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Original research article

**CARBON DIOXIDE LEVELS IN THE BREATH OF SMOKERS AND NON
SMOKERS A COMPARATIVE STUDY**

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**Study Title: CARBON DIOXIDE LEVELS IN THE BREATH OF SMOKERS AND
NON-SMOKERS: A COMPARATIVE STUDY**

Abstract:

Background: Smoking is a major public health issue, leading to diseases like COPD, lung cancer, and cardiovascular diseases. It introduces toxic substances into the respiratory system, causing inflammation, reduced lung function, and impaired gas exchange. Measuring end-tidal CO₂ (EtCO₂) provides insights into respiratory efficiency and health. **Objectives:**

Compare EtCO₂ levels in the breath of smokers and non-smokers.

1. Analyze physiological mechanisms behind differences in EtCO₂ levels.
2. Discuss health implications of these differences.

Methods: The study involved 50 participants (25 smokers, 25 non-smokers). Smokers consumed at least 10 cigarettes daily for five years, while non-smokers had no history of smoking. A capnometer measured EtCO₂ levels over 30 second of normal breathing. Statistical analysis used t-tests to assess the significance of differences. **Results:** Smokers had significantly higher EtCO₂ levels (41.5 mmHg) compared to non-smokers (36.0 mmHg), with $p < 0.001$. This indicates impaired gas exchange and higher CO₂ retention in smokers.

Conclusion: The study highlights significant differences in EtCO₂ levels between smokers and non-smokers, demonstrating the impact of smoking on respiratory health. Capnometry is a valuable tool for early detection and intervention to mitigate smoking's adverse effects.

Keywords: Smoking, Carbon Dioxide, Capnometer, Respiratory Health, End-tidal CO₂, Gas Exchange, COPD

Background

Smoking remains a significant public health issue, contributing to numerous diseases, including chronic obstructive pulmonary disease (COPD), lung cancer, and cardiovascular diseases. The inhalation of tobacco smoke introduces various toxic substances into the respiratory system, leading to inflammation, reduced lung function, and impaired gas exchange.



Importance of CO₂ Measurement:

Carbon dioxide (CO₂) is a key indicator of respiratory function. The measurement of end-tidal CO₂ (EtCO₂) provides valuable insights into the efficiency of ventilation and the health of the respiratory system. EtCO₂ represents the concentration of CO₂ in the alveoli at the end of exhalation, reflecting the effectiveness of CO₂ elimination from the body.

Objectives: The objectives of this study are:

1. To compare the EtCO₂ levels in the breath of smokers and non-smokers.
2. To analyze the physiological mechanisms contributing to differences in EtCO₂ levels.
3. To discuss the potential health implications of these differences.

Methods**Participants:**

A total of 50 participants were recruited, with 25 smokers and 25 non-smokers. The smokers were regular users of tobacco products, smoking at least 10 cigarettes per day for the past five years. Non-smokers had no history of smoking or exposure to secondhand smoke.

Equipment:

A capnometer was used to measure the EtCO₂ levels. This device provides real-time, non-invasive measurements of CO₂ concentrations in exhaled breath, offering a reliable and accurate assessment of respiratory function.

Procedure:

1. **Preparation:** Participants were seated comfortably in a controlled environment to ensure accurate measurements. They were instructed to relax and breathe normally.
2. **Measurement:** The capnometer sensor was placed near the participant's mouth. Measurements were taken continuously for 30 Second to obtain stable EtCO₂ readings.
3. **Data Recording:** The average EtCO₂ levels were recorded for each participant, and data were subsequently analyzed to compare the results between smokers and non-smokers.

Statistical

Analysis:

Data were analyzed using statistical software. The mean EtCO₂ levels for both groups were calculated, and t-tests were used to determine the significance of the differences. A p-value of less than 0.05 was considered statistically significant.

Results

Demographic Data

Group	Number of Participants	Average Age (years)	Gender (M/F)
Smokers	25	36	15/10
Non-smokers	25	35	14/11

EtCO₂ Levels

Group	Average EtCO ₂ (mmHg)	Standard Deviation (mmHg)	Range (mmHg)
Smokers	41.5	4.2	35-48

Non-smokers	36.0	3.0	32-40
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Statistical Analysis:

The t-test results indicated a significant difference in EtCO₂ levels between smokers and non-smokers ($p < 0.001$).

Discussion

Physiological Mechanisms:

The higher EtCO₂ levels observed in smokers can be attributed to several physiological changes induced by smoking:

1. **Airway Inflammation:** Smoking causes chronic inflammation of the airways, leading to swelling and obstruction, which can reduce the efficiency of gas exchange.
2. **Reduced Lung Function:** Long-term smoking can lead to a decline in lung function, including a decrease in vital capacity and increased residual volume, contributing to higher CO₂ retention.
3. **Increased Dead Space Ventilation:** Smoking increases the amount of dead space in the lungs, areas where gas exchange is ineffective, resulting in higher EtCO₂ levels.

Health Implications:

Elevated EtCO₂ levels in smokers suggest impaired respiratory function, which can lead to various health issues:

1. **Respiratory Diseases:** Higher CO₂ levels can indicate a higher risk of developing conditions like COPD and chronic bronchitis.

2. **Cardiovascular Strain:** Elevated CO₂ levels can place additional strain on the cardiovascular system, potentially leading to hypertension and other heart-related conditions.
3. **Early Detection:** Monitoring EtCO₂ levels can serve as an early indicator of respiratory dysfunction, allowing for timely interventions.

Conclusion

This study highlights the significant differences in EtCO₂ levels between smokers and non-smokers, emphasizing the impact of smoking on respiratory health. The use of a capnometer provides a valuable tool for assessing these differences and underscores the importance of early detection and intervention in mitigating the adverse health effects of smoking.

References

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Appendices

Appendix A: Participant Information Sheet

Title: CARBON DIOXIDE LEVELS IN THE BREATH OF SMOKERS AND NON-SMOKERS: A COMPARATIVE STUDY

Purpose: To investigate the impact of smoking on CO₂ levels in exhaled breath using a capnometer. **Procedures:** Participants will undergo a non-invasive breath analysis using a capnometer, with measurements taken over a 30 Second period.

Risks: The procedure is non-invasive and poses minimal risk.

Benefits: Participants will contribute to research that may improve understanding of respiratory health in smokers and non-smokers.

Appendix B: Capnometer Calibration and Usage

Calibration: The capnometer was calibrated according to the manufacturer's guidelines before each use to ensure accuracy.

Usage: The sensor was positioned near the mouth, and participants were instructed to breathe normally to obtain reliable EtCO₂ measurements.

Appendix C: Detailed Statistical Analysis

Software: Statistical analysis was conducted using SPSS version 25.

Test: Independent t-test was used to compare the mean EtCO₂ levels between smokers and non-smokers.

Results: The t-test showed a significant difference in EtCO₂ levels ($t(48) = 7.12, p < 0.001$), confirming the hypothesis that smokers have higher CO₂ levels in their breath compared to non-smokers.

Conflict of interest Nil

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