



Research Article

EFFECT OF GOLD MINING ON PULMONARY FUNCTIONS SIMPLE SPIROMETRY STUDY

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ABSTRACT

**Background:** Gold mining is multiple activities and procedures that aims to extract gold, these activities start from survey to assess the availability of gold, crushing of large gold ore, transportation, screening, grinding which is continuation of crushing in order to carry out classification, classification and gold mining process (cyanidation, flotation, gravity separation and mercury amalgamation, each of these process has different harm effect on human health and mainly on respiratory system. In Sudan most of gold mining is traditional which not follow proper safety measures and increases the risk, but even in those registered company still there is risk and respiratory system which is at highest risk may developed several disorders that affect its function, both restrictive lung disease and obstructive disease may occur. Despite this few study done in Sudan to assess the effect of gold mining on human health and no one of these study assess the effect of gold on respiratory system.

**Objectives:** to assess the effect of gold mining on pulmonary function.

**Methodology:** This is a prospective, cross sectional analytical study, done in Red sea state, eastern Sudan, in period from January 2019 to February 2020.

**Result:** 250 gold miners from registered company were enrolled in this study. Using simple spirometry test 56 of the study population (22.4%) have restrictive pattern while 12 of them (4.8%) have obstructive pattern. (62.5%) of those with restrictive pattern showed mild restriction, (17.9%) moderate restriction and (19.6%) severe restriction while all obstructive patterns are mild.

**Conclusion:** Pulmonary function affected in gold miners in red sea state, Sudan due to several causes but period and dose of exposure to various harmful materials are the major risks factors. Restrictive pattern occurs more than obstructive pattern. Both obstructive and restrictive disorders are less in this study group because of applying proper safety measures and adhering to it.

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INTRODUCTION

Respiratory system has many functions such as humidification of gases that prevent dryness and thermal injury of mucosal epithelium, also it has protective roles against various organism and different particles either through bronchial secretion that contain immunoglobulins as IgA And other substances that resist infection or through cilia, again respiratory system has metabolic and endocrine functions such as lipid metabolism and synthesis of histamine and angiotensin converting enzyme but Ventilation and gas exchange are the most important function of respiratory system(1)

Many factors may affect the function of respiratory function in positive or negative effect, these include pathological, biological and environmental factors. The environmental factors are an important one that affect the respiratory system mechanically, functionally or pathologically, through mechanical destruction of respiratory organs, activating various organisms and altering the functions.

Gold mining is one of environmental factors that affect the respiratory function throughout its different procedures from extraction up to marketing, although it is a major economic resource for Sudan which is the third biggest gold producer in the world (2) and just 20% of gold registered by officially registered companies (3) the thing make it difficult to assess the effect of gold mining on Sudanese health in general and on respiratory function specially because many metals are combined to gold ore in the rocks.

Gold mining may cause both obstructive and obstructive lung diseases and other lung problems due to exposure to different substances to different toxic agents such as Sulphur oxide that cause chronic air way obstruction (4) and silica that may cause extensive fibrosis (5).

The registered companies' fellow safety procedures in pre extraction test for soil, rocks and environment; wearing personal protective equipment and ventilation of harmful gases but despite these measures still gold mining affect the respiratory system and alter its functions and at the same time those unemployed who leave in mining area are at great risk

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for respiratory problems that impair pulmonary function; so this study done to assess the respiratory function among gold miner workers.

**Objective**

This study aims to assess the effect of gold mining on respiratory function among people who work in organized sector of gold mining.

**METHOD AND MATERIALS**

**Study design**

This is prospective analytical cross section study.

**Study duration**

This study done in period from January 2019 to February 2020.

**Study area**

This study done in Port Sudan- eastern Sudan.

**Study population**

People who work in gold mine and related jobs in an organized gold mining company.

**Sample size**

Using the below equation sample size was 250In:

$$SS = \frac{z^2 p(1-p)}{c^2}$$

Where:

SS = Sample size

Z = z- value

P = percentage of population

C = confidence interval

**Including criteria**

People who work in the company, able to conduct spirometry test and accept to participate in this study were included.

**Excluding criteria**

Those who are unable to conduct spirometry test, smokers and those who have acute respiratory disease during time of test were excluded from study.

**MATERIALS AND DATA COLLECTION**

Data collected by interview and written modified respiratory questionnaire. Simple spirometry test done for all participant, spirometry data interperitated and then all data analyzed with SPSS.

**RESULT**

250 males who work in mining company in Red sea state – eastern Sudan were enrolled in this study. Thiers age between 18 to 58 years, mean age(42 ± 5).

Using simple spirometry test 56 of the study population (22.4%) have restrictive pattern while 12 of them (4.8%) have obstructive pattern. (62.5%) of those with restrictive pattern showed mild restriction, (17.9%) moderate restriction and (19.6%) severe restriction.

Restrictive pattern appears in one-personage less than 20 years (1,8%), in three person of age group 20 to 29 years (5.4%), nineteen of those in age group 20 to 39 years (33.9%), fourteen of those in age group 40 to 49years (25%) and

nineteen in those more than 50 years (33.9%). According to period of exposure restrictive pattern appears in (17.9%) of those who joint the company for less than 5 years, this raised to (35.7%) in those work for 5 to 10 years and (46.4%) in those work more than 10 years. Distribution of restrictive pattern comparing to work nature, appears in32laborers (57.1 %) (who contact the field during drilling, extraction and transportation to laboratories),6 engineers (10. 7%), 5 officers (9%) and 13 other jobs (23.2%) those (include guard, washers, cockers).

All those of obstructive pattern were mild obstructive, 6 of them (50%) are 30 to 39 years’ age, 4 of them (33.3%) in age group 40 to 49 years and 2 (16.7%) are more than 50years’ age. According to period of exposure all those of obstructive pattern (100%) work for 5 to 10 years. Comparing to work nature 9 are laborers (75%) and 3 are engineers (25%).

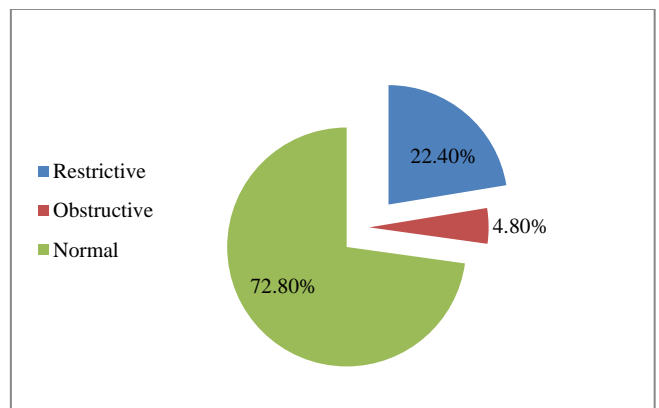


Figure 1 Simple Spirometry Result

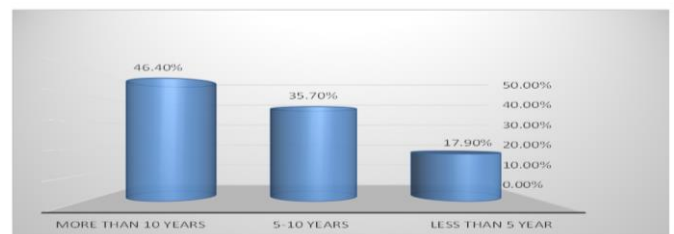


Figure 2 Occurrence of restrictive pattern according to duration of work

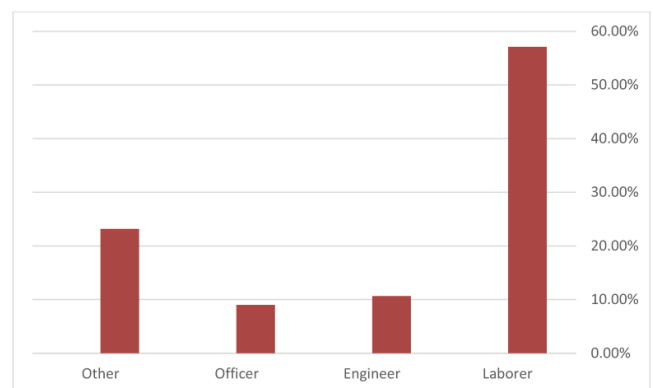


Figure 3 Restrictive Pattern According To Job Nature

**DISCUSSION**

In spite of its major contribution in Sudan economy; gold mining has several adverse effect on population health and these bad effects mainly appear in respiratory system, very few studies done to assess the effect of mining on human health in Sudan and no one studied the effect of gold mining on pulmonary functions in Sudan.

This Study conducted in one registered company that fellow proper safety procedures and it showed that the prevalence of restrictive disorders among gold miners is 22.4% and the prevalence of obstructive pattern is 4,8%, the latter may be underestimated because spirometry study done during vacation, again both obstructive and restrictive disorder are underestimated because most of gold mining in Sudan are traditional which has no protective measures and therefore has more effect.

Ababa et al in Ghanain their study found that prevalence obstructive pattern in gold mines exceed 47% (6), which is very high comparing to obstructive pattern in our study this may return to proper safety measures in our study area the thing that reduce occupational risk, in addition to that in our study spirometry study done during vacation.

More than 60% of restrictive pattern are midland occur in two age group those of 30 to 39 years' age and those above 50 years old, this because most of those in age group 30 to 39 are laborers who are at high risk and more period of exposure to multiple minerals and dust beside gold ore in field work, this reinforce by that 50% of restrictive pattern occur in laborers, this means that exposure to dust, mineral and gold ore is the main risk factor to develop restrictive lung disease in gold miners and the exposure dose is very important (7), which is supported by the fact that more than 46% of restrictive pattern occur in those who joint the company for more than 10 years.

Many etiologies associated to gold mining may affect lung functions and presented with restrictive pattern, such as pneumoconiosis that caused by inhalation of organic and non-organic dust and end with fibrosis and restrictive lung, again exposure to silica during drilling and extraction result in silicosis that lead to restrictive lung (8).

Occupational asthma may be the common cause of obstructive lung disease but other causes as COPD due to air pollution, bronchiolitis obliterans due to nitric oxide inhalation and pneumoconiosis may presented with restrictive pattern.

Make spirometry test in vacation period, restricting the study on one company and excluding criteria are main limitation of this study.

## CONCLUSION

Working in gold mining is a high risk to develop both restrictive and obstructive pulmonary disease. Restrictive disorder is more common than obstructive disease because most of mining minerals affect the lung parenchyma more than bronchial tree.

The common risk factor that affect the pulmonary function in gold mining is the dose of exposure of different harmful agents, which is related to nature of the job, so most population affected are laborers whose work in the field from drilling through extraction to transportation of gold ore.

Proper safety measures decrease the prevalence of both restrictive and obstructive lung diseases in miners and may preserve lung function to normal.

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