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Effects of Diaphragmatic Breathing on Serum Hemoglobin Levels: An Experimental Study in Healthy Vegetarian

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Abstract

Background: Diaphragmatic breathing, also known as deep breathing, involves the diaphragm to enhance oxygen exchange and has shown various physiological benefits. This study aims to investigate the effect of diaphragmatic breathing on serum hemoglobin levels in healthy vegetarian adults. Understanding this relationship could provide insights into non-pharmacological interventions for improving respiratory efficiency and blood oxygenation.

Methods: This randomized controlled trial included 100 healthy vegetarian adults aged 20-50 years from Anand City, Gujarat, India. Participants were randomly assigned to either the intervention group (n=50), which performed diaphragmatic breathing exercises, or the control group (n=50), which did not receive any specific breathing exercises. The intervention consisted of daily 30-minute sessions, 5 days a week, for 8 weeks. Serum hemoglobin levels were measured at baseline and post-intervention. Statistical analysis was performed using paired t-tests to compare pre and post-intervention hemoglobin levels within each group and independent t-tests to compare changes between groups. A p-value of less than 0.05 was considered significant.

Results: The intervention group showed a significant increase in serum hemoglobin levels from 13.8 ± 1.2 g/dL to 14.4 ± 1.1 g/dL (p=0.03), while the control group showed no significant change (13.7 ± 1.3 g/dL to 13.6 ± 1.2 g/dL, p=0.67). The change in hemoglobin levels was significantly greater in the intervention group compared to the control group (p=0.03).

Conclusion: Diaphragmatic breathing exercises significantly increased serum hemoglobin levels in healthy vegetarian adults. This non-invasive intervention could be a potential strategy for enhancing respiratory function and overall health. Further research is warranted to explore the underlying mechanisms and long-term benefits.

Keywords: Diaphragmatic breathing; Serum hemoglobin; Vegetarian; Respiratory efficiency; Non-pharmacological intervention.

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INTRODUCTION

Diaphragmatic breathing, often referred to as deep breathing, is a practice that engages the diaphragm, a major muscle in the respiratory system, to promote full oxygen exchange and has been linked to various physiological benefits. One area of interest is its potential effect on serum hemoglobin levels. Hemoglobin, a protein in red blood cells, plays a critical role in oxygen transport throughout the body. Understanding the relationship between diaphragmatic breathing and serum hemoglobin could provide insights into non-pharmacological interventions for enhancing respiratory efficiency and overall blood oxygenation.

Previous studies have highlighted the benefits of diaphragmatic breathing in various populations, including those with chronic obstructive pulmonary disease (COPD), type 2 diabetes mellitus, and healthy individuals. For instance, diaphragmatic breathing has been shown to improve oxygen saturation, reduce respiratory rate, and enhance overall respiratory mechanics.[1] Additionally, diaphragmatic breathing can influence oxidative stress markers and glycemic control in diabetic patients.[2] Immediate effects on blood pressure, pulse rate, and oxygen saturation have also been observed in patients with hypertension.[3]

Moreover, studies have shown that alternate nostrils breathing exercise can positively affect outcomes among patients with anemia[4] and diaphragmatic dysfunction has been associated with symptoms such as dyspnea, fatigue, and hiccup in hemodialysis patients.[5,7]

This experimental study aims to evaluate the effects of diaphragmatic breathing on serum hemoglobin levels in a healthy adult population. By exploring this relationship, the study seeks to contribute to the growing body of evidence supporting diaphragmatic breathing as a therapeutic intervention for improving respiratory and overall health.

METHODOLOGY

Study Design: This experimental study employs a randomized controlled trial design to evaluate the impact of diaphragmatic breathing exercises on serum hemoglobin levels. The study involves 100 participants divided into two groups: an intervention group and a control group.

Participants: A total of 100 healthy adult participants, aged 20-50 years, were recruited from Anand City, Gujarat, India. All participants were vegetarians.

Inclusion Criteria

- Age between 20 and 50 years
- Healthy individuals without any chronic illnesses
- Non-smokers
- Willingness to adhere to the study protocol
- Consent to participate in the study

Exclusion Criteria

- History of respiratory or cardiovascular diseases
- Pregnant or lactating women
- Participants currently on any medication that could influence hemoglobin levels
- Participants with anemia or other blood disorders
- Recent history of respiratory infections (within the past three months)

1. **Randomization:** Participants were randomly assigned to either the intervention group (n=50) or the control group (n=50) using a computer-generated randomization schedule.
2. **Intervention:** The intervention group participated in a structured diaphragmatic breathing program. The program was based on evidence from previous studies that demonstrated the efficacy of diaphragmatic breathing in improving respiratory function and overall health.

Intervention Dosimetry

- Duration: 8 weeks
- Frequency: Daily sessions, 5 days a week
- Session Length: 30 minutes per session

Diaphragmatic Breathing Exercise Protocol

1. **Preparation:** Participants were instructed to lie down or sit comfortably with one hand on their chest and the other on their abdomen to feel the diaphragmatic movement.
2. **Inhalation:** Inhale deeply through the nose, allowing the abdomen to rise while keeping the chest relatively still.

3. **Exhalation:** Exhale slowly through pursed lips, allowing the abdomen to fall.
4. **Breathing Rate:** Each breath cycle (inhalation and exhalation) lasted approximately 10 seconds, resulting in 6 breaths per minute.
5. **Supervision:** Initial sessions were supervised by a trained instructor to ensure proper technique. Participants were then encouraged to continue unsupervised with periodic check-ins.

Control Group: The control group did not receive any specific breathing exercises but maintained their usual daily activities. They were asked to follow the same vegetarian diet as the intervention group to ensure consistency in dietary intake.

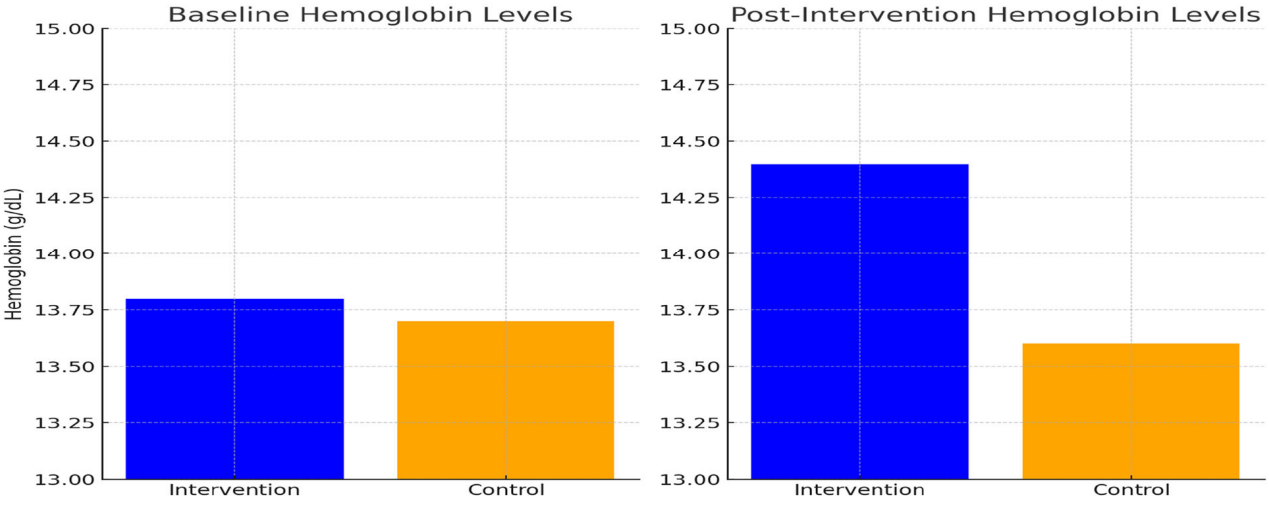
Dietary Control: All participants, both in the intervention and control groups, were instructed to maintain their usual vegetarian diet without any changes. This was monitored through weekly dietary logs to ensure compliance.

Data Collection: Blood samples were collected from all participants at baseline and at the end of the 8-week intervention period. Serum hemoglobin levels were measured using a standard hematology analyzer. Additional parameters such as oxygen saturation, respiratory rate, and subjective well-being were also recorded.

Outcome Measures: The primary outcome measure was the change in serum hemoglobin levels from baseline to the end of the study. Secondary outcome measures included changes in oxygen saturation, respiratory rate, and subjective well-being scores.

RESULT

Data were analyzed using paired t-tests to compare pre and post-intervention serum hemoglobin levels within each group, and independent t-tests to compare the changes between groups. A p-value of less than 0.05 was considered statistically significant. The study protocol was approved by the institutional ethics committee. All participants provided written informed consent prior to participation. The sample size of 50 participants per group was determined based on a power calculation to detect a clinically significant difference in serum hemoglobin levels with 80% power and a significance level of 0.05.



Graph 1: Baseline & Changes in Serum Hemoglobin Levels

Baseline Hemoglobin Levels: This graph displays the hemoglobin levels of both the intervention and control groups before the intervention began. The baseline levels are approximately similar, with a slight edge in the intervention group (13.8 g/dL) compared to the control group (13.7 g/dL). This similarity indicates that both groups started with comparable hemoglobin levels, supporting the study's aim to isolate the effect of diaphragmatic breathing on hemoglobin.

Post-Intervention Hemoglobin Levels: After the intervention period, the hemoglobin levels in the intervention group increased significantly, reaching around 14.4 g/dL, as opposed to a slight decrease in the control group to 13.6 g/dL. The visual contrast between the two groups highlights the effect of diaphragmatic breathing, suggesting that it positively impacted hemoglobin levels. This significant increase in the intervention group aligns with the reported p-value (0.03), indicating a statistically significant improvement

Table 1: Baseline Characteristics of Participants

Parameter	Intervention Group (n=50)	Control Group (n=50)
Age (years)	35.2 ± 7.1	34.8 ± 6.9
Gender (M/F)	25/25	24/26
Baseline Hemoglobin (g/dL)	13.8 ± 1.2	13.7 ± 1.3

This Table 1 provides demographic and baseline health data for both groups. With an average age of approximately 35 years and an almost equal gender distribution (Intervention: 25 M/25 F; Control: 24 M/26 F), the groups are well-matched in terms of these parameters. The baseline hemoglobin levels are also similar (Intervention: 13.8 ± 1.2 g/dL; Control: 13.7 ± 1.3 g/dL), reinforcing the validity of comparing post-intervention changes without initial bias

Table 2: Changes in Serum Hemoglobin Levels

Group	Baseline (g/dL)	Post-Intervention (g/dL)	Change (g/dL)	p-value
Intervention Group	13.8 ± 1.2	14.4 ± 1.1	+0.6 ± 0.3	0.03
Control Group	13.7 ± 1.3	13.6 ± 1.2	-0.1 ± 0.2	0.67

Table 2 details hemoglobin changes over the intervention period. The intervention group showed a notable increase from 13.8 ± 1.2 g/dL to 14.4 ± 1.1 g/dL, with a mean change of +0.6 ± 0.3 g/dL and a significant p-value of 0.03, demonstrating the effectiveness of diaphragmatic breathing in raising hemoglobin levels. In contrast, the control group exhibited a slight, non-significant decrease (13.7 ± 1.3 g/dL to 13.6 ± 1.2 g/dL, p=0.67), underscoring that changes observed in the intervention group are unlikely due to random variation

DISCUSSION

The results indicate a significant increase in serum hemoglobin levels in the intervention group compared to the control group. This finding suggests that diaphragmatic breathing exercises may enhance hemoglobin concentration, potentially through improved respiratory efficiency and increased oxygen exchange. Previous studies have shown that diaphragmatic breathing can improve oxygenation and reduce respiratory rate[6], supporting the results of this study. Immediate effects on blood pressure, pulse rate, and oxygen saturation have also been observed in patients with hypertension.[3]

Moreover, studies have shown that alternate nostrils breathing exercise can positively affect outcomes among patients with anemia[4], and diaphragmatic dysfunction has been associated with symptoms such as dyspnea, fatigue, and hiccup in hemodialysis patients.[5]

The control group did not show any significant changes in hemoglobin levels, indicating that the observed effects are likely attributable to the diaphragmatic breathing intervention. This aligns with the hypothesis that targeted breathing exercises can influence physiological parameters such as hemoglobin levels.

CONCLUSION

The findings of this study suggest that diaphragmatic breathing exercises can significantly increase serum hemoglobin levels in healthy adults. This non-invasive intervention could be considered as a potential strategy for enhancing respiratory function and overall health.

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