

# Prevalence of chronic obstructive pulmonary disease and correlation with occupational exposure in milos milos Island in Greece

## Abstract

**Aims:** Evaluation of general health level of residents of Milos Island and through respiratory functional testing, bone density measurement in correlation with occupational and environmental exposure.

**Case:** Study protocol consisted of only one visit during which nativity, demographic characteristics, risk factors, occupational exposure, comorbidities and current medication were recorded and FEV1, FVC, FEV1/FVC, SatO<sub>2</sub>% and T-score were measured. The participants were over 35 years of age. For the description of the qualitative variables, absolute (number of observations) and relative frequencies (percentages) were used.

**Results:** 181 residents fulfilled the inclusion criteria of the study. 5.5% of the participants suffered from COPD, while 22.1% of the study population was exposed to perlite or other mineral dust. According to our analysis it is shown that COPD and occupational exposure to mineral dust are not correlated. Osteoporosis and osteopenia were recorded in 10.5% of the cases. Other co-morbidities recorded were hypothyroidism and eye disorders.

**Conclusion:** The prevalence of the patients with COPD (5.5%) is lower than the rates established in previous studies for the general population. The majority of the study population (77.9%) was not exposed to perlite, bentonite, caoline or asbestos. The exposure degree of the population probably plays a crucial role in the impact of mineral dust on its general health level.

**Keywords:** COPD, perlite, osteoporosis, milos island, bentonite, caoline, asbestos chronic obstructive, FVC, pulmonary disease, FEV, threshold limit value

Volume 3 Issue 3 - 2015

Eleni Bania,<sup>1</sup> Ilias Apostolopoulos,<sup>2</sup> Zampeta Kiritsi,<sup>2</sup> Ioanna Ninou,<sup>2</sup> Viorelis Drougias,<sup>1</sup> Stergios Giotas,<sup>1</sup> Dimitris Maroulis,<sup>3</sup> Ilias Zoidakis,<sup>3</sup> Konstantinos Gourgoulis<sup>1</sup>

<sup>1</sup>Department of Pneumology, University of Thessaly, Greece

<sup>2</sup>General Practitioner, Director of Milos Health Center, Greece

<sup>3</sup>Physical therapist, Angelini Pharma Hellas, Greece

**Correspondence:** Eleni Bania, Pneumologist, PhD Candidate of Medical School, University of Thessaly, Clinic, Lampra 15–Girokomeio, Greece, Tel 0030 6958008644, Email bania.eleni@hotmail.com

**Received:** November 04, 2015 | **Published:** December 03, 2015

**Abbreviations:** COPD, chronic obstructive pulmonary disease; EU, European union; FEV1, forced expiratory volume in 1 second; FVC, forced vital capacity; GOLD, global initiative for chronic obstructive lung disease; TLV, threshold limit value; TWA, time weighted average

## Introduction

The adverse effect of mineral dust on general health level of the population has been widely studied lately. The research interest has been mainly focused on the respiratory function of coal miners and workers exposed to silica and asbestos containing dust<sup>1–3</sup> because a significant increase in COPD independent of smoking has been observed.<sup>4–5</sup> Among the materials considered hazardous for workers' health are perlite, bentonite and caoline.<sup>6</sup> Perlite is an amorphous volcanic glass that has relatively high water content. It is mainly used as a soil conditioner, packaging material, construction insulator, agriculture substrate and as a filter aid. Perlite is regarded as a generally safe material, and the threshold limit value for perlite is 5mg/m.<sup>7,8</sup> Bentonite is a clay mineral, which contains silica in percentages which range from 1–20%. Up to date, several studies<sup>9–11</sup> have shown that exposure especially occupational—to silica, may be associated mainly with lung and kidney malignancies in workers. Researchers found that bentonite particles may induce cytotoxicity and oxidative stress, as well as genotoxicity in human lymphoblast B cells.<sup>12,13</sup> The use of bentonite is widely spread in chemical, pharmaceutical, cosmetic

and food industry, engineering, agriculture and mining. Humans are exposed to bentonite through occupational and environmental pathways, mostly by the respiratory tract and dermal contact.

The island of Milos belongs to the Cycladic island complex and is located 140km southeast of Attiki. It is a product of volcanic activity with more than 100 mining sites located in the island, 25 of which are active perlite and bentonite mines.<sup>14</sup> Milos is the largest bentonite and perlite production and processing center in the European Union, with an excavation rate of about 1,000,000 tons bentonite and 500,000 tons perlite per year. Based on the above we conducted an epidemiological study in order to evaluate the general health level of Milos' residents through respiratory functional testing, bone density measurement in correlation with occupational and environmental exposure.

## Case

This is an on-interventional epidemiological study of three days duration that took place in Milos Island on July 2013. It was conducted by a research team in collaboration with Milos Health Center. The study population consisted of 181 permanent residents of either gender, aged over 35 years. All of the participants gave informed written consent. Study protocol consisted of only one visit during which nativity, demographic characteristics, risk factors, occupational exposure, comorbidities and current medication were recorded and FEV1, FVC, FEV1/FVC, SatO<sub>2</sub>% and T-score were measured.

### Inclusion criteria

- i. Male or female patients >35 years, permanent residents of Milos Island.
- ii. Available data: Patient's history
- iii. Patients who have provided written informed consent for their participation in the present research.

### Exclusion criteria

- i. Patients who refuse to provide written informed consent
- ii. Patients who participate in clinical trial with study drug.

COPD classification by severity was based on revised GOLD 2014 guidelines.<sup>15</sup> According to bone density measurement, patients with T-score ≤ -2.5 were defined as suffering from osteoporosis, while patients with T-score -2.5 < T-score < -1 were defined as suffering from osteopenia.<sup>16</sup> For the description of the qualitative variables, absolute (number of observations) and relative frequencies (percentages) were used. The level of statistical significance was set at  $p < 0.05$ .

### Results

181 permanent residents of Milos participated voluntarily in the study. 5.5% of the study population suffered from COPD (10/181). According to respiratory functional testing, 3 patients suffered from moderate COPD ( $50\% \leq FEV_1 < 80\%$ ) and only 1 from severe COPD ( $30\% \leq FEV_1 < 50\%$ ). Moreover, the majority of the residents (77.9%–146/181) did not report any exposure to perlite, bentonite, caoline or asbestos etc. Population distribution by COPD and exposure to mineral dust can be seen in Table 1. According to our analysis it is shown that COPD and occupational exposure to mineral dust are not correlated ( $p\text{-value} = 0.536 > 0.05$ ). 10.5% of the participants suffered from osteoporosis (19/181). Population distribution by bone density measurement can be seen in Figure 1. According to our analysis it is shown that COPD and metabolic bone disease (osteoporosis–osteopenia) are not correlated ( $p\text{-value} = 0.052 > 0.05$ ) 23 participants suffered from a thyroid disorder (12.71%) by hypothyroidism in most of the cases (Figure 2) while only 6.1% (11/181) of the study population reported an eye disorder.

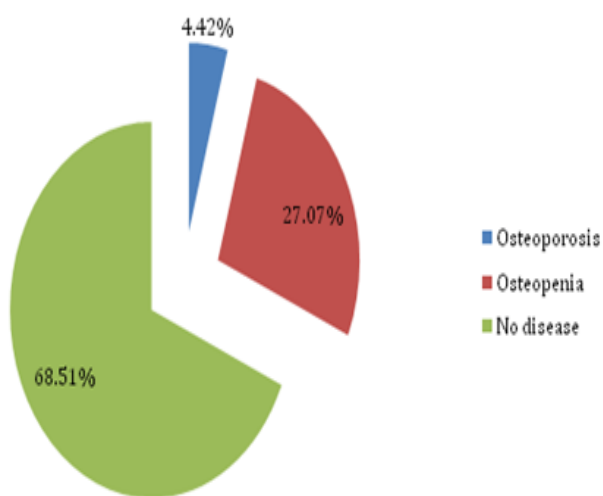


Figure 1 Metabolic bone disease.

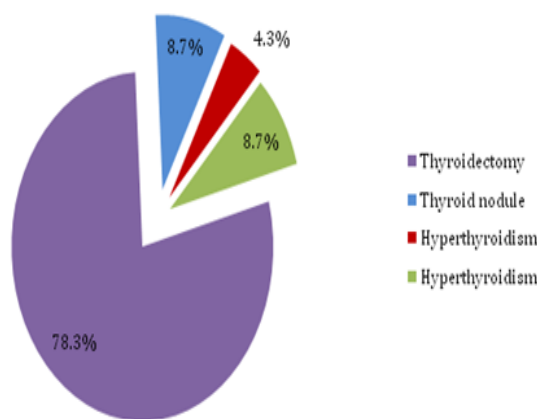


Figure 2 Thyroid disorders.

Table 1 Distribution of COPD\* and exposure to minerals

Distribution of COPD* and exposure to minerals			
Exposure to Minerals	COPD*		Total
	Yes	No	
Yes	3	37	40
No	7	134	141
Total	10	171	181

\*Chronic obstructive pulmonary disease

### Discussion

Although relevant bibliographic references are limited, there is evidence that prolonged occupational and environmental exposure to “nuisance” mineral dusts may have an adverse effect upon general health level and especially the respiratory function of the population. However, according to our study, the percentage of permanent residents of Milos that suffered from COPD was 5.5%, although 22.1% of the population reported some exposure to perlite, bentonite, caoline or asbestos etc. It is worth noticing that the estimated prevalence of COPD in Milos’ permanent population is lower than the rates established for the general population. In a study<sup>17</sup> published in 2004 by Tzanakis and co. the COPD prevalence by community setting was as follows: Athens, 6%; other urban areas, 10.1%; semiurban areas, 8.5%; and rural areas, 9.1%. There could be a possible selection bias due to the time period and seasonal variations, especially regarding COPD exacerbations. This is due to the fact that COPD exacerbations (which are related to symptoms deterioration) are more frequent during the winter season,<sup>18</sup> a fact that could sensitize more COPD patients to participate to the study. Nevertheless, the percentage of the population suffering from COPD shown in our study seems to be in accordance with the respective rates in EU.<sup>19–22</sup>

The absence of correlation between COPD presence and exposure to mineral dust shown in our study comes in opposition to recent study<sup>23</sup> published in 2013 by Sampatakis and co. Demonstrating that permanent residents of Milos island exposed to perlite and bentonite mining dust, indicate an increased risk of developing diseases of the respiratory system, such as pneumonia, chronic obstructive pulmonary disease and allergic rhinitis. Internationally, there are only two recent studies examining the effect of perlite dust on the health of exposed workers available. In the first study<sup>24</sup> the authors reached

to the conclusion that although 12-year perlite exposure did not lead to decreased spirometric indices, there was a significant decrease in diffusion capacity of the lungs, which indicates a possible small airway obstruction. In the second study,<sup>25</sup> 24 industrial workers in Taiwan that were exposed accidentally to large quantities of perlite dust were followed for 6 months. During this period the symptoms observed among the workers were cough, eye irritation, shortness of breath and throat irritation. Moreover, three of them developed signs of Reactive Airway Dysfunction Syndrome (RADS)<sup>26</sup> and performed a Forced Expiratory Volume in one second (FEV1) less than 80%. Both studies were conducted in working places. In the first one, the long term effects of exposure to perlite dust were studied, while in the second one, its acute effects. In our study, a whole population is under study, based on their permanent residential area and not just their working place.

The only epidemiological studies in general population available regarding both exposure to perlite and bentonite mining dust are the ones concerning the Milos' island.<sup>27,28</sup> Both these studies are limited by the fact that other risk factors of respiratory disease (e.g. smoking) were not taken into account in the analysis. Moreover, there were not used data concerning the perlite and bentonite dust concentration in ambient air and their potential to exceed the officially set limits. This element probably plays a crucial role, given that in both the studies that took place in Turkey and Taiwan demonstrating an adverse effect on respiratory health of the workers, exposure exceeded the official set limits. Likewise, in the case described by Gibbs and Pooley pneumonociosis was a result of prolonged heavy exposure to calcium montmorillonite. On the contrary, in an older study<sup>29</sup> concerning 152 workers occupied in perlite mining and processing factories that were exposed to perlite dust for up to 23 years within the official set limits, there was no evidence of pneumoconiosis by using chest radiography or pulmonary functional tests.<sup>30</sup> In conclusion, we believe that the exposure degree is a major determinant of the impact of mineral dust on general health level of Milos' population and especially its respiratory aspect, a subject that needs further discussion and investigation.

## Conclusion

The prevalence of the patients with COPD in Milos Island is 5.5%). The majority of the study population (77.9%) was not exposed to perlite, bentonite, caoline or asbestos. Among the participants that reported occupational exposure we found no correlation between COPD presence and exposure to mineral dust. The exposure degree of the population probably plays a crucial role in the impact of mineral dust on its general health level.

## Acknowledgements

The present study is under the auspices of the Hellenic Thoracic Society and has been funded from Angelini Pharma Hellas in terms of Corporate Social Responsibility.

## Conflict of interest

The author declares no conflict of interest.

## References

1. Wang XR, Christiani DC. Respiratory symptoms and functional status in workers exposed to silica, asbestos and coal mine dusts. *J Occup Environ Med.* 2000;42(11):1076–1084.

2. Henneberger PK, Attfield MD. Respiratory symptoms and spirometry in experienced coalminers: effects of both distant and recent coal mine dust exposures. *Am J Ind Med.* 1997;32(3):268–274.
3. Mamuya SH, Bråtveit M, Mashalla Y, et al. High prevalence of respiratory symptoms among workers in the development section of a manually operated coal mine in a developing country: a cross sectional study. *Ann Occup Hyg.* 2006;50(7):737–745.
4. Hendrick DJ. Occupation and chronic obstructive pulmonary disease (COPD). *Thorax.* 1996;51(9):947–955.
5. Oxman AD, Muir DC, Shannon HS, et al. Occupational dust exposure and chronic obstructive pulmonary disease, a systematic overview of the evidence. *Am Rev Resp Dis.* 1993;148(1):38–48.
6. Elmes PC. Perlite and other “nuisance” dust. *J R Soc Med.* 1987;80(7):403–404.
7. American Conference of Government Industrial Hygienists (ACGIH). Threshold limit values for chemical substances and physical agents in the work environment, Cincinnati, USA: ACGIH; 2005.
8. International federation of chemical, energy and general workers' Unions (IFCEG). *Occupational Health Program: Threshold limit values.* Geneva, Switzerland: IFCEG; 1982. p. 1–51.
9. McDonald AD, McDonald JC, Rando RJ, et al. Cohort mortality study of North American industrial sand workers: Mortality from lung cancer, silicosis and other causes. *Ann Occup Hyg.* 2001;45(3):193–199.
10. McDonald JC, McDonald AD, Hughes JM, et al. Mortality from lung and kidney disease in a cohort of North American industrial sand workers, an update. *Ann Occup Hyg.* 2005;49(5):367–373.
11. Geh S, Shi T, Shokouhi B, et al. Genotoxic potential of respirable bentonite particles with different quartz contents and chemical modifications in human lung fibroblasts. *In Hal Toxicol.* 2006;18(6):405–412.
12. Zhang M, Lu Y, Li X, et al. Studying the cytotoxicity and oxidative stress induced by two kinds of bentonite particles on human B lymphoblast cells *in vitro.* *Chem Biol Interact.* 2010;183(3):390–396.
13. Zhang M, Lu Y, Li X, et al. Studying the genotoxic effects induced by two kinds of bentonite particles on human B lymphoblast cells *in vitro.* *MutRes.* 2011;720(1–2):62–66.
14. Gaga Andromaxi. Study for the sustainable development in Milos. Dafni network of Aegean islands for sustainability; 2006.
15. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global Strategy for the Diagnosis, Management and prevention of COPD; 2015.
16. Jeannette E South Paul. Osteoporosis Part I evaluation and assessment. *Am Fam Phys.* 2001;63(5):897–905.
17. Tzanakis N, Anagnostopoulou U, Filaditaki V, et al. Prevalence of COPD in Greece. *Chest.* 2004;125(3):892–900.
18. Papaioannou AI, Bania E, Alexopoulos EC, et al. Sex discrepancies in COPD patients and burden of the disease in females: a nationwide study in Greece (Greek obstructive lung disease epidemiology and health economics: GOLDEN study). *Intern J Chron Obst Pulm Dis.* 20014;9:203–213.
19. Cazzola M, Puxeddu E, Bettoncelli G, et al. The prevalence of asthma and COPD in Italy: a practice-based study. *Resp Med.* 2014;105(3):386–391.
20. Miravittles M, Soriano JB, García-Río F, et al. Prevalence of COPD in Spain: impact of undiagnosed COPD on quality of life and daily life activities. *Thorax.* 2009;64(10):863–868.
21. Zachariades AG, Zachariadou T, Adamide T, et al. Prevalence of chronic obstructive pulmonary disease in Cyprus: a population-based study. *COPD.* 2012;9(3):259–267.

22. Raheison C, Girodet PO. Epidemiology of COPD. *Eur Resp Rev.* 2009;18(114):213–221.
23. Sampatakakis S, Linos A, Papadimitriou E, et al. Respiratory disease related mortality and morbidity on an island of Greece exposed to perlite and bentonite mining dust. *Inter J Environm Res Public Health.* 2013;10(10):4982–4995.
24. Polatli M, Erdinç M, Erdinç E, et al. Perlite exposure and 4–year change in lung function. *Environm Res.* 2001;86(3):238–243.
25. Du CL, Wang JD, Chu PC, et al. Acute expanded perlite exposure with persistent reactive airway dysfunction syndrome. *Ind Health.* 2010;48(1):119–122.
26. Brooks SM, Weiss MA, Bernstein IL. Reactive airways dysfunction syndrome (RADS)—Persistent asthma syndrome after high level irritant exposures. *Chest.* 1985;88(3):376–384.
27. Gibbs AR, Pooley FD. Fuller’s earth (montmorillonite) pneumoconiosis. *Occup Environ Med.* 1994;51(9):644–646.
28. Phibbs BP, Sundin RE, Mitchell RS. Silicosis in Wyoming bentonite workers. *Am Rev Respir Dis.* 1971;103(1):1–17.
29. Cooper WC. Radiograph survey of perlite workers. *J Occup Med.* 1975;17(5):304–307.
30. Cooper WC, Sargent EN. Study of chest radiographs and pulmonary ventilator functions in perlite workers. *J Occup Med.* 1986;28(3):199–206.