

# A Heat and Moisture Exchange Mask Improves Cardiopulmonary Function in COPD Patients during Cold Exposure

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## ABSTRACT

COPD is the fourth leading cause of death in the U.S. It is well known that cold air inhalation exacerbates cardiopulmonary stress in the COPD patient. Therefore, minimizing cold air exposure is critical in maintaining the health and functional capacity of these individuals. A heat and moisture exchange mask (HME) warms and humidifies the cold, dry inspired air via latent heat exchange. However, it is not known if COPD patients would benefit from such a mask. The purpose of this study was to study the influence of an HME on pulmonary and cardiovascular responses in COPD patients during 60 min of -7C exposure. Methods. Five COPD patients (stage I: n=3, stage II: n=2) completed 4 intervals of cycling for 5 minutes at 30W followed by 10 minutes seated rest (60 minutes cold exposure time). Patients wore the HME or no mask (NM) during cold exposure in this crossover design study. Results. Relative change and absolute systolic BP at 60 min was less ( $p < .025$ ) in the HME trial than NM trial,  $3 \pm 5.0$  mmHg v.  $19.5 \pm 2.5$  mmHg and  $134.5 \pm 9.0$  mmHg v.  $143.5 \pm 7.4$  mmHg. % Change from baseline was significantly different between HME and NM at 5 min post exposure for FVC ( $4.6 \pm 5.9\%$  v.  $-5.1 \pm 7.3\%$ ), FEV1 ( $7.13 \pm 8.2\%$  v.  $-4.63 \pm 8.8\%$ ), and FEV.5 ( $7.9 \pm 9.0\%$  v.  $-5.9 \pm 11.3\%$ ). One subject was unable to complete the exercise under the NM trial, but was able to complete the 4 intervals during the HME trial. Conclusions. Wearing an HME during cold exposure significantly improves cardiovascular and pulmonary function in the COPD patient compared to not wearing a mask. The results also indicate that functional capacity can be improved in COPD patients when an HME is worn during cold exposure.

## INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the 4th largest cause for mortality in the U.S. and the world. COPD is the only major disease, which is experiencing an increase in death rate. The NHLBI has estimated the cost for treatment of COPD to be \$32 billion. Hospitalization of a COPD patient is most often caused by an exacerbation. There is much research that has concluded that there is a significant seasonality to hospitalizations for COPD with the peak being closely related to the coldest periods of the year. The length of hospitalization stay has also been demonstrated to be longest in the winter with an average increase of 2+ days during the winter season. In addition, it is well known that there is a very common comorbidity of hypertension along with COPD.

Treatment methods for COPD include the use of medication as well as respiratory therapy. Exercise and diet have been found to be important contributors to improved quality of life for the COPD patient. Exercising with COPD in the winter can often be limited due to the discomfort and pain often experienced during the inhalation of cold air. When a COPD patient has difficulty inhaling cold air, it often leads to a significant limitation to outdoor activities, which certainly include exercise as well as a decrease in the quality of life. Clinical experience in colder regions shows that COPD patients often reduce their exercise, become house bound, and present an increase in weight. It is no surprise that a COPD patient who experiences dyspnea during cold air inhalation will respond by limiting exposure to cold air. The problem is that these patients cannot entirely prevent even small exposures to cold air. The common methods for protection from cold air inhalation, such as the use of a scarf or covering the face with one's hand, have not demonstrated effective protection. Since there are direct connections between the mechanisms of both cardiovascular and pulmonary stress, it appears that further investigation into the possible clinical benefits of an HME mask used by COPD patients is warranted.

The scope of this investigation is based on earlier studies that have been performed which have had narrower focus but have resulted in progressive understanding of the mechanisms behind the stress of cold air inhalation and possible methods for reducing this stress which may have important clinical benefit within the COPD population.

## PURPOSE

The purpose of this study was to study the influence of an HME on pulmonary and cardiovascular responses in COPD patients during 60 min of -7C exposure.

## METHODS

- Five COPD patients (stage I: n=3, stage II: n=2) volunteered
- Exercise/rest intervals performed at -7C
- Completed 4 intervals of cycling for 5 minutes at 30W followed by 10 minutes seated rest (60 minutes cold exposure time)
- Patients wore the HME (AirGuard Medical) or no mask (NM) during cold exposure in this crossover design study
- Pulmonary function was tested pre- and 5 min post cold exposure in room temperature (Jones Spirometer)
- Blood pressure was measured via auscultatory method
- Blood pressure data was collected at the end of each 10 min seated rest
- Data was analyzed using repeated measures ANOVA. Significance was established at  $p < 0.05$ .

## RESULTS

Relative change and absolute systolic BP at 60 min were less ( $p < .025$ ) in the HME trial than NM trial,  $3 \pm 5.0$  mmHg v.  $19.5 \pm 2.5$  mmHg and  $134.5 \pm 9.0$  mmHg v.  $143.5 \pm 7.4$  mmHg.

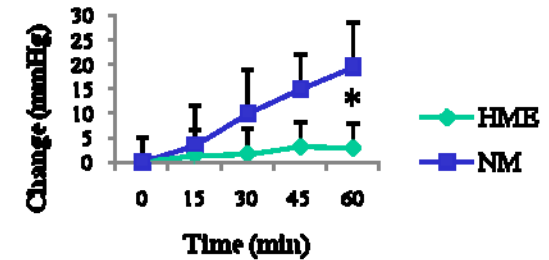
% Change from baseline was significantly different between HME and NM at 5 min post exposure for FVC ( $4.6 \pm 5.9\%$  v.  $-5.1 \pm 7.3\%$ ), FEV1 ( $7.13 \pm 8.2\%$  v.  $-4.63 \pm 8.8\%$ ), and FEV.5 ( $7.9 \pm 9.0\%$  v.  $-5.9 \pm 11.3\%$ ).

One subject was unable to complete the exercise under the NM trial, but was able to complete the 4 intervals during the HME trial.

## CONCLUSIONS

The results indicate that functional capacity can be improved in COPD patients when an HME is worn during cold exposure. Blood pressure was maintained during the cold and exercise by use of the HME, while it increased significantly when subjects did not wear the mask. Pulmonary function was improved, compared to the NM trial, when combining exercise and use of the HME.

## Change in Blood Pressure



## Pulmonary Function

