

Brick Kilns and Sugar Mill: Severe Environmental Health Hazards Cause Respiratory Diseases in Tehsil Darya Khan, District Bhakkar, Punjab, Pakistan

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ABSTRACT

Besides supporting economic structure, brick kilns and Fecto sugar mill both produce air pollutants, including Particulate Matter (PM), SO₂, CO₂, CO, Polycyclic Aromatic Hydrocarbons (PAHs) and other organic pollutants. In the present study, impact of brick kilns and sugar mill on general health of people is analyzed. The data has been collected from Tehsil Head Quarters (THQ) Hospital Darya Khan (official) and Mahota, a private clinic (non-official). With respect to operating duration of sugar mill, collected data has been divided into crushing season (160 to 180 days from mid-October or November onwards) and non-crushing season (April onwards). Analytical and critical analysis of official data shows that during crushing season, as sugar mill and brick kilns both are being operated so ultimately people are also being affected from various respiratory diseases with high number (3649) in contrast with that of non-crushing season (2888). The number decreased dramatically because during non-crushing season, only brick kilns are operated. Unofficial data shows that during crushing season the percentage of asthma individuals was high while percentage of other respiratory disease percentage was high during non-crushing season. The sum of official and non-official data revealed that rate of respiratory infected individuals was 53.64% during crushing and 46.35% during non-crushing season. Hence, in Tehsil Darya Khan, both Kilns and the sugar mill are major hectic sources of air pollution and are contributing severely to various respiratory diseases like Acute (upper) Respiratory Infections, Cough, Chronic Obstructive Pulmonary Diseases and Asthma as well.

KEYWORDS: Air Pollutants, Brick Kilns, Sugar Mill, Particulate Matter, Chronic Obstructive Pulmonary Disease,

1. INTRODUCTION

Environmental air pollution has been recognized as one of the major concern of the modern age of technology (Saranraj and Stella, 2014). According to published data, every year around the world, air pollution is the cause of death of seven million people (Air Pollution). Out of these figures, about 3.3 million people die due to indoor air pollution and about 2.6 million die due to outdoor air pollution (Air Pollution). A total of 14% outdoor pollution related deaths are due to chronic obstructive pulmonary disease around the world (Ambient air quality and health-World Health Organization).

Brick kilns and sugar mills produce various pollutants that cause air pollution. In brick kiln, average 160 Kg coal is required for baking 1000 bricks (Raza, 2014). About 350 tons of wood are used annually in a brick kiln, and thus contributing pollutants in environment and ultimately biodiversity loss (Pariyar, 2013).

These brick kilns contribute in air pollution by emitting CO, CO₂, SO₂, NO_x, organic pollutants and particulate matter of aerodynamic diameter of 10 µm (Joshi, 2008). A study shows that during preoperational time of brick kilns PM10 concentration was 0.029 mg/m³ in air, and during operational time was 0.050 mg/m³ (Pariyar, 2013). On the other hand, a sugar mill during sugarcane burning also produces various pollutants like CO, CO₂, SO₂, hydrocarbons, particulate matter of aerodynamic diameter of 10 µm (PM10) and 2.5 µm (PM2.5), benzopyrene and various polycyclic aromatic hydrocarbons (PAHs) (Ribreio, 2008). These pollutants are the cause of various respiratory diseases like bronchitis, emphysema, pharyngitis, cough and decreased lung function ((Jose et al., 2006; Joshi, 2008; Ribreio, 2008; Mongra, 2012; Shaikh, 2012; Nikhade and Nitin S Nikhade Jan-Ma, 2013; Pariyar, 2013; Tasnuva, 2014; Skinder, 2014; Raza, 2014).

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A study by Tasnuva (2014) showed the presence of various air pollutants in the emission of Kushtia Sugar Mill, Bangladesh. He calculated PM₁₀ (1 to 1.5 Kg), SO₂ (0.07 to 0.12 Kg), and NO_x (0.2 to 0.3 Kg) in the every Per Metric Tons (PMT) of emission. While as per rate of sugar production, Kushtia mill emits 24.0625 Kg PM₁₀, 1.82875 SO₂, and 4.8125 Kg NO_x in every hour.

According to World Health Organization (WHO), various air pollutants should not be increased than the standard concentrations. Standard concentration of SO₂, NO_x, and PM₁₀ by WHO are 100 µg/m³, 150 µg/m³, and 150 µg/m³, respectively. Tasnuva calculated 28.3957 µg/m³ SO₂, 76.1779 µg/m³, NO_x, 380.889 µg/m³, PM₁₀ in the surrounding area of Kushtia Sugar Mill.

Particulate matter (PM) contains various particles like Respirable Suspended Particles (RSP) of 10 µm or less aerodynamic diameter, fine particles of 2.5 µm aerodynamic diameter and ultra-fine particles of aerodynamic diameter of less than 100 nm. PM 2.5 penetrates deeply into lungs and damages respiratory system (Jose, 2006; Raza 2014). PM enters into lungs and causes asthma and chronic obstructive pulmonary diseases like emphysema and bronchitis (Jimoda, 2012; Tasnuva, 2014). PM carries SO₂ and PAHs and causes respiratory problems (Zamperlini, 1997; Skinder, 2014). SO₂, NO_x, PM and PAHs along with various respiratory diseases also cause asthma in human (Daghri, 2013).

Darya Khan is the Tehsil of District Bhakkar (Punjab) Pakistan. Its location on the map is latitude 31.79 degree N, and longitude 71.1 degree E (Darya Khan Photos). Tehsil Darya Khan has one town and eight union councils. Darya Khan City is Tehsil headquarter and its population is about 100,000. The all other remaining people live in its surrounding rural areas.

The purpose of this research work was to analyze the effects of different air pollutants (emitted by more than 40 brick kilns and the sugar mill housed in the radius of 7 km) on the residents of this Tehsil especially the people of urban locality. The sugar mill has an area of 200 acres (0.81 km²). It has two sugar production units and one paper making unit. It is employing about 1500 workers (Fecto Sugar Mills Ltd). Initially, its production capacity was 20728 tons, but in 1996 it was increased up to 40800 tons (Fecto Sugar Mills Ltd).

2. MATERIALS AND METHODS

A detailed survey of the city and its surroundings has been arranged to get a rough idea of the air pollution and over all public health. Tehsil Head Quarters (THQ) Hospital Darya Khan (for official data) and a private clinic Mahota Clinic (for non-official data) have been visited after regular time intervals of one month, and about one year data was recorded from both hospitals. Collected data was compiled and compared to observe the effects of crushing and non-crushing seasons on the public health especially in stipulations of respiratory diseases and infections.

1. It is stated that Principal, Govt. Post Graduate College Darya Khan, District Bhakkar & Medical Superintendent of Tehsil Head Quarter Darya Khan, Bhakkar anonymized the data.
2. It is also stated that no formal IRB was consulted but only Govt. Post Graduate College Darya Khan, District Bhakkar & Medical Superintendent of Tehsil Head Quarter Darya Khan, Bhakkar were consulted and they verified the data.
3. Ethically we have not deceived or provided wrong data to the journal as well as we have anonymized the data too.

3. ANALYSIS OF COLLECTED DATA

Data collected from THQ Darya Khan and Mahota clinic has been analyzed and compared. Collected data has been divided into crushing and non-crushing seasons. After compilation, the ratio of individuals with ARI, cough, COPD and asthma was compared with the total number of reported individuals (Fig.1-4). During crushing season (Nov to March), there was an increasing tendency rate of individuals having asthma (Fig. 1) that gradually decreased on approaching non-crushing season (April to Sept). In case of cough, no significantly change was seen during crushing and non-crushing season (Fig. 2). Numbers of individuals fluctuated but remained within the range of 200.

However, a dramatically drop with only 41 individuals was seen during August. Number of individuals with COPD was increased day by day right from the start of crushing season and approached at its maximum with 86 individuals in March and then decreased abruptly with the start of non-crushing season (Fig. 3). However, after June, there was increasing tendency. Data showed a clear high number projection of individuals with asthma during crushing season as compared with non-crushing season (Fig. 4).

Similarly, Number of individuals (unofficially reported) with ARI was increased from November to March and then decreased suddenly in April. After June, there was steady increase till the start of Oct. (Fig. 5). January to May time duration was critical causing cough among individuals with high rate (Fig. 6). COPD was widely spread during

Feb. and March. The rest of the year was somehow torpid with range 25-30 individuals (Fig. 7). Asthma was at its peak during Feb. and March, while non-crushing season showed immobile rate (Fig. 8).

The total number of reported individuals suffering from ARI, cough, COPD, and asthma during the crushing season was summarized and compared with that of non-crushing one (Table 1). The official data showed that during crushing season, the number of infected individuals having ARI and asthma were 34.15% and 39.64% (respectively) more as compared with that reported in non-crushing season. However cough and COPD data projected different results as their %age was high during non-crushing season. Analysis of unofficial data revealed that number of individuals with ARI, cough and COPD were 45.1%, 18.87% and 15.9% significantly high during non-crushing. While during crushing season number of individuals with asthma was 7.82% elevated.

Total number of diseased and infected individuals during crushing and non-crushing season was calculated on the basis of infection and disease categories (Fig. 9), and their relative percentages (%age) were figured out (Fig. 10). Among people with ARI, 57.62% was reported during crushing season. Data exposed a low %age (47.11%, 45.32%) of individuals having Cough and COPD, respectively during crushing. During the same season, a total of 58.31% individuals were come into the record having COPD. Overall rate and tendency of data depicted that 53.64% diseased and infected individuals were reported by official and unofficial data during crushing months while of non-crushing, rate was 46.35%. Fig. 1-4: Official data obtained during crushing and non-crushing season representing the comparative analysis of the total number of diseased and affected individuals recorded with the individuals having; (Fig. 1) Acute (upper) Respiratory Infection (ARI), (Fig. 2) Cough, (Fig. 3) Chronic Obstructive Pulmonary Disease (COPD) & (Fig. 4) asthma. Fig. 5-8: Unofficial data obtained during crushing and non-crushing season representing the comparative analysis of the total number of diseased and affected individuals recorded with the individuals having; (Fig. 5) Acute (upper) Respiratory Infection (ARI), (Fig. 6) Cough, (Fig. 7) Chronic Obstructive Pulmonary Disease (COPD) & (Fig. 8) asthma.

Table 1: A summarized view of the data obtained during crushing and non-crushing season showing summery of official and unofficial data. Fig. 9: A brief comparison of sum of official and unofficial data (Acute (upper) Respiratory Infection (ARI), Cough, Chronic Obstructive Pulmonary Disease (COPD) & asthma) on the basis of crushing and non-crushing season. Fig. 10: A horizontal bar graph compares Acute (upper) Respiratory Infection (ARI), Cough, Chronic Obstructive Pulmonary Disease (COPD) & asthma (during crushing and non-crushing season) in terms of percentage.

4. DISCUSSION

Being an agricultural country, Pakistan is socioeconomically backboned with sugar industry. Besides the socioeconomic development, this industry is also affecting the environment on a large scale by emitting its wastes directly into the air. This emission is a major factor that is polluting the environment thus, causing air pollution (Saranraj and Stella, 2014). Similarly, in most of the rural areas, brick kilns are the major source of income generation for surrounding population. These kilns are the prime base of the construction and development of the country.

The present study was planned to investigate the negative impact of brick kilns and Sugar Mill for the degradation of the environment and thus causing the human health problems especially with respect to respiratory diseases in Tehsil Darya Khan and its surrounding areas.

Tehsil Darya Khan houses 40 brick kilns and one sugar industry. These kilns use primitive technology to bake bricks. Low cost fuel, waste oil, tyres, bio-gas, animal dung etc. are being used to fire bricks ultimately causing severe air pollution (Sadaqat, 2012).

A common investigation depicted that the major category of diseases in the Tehsil Darya Khan are respiratory diseases like ARI, cough, COPD and Asthma. Official and unofficial data showed that throughout the year (Fig. 1-8), ARI, cough, COPD and asthma patients visited the health maintenance departments. This indicates that crushing and non-crushing seasons both are responsible to cause respiratory diseases, but number of infected persons varies. The data indicates that the rate of infected individuals was high during crushing season exploring the fact that in non-crushing season; only the brick kilns are accountable for overall health problems. While during crushing season, paired effect of both brick kilns and sugar mill cause large amount of emission of air pollutants that imbalance the environmental composition. As a result, the percentage of infected and diseased person is high (53.64%) during crushing and low (46.35%) during non-crushing season (Fig. 10).

From brick kilns, emission of air pollutants including carbon monoxide, sulphur dioxide, nitrogen oxides and particulate matter leads to respiratory ailments like bronchitis and asthma (Sadaqat, 2012; Pariyar, 2013; Tasnuva, 2014; Skinder, 2014). Our data is in accordance with this fact as the %age of individuals with asthma is 41.68% during non-crushing season when only the brick kilns work in Tehsil Darya Khan (Fig. 9). While crushing season's data demonstrates 58.31% infected individuals, predicting that sugar mill emission is responsible for causing 16.63% more asthma in total infected individuals (Fig. 10). These results also confirmed the investigation of Tasnuva (2014) who calculated high amount of PM, NO₂ and NO_x in the surrounding area of Kushtia Sugar Mill.

During crushing season the percentage ARI is high (57.62%) than during non-crushing season (42.37%) showing 15.25% more patients during crushing season depicting the effect of sugar mill. Muthusamy et al. (2012) investigated that the brick kilns and sugar mill are emitting PM, SO₂, CO₂, CO and various other organic pollutants in the atmosphere. According to UPPCB report, SO₂ leads to itching in the eyes, CO and CO₂ cause increased temperature and the presence of NO_x leads to lungs and skin infections. So, it can be said that increasing rate of ARI is due to the presence of NO_x in the environment of Tehsil Darya Khan.

Hundreds of brick kilns and sugar mill workers including children and women are also exposed to health hazards as they continuously inhale the polluted air. Data revealed that the brick kilns and sugar industry both are health hazards, and contributing largely to cause respiratory based diseases and infections among the population of Tehsil Darya Khan.

Table-1

Season	Diseases and Infections	Data of Diseased and Infected Individuals		Total
		Official	Un-Official	
Crushing	ARI	2375	168	2543
	Cough	692	361	1053
	COPD	249	148	397
	Asthma	333	179	512
	Total	3649	1075	4724
Non-Crushing	ARI	1564	306	1870
	Cough	737	445	1182
	COPD	303	176	479
	Asthma	201	165	366
	Total	2888	1194	4082

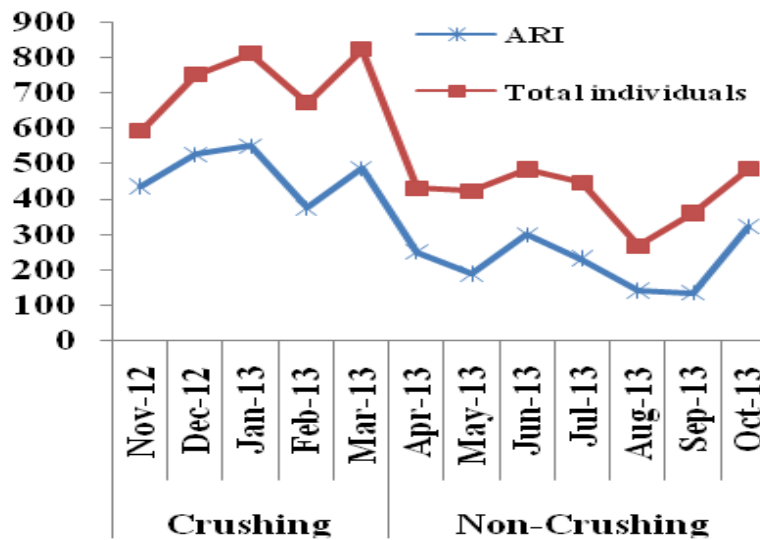


Fig. 1 Graph showing Individuals checked and having ARI

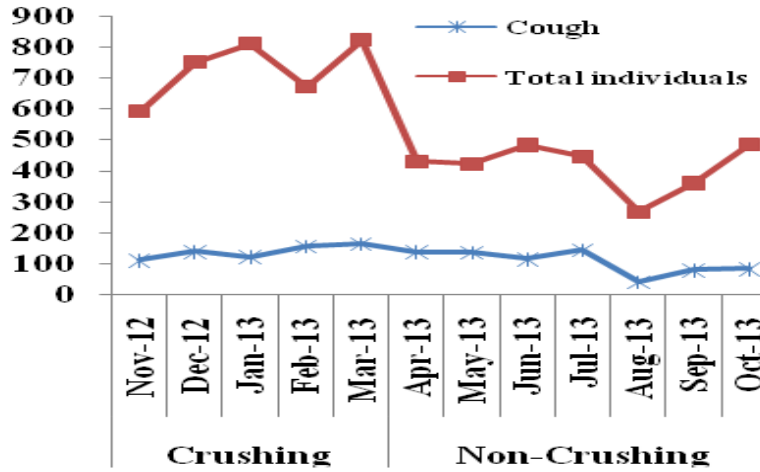


Fig. 2 Graph showing Individuals checked and having Cough

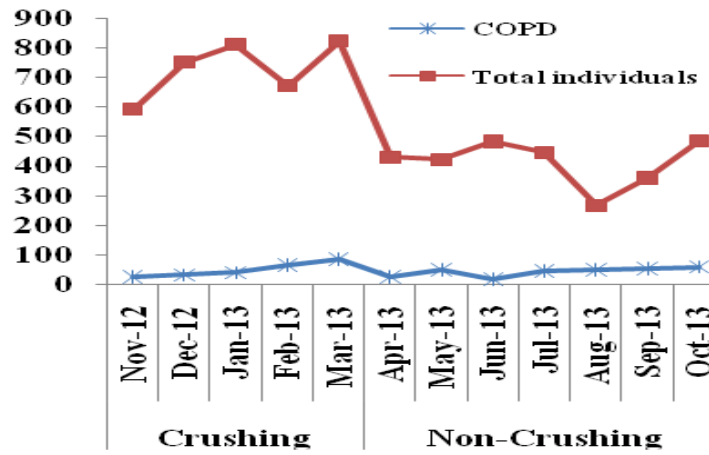


Fig. 3 Graph showing Individuals checked and having COPD

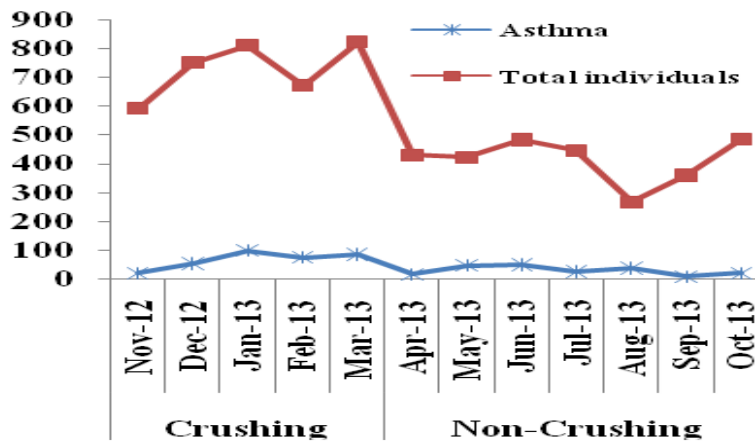


Fig. 4 Graph showing Individuals checked and having Asthma

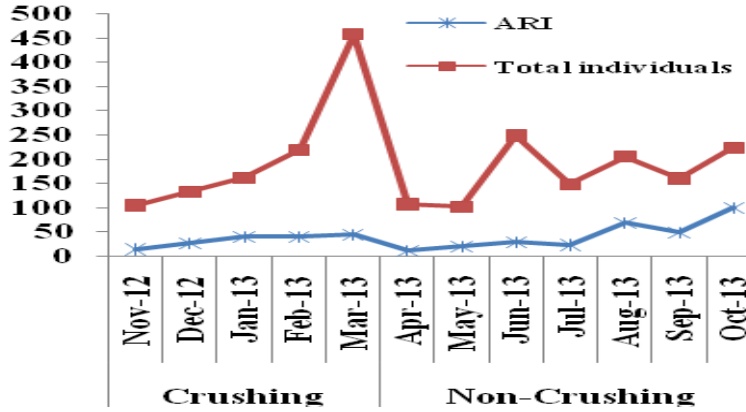


Fig. 5 Graph showing Individuals checked and having ARI non-Governmental Data

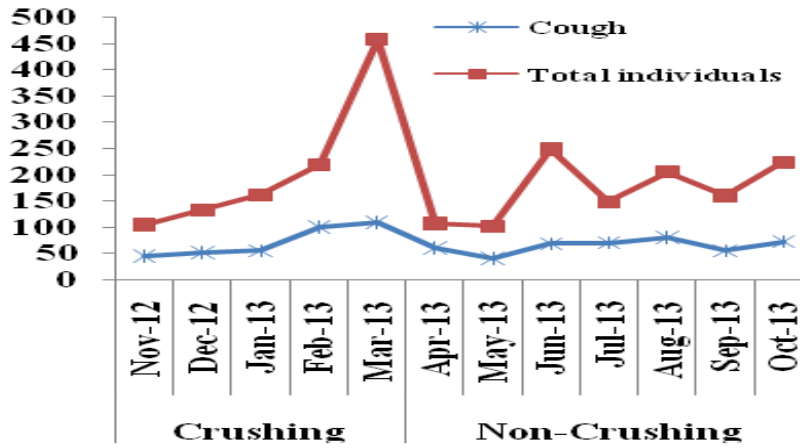


Fig. 6 Graph showing Individuals checked and having Cough non-Governmental Data

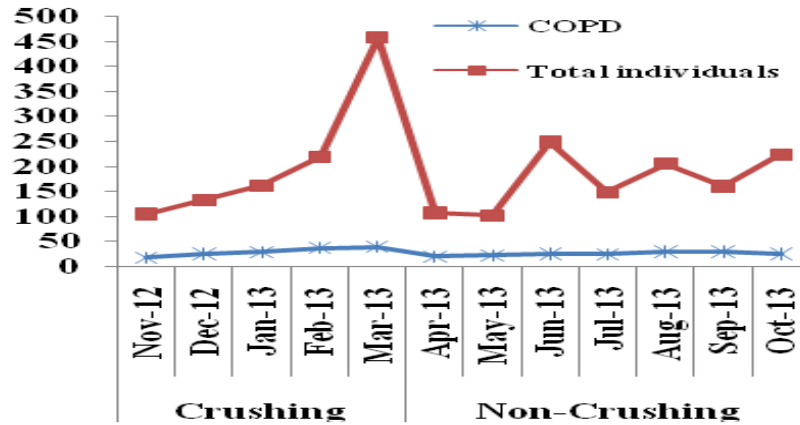


Fig. 7 Graph showing Individuals checked and having COPD non-Governmental Data

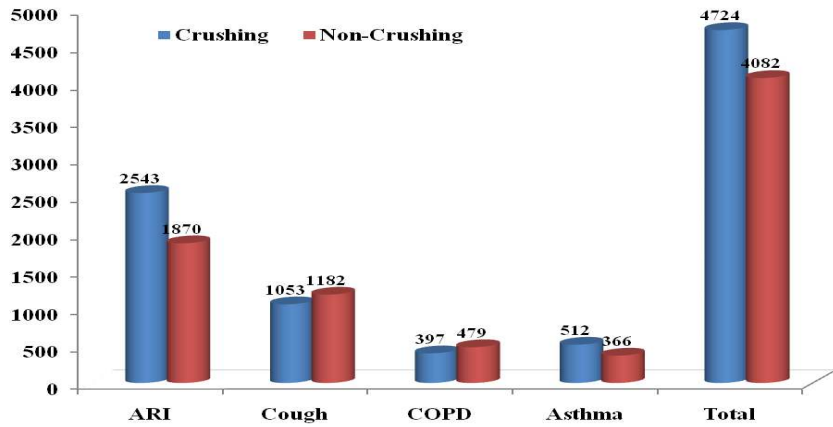


Fig. 9: A brief comparison of sum of official and un-official data (Acute (upper) Respiratory Infection (ARI), Cough, Chronic Obstructive Pulmonary Disease (COPD) & asthma) on the basis of crushing and non-crushing season.

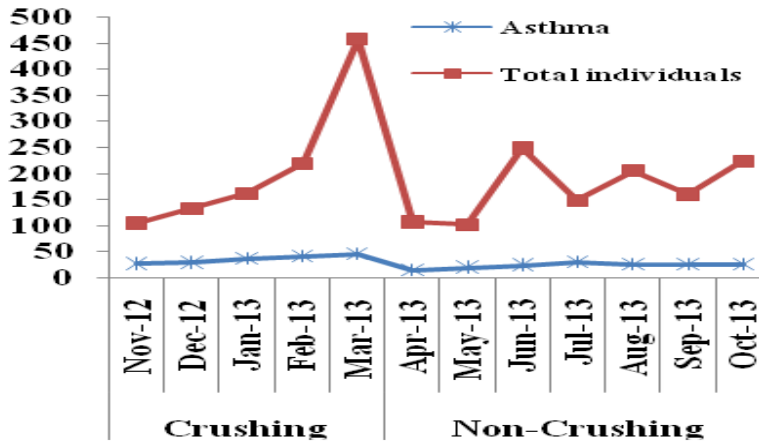


Fig. 8 Graph showing Individuals checked and having Asthma non-Governmental Data

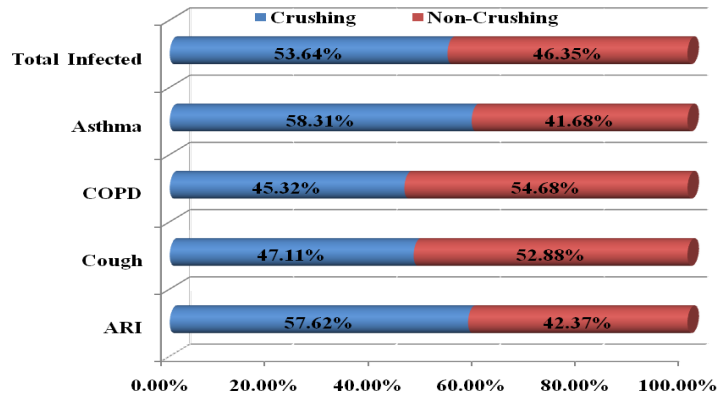


Fig. 10: A horizontal bar graph compares Acute (upper) Respiratory Infection (ARI), Cough, Chronic Obstructive Pulmonary Disease (COPD) & asthma (during crushing and non-crushing season) in terms of percentage

5. CONCLUSION

Both the brick kilns and the sugar mill are producing serious air pollutants which are a cause of various respiratory diseases. But the Environmental Protection Authority (EPA) has failed to check pollution created by these units in Tehsil Darya Khan situated in the vicinity of Bhakkar.

6. RECOMMENDATIONS

1. The human life in the city is facing serious hazards from the brick kilns and the sugar mill.
2. Precautionary measures should be taken to save human life in the city. Air pollutants emitted by brick kilns and sugar mill from their chimneys should be screened out.
3. This is a challenge for future concern to properly incorporate the disposal of the sugar mill wastes in a controlled management program.
4. It is the prime responsibility of the Govt. of Punjab Pakistan to take brick kilns owner into confidence over the new technology, and to encourage them by extending carbon credit facility. Moreover, these kilns should be constructed outside the city.

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