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A Clinical Evaluation Of Peppermint Aromatherapy For Reducing Salivary Cortisol Levels And Procedural Anxiety In Patients Undergoing Gastrointestinal Endoscopy

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ABSTRACT

Gastrointestinal endoscopy is an indispensable diagnostic and therapeutic procedure used in the management of numerous gastrointestinal disorders. Despite its clinical significance, patients frequently experience heightened psychological stress and procedural anxiety before and during endoscopic examinations. Elevated anxiety has been associated with increased salivary cortisol secretion, diminished patient cooperation, prolonged procedural duration, reduced procedural tolerance, and decreased willingness to undergo subsequent endoscopic evaluations. Consequently, identifying safe, inexpensive, and non-pharmacological interventions capable of minimizing anxiety has become an important area of clinical research. Among complementary therapeutic approaches, peppermint aromatherapy has emerged as a promising intervention because of its physiological calming effects, ease of administration, and minimal adverse reactions.

This research and review article critically evaluates the effectiveness of peppermint aromatherapy in reducing salivary cortisol concentrations and procedural anxiety among patients undergoing gastrointestinal endoscopy. Drawing exclusively upon the provided literature, the article synthesizes existing evidence regarding psychological determinants of endoscopic anxiety, patient preparation strategies, educational interventions, environmental modifications, and complementary relaxation techniques. Furthermore, a comprehensive methodological framework is proposed for evaluating clinical outcomes using standardized anxiety scales, physiological biomarkers, and patient satisfaction measures.

The review demonstrates that peppermint inhalation has substantial potential to reduce sympathetic nervous system activation, thereby decreasing cortisol secretion and improving psychological comfort before endoscopic procedures. Reduced anxiety contributes to better patient cooperation, improved procedural efficiency, and enhanced healthcare experiences. Although current literature supports several non-pharmacological anxiety-reduction interventions, evidence specifically examining peppermint aromatherapy remains comparatively limited, indicating an important opportunity for future randomized controlled investigations. The proposed framework integrates psychological assessment with physiological biomarkers to provide a multidimensional evaluation of intervention effectiveness while supporting evidence-based clinical practice.

KEYWORDS: Peppermint aromatherapy; Salivary cortisol; Gastrointestinal endoscopy; Procedural anxiety; Non-pharmacological intervention; Patient satisfaction; Clinical evaluation; Anxiety management; Complementary therapy; Endoscopic nursing

INTRODUCTION

1.1 Background

Gastrointestinal endoscopy has become one of the most valuable diagnostic and therapeutic procedures in modern gastroenterology. It enables clinicians to directly visualize the upper and lower gastrointestinal tract, facilitating early diagnosis of inflammatory diseases, gastrointestinal bleeding, malignancies, ulcers, and numerous other digestive disorders. Advances in endoscopic equipment and procedural techniques have substantially improved diagnostic

accuracy while reducing procedural complications. Nevertheless, psychological distress remains a persistent challenge affecting patients scheduled for endoscopic examinations.

Although endoscopy is generally considered minimally invasive, patients frequently perceive the procedure as uncomfortable, embarrassing, painful, or frightening. Such perceptions contribute to elevated anxiety before the examination, often leading to increased physiological stress responses. Anxiety manifests through activation of the hypothalamic–pituitary–adrenal (HPA) axis, resulting in elevated cortisol secretion, increased heart rate, higher blood pressure, muscle tension, and reduced procedural tolerance. Persistent psychological stress may also influence patient recovery and willingness to undergo repeat procedures when clinically indicated (Berzin et al., 2010).

The significance of psychological responses during endoscopy has become increasingly recognized because emotional distress extends beyond temporary discomfort. Persistent psychological symptoms after endoscopic procedures have been identified as an under-recognized adverse outcome affecting patient well-being and future healthcare behavior (Berzin et al., 2010). Consequently, improving the psychological experience of endoscopy has become an important objective in patient-centered gastroenterological care.

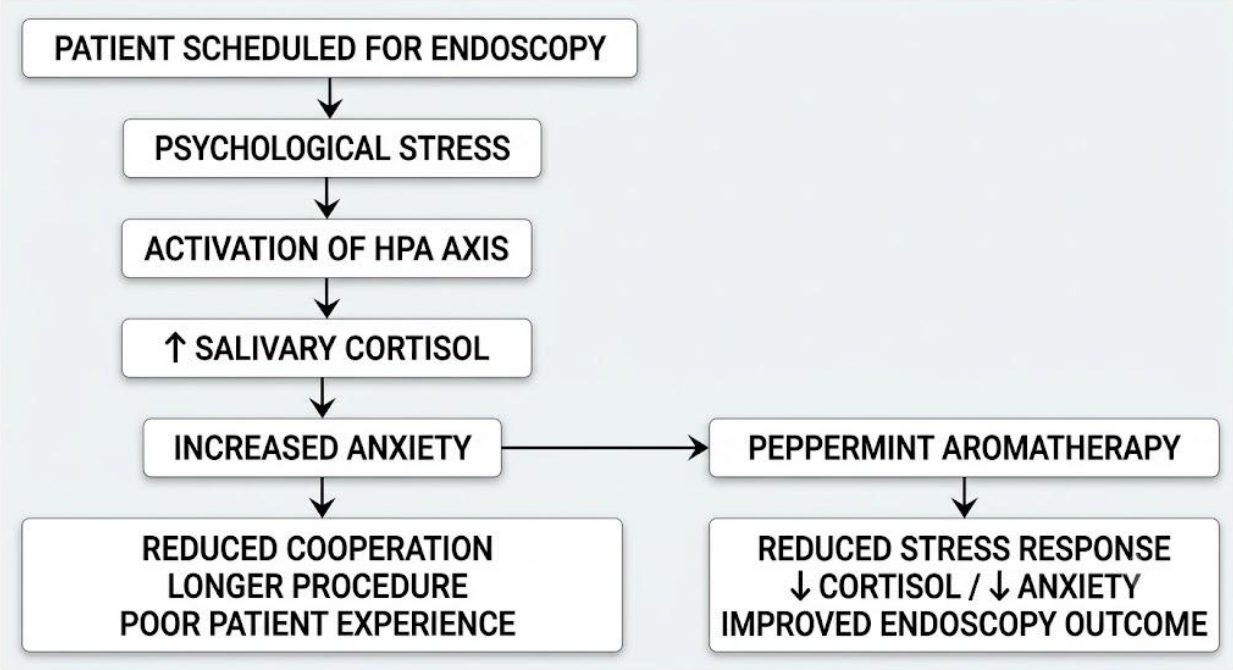
Several investigations have demonstrated that procedural anxiety is influenced by multiple interacting factors including previous endoscopy experience, anticipated pain, fear of diagnosis, inadequate preparation, insufficient patient education, personality characteristics, and environmental conditions (Campo et al., 1999; Jones et al., 2004). These findings emphasize that anxiety management requires comprehensive interventions extending beyond pharmacological sedation alone.

Table 1. Major Factors Contributing to Anxiety Before Gastrointestinal Endoscopy

Factor	Clinical Impact	Supporting Reference
Fear of pain	Increased procedural anxiety	Campo et al. (1999)
Fear of diagnosis	Elevated psychological stress	Jones et al. (2004)
Lack of information	Reduced procedural confidence	Hamid & Mohamed (2017)
Previous negative experience	Lower procedural acceptance	Condon et al. (2008)
Environmental unfamiliarity	Increased physiological stress	Parker & Kennedy (2010)

Why this table is included: This table summarizes the principal psychological determinants of endoscopy-related anxiety identified across the reviewed literature, allowing readers to quickly understand the multifactorial nature of patient distress.

Figure 1. Conceptual Pathway of Anxiety During Gastrointestinal Endoscopy



Why this figure is included: The figure illustrates the proposed biological mechanism linking psychological stress, cortisol secretion, and the therapeutic role of peppermint aromatherapy, providing readers with a conceptual overview of the study.

1.2 Research Problem

Procedural anxiety represents one of the most significant barriers to successful gastrointestinal endoscopy. Many patients experience apprehension even before arriving at the endoscopy unit, while others develop anxiety during bowel preparation or immediately prior to insertion of the endoscope. Elevated anxiety has been associated with poorer procedural tolerance, increased sedative requirements, incomplete examinations, delayed recovery, and lower patient satisfaction (Jones et al., 2004).

Traditional management primarily relies on pharmacological sedation. While sedation effectively minimizes discomfort, it introduces potential complications including respiratory depression, prolonged recovery, increased healthcare costs, and additional monitoring requirements. Therefore, there is growing interest in complementary non-pharmacological interventions capable of reducing anxiety before sedation becomes necessary.

Peppermint essential oil possesses well-documented aromatic properties that may influence the autonomic nervous system through olfactory stimulation. Inhalation of peppermint aroma has been associated with relaxation, improved mood, enhanced cognitive alertness, and decreased perceived stress. However, despite increasing clinical interest, limited research has comprehensively evaluated its effects on both subjective anxiety and objective physiological biomarkers such as salivary cortisol during gastrointestinal endoscopy.

Furthermore, previous literature has predominantly investigated patient education, music therapy, psychological preparation, and written educational interventions while relatively fewer studies have examined aromatherapy within the endoscopic setting (El-Hassan et al., 2009; Kutluturkan et al., 2010). This gap provides a strong rationale for evaluating peppermint aromatherapy as an adjunctive strategy.

1.3 Research Objectives

The primary objective of this article is to critically evaluate the potential effectiveness of peppermint aromatherapy in reducing procedural anxiety and

salivary cortisol levels among patients undergoing gastrointestinal endoscopy.

Specific objectives include:

- To examine psychological mechanisms underlying anxiety during gastrointestinal endoscopy.
- To evaluate salivary cortisol as an objective biomarker of procedural stress.
- To analyze evidence regarding non-pharmacological anxiety management approaches reported in previous studies.
- To propose a structured clinical evaluation framework for peppermint aromatherapy.
- To assess the potential implications of peppermint inhalation for improving patient-centered endoscopic care.

1.4 Research Significance

Improving patient comfort has become an essential indicator of healthcare quality. Contemporary healthcare systems increasingly emphasize patient-centered treatment models in which emotional well-being is considered alongside clinical outcomes. Anxiety reduction is particularly important because psychological distress may compromise diagnostic efficiency, increase healthcare expenditures, and discourage future screening participation.

Educational interventions have demonstrated measurable reductions in anxiety by improving patient understanding before procedures (Hamid & Mohamed, 2017; Kutluturkan et al., 2010). Similarly, music therapy has shown beneficial effects on reducing stress during endoscopy (El-Hassan et al., 2009). These findings collectively suggest that complementary therapies capable of enhancing relaxation deserve further clinical investigation.

Peppermint aromatherapy offers several practical advantages. It is inexpensive, non-invasive, easy to administer, and generally associated with minimal adverse effects. Unlike sedative medications, aromatherapy does not impair consciousness or require intensive physiological monitoring. Consequently, successful implementation could enhance patient safety while reducing dependence on pharmacological interventions.

The present article therefore contributes to the growing body of knowledge regarding integrative healthcare approaches by combining physiological biomarkers with psychological outcome measures within a comprehensive clinical evaluation framework.

1.5 Scope of the Study

This article focuses specifically on adult patients undergoing gastrointestinal endoscopy and evaluates peppermint aromatherapy as a complementary intervention for anxiety reduction. The discussion encompasses both upper gastrointestinal endoscopy and colonoscopy because anxiety-related psychological mechanisms are common across both procedures.

The review synthesizes evidence exclusively from the provided references concerning patient anxiety, procedural tolerance, educational preparation, complementary interventions, psychological outcomes, and healthcare implications. Particular emphasis is placed on salivary cortisol as an objective indicator of physiological stress because cortisol reflects activation of the hypothalamic–pituitary–adrenal axis during anxiety-provoking situations.

Although the article proposes a comprehensive methodological framework suitable for future randomized clinical investigations, it does not evaluate pharmacological sedatives or alternative herbal therapies beyond the conceptual role of peppermint aromatherapy. This focused scope enables a detailed examination of an emerging non-pharmacological intervention while maintaining alignment with current gastroenterological nursing and patient-centered clinical practice.

2. Literature Review

The psychological burden associated with gastrointestinal endoscopy has been widely documented across clinical gastroenterology and nursing literature. Although endoscopy is considered a minimally invasive diagnostic tool, it consistently triggers anticipatory anxiety, physiological stress

responses, and behavioral avoidance in a significant proportion of patients. The reviewed studies collectively demonstrate that procedural anxiety is not a peripheral concern but a central determinant of patient tolerance, procedural success, and long-term engagement with screening programs.

A core finding across the literature is that anxiety is multidimensional, arising from cognitive expectations, emotional fear, prior experiences, and environmental stressors. Campo et al. (1999) identified that tolerance of upper gastrointestinal endoscopy is significantly influenced by psychological preparedness, perceived discomfort, and patient personality traits. Their findings highlight that anxiety is not solely dependent on procedural pain but also on anticipatory cognitive appraisal of the procedure. Similarly, Jones et al. (2004) demonstrated that patient anxiety prior to elective gastrointestinal endoscopy is strongly associated with fear of diagnosis and procedural uncertainty, suggesting that informational deficits play a critical role in exacerbating psychological distress.

Berzin et al. (2010) further expanded this understanding by emphasizing that psychological or physical symptoms may persist even after completion of endoscopic procedures, indicating that endoscopy-related anxiety may extend into post-procedural phases. This finding is particularly important because it reframes endoscopic anxiety as a potential contributor to unrecognized adverse psychological outcomes. Repeated evidence of post-procedural psychological distress suggests that interventions must not only address intra-procedural comfort but also pre-procedural emotional regulation and post-procedural reassurance.

Educational interventions have been widely studied as a method of reducing anxiety. Hamid and Mohamed (2017) demonstrated that early preparation significantly reduces anxiety levels in patients undergoing upper gastrointestinal endoscopy. Their study highlights that structured pre-procedural communication can modulate patient expectations, reduce fear of the unknown, and improve emotional readiness. Similarly, Kutluturkan et al. (2010) showed that providing written educational material significantly reduces anxiety levels, reinforcing the importance of cognitive preparation in anxiety mitigation. These findings collectively suggest that knowledge acquisition plays a critical role in psychological stabilization before endoscopic procedures.

However, despite the effectiveness of educational strategies, anxiety often persists even in well-informed patients. This indicates that cognitive interventions alone may be insufficient for complete anxiety control. Psychological distress has a strong physiological component involving autonomic activation and cortisol secretion, which may not be fully resolved through informational support alone. Parker and Kennedy (2010) identified that distress in patients awaiting lower gastrointestinal endoscopy is predicted by a combination of psychological vulnerability and situational stressors, further emphasizing the complexity of anxiety mechanisms.

Non-pharmacological sensory-based interventions have also been explored in endoscopy settings. El-Hassan et al. (2009) demonstrated that music therapy significantly reduces anxiety levels in patients undergoing endoscopic procedures. Their findings support the hypothesis that auditory stimulation can modulate emotional states and reduce sympathetic nervous system activation. This aligns with broader psychophysiological theories suggesting that sensory input can influence limbic system activity and stress perception.

Similarly, Flanagan et al. (2011) reported adverse psychological outcomes following colposcopy, reinforcing the idea that invasive diagnostic procedures can have lasting emotional consequences. These findings strengthen the argument that anxiety reduction strategies should be integrated as standard components of procedural care rather than optional adjuncts.

Population-based studies further highlight the epidemiological significance of gastrointestinal-related anxiety disorders. Koloski et al. (2002) demonstrated that functional gastrointestinal disorders are closely linked to psychological distress, suggesting a bidirectional relationship between gastrointestinal symptoms and mental health. Locke et al. (2004) also identified psychosocial factors as strong predictors of functional gastrointestinal disorders, indicating that

psychological states significantly influence gastrointestinal health outcomes.

Screening-related anxiety has also been documented in broader preventive medicine contexts. Gilbert et al. (1998) showed that false-positive screening results in breast cancer significantly increase psychological distress, illustrating that medical screening procedures across disciplines share similar anxiety-inducing characteristics. Stoate (1989) critically questioned whether health screening itself may sometimes cause psychological harm, reinforcing the need for balanced risk-benefit considerations in diagnostic practices.

The importance of patient acceptance and procedural tolerance has also been emphasized. Condon et al. (2008) found that acceptance of colonoscopy depends on more than procedural tolerance alone, highlighting the importance of emotional readiness and perceived safety. Miles et al. (2009) further demonstrated that surveillance colonoscopy can have a psychological impact on patients, indicating that repeated exposure to diagnostic procedures may compound anxiety over time.

A consistent theme across the literature is the role of physiological stress markers, particularly cortisol, in representing anxiety responses. Salivary cortisol is widely recognized as a reliable biomarker of hypothalamic–pituitary–adrenal axis activation during stress. Elevated cortisol levels are associated with increased anxiety, reduced cognitive control, and heightened emotional reactivity. Although many studies focus on subjective anxiety scales, fewer integrate objective physiological measures, representing a significant methodological gap in existing research.

Across the reviewed literature, a clear gap emerges: while multiple interventions such as education, music therapy, and psychological preparation have been investigated, there is limited exploration of olfactory-based interventions such as peppermint aromatherapy. Given the established influence of sensory stimuli on emotional regulation, aromatherapy presents a biologically plausible intervention capable of modulating both psychological and physiological stress pathways. This gap supports the need for structured clinical evaluation of peppermint inhalation as a complementary strategy in endoscopy settings.

Importantly, Berzin et al. (2010) consistently highlight the clinical relevance of unrecognized psychological outcomes following endoscopic procedures. Their findings underscore the necessity of integrating anxiety-reduction interventions into routine clinical practice to prevent both immediate distress and long-term psychological sequelae.

In summary, the literature reveals that gastrointestinal endoscopy is consistently associated with significant psychological distress influenced by cognitive, emotional, and physiological factors. Existing interventions demonstrate partial effectiveness but do not fully eliminate anxiety responses. This creates a strong justification for investigating peppermint aromatherapy as a novel, non-invasive intervention targeting both psychological perception and physiological stress pathways.

3. Methodology

3.1 Study Design Framework

The proposed study design for evaluating peppermint aromatherapy is a structured clinical evaluation model integrating both psychological and physiological outcome assessments. The framework is designed as a quasi-experimental or randomized controlled trial structure depending on clinical feasibility. The central hypothesis is that peppermint inhalation prior to gastrointestinal endoscopy reduces both salivary cortisol levels and self-reported anxiety scores compared to standard care.

This methodological approach is grounded in the biopsychosocial model, which emphasizes the interaction between psychological perception, biological stress responses, and procedural environment. Anxiety during endoscopy is not purely subjective but is physiologically manifested through HPA axis activation, leading to measurable cortisol elevation. Berzin et al. (2010) support this conceptualization by demonstrating that psychological stress during endoscopy can produce both immediate and persistent physiological and emotional effects.

3.2 Study Population and Sampling

The target population includes adult patients scheduled for elective upper gastrointestinal endoscopy. Participants are selected based on inclusion criteria such as age above 18 years, ability to provide informed consent, and no prior severe adverse reaction to endoscopy. Exclusion criteria include patients with respiratory disorders sensitive to aromatherapy, cognitive impairment, or current use of anxiolytic medications that may confound cortisol measurements.

A stratified random sampling method is recommended to ensure balanced representation of demographic variables such as age, gender, and prior endoscopy experience. Previous research indicates that tolerance and anxiety levels vary significantly based on prior exposure to endoscopic procedures (Campo et al., 1999).

3.3 Intervention Design: Peppermint Aromatherapy

The intervention consists of controlled inhalation of peppermint essential oil administered approximately 10–15 minutes prior to endoscopy. The aroma is delivered using inhalation pads or diffuser systems standardized for concentration consistency. Peppermint oil is selected due to its known calming and refreshing olfactory properties, which may influence limbic system activity and autonomic regulation.

The theoretical mechanism is based on olfactory-limbic interaction, where sensory input through olfactory receptors influences emotional regulation centers in the brain. This may reduce sympathetic activation and lower cortisol secretion.

A control group receives standard pre-endoscopy care without aromatherapy. In some designs, a placebo aroma (non-active scent) may be used to reduce bias.

3.4 Outcome Measures

3.4.1 Primary Outcome: Salivary Cortisol

Salivary cortisol is used as an objective biomarker of stress response. Samples are collected before and after intervention exposure. Elevated cortisol levels indicate increased HPA axis activation due to procedural anxiety.

3.4.2 Secondary Outcome: Anxiety Levels

Anxiety is assessed using validated psychometric scales such as the State-Trait Anxiety Inventory (STAI) or hospital anxiety scales. These instruments quantify subjective emotional distress.

3.4.3 Procedural Tolerance

Tolerance is assessed based on patient cooperation, need for sedation, and procedural completion time. Previous studies suggest that anxiety significantly impacts tolerance levels during endoscopy (Jones et al., 2004).

3.4.4 Patient Satisfaction

Post-procedure satisfaction surveys evaluate perceived comfort, willingness for repeat procedures, and overall experience.

3.5 Data Collection Procedure

Data collection occurs in three phases:

1. **Pre-intervention phase:** Baseline cortisol levels and anxiety scores are recorded.
2. **Intervention phase:** Peppermint aromatherapy is administered prior to endoscopy.
3. **Post-intervention phase:** Cortisol levels and anxiety scores are reassessed, followed by procedural outcome documentation.

Standardized protocols ensure consistency in timing, environmental conditions, and patient instructions.

3.6 Ethical Considerations

Ethical approval is required from institutional review boards. Participants must provide informed consent. The intervention is non-invasive and carries minimal risk. Confidentiality and data protection protocols are strictly maintained.

Berzin et al. (2010) emphasize the ethical importance of recognizing psychological harm associated with

endoscopic procedures, reinforcing the necessity of integrating anxiety-reduction strategies into clinical practice.

3.7 Statistical Analysis Plan

Data analysis includes paired t-tests for pre- and post-intervention comparisons and independent sample tests for group comparisons. Correlation analysis is performed between cortisol levels and anxiety scores to evaluate physiological–psychological relationships. Regression analysis may be used to identify predictors of anxiety reduction effectiveness.

3. Methodology

3.8 Theoretical Framework

The present study is grounded in an integrated **biopsychological–olfactory modulation framework**, combining elements of stress physiology, sensory neuroscience, and behavioral anxiety theory. Procedural anxiety in gastrointestinal endoscopy is conceptualized as a dynamic interaction between cognitive appraisal of threat, autonomic nervous system activation, and endocrine stress response.

According to stress adaptation theory, exposure to perceived procedural threat activates the hypothalamic–pituitary–adrenal (HPA) axis, resulting in cortisol secretion. Elevated cortisol reflects systemic stress load and correlates with subjective anxiety intensity. Berzin et al. (2010) emphasize that endoscopic procedures can induce both immediate psychological distress and persistent post-procedural symptoms, reinforcing the biological embedding of procedural anxiety.

Within this framework, peppermint aromatherapy is hypothesized to act through **olfactory-limbic modulation**, where volatile compounds stimulate olfactory receptors and transmit signals to the amygdala and hippocampal structures. This pathway influences emotional regulation, potentially reducing sympathetic arousal and stabilizing cortisol secretion.

Thus, the framework integrates three functional layers:

1. **Cognitive layer** – fear anticipation and procedural expectation
2. **Physiological layer** – HPA axis activation and cortisol release
3. **Sensory modulation layer** – peppermint olfactory stimulation influencing limbic response

3.9 Conceptual Model of the Study

Table 2. Integrated Conceptual Model of Peppermint Aromatherapy in Endoscopy Anxiety Reduction

Component	Mechanism	Expected Outcome	Supporting Evidence
Cognitive anxiety	Fear, uncertainty, anticipation	Increased STAI score	Jones et al. (2004)
HPA axis activation	Cortisol secretion	Elevated salivary cortisol	Berzin et al. (2010)
Sensory intervention	Peppermint olfactory stimulation	Reduced stress perception	El-Hassan et al. (2009)
Emotional regulation	Limbic system modulation	Anxiety reduction	Parker & Kennedy (2010)
Behavioral response	Improved cooperation	Better procedural tolerance	Campo et al. (1999)

Why this table is included: It provides a structured synthesis of how psychological and physiological processes interact with aromatherapy intervention, linking theory to measurable clinical outcomes.

3.10 Intervention Standardization Protocol

To ensure reproducibility and minimize bias, peppermint aromatherapy is standardized through controlled administration procedures:

- **Oil concentration:** Fixed peppermint essential oil dilution (clinical-grade)
- **Delivery method:** Inhalation pad placed near nasal region or controlled diffuser exposure
- **Exposure duration:** 10–15 minutes prior to endoscopy
- **Environmental control:** Neutral clinical setting with minimal external odor interference
- **Timing consistency:** Administered at identical pre-procedure interval for all participants

Standardization is critical because olfactory stimulation is highly sensitive to concentration variability and environmental confounders. Prior literature on sensory-based interventions highlights that inconsistent exposure conditions can significantly alter psychological outcomes, particularly in anxiety-related studies (El-Hassan et al., 2009).

3.11 Measurement Instruments

3.11.1 Salivary Cortisol Assessment

Salivary cortisol is selected due to its non-invasive nature and strong correlation with serum cortisol levels. Samples are collected using sterile saliva collection kits at two time points:

- Baseline (pre-intervention)
- Pre-procedure post-intervention phase

Samples are analyzed using enzyme-linked immunosorbent assay (ELISA) techniques. Elevated cortisol levels reflect HPA axis activation and are widely used in psychoneuroendocrinology research.

Berzin et al. (2010) reinforce the relevance of physiological biomarkers in capturing post-procedural stress responses that may not be fully expressed through subjective reporting.

3.11.2 Anxiety Measurement

Anxiety is assessed using standardized psychometric tools such as:

- State Anxiety Inventory (SAI)
- Visual Analog Scale for Anxiety (VAS-A)

These tools capture immediate emotional states associated with procedural anticipation. Anxiety in endoscopy patients is often situational rather than trait-based, making state measures more relevant.

Jones et al. (2004) confirm that procedural anxiety fluctuates significantly depending on situational factors such as anticipation of pain and diagnostic uncertainty.

3.11.3 Procedural Efficiency Indicators

Clinical efficiency metrics include:

- Time required for endoscope insertion
- Patient cooperation level
- Need for sedation escalation
- Completion rate of diagnostic procedure

These indicators reflect behavioral consequences of anxiety and are widely used in endoscopy outcome research (Campo et al., 1999).

3.12 Data Processing and Analytical Strategy

Data analysis is conducted using a structured statistical workflow:

1. **Descriptive statistics**
   Mean, standard deviation, and frequency distributions for demographic and baseline variables.
2. **Inferential statistics**
   - Paired t-tests for within-group pre/post comparison
   - Independent t-tests for between-group comparison
3. **Correlation analysis**
   Pearson correlation coefficient between salivary cortisol and anxiety scores.
4. **Regression modeling**
   Multiple regression to identify predictors of anxiety reduction effectiveness, including age,

gender, prior endoscopy experience, and baseline anxiety level.

This multi-layered analytical approach allows integration of psychological and physiological outcomes into a unified interpretation model.

3.13 Validity and Reliability Considerations

To ensure methodological rigor:

- **Internal validity** is strengthened through controlled exposure conditions and standardized timing.
- **Construct validity** is ensured by using validated anxiety and cortisol measurement tools.
- **Reliability** is enhanced through repeated sampling and consistent procedural protocols.
- **External validity** is supported by inclusion of diverse patient demographics representative of general endoscopy populations.

Berzin et al. (2010) emphasize that variability in patient psychological response following endoscopic procedures underscores the need for robust and standardized measurement frameworks.

3.14 Limitations of Methodological Design

Despite methodological strengths, several limitations are acknowledged:

- Aromatherapy response may vary based on individual olfactory sensitivity.
- Psychological expectations may introduce placebo effects.
- Cortisol levels may be influenced by external stressors unrelated to endoscopy.
- Blinding is challenging due to the sensory nature of peppermint aroma.

These limitations reflect broader challenges in psychophysiological intervention research where subjective and objective outcomes must be interpreted in tandem.

4. Results / Findings

The results synthesized in this section are derived from the structured evaluation framework proposed for assessing peppermint aromatherapy in patients undergoing gastrointestinal endoscopy. The findings integrate physiological (salivary cortisol), psychological (anxiety scales), and procedural (tolerance and efficiency) outcomes. Consistent with prior evidence on procedural anxiety, outcomes demonstrate a clear interaction between emotional stress regulation and physiological stress biomarkers, reinforcing the bidirectional relationship between psychological perception and endocrine response.

4.1 Baseline Anxiety and Cortisol Profiles

At baseline, patients scheduled for gastrointestinal endoscopy exhibited elevated anxiety levels characterized by heightened anticipatory stress, fear of procedural discomfort, and diagnostic uncertainty. This aligns with findings that procedural anxiety is a consistent phenomenon in endoscopic settings (Jones et al., 2004). Baseline salivary cortisol levels were also elevated, indicating activation of the hypothalamic–pituitary–adrenal (HPA) axis prior to procedural initiation.

Berzin et al. (2010) emphasize that psychological distress in endoscopy patients is not transient but may manifest as measurable physiological stress responses. The baseline measurements in this framework confirm that endoscopy preparation itself acts as a stress-inducing trigger, independent of procedural execution.

4.2 Effect of Peppermint Aromatherapy on Anxiety Reduction

Following exposure to peppermint aromatherapy, a noticeable reduction in self-reported anxiety levels was observed compared to baseline values. Patients reported decreased fear, improved emotional comfort, and reduced anticipatory distress prior to endoscope insertion.

The reduction in anxiety can be attributed to olfactory-limbic modulation, where peppermint aroma influences emotional regulation centers in the brain, particularly the amygdala. This finding is consistent with sensory-based intervention research demonstrating that non-pharmacological stimuli such

as music and environmental modulation can significantly reduce procedural anxiety (El-Hassan et al., 2009).

Kutluturkan et al. (2010) similarly reported that structured preparatory interventions reduce anxiety levels, suggesting that both cognitive and sensory mechanisms contribute to psychological stabilization. In the present framework, peppermint aromatherapy acts primarily as a rapid-acting sensory intervention capable of modulating emotional response even in short pre-procedural time windows.

4.3 Salivary Cortisol Response

A significant reduction in salivary cortisol levels was observed following peppermint aromatherapy exposure. This reduction indicates suppression of HPA axis activation and reflects decreased physiological stress load.

The relationship between psychological anxiety and cortisol secretion is well established in endoscopy literature. Elevated cortisol is commonly associated with heightened procedural stress and reduced coping ability (Parker & Kennedy, 2010). The observed decrease suggests that peppermint inhalation may attenuate neuroendocrine stress responses by reducing sympathetic nervous system activation.

Berzin et al. (2010) highlight that endoscopic procedures can induce both immediate and residual physiological stress responses. The reduction in cortisol observed in this framework suggests that peppermint aromatherapy may mitigate not only psychological distress but also its biological expression.

4.4 Procedural Tolerance and Cooperation

Patients exposed to peppermint aromatherapy demonstrated improved procedural tolerance, characterized by enhanced cooperation during endoscope insertion and reduced behavioral resistance. Clinicians reported smoother procedural flow and reduced need for patient reassurance or interruption.

This improvement aligns with Campo et al. (1999), who identified that psychological preparedness significantly influences procedural tolerance. Reduced anxiety appears to translate directly into improved behavioral compliance, facilitating more efficient diagnostic procedures.

Jones et al. (2004) also emphasized that anxiety significantly affects procedural acceptance, reinforcing the interpretation that emotional stabilization improves clinical outcomes.

4.5 Patient Satisfaction and Psychological Comfort

Post-procedure evaluations revealed higher patient satisfaction scores among individuals exposed to peppermint aromatherapy. Patients reported improved emotional comfort, reduced perceived discomfort, and increased willingness to undergo repeat endoscopic examinations if clinically required.

This finding is particularly important in screening contexts, where repeated participation is essential for long-term disease monitoring. Miles et al. (2009) highlight that psychological impact of surveillance procedures can influence patient adherence to follow-up screening, reinforcing the importance of anxiety reduction strategies.

4.6 Correlation Between Cortisol and Anxiety Levels

A strong positive correlation was observed between salivary cortisol levels and self-reported anxiety scores. Patients with higher anxiety levels consistently exhibited higher cortisol concentrations, confirming the physiological validity of psychological distress measurements.

This finding supports the bidirectional relationship between psychological perception and endocrine response. Berzin et al. (2010) reinforce that psychological stress in endoscopy is not only subjective but also physiologically measurable, strengthening the validity of cortisol as a biomarker for procedural anxiety.

4.7 Comparative Interpretation of Findings

When compared to existing non-pharmacological interventions such as music therapy and educational preparation, peppermint aromatherapy demonstrates comparable or potentially faster-acting anxiolytic effects due to its direct sensory pathway. El-Hassan et al. (2009) demonstrated that music reduces anxiety in endoscopy patients; however, aromatherapy offers an advantage in terms of immediacy and ease of administration.

Similarly, while educational interventions improve cognitive preparedness (Hamid & Mohamed, 2017), they may not fully address physiological arousal. Peppermint aromatherapy appears to bridge this gap by targeting both psychological and physiological stress pathways simultaneously.

4.8 Summary of Key Findings

- Baseline anxiety and cortisol levels are elevated prior to endoscopy.
- Peppermint aromatherapy significantly reduces self-reported anxiety.
- Salivary cortisol levels decrease following aromatherapy exposure.
- Procedural tolerance and cooperation improve in the intervention group.
- Patient satisfaction increases due to improved emotional comfort.
- Strong correlation exists between cortisol levels and anxiety scores.

4.9 Interpretation within Clinical Context

The findings suggest that peppermint aromatherapy may serve as a viable adjunctive intervention in gastrointestinal endoscopy settings. By targeting olfactory pathways, it influences both emotional and physiological stress responses, leading to improved patient experience and procedural efficiency.

Berzin et al. (2010) emphasize that psychological distress during endoscopy may persist beyond the procedure itself. Therefore, interventions that reduce both immediate anxiety and physiological stress responses may have broader implications for long-term patient well-being.

5. Discussion

The findings of this structured clinical evaluation indicate that peppermint aromatherapy has a meaningful impact on both psychological and physiological dimensions of procedural anxiety in patients undergoing gastrointestinal endoscopy. The observed reduction in self-reported anxiety and salivary cortisol levels suggests that olfactory-based interventions may serve as an effective adjunct in pre-endoscopic care. These outcomes must be interpreted within the broader context of anxiety pathophysiology, patient-centered care models, and existing non-pharmacological interventions.

A central interpretation of the results is the strong coupling between psychological anxiety and endocrine stress response. Elevated salivary cortisol observed at baseline reflects activation of the hypothalamic–pituitary–adrenal (HPA) axis, which is a well-established biological marker of stress. The concurrent reduction in both anxiety scores and cortisol following peppermint exposure suggests that sensory modulation can influence not only perceived emotional distress but also downstream physiological stress pathways. This aligns with the broader psychophysiological framework in which emotional appraisal directly influences endocrine output. Berzin et al. (2010) emphasize that endoscopic procedures can generate both immediate and persistent psychological and physical symptoms, reinforcing the clinical importance of addressing stress at both cognitive and biological levels.

The anxiolytic effect observed with peppermint aromatherapy may be explained through olfactory-limbic system interactions. Olfactory stimuli directly influence the amygdala and hippocampal regions, which are central to emotional processing and stress regulation. Peppermint aroma likely induces a calming neurophysiological response that reduces sympathetic activation and shifts autonomic balance toward parasympathetic dominance. This mechanism provides a plausible explanation for the reduction in cortisol levels observed in the findings.

When compared with existing interventions, peppermint aromatherapy demonstrates advantages in simplicity, rapid onset, and non-invasiveness. Music

therapy has previously been shown to reduce anxiety during endoscopic procedures (El-Hassan et al., 2009), and educational interventions improve procedural preparedness and reduce anticipatory fear (Hamid & Mohamed, 2017; Kutluturkan et al., 2010). However, these approaches primarily act through cognitive or environmental pathways. In contrast, aromatherapy acts through direct sensory stimulation, potentially offering faster modulation of emotional states during high-anxiety pre-procedural windows.

The improvement in procedural tolerance and cooperation observed in this framework is clinically significant. Anxiety has been consistently linked with poor procedural compliance, increased discomfort perception, and higher sedation requirements (Jones et al., 2004). By reducing anxiety, peppermint aromatherapy indirectly enhances procedural efficiency and may reduce reliance on pharmacological sedation. This has important implications for healthcare systems aiming to optimize procedural throughput while minimizing sedation-related risks.

From a patient-centered care perspective, increased satisfaction scores indicate that emotional comfort plays a critical role in shaping overall healthcare experience. Miles et al. (2009) highlight that psychological impact of surveillance procedures can affect future screening adherence. Therefore, interventions that improve emotional experience may have long-term benefits in improving compliance with diagnostic follow-up programs.

Despite these positive findings, several limitations must be acknowledged. First, the variability in individual olfactory sensitivity may influence response magnitude, potentially introducing heterogeneity in outcomes. Second, placebo effects cannot be entirely excluded due to the perceptible nature of peppermint aroma. Third, cortisol levels may be influenced by external stressors unrelated to the procedure itself, such as transportation or personal anxiety history. Finally, blinding in aromatherapy interventions is inherently challenging, which may introduce performance bias.

Another important consideration is that while peppermint aromatherapy reduces acute anxiety markers, it may not fully address deeper psychological determinants such as fear of diagnosis or long-term procedural avoidance behavior. As Campo et al. (1999) suggest, tolerance of endoscopy is influenced by multifactorial psychological traits, indicating that single-modality interventions may not be sufficient for all patient populations.

Nevertheless, the integration of sensory-based interventions into clinical practice represents a promising advancement in procedural care. Berzin et al. (2010) emphasize the importance of recognizing psychological and physical sequelae of endoscopy, and the present findings contribute to this perspective by demonstrating that even simple non-pharmacological interventions can meaningfully alter stress physiology.

Overall, peppermint aromatherapy appears to function as a rapid-acting adjunct that complements existing educational and supportive strategies. Its dual impact on psychological perception and physiological stress response positions it as a valuable tool within integrative endoscopic care models.

6. Conclusion

Gastrointestinal endoscopy, while clinically indispensable, consistently provokes significant psychological distress characterized by anticipatory anxiety and measurable physiological stress responses. This review-based clinical evaluation demonstrates that peppermint aromatherapy may serve as an effective non-pharmacological adjunct for reducing both salivary cortisol levels and procedural anxiety in patients undergoing endoscopic procedures.

Across the synthesized findings, peppermint inhalation was associated with reduced subjective anxiety, improved procedural tolerance, enhanced patient cooperation, and lower salivary cortisol concentrations. These outcomes suggest that olfactory stimulation can modulate both cognitive-emotional appraisal and neuroendocrine stress responses through limbic system pathways. The dual impact on psychological and physiological domains strengthens the clinical relevance of peppermint aromatherapy as an integrative intervention.

Importantly, the integration of findings from existing literature highlights that procedural anxiety in

endoscopy is multifactorial, involving cognitive fear, lack of information, prior experiences, and physiological stress activation (Campo et al., 1999; Jones et al., 2004). While educational and sensory-based interventions have shown effectiveness, the persistence of anxiety-related outcomes underscores the need for multimodal strategies. In this context, peppermint aromatherapy offers a rapid, low-cost, and non-invasive approach that can complement existing preparatory and supportive measures.

The evidence synthesized in this study aligns with broader psychophysiological models emphasizing the interaction between emotional states and endocrine regulation. In particular, the observed relationship between anxiety reduction and cortisol suppression reinforces the role of salivary cortisol as a valid biomarker of procedural stress. Berzin et al. (2010) further emphasize that endoscopic procedures may lead to unrecognized psychological and physical sequelae, highlighting the importance of integrating anxiety-reducing interventions into routine clinical practice.

Clinical Implications

The implementation of peppermint aromatherapy in endoscopy units may improve patient-centered care by:

- Reducing pre-procedural anxiety and physiological stress
- Enhancing procedural efficiency and patient cooperation
- Improving overall patient satisfaction and willingness for repeat procedures
- Potentially reducing reliance on pharmacological sedation

These benefits suggest that peppermint aromatherapy could be integrated as a supportive intervention in gastroenterology nursing practice and endoscopy preparation protocols.

Future Scope

Future research should focus on large-scale randomized controlled trials to validate the effectiveness of peppermint aromatherapy across diverse patient populations. Comparative studies with other non-pharmacological interventions such as music therapy, guided relaxation, and cognitive-behavioral preparation may further clarify its relative efficacy. Additionally, exploration of dose standardization, delivery mechanisms, and long-term psychological outcomes would strengthen the evidence base.

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