus after bowel resection in a study involving 30 children, and they reported that there was no statistically significant difference between groups in time to first flatus. The difference between the results of the studies may be attributed to the fact that the timing of starting gum chewing varies (Cavusoglu et al., 2009).

In our study, it was found that menthol gum chewing reduced the time to first defecation by 3 h. Similar to our study results, a meta-analysis study examining the effect of gum chewing on postoperative ileus after colorectal surgery (Roslan et al., 2020) and a study conducted with children who underwent abdominal surgery (Abd-Elhamed et al., 2020) reported that the time to first defecation was shorter in the group that chewed gum. In contrast to our study results, Ge et al. (2017) examined the effect of chewing sugar-free gum on bowel

activity in adult patients undergoing laparoscopic surgery for gastric cancer, and they reported that there was no statistically significant difference between groups in terms of time to first defecation (Ge et al., 2017). This difference between the results of the studies may be attributed to the difference in the type of gum used, the type of surgery, and the mean sample.

The length of hospital stay of the children included in the study was also examined, and it was found that the length was shorter in the menthol gum group. Similar to our study results, a study of adult patients undergoing appendectomy found that the hospital stay of the group that chewed sugarless gum was shorter than that of those who did not chew the gum (Mahmoud & Muhammad, 2018). A Cochrane review of 1523 patients undergoing colorectal surgery reported that chewing gum can reduce hospital stay by 1 day (Shor et al., 2015). In contrast to our study results, a study by De Leede et al. (2018) involving patients undergoing abdominal surgery reported that chewing of sugar-free mint-flavored gum had no effect on the length of hospital stay (De Leede et al., 2018). In contrast Lopez-Jaimes and Cuello-García (2016), in a study involving children undergoing appendectomy, reported that length of hospital stay was longer in the group that chewed sugarless gum (Lopez-Jaimes &

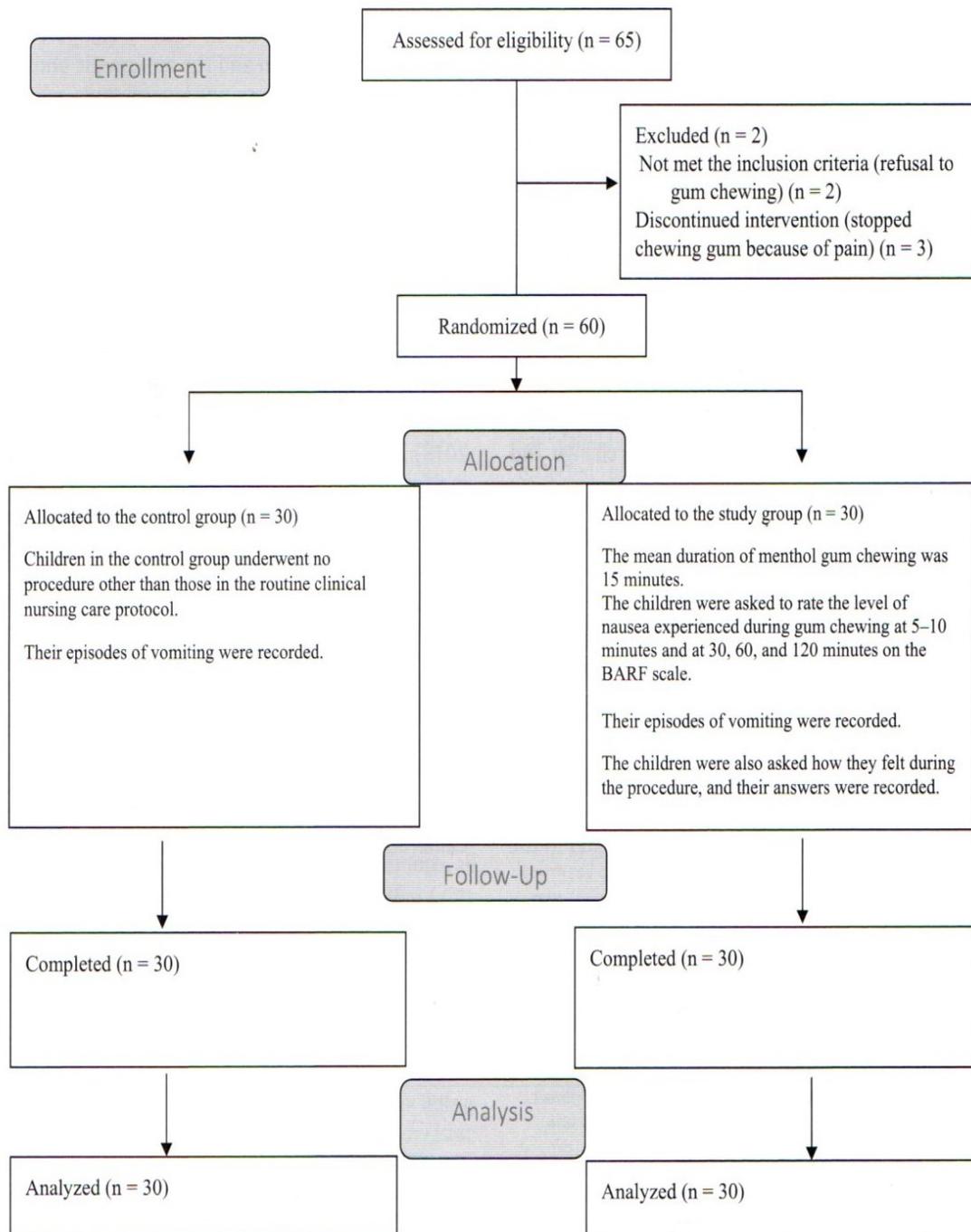


Fig. 2. Flow diagram of the study.

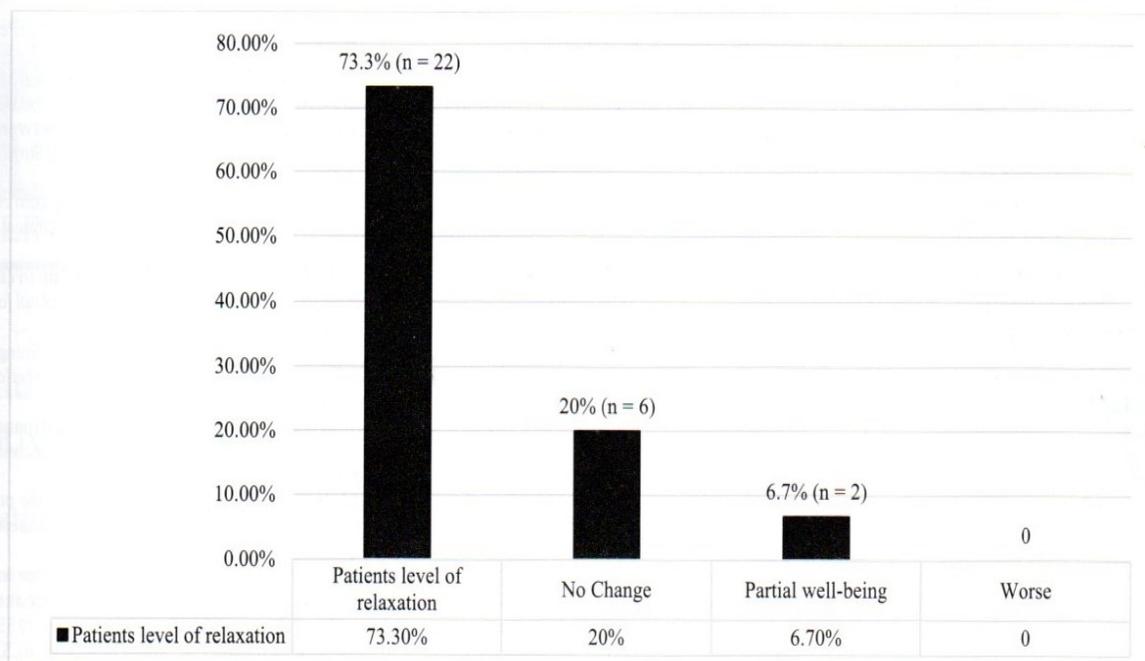


Fig. 3. Evaluation of the patient's level of relaxation after chewing gum.

Cuello-García, 2016). This difference in study results could be due to differences in gum chewing practices.

In our study, vomiting was observed in only eight patients. However, there was no significant difference between patients with and without vomiting in terms of the duration of surgery.

In our study, patients were rated for their level of relaxation after chewing gum, and 73.7% of patients reported complete well-being (Fig. 2). Similar to our results, Darvall et al. (2017) compared peppermint-flavored chewing gum and ondansetron for the relief of postoperative nausea and vomiting, and they reported that 75% of women patients in the chewing gum group (9 of 12 patients) and 39% of patients in the ondansetron group (5 of 13 patients) were in complete well-being (Darvall et al., 2017). In a survey involving postoperative examination of patients for PONV and its management, it was reported that 92% of patients were willing to try nondrug treatment for PONV, and 84% were willing to chew gum (Darvall et al., 2019).

Limitations of the study

This study had some limitations. First, this was a single-center study design. Second, this small size of the study was small and inadequate to appropriately evaluate the examined parameters. Therefore, the results cannot be generalized to all children undergoing appendectomy. Future studies should include a larger population of pediatric patients and be conducted multi-center to confirm the findings of this study. Third, this is a single-blind randomized controlled trial, and only patients were blinded. Because staff blinding was difficult during the procedure and outcome assessment phase, and the nurse works in the same clinic. Future studies, postoperative events may be documented by an independent evaluator to provide a more objective assessment. Moreover, in this study, only sugar-free menthol chewing gum was used as type of gum. Inclusion of a flavourless gum group could have enriched the content of the study. Future studies need to be conducted using different type of chewing gum.

Implication to practice

As nonpharmacological method, chewing gum facilitate the treatment, process involving nurses and children, reduce hospital cost and improve patient satisfaction. Hospital policies on the chewing gum for reducing severity PONV.

Conclusion

In our study, gum chewing—an easy-to-use, inexpensive, reliable, accessible, and nonpharmacological method, was shown to be effective in reducing the severity of post-appendectomy nausea, the time to first flatus and defecation, and the length of hospital stay.

As part of nursing practices, menthol gum chewing practice can be widely used in clinical practice to reduce the severity of nausea and shorten hospital stays in children undergoing appendectomy. We recommended investigating the effects of postoperative gum chewing in different types of surgery to reduce nausea and vomiting.

CRedit authorship contribution statement

Rüya Naz: Conceptualization, Resources, Supervision, Writing – original draft, Software, Visualization. **Nurcan Özyazıcıoğlu:** Methodology, Investigation, Data curation, Writing – review & editing, Formal analysis, Resources, Software, Validation. **Mete Kaya:** Conceptualization, Writing – review & editing, Writing – original draft.

Declaration of Competing Interest

None.

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