UNDERSEA & HYPERBARIC MEDICINE

# Effect of hyperbaric exposure on pulmonary functions in hyperbaric chamber inside attendants

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**ABSTRACT**

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**Objective:** The objective of the study was to compare pulmonary function tests results of hyperbaric chamber inside attendants (HCIAs) working in a hyperbaric chamber before and after sessions.

**Methods:** A total of 68 health care personnel working as HCIAs in the hyperbaric oxygen therapy unit between June 2019 and September 2019 were included in the study. All participants experienced the pressure chamber for the first time. In spirometric evaluation, we measured forced vital capacity (FVC), forced expiratory volume at one second ($FEV_1$), forced expiratory flow at 25%-75% of FVC ($FEF_{25-75}$) and peak expiratory flow (PEF). In addition, $FEV_1$/FVC ratio (FEV1%) was also calculated.

**Results:** The mean FVC was found as 3.56 ± 0.66 (min-max: 2.17-5.63) before hyperbaric exposure and 3.44 ± 0.62 (min-max: 2.30-5.28) after the exposure (3.4%) ($p<0.05$). The mean $FEV_1$ was found as 3.37 ± 0.63 (2.13-5.39) before the session and 3.24 ± 0.59 (min-max: 2.3-5.28) after the session (3.9%) ($p<0.05$). There was no statistically significant difference between the mean $FEV_1$/FVC ratio, PEF and $FEF_{25-75}$ measured before and after hyperbaric exposure.

**Conclusion:** The results of this study indicated that among pulmonary function test parameters, decreases were found in $FEV_1$, FVC, $FEF_{25-75}$, PEF, but clinical significance has not been established.

**KEYWORDS:** hyperbaric medicine; hyperbaric oxygen therapy; pulmonary function

## INTRODUCTION

Hyperbaric oxygen ($HBO_2$) therapy has evolved as an important treatment method for numerous diseases and injuries. The Undersea and Hyperbaric Medical Society (UHMS) defines $HBO_2$ as an intervention in which an individual breathes near-100% oxygen intermittently while inside a hyperbaric chamber that is pressurized to greater than sea-level pressure in atmospheres absolute (ATA). For clinical purposes, the pressure must equal or exceed 1.4 ATA while breathing near-100% oxygen [1]. $HBO_2$ therapy can be provided in monoplace chambers or multiplace chambers which have a capacity for many patients.

Hyperbaric chamber inside attendants (HCIAs) accompany patients for technical support, medical care and intervention in case of emergency during $HBO_2$ therapy in multiplace chambers. These HCIAs perform tasks such as preparation of the session and monitoring during the session (both patients and equipment) [2]. Thus, they can be exposed to various health risks. Unlike the patients, HCIAs do not inhale 100% oxygen despite the fact that they are in the same chamber and are subject to repetitive chamber sessions. HCIAs inhale pressurized air while in the chamber and are still at risk of developing decompression illness (DCI), barotrauma, and the detrimental effects that can be caused by these illnesses on various systems and organs of the body. The incidence of DCI has been reported as 0-37/100,000 hyperbaric sessions and although rarely seen, DCI may lead to serious outcomes [3]. In order to prevent DCI, HCIAs usually inhale oxygen at the end of the isobaric phase and during decompression [4].

Hyperbaric exposure may also affect pulmonary functions. Exposure to high oxygen partial pressure may increase oxidative stress through free radicals, inducing inflammatory processes. Hyperoxia has been associated with lung injury, causing destruction of endothelial and type I cells and hypertrophy of type II cells with interstitial edema, as well as causing inflammatory accumulation in the intra- and extravascular spaces [5].

Because of these changes, individuals with preexisting airway obstruction may be at increased risk of pulmonary barotrauma, making it a relative contraindication to work in a hyperbaric environment. Evaluation of pulmonary functions is of paramount importance in HCIAs working under these conditions. However, studies investigating the effects of hyperbaric exposure on pulmonary functions of HCIAs are very limited, with only a few studies in the literature. The objective of this study was to compare pulmonary function tests (PFT) results of HCIAs working in a hyperbaric chamber before and after a session.

## METHODS

This study was conducted during a period when regular HCIAs working in $HBO_2$ therapy unit were sent out of town for education. During this time, nurses and paramedics working in all clinics within the hospital were assigned as HCIAs based on the hospital administrative decision in order to ensure that the service was not interrupted. All new HCIAs received six-hour theory training from the undersea and hyperbaric medicine physician who was staffing the $HBO_2$ therapy unit. Additionally, prior to starting their duties, HCIAs performed two-session observation and two-session practice, all under the supervision of a certified hyperbaric registered nurse (CHRN) and a certified hyperbaric technologist (CHT). In the observation sessions the new HCIA and the CHRN were both in the hyperbaric chamber. The new HCIA observed only from beginning to end of each session. During practice sessions only the new HCIA was inside the hyperbaric chamber, while the CHRN observed from outside the chamber. The CHRN was ready to intervene in case of emergency.

All participants fulfilled this task during the first session. All HCIAs underwent medical screening according to the UHMS *Guidelines for Multiplace Inside Attendants Medical Fitness to Work* 2018 [6] as well. Of the 77 participants, two were excluded from the study because they were pregnant, two had a history of asthma, one reported a history of epilepsy, and two had a previous history of pneumothorax. Two of the remaining 70 participants could not be included in the study because of ear equalizing problems. Finally, a total of 68 health care personnel working as HCIAs in HBO2 therapy unit of our hospital between June 2019 and September 2019 were included in the study.

Participants' demographic data including race, age, gender, weight and height were recorded. Participants were weighed, and their height was measured in indoor clothing without shoes using a calibrated scale and stadiometer, respectively. Age was recorded as to the nearest birthday. Body mass index (BMI) was calculated by dividing height by square of weight. In addition, history of atopy and smoking habits of HCIAs were also recorded.

### Hyperbaric oxygen therapy protocol

$HBO_2$ treatments were performed for sessions of 90 minutes at 2.5 ATA (250 kPa). For protection against DCI all HCIAs inhaled 100% oxygen during the last 15 minutes of the isobaric phase and until leaving the pressure chamber.

PFTs were performed in all participants before and after the first observational session of $HBO_2$ by a pulmonologist according to the method previously described in the literature (the PFT results were considered on the best of three approaches according to the European Respiratory Society [7]. In our study, all PFTs were conducted and interpreted by a single pulmonologist with the same device and components (Spirodoc, MIR Research & Development, Via del Maggiolino, Italy), in the same room (under the same air, temperature, light and noise conditions) immediately before entering and after leaving the pressure chamber in order to provide standardization. The spirometer was regularly calibrated before each use in compliance with the recommendations of the manufacturer. PFT results before the session were taken as the baseline values. Participants did not smoke just before the $HBO_2$ and PFT assessments.

In spirometric evaluation forced vital capacity (FVC, mL), forced expiratory volume at one second ($FEV_1$, mL), forced expiratory flow at 25%-75% of FVC ($FEF_{25-75}$, mL/s) and peak expiratory flow (PEF, L/min) were measured and recorded. In addition, $FEV_1$/FVC ratio was calculated.

Before the beginning of the study, ethics committee approval was received from the Non-Invasive Clinical Research Ethics Committee of Pamukkale University (Denizli/Turkey), with the registration number of 11 on 11/06/2019. All participants were informed about the study in detail and gave verbal and written consent. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

### Statistical analysis

Data obtained in the study were analyzed using SPSS for Windows version 21.0 statistical package software. Student's t-test and analysis of variance (ANOVA) test were used for the analysis of parametric variables. Non-parametric variables were analyzed using the Mann-Whitney U test and the Kruskal-Wallis test. Normally distributed variables are expressed as descriptive statistics mean, standard deviation, minimum and maximum values. Qualitative variables are given as number and percentage. Values of $p<0.05$ were considered statistically significant.

## RESULTS

A total of 68 HCIAs who entered the hyperbaric chamber for the first time were included in the study. Of all participants, 11 (16%) were male, 57 (84%) were female and 68 (100%) were of Caucasian race. The mean age of participants was 21.19 ± 1.72 (min-max: 19-26) years; mean height was 165.60 ± 7.263 cm (min-max: 145-182); mean weight was 60.07 ± 9.864 kg (min-max: 42-88); and mean body BMI value was 21.44 ± 3.392 kg/m$^2$ (min-max: 16-33).

When the participants were evaluated according to BMI, 56 participants (82.2%) had a normal BMI, 11 participants (16.1%) were overweight and one participant (0.01%) was obese. Five participants (7.4%) had a history of atopy. Number of participants who actively smoked was 32 (41.1%). Demographic features of the participants are given in Table 1.

When the PFTs of HCIAs were evaluated, the mean FVC was 3.56 ± 0.66 L (min-max: 2.17-5.63) before hyperbaric exposure and 3.44 ± 0.62 L (min-max: 2.30-5.28) after the exposure. There was a 3.4% statistically significant decrease in the mean FVC after hyperbaric exposure ($p<0.05$).

The mean $FEV_1$ of HCIAs was 3.37 ± 0.63 L (min-max: 2.13-5.39) before the session and 3.24 ± 0.59 L (min-max: 2.30-5.28) after the session. There was a 3.9% statistically significant decrease in the mean $FEV_1$ after hyperbaric exposure ($p<0.05$).

The mean $FEV_1$/FVC ratio of HCIAs was 94.43 ± 5.22% (min-max: 82-100) before hyperbaric exposure and 94.51 ± 5.43 % (min-max: 74.7-100) after the exposure. There was no statistically significant difference in the mean $FEV_1$/FVC ratios after hyperbaric exposure ($p=0.90$).

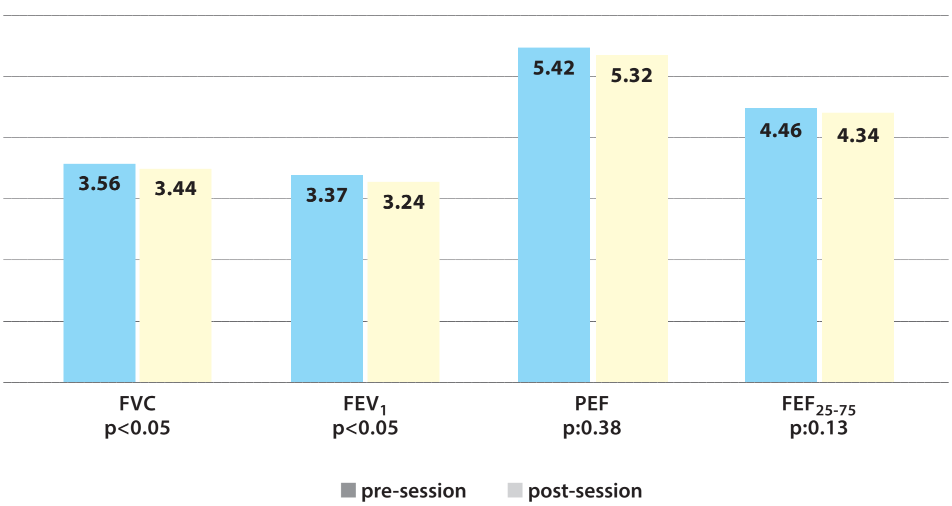
The mean PEF of HCIAs was measured as 5.42 ± 1.47 L/sec (min-max: 2.94-10.41) before hyperbaric exposure, while it was found as 5.32 ± 1.49 L/sec (min-max: 3.22-11.44) after the exposure. There was no statistically significant difference in the mean PEF after hyperbaric exposure ($p=0.38$).

**Table 1. Demographic data of the participants**

| | n | % | mean | SD | min-max |
|---|---|---|---|---|---|
| **age** (years) | | | 21.19 | 1.721 | 19-26 |
| **gender** | | | | | |
| male | 11 | 16.1 | | | |
| female | 57 | 83.8 | | | |
| **height** (cm) | | | 165.60 | 7.263 | 145-182 |
| **weight** (kg) | | | 60.07 | 9.864 | 42-88 |
| **BMI** (kg/m$^2$) | | | 21.44 | 3.392 | 16-33 |
| normal (18,5-24,9) | 56 | 82.2 | | | |
| overweight (25-29,9) | 11 | 16.1 | | | |
| obese (30.0-39,9) | 1 | 0.01 | | | |
| **history of atopy** | | | | | |
| yes | 5 | 7.4 | | | |
| no | 63 | 92.6 | | | |
| **smoking** | | | | | |
| yes | 32 | 41.1 | | | |
| no | 36 | 58.9 | | | |

BMI: body mass index

**Figure 1. Comparison of pulmonary function test results before and after hyperbaric session**




FVC: forced vital capacity; $FEV_1$: forced expiratory volume in 1 second;
PEF: peak expiratory flow; $FEF_{25–75}$: forced expiratory flow at 25–75% of FVC

The mean $FEF_{25-75}$ of HCIAs was found as 4.46 ± 1.06 L/sec (min-max: 2.55-9.06) before hyperbaric exposure and 4.34 ± 1.08 L/sec (min-max: 2.53-9.25) after the exposure. There was no statistically significant difference in the mean $FEF_{25-75}$ after hyperbaric exposure (p=0.13). The results of PFTs performed before and after the session of hyperbaric exposure are shown in Figure 1.

In a substantial portion of HCIAs, PFT values changed by more than 5%. In 23 participants, mean FVC decreased 10.13 ± 4.83 % (5.0-23.0), in 28 participants mean $FEV_1$ decreased 10.23 ± 5.38 % (5.0-23.0), in 25 participants mean $FEF_{25-75}$ decreased 16.46 ± 9.36 % (5.2-39.1) and in 27 participants the mean PEF decreased 15.06 ± 9.20% (5.1-41.1). It was found that just the weight was the significant factor in decreasing more than 5% for $FEV_1$ and FVC (Table 2).

## DISCUSSION

In the present study, effects of hyperbaric exposure on pulmonary functions in HCIAs were investigated. For this purpose, parameters obtained from the PFTs performed before and after the hyperbaric exposure sessions were compared.

When breathing under normal conditions the inspired gas mixture consists of 78% nitrogen, 21% oxygen and other trace elements. In the hyperbaric chamber, composition of the inspired gas is comparable with sea level, but it is denser. For example, at a depth of 30 meters, air density is approximately four times greater than at sea level. Breathing air at 40 meters' depth is equivalent to inhaling 100% oxygen at surface. Therefore, divers' lungs are exposed to oxygen at a higher partial pressure. HCIAs breathe pressurized air during an $HBO_2$ therapy session, an experience similar to that of divers. $HBO_2$ clinical treatments are between 10-15 meters, where the partial pressures of oxygen are elevated but only slightly. The increased oxygen partial pressure during a session as well as the 100% oxygen breathed at the end of the treatment may contribute to the impairment of pulmonary functions due to the oxygen toxicity. During compression, nitrogen molecules diffuse into the body tissues, whereas during decompression this diffusion reverses and tissue nitrogen pressure exceeds alveolar nitrogen pressure. Nitrogen gas microbubbles may evolve from the existing gas nuclei and transfer to the pulmonary microvasculature. These inert gas microemboli may cause inflammatory stress on the pulmonary microvasculature, which in turn negatively affects pulmonary function [8].

To our best knowledge, our study is the first to investigate the effects of hyperbaric exposure on pulmonary functions of HCIAs after one $HBO_2$ therapy session. There were only two studies in the literature investigating effects of $HBO_2$ therapy on pulmonary functions of HCIAs, first conducted by Ozdemir et al. [9]. This study evaluated the PFT at baseline and after 12 months. They found that $FEV_1$, $FEV_1$/FVC and $FEF_{25-75}$ were significantly reduced in study and control groups after 12 months. However, the rate of change in all parameters was similar in both groups (p>0.05). The other study by Poolpol et al. investigated the effects of $HBO_2$ therapy on pulmonary function on 51 HCIAs with a mean follow-up of 9.26 years. The HCIAs showed a significant decrease in measured pulmonary functions in mean $FEV_1$, $FEF_{25-75}$ and $FEV_1$/FVC ratios over time [10]. Although these changes are small and could be considered in the realm of normal variability, this study supports the idea that working in a hyperbaric environment may affects lung function of HCIAs. In our study we found decreases in PFTs but not determine clinical significance.

Other studies in the literature mostly include the effects of $HBO_2$ therapy on patients themselves and divers. Study periods are highly variable. There are some studies reporting a decrease in FVC of divers (Table 3) [11-13]. In our study, the mean FVC of HCIAs was decreased after hyperbaric exposure compared to before exposure. However, it should be kept in mind that in our study PFTs were performed before and after a single session.

Poolpol et al. [10] studied 51 HCIAs, Fitzpatrick et al. [11] reviewed 43 commercial divers, Zrane et al. [12] looked at 12 scuba divers, Skogstad et al. [13] studied 77 professional divers, Thorsen, et al. [14]

**Table 2. Comparison of demographic factors to pulmonary function test parameters**

| PFT Variables | Decrease less than 5% | Decrease more than 5% | p |
|---|---|---|---|
| **$FEV_1$** | | | |
| N | 40 (58.8%) | 28 (41.2%) | |
| sex | 6 male (15.0%), 34 female (85.0%) | 5 male (19.9%), 23 female (82.1%) | 0.76 |
| age (year) | 20.93± 1.56 (19-26) | 21.57 ± 1.89 (19-25) | 0.13 |
| height (cm) | 165.10 ± 6.74 (145-180) | 166.32 ± 8.03 (155-182) | 0.50 |
| weight (kg) | 57.48 ± 6.73 (47-73) | 63.79 ± 12.32 (42-88) | **0.008** |
| BMI (kg/m$^2$) | 20.68 ± 2.47 (17-26) | 22.54 ± 4.19 (16-33) | **0.03** |
| atopy (n=5) | 2 | 3 | 0.38 |
| smoker (n=32) | 20 | 12 | 0.57 |
| **FVC** | | | |
| N | 45 (66.2%) | 23 (33.8%) | |
| sex | 6 male (13.3%), 39 female (86.7%) | 5 male (%21.7%), 18 female (78.3%) | 0.38 |
| age (year) | 21.24 ± 1.82 (19-26) | 21.09 ± 1.54 (19-25) | 0.72 |
| height (cm) | 165.04 ± 6.83 (145-182) | 166.70 ± 8.09 (156-182) | 0.38 |
| weight (kg) | 58.38 ± 7.58 (45-76) | 63.39 ± 12.81 (42-88) | **0.05** |
| BMI (kg/m$^2$) | 20.98 ± 2.69 (16-27) | 22.35 ± 4.39 (16-33) | 0.12 |
| atopy (n=5) | 4 | 1 | 0.51 |
| smoker (n=32) | 22 | 10 | 0.68 |
| **$FEF_{25-75}$** | | | |
| N | 43 (63.2%) | 25 (36.8%) | |
| sex | 8 male (18.6%), 35 female (81.4%) | 3 male (12.0%), 22 female (88.0%) | 0.48 |
| age (year) | 21.05 ± 1.60 (19-26) | 21.44 ± 1.92 (19-25) | 0.37 |
| height (cm) | 164.95 ± 7.07 (145-180) | 166.72 ± 7.60 (155-182) | 0.34 |
| weight (kg) | 59.14 ± 8.76 (42-82) | 61.68 ± 11.54 (45-88) | 0.31 |
| BMI (kg/m$^2$) | 21.35 ± 3.51 (16-33) | 21.60 ± 3.24 (16-29) | 0.77 |
| atopy (n=5) | 2 | 3 | 0.27 |
| smoker(n=32) | 22 | 10 | 0.38 |
| **PEF** | | | |
| N | 41 (34.1%) | 27 (65.9%) | |
| sex | 9 male (%21.9), 32 female (%78.4) | 2 male (%7.4), 25 female (%92.6) | 0.11 |
| age (year) | 21.17 ± 1.66 (19-25) | 21.22 ± 1.85 (19-25) | 0.91 |
| height (cm) | 165.63 ± 7.95(145-182) | 165.56 ± 6.22(155-178) | 0.97 |
| weight (kg) | 59.39 ± 9.19 (42-82) | 61.11 ± 10.90 (45-88) | 0.49 |
| BMI (kg/m$^2$) | 21.24 ± 3.50 (16-33) | 21.74 ± 3.27 (16-29) | 0.56 |
| atopy (n=5) | 2 | 3 | 0.340 |
| smoker (n=32) | 21 | 11 | 0.41 |

$FEV_1$: forced expiratory volume in 1 second; FVC: forced vital capacity;
$FEF_{25-75}$: forced expiratory flow at 25-75% of FVC; PEF: peak expiratory flow

**Table 3. Results of the studies**

| authors (publication yr) | population (n) breathing gas | PFT measurements before and after $HBO_2$ treatment (amount of decrease) | | | |
|---|---|---|---|---|---|
| | | FEV$_1$[a] | FVC[b] | FEF$_{25-75}$[c] | PEF[d] |
| Ozdemir A, et al. [9] (2016) | 11 ICAs air | no significant change | NR | no significant change | NR |
| Poolpol P, et al. [10] (2016) | 51 ICAs air | significantly decreased (22.52 mL per year) | no significant change | significantly decreased (44.92 mL/s per year) | NR |
| Fitzpatrick DT et al. [11] (2003) | 42 commercial divers 46% $O_2$ | 5.5% $p<0.001$ | 6.3% $p<0.001$ | no significant change | no significant change |
| Zrane A et al. [12] (2017) | 12 scuba divers air | 2.3% $p<0.05$ | 2.7% $p<0.05$ | NR | 2.9% $p<0.05$ |
| Skogstad M et al. [13] (2002) | 77 professional divers air | 3.3% $p<0.05$ | 2.1% $p<0.05$ | 4.0% $p<0.05$ | 2.7% $p<0.05$ |
| Thorsen E et al. [14] (1998) | 20 $HBO_2$ patients 100% $O_2$ | 3.5% $p<0.001$ | no significant change | 10.7% | no significant change |
| Sames C et al. [15] (2009) | 336 commercial divers air | 0.27% decrease after NHANES III equations $p=0.02$ | no significant change | no significant change | 0.47% decrease after NHANES III equations $p=0.04$ |
| Tetzlaff K et al. [16] (2006) | 468 scuba divers air | 3.7% decrease | no significant change | no significant change | NR |
| Voortman M et al. [17] (2016) | 1260 Navy divers air and $O_2$ | no significant change | no significant change | 23 mL/s/year decrease for FEF$_{75}$ | NR |
| Mirasoglu B et al. [18] (2018) | 73 scuba divers air | no significant change | no significant change | 8.5% | no significant change |
| our study [19] (2019) | 68 ICAs air | $p<0.05$ | $p<0.05$ | $p=0.13$ | $p=0.38$ |

[a] FEV$_1$: forced expiratory volume in 1 second; [b] FVC: forced vital capacity;
[c] FEF$_{25-75}$: forced expiratory flow at 25–75% of FVC; [d] PEF: peak expiratory flow; NR: not reported

looked at 20 $HBO_2$ patients, and Sames et al. [15] reviewed 336 commercial divers; all reported a decrease in FEV$_1$. In addition, Tetzlaff et al. followed up the divers five years later and reported that there was a 3.7% decrease in FEV$_1$ but saw no difference in the control group [16]. In our study the mean FEV$_1$ of HCIAs was lower after hyperbaric exposure compared to before. Furthermore, change patterns in FEV$_1$ over time cannot be expected to be same between divers and HCIAs, because durations and ways of exposure to pressurized air may differ. It may also be considered that the professional divers may be more tolerant of pulmonary changes than healthcare professionals.

Studies examining FEF$_{25-75}$ parameter have reported a decrease over time (Table 3) [10,13,14,17-19]. In our study the mean FEF$_{25-75}$ was lower after the session compared to before one, although the difference was not statistically significant.

A decrease in PEF has also been shown in some studies (Table 3) [12,13,15]. In our study PEF was lower after the session compared to the one before the session. However, no significant difference was found (Table 2).

Rojas and Goldman found that both $FEV_1$ and FVC showed a change by 2.8% at the measurements taken at the same time every day on five consecutive days. In the same study the authors reported that a daily change up to 5% can be considered usual in patients with previously normal PFT results, but a decrease higher than 5% should be considered a significant change [20]. In our study, the changes in mean values in $FEV_1$ and FVC were statically significant but not clinically significant according to the National Health and Nutrition Examination Survey (NHANES) and the American Thoracic Society (ATS) and because of being under 5% [21,22]. Additionally, in a substantial portion of HCIAs, PFT values changed by more than 5%. We compared the groups whose PFTs decreased less or more than 5% in terms of sex, age, height, weight, BMI, atopy and smoking habits. We found that just the weight was the significant factor in decreases greater than 5% for $FEV_1$ and FVC. Kangal et al. studied the factors on PFT parameters in occupational divers and found that smoking showed no significant influence. [19].

### Limitations and strengths

This study has some limitations. Our participants had no typical and general characteristics of regular HCIAs. Our participants were very young, many were smokers, had a history of atopy and experienced the pressure chamber for the first time. This might have affected their ability to adequately participate in PFT measurements since PFT results can be skewed by problems with volitional effort and lack of concentration. In addition, there was a significant proportion of women in the study, and all participants were Caucasian. This further makes the ability to generalize the results more difficult.

In our study, PFTs were performed before and after the session in all HCIAs; no additional tests were carried out. Further studies are needed in order to understand whether the decrease found in PFTs is permanent.

Our study has several strengths. It has a prospective design with a high number of HCIAs, and it is the first study in the literature investigating effects of hyperbaric exposure on pulmonary function of HCIAs after a single session. Evaluation of long-term effects of hyperbaric exposure on pulmonary functions may have confounding factors such as smoking or diseases. It is important to investigate short-term effects of hyperbaric exposure on pulmonary function in order to better understand the exact effects of hyperbaric exposure itself.

## CONCLUSION

The results of this study indicated that among PFT parameters, decreases due to various factors were found in $FEV_1$, FVC, $FEF_{25-75}$, PEF, but the clinical significance has not been established because the test population was smaller than 5%. With respect to HCIAs we do not yet know if those small incremental changes which may be in the realm of normal variability are clinically significant for HCIAs. Therefore, PFT measurements taken before and after the first session may be more helpful in the selection of HCIAs and determination of susceptible individuals.

Additionally, weight seems to be a significant factor for FVC and $FEV_1$ in decreases of more than 5%. Given the scarcity of studies in the literature on this issue, further studies are needed in order to clarify the effects of hyperbaric oxygen on the pulmonary function of inside attendants.

■

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