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Impact of miners' QoL on productivity: a strategic study for optimizing coal mining operation through sustainable human resource management

This research article is an attempt made to study the impact of factors of the domains such as socio-economic, health, sanitation, living environment and working environment on quality of life (QoL) of miners of five coal mines industries. A questionnaire was prepared comprising 15 questions for each domain. Twenty miners per mine were assessed and the data was prepared using excel spread sheet. The quality of life indices were compacted using quality functions for each parameters based on the sensitivity function defined on the quality interval as per the standards or criteria intended. The results show that Ramkanali underground mine possesses the quality of life index of 32.86 while the production per capita was 121.854 and similarly Keshalpur underground mine, WMC opencast mine, BCCL Block-II opencast mine and Salampur underground mines possess 29.37, 33.54, 34.28 and 32.77 while the production per capita were 431.272, 467.561, 397.667 and 171.765 respectively.

The present study reveals that the present approach for computing quality of life indices would be functional for planning socio-economic development activities. It is obvious that there will be significant correlation of quality of life index with the productivity; the study could not establish any relation between quality of life and productivity. Thus the study reveals that there may be other domain other than the fore said five, which has not been incorporated in the present study and such domains have to be identified so that the relationship may be established.

The present approach is unique and very much useful for assessing not only quality of life but also any system individually. If the quality of the miners' life with respect to socio-economic, health, sanitation, living environment and working environment is separately computed, this would be a very good study to prepare strategic plan for improving productivity for different mines.

Keywords: Miners' quality of life, sustainable coal mining operation, human resource management in coal mines

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1.0 Introduction

The the occupation in mining is being felt very difficult since its beginning and accountable to injury to body as well as health (Agricola, 1950; Ramazzini, 1940). The mining industry involves activities such as exploration, mine development, mining operations, mine closure, rehabilitation and resettlement. Mining opens job opportunities to people with multi-disciplinary on several professions and trades. It is essential to enquire about the details of occupation in order to make certain the clinical precision and epidemiological employment with the details whether the mine is metalliferous or coal including the details such as surface or underground. For coal mining, many of the occupational health hazards relate to various activities such as excavating, disposing of waste materials, loading, unloading, screening, cutting,washing, processing and transporting etc. The miners are exposed continuously in their respective working environment which induces many diseases such as hearing problem due to noise, respiratory disease, ergonomics and also remains working for eight hours per day in unsafe and risky situation.

The sanitation status is not up to the standard of healthy environment and also causes malaria and other water-borne diseases. The socio-economic condition of the miners is also considerably weak due to their low-income. Sometime the miners go through depression as they are unable to meet the daily requirements of their children and family. They seek a way to release their mental strain and stress. Consequently, they are habituated and addicted as they are charmed by alcohol and other drugs. This situation might have a direct impact on the productivity of the industry. Thus, there is a need for assessing the quality of life (QoL) of the miners and investigate its impact on the coal production. The

quality of life of a miner is determined by major factors of socio-economic status, sanitation condition and health of the miners. Therefore, an attempt would made to identify various governing parameters of these three factors to compute the miners' quality of life in coal mining industries and further to carry out some statistical analysis over the collected data and QoL indices for investigating its correlation with the production of the respective industries. Further, the results would be used for devising appropriate strategies in order to bring a significant inducement in productivity by improving the socio-economic status, sanitation condition and health of the miners as well as their working environment.

2.0 Literature review

Several scientific studies have been carried on occupational diseases that prevail among miners, particularly, in coal mining industries. The impacts of the coal mining operations on human health have been categorized as physical, chemical, biological, psychological and ergonomic hazards. The state-of-the art of the occupational health hazards have been studied from various articles and briefly discussed as well through a detailed literature review as follows:

2.1 Physical hazards

A major occupational problem is hurtful physical injuries varying from slight injuries to the deadly one continues (NIOSH, 2000). Falls, roof failures, fires and explosions, accidents, entrapment and electrocution are the considerable reasons for physical injuries. Seepage of water, water flow and air blast are not common but causes for fatal injuries. Noise is almost everywhere as it is unavoidably generated by drilling, blasting, cutting, materials handling, crushing, conveying and ore processing and ventilation. Studies have established that controlling noise is very difficult in mining areas and noise-induced hearing loss remains common (Hessel and Sluis-Cremer, 1987; Frank, Bise and Michael, 2013). Handling of vibrating instruments, operating mobile equipment may be encountered with hand–arm vibration syndrome and exacerbate pre-existing spinal disorders (Dasgupta and Harrison, 1996; Narini et al., 1993; Bovenzi et al., 1988; Brubaker et al., 1986; Chatterje et al., 1978). Heat, temperature and humidity in tropical locations, underground mines, virgin rocks and air increase with the increase in depth principally because of the auto-compression of the air column and the geothermal rise (Donoghue et al., 2000). Working in underground mining has augmented the risk of lung cancer, but is now generally controlled by mine ventilation (Roscoe et al., 1989; Yu-tang and Zhen, 1996).

2.2 Chemical hazards

Crystalline silica had been a serious hazard in mining for a long time to cause the serious risk of silicosis during dry drilling till the end of nineteenth century (Kreiss and Zhen, 1996). Silicosis remains a problem in developing countries and silico-tuberculosis is significant in Africa, wherein HIV infection among miners with high occurrence increases the risk. Extended exposure to crystalline silica dust can also cause chronic obstructive pulmonary disease (de Klerk and Musk, 1998). There are a few evidences for accelerated silicosis in rheumatoid arthritis and of renal disease following extended silica exposure (Hnizdo and Murray, 1998; Steenland and Brown, 1995). Many studies have established that prolonged exposure to crystalline silica increases the risk of lung cancer (Buchanan et al., 2003). Serious hazards such as coal workers' pneumoconiosis or 'black lung' and chronic obstructive pulmonary disease have been caused due to coal dust in mining areas (Mannetje et al., 2002; Hnizdo and Sluis-Cremer, 1993; Cowie and Mabena, 1991). The risks have now been mostly controlled in developed countries by dust ventilation, suppression, and respiratory protection (Attfield and Seixas, 1995; Hurley and Maclaren, 1987).

Problems of CO_2 and H_2S gases also prevail in some of the underground coal mines. SO_2 gas generated from coal dumps can cause acute bronchospasm. The burning coal in fire areas and domestic coal burning cause emission of NO_x and SO_2 into atmosphere and result into various health problems. Lung and bladder cancers are caused by exposures to volatiles of coal dust (Attfield, 1992). Alergical diseases has also been an issue in the coal mining areas. Fine coals of aerodynamic particulate matters and CH_4 gas explosions in underground coal mines continue a serious risk (Hurley et al., 1987).

2.3 Biological hazards

Malaria and dengue fever prevails at some outer areas of mining. Leptospirosis and ankylostomiasis had been widespread in mines, but such hazards have been significantly controlled in the developed world through eradication of rats and improved sanitation (Kizil and Donoghue, 2002). Cooling systems are normally found on mine sites. Regular microbiological analysis of the water is essential to analyse Legionella contamination or concentrations of other heterotrophic microorganisms, which derives its nutritional requirements from complex organic substances (Li et al., 2002).

2.4 Ergonomic hazards

Manual handling is continuing in the mining operations and a largest group of occupational diseases are continued to be constituted by disorders of cumulative trauma in mining and frequently result in protracted disabilities although mining has become increasingly mechanized (NIOSH, 2000). The works, which are overhead during ground support, the suspension of pipes and electrical cables are common in underground mines and such works can cause or aggravate shoulder disorders. Biased ground is often encountered and can cause ankle and knee injuries. Most of the mines operate 24 hrs per day and 7 days per week, so shift-work is very common. There has usually been a trend towards 12 hrs shifts in recent years. Fatigue concerned with shift-work has been

subject to considerable investigation in the industry (Borgia et al., 1994). It has been established that sleep discrepancies that might be expected in hot locations, have caused injuries of cognitive and motor performance among drivers from other industries (Gustavsson et al., 1990).

2.5 Psychosocial hazards

In mining profession, drug and alcohol abuses had been common and serious issues in mining areas. Massive ore-bodies have been mined and being the causes for the establishment of many cities, however, some of them tend to be smaller and do not justify establishment of permanent townships. As a result, mine employees separated from their families and communities during work periods and migrated to other cities established due to function of mining industries. Migrant placements are also common in mining areas and the associated psychosocial hazards have recently been reviewed (Hansen, 1993). Fatal and severe traumatic injuries continue unfortunately to occur in mining and often have a profound impact on morale. The mine managers often feel personally responsible for post-traumatic disorder injuries among colleagues after even in the absence of negligence, and face the suffering of government inquiries and legal proceedings.

3.0 Objectives

The broad objective of the present work is to carry out a strategic study on the miners' quality of life based on their socio-economic status, sanitation condition and health for bringing a significant incentive in productivity through appropriate straggles.

4.0 Methodology

The detailed methodology includes selection of study domain, data collection, data analysis and devising of strategies.

4.1 Study Domain

Five collieries of Jharia coalfields would be chosen for the present study. Jharia coalfields are situated on the northern side of the Damodar river stretch of about 38 km in Dhanbad district of Jharkhand State in India. Its geographical boundary falls within a window of 23°35'00" to 23°45'00" N latitude and 86°15'00" to 86°30'00" E longitude. The Jharia coalfield, which is in progress for more than 100 years because of its coal deposition at shallow depths and easily available in thick seams. The mines of the coalfield has been unscientifically exploited during pre-independence period and having a total area of around 450km^2. It produces about 27,000 tonnes of prime coking coal. There coalfield has been divided into 14 areas and each area has many opencast as well as underground mines, which are being operated by Bharat Coking Coal Limited (BCCL) under Coal India Limited (CIL).

4.2 Method of Data Analysis

An approach developed by Sundararajan and Loveson (Sundararajan and Loveson, 2002) for assessing integrated environmental quality of the environmental system would be adopted for assessing the integrated quality of life indices of the miners. In the present study, each miner would be treated as system and the components such as physical, chemical, biological, psychological and ergonomic factors would be the sub-system built up with multiple parameters to assess the integrated quality indices of the miners.

Every system parameter has its own recommended value (***r***) or recommended range ($r_1 \le x \le r_2$) and also minimum (***l***) and maximum (***u***) permissible limits (in mathematical language these limits are called lower and upper limits respectively) from the quality point of view for a definite use. The projection mapping defined on the real number system f_p: $R \rightarrow [-1,1]$ is said to be sensitivity function of a parameter *'p'* if it is defined as follows:

$$f_p(x) = \begin{cases} -1 & \text{if } x < l \\ \dfrac{x - r_1}{r_1 - l} & \text{if } l \le x < r_1 \\ 0 & \text{if } r_1 \le x \le r_2 \\ \dfrac{x - r_2}{u - r_2} & \text{if } r_2 < x \le u \\ +1 & \text{if } x > u \end{cases}$$

The absolute value of the sensitivity number of a parameter is said to be impact index (II) and is denoted by *'p'*. Based on II *'p'*, the quality index (QI) *'q'* is derived as $q = 1–p$. The range of quality interval may be enlarged as [0, 100], [0, 1000] and [0, 10000] by multiplying with 100, 1000 and 10000, respectively, for micro-level analysis. These multipliers are called Microscopic Numbers (***M***). IQI may be calculated using the following equation for the system which has been considered for the quality assessment for the intended use.

$$IQI = \frac{1}{2} \times \left[\frac{1}{n} \sum_{i=1}^{n} q_i + \left(\prod_{i=1}^{n} q_i \right)^{1/n} \right] \times M$$

4.3 Data Collection and Analysis

An appropriate questionnaire would be prepared for carrying out a socio-economic, sanitation and health survey. The working environment also would be studied from the ergonomic, psychological and environmental point of view. Again the factors such as physical, chemical, biological hazards would be covered under the view of their living environment.

Data were collected from the miners working in different five mines of Dhanbad district and the name of the mines and their codes are listed below:

(i) Ramkanali underground mines (RAM)

(ii) Keshalpur underground mines (KSP)

(iii) WMC opencast mines (WMC)

(iv) BCCL Block II opencast mines (BB2)

(v) Salanpur underground mines (SAL)

The data have been classified into five major factors of QoL as follows:

(i) Socio-economic

(ii) Health

(iii) Sanitation

(iv) Living environment and

(v) Working environment

Each category has been identified with fifteen parameters that directly or indirectly influence the quality of life of a miner. The data pertaining to living and working environment are collected from various resources available such as project reports, publications and web pages. All other parameters are collected through survey from different miners.

The seventy five significant parameters of five the samples are considered for assessing the intended quality of different miners working at different mines. The criteria or standards which are considered for the data analysis have been presented in Annexure-A 1.

5.0 Results

The quality of life (QoL) indices of twenty miners from each miner are estimated using the present approach and the results are presented for different mines using the bar graphs as shown in Figs.1 to 5. Further, the QoL indices of twenty miners for each mine are statistically analyzed to observe the minimum, maximum and average values of QoL indices of the miners and presented in Table 1. Although the correlation between QoL of the miners and production of the mines is very poor, the linear trend are plotted as shown in Fig. 6 for establishing the overall impact of QoL of miners on the production of coal mines through the trend analysis.

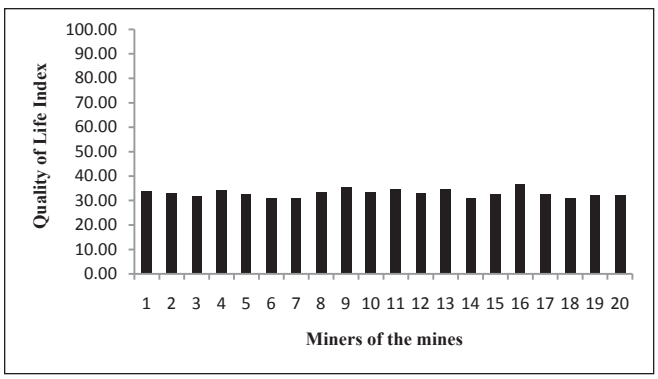

Fig.1: Plot of QoL index for miners of Ramkanali underground mine

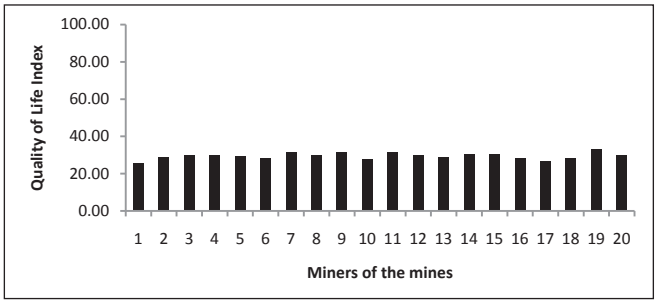

Fig.2. Plot of QoL index for miners of Keshalpur underground mine

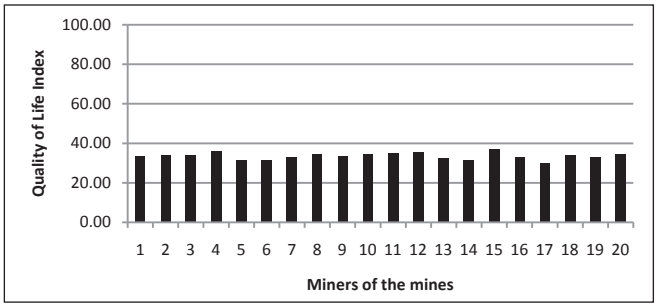

Fig.3. Plot of QoL index for miners of WMC opencast mine

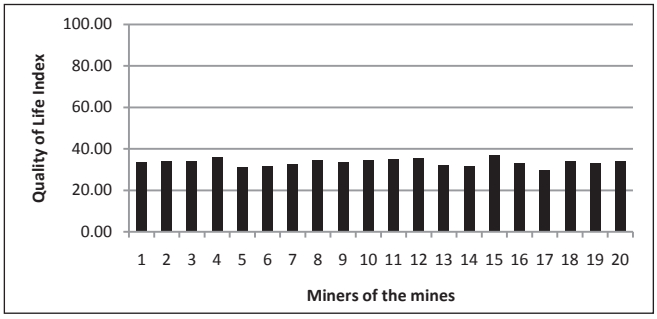

Fig.4. Plot of QoL index for miners of BCCL Block-II opencast mine

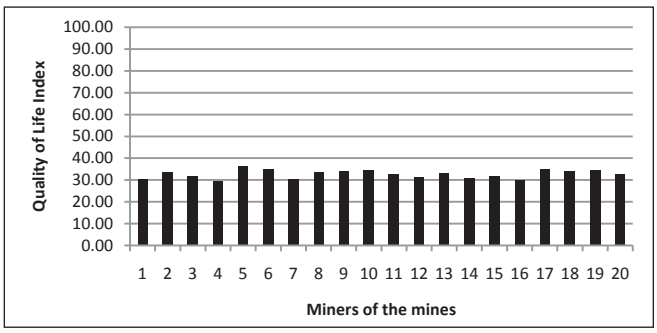

Fig.5. Plot of QoL index for miners of Salanpur underground mine

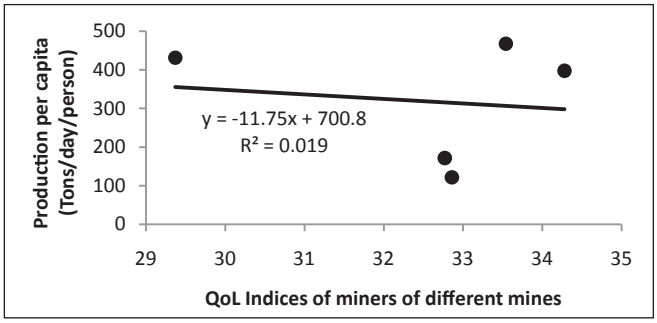

Fig.6. Overall trend showing the decrease in production per capita with QoL

Table 1. The average values of QoL Indices of miners working at different mines

	Name of the Mines	Code	QoL Index			Av. production per capita (tonnes/day/person)
			Min.	Max.	Average	
1.	Ramkanali underground mine	RAM	30.65	36.44	32.86	121.854
2.	Keshalpur underground mine	KSP	25.45	33.17	29.37	431.272
3.	WMC Opencast mine	WMC	29.90	37.07	33.54	467.561
4.	BCCL Block-II opencast mine	BB2	30.81	36.40	34.28	397.667
5.	Salanpur underground mines	SAL	29.71	36.51	32.77	171.765

6.0 Discussion

The results reveal that none of the mines possesses quality of life index above 50 which means the miners are not living with satisfied life with all factors that we have considered. The result reveals that the BCCL Block-II opencast mine possesses the highest average QoL index. However, WMC opencast mine possesses the miner who has the highest QoL index of 37.04 and the Salanpur mine possesses the miner who has the QoL index of minimum of 29.71. It is attempted to correlate the average production of mines in the last five years with its average QoL indices. The correlation coefficient, R2 is found to be 0.0194 and as a result, the relationship cannot be well-established with satisfactory value of correlation coefficient as presently available data is insufficient. There is need for funding a separate project to conduct a field survey and also to think whether some more factors other than the five factors to be considered or some more parameters have to be incorporated under these factors. However, the negative slope of the linear trend that relates the QoL with production per capita in Fig. 6 reveals that the production decreases with the decrease in QoL. Various development schemes for improving the key parameters of each factor in order to QoL of the miners have been suggested below, which may lead the industries to improve the productivity of the mines:

- Socio-economic condition of the people has to be improved by increasing fund for CSR fund to establish tutorials for the children of the miners and give job oriented training programme so that their decedents may get jobs and lead the family without any financial crisis
- Library and club may be established in the company-provided colonies as well as the villages in the surroundings so that the children of the miners who stay in the respective villages may be aware of job opportunities in different companies and fields. This may inspire them for higher education and aware them about various opportunities for placements
- Pesticide or remedial for mosquitoes, bugs, insects and microbes may be issued to the miners and their family members periodically. Cleaning the surroundings may be implemented regularly from company expenditures. Pesticides may be applied in the water stagnant areas during rainy season. Measures for killing mosquitoes may be implemented in the colony and the villages where the miners are living.
- Toilet for the villages may be built up from company cost. Activities like cleaning of bushes and grasses after the rainy season may be implemented in the residential areas. Cow-sheds and sheds for poultry and piggery may be facilitated to the poor people in the village areas. Doctors may be called to take care of animals and cattles in the villages at company cost.
- Regular monitoring of air pollutants in the villages and colonies must be done. Water quality analysis must be frequently carried out in the villages. Drinking water facilities must be arranged for the people at company expenditures.
- DGMS norms for safety measures must be strictly adopted for the miners during working hours. The higher officers must behave in good manner with miners. There must be regular monitoring over the drinking habits of the miners while they come for working in the mines. Separate water for drinking in the underground mines should be arranged for the miners.

This is not only a pioneer study for improving the productivity of coal mining industries but any kind of industry or organization that manufactures goods, produces any material or intellectual goods or inventions. The quality of life of the workers should be the prime concern of the industrial owners instead of the production to find a tremendous change in the progress of the industry as well as amazing harmony in relation between the employers and employees. The strategies planned for the coal mining industries would be very much useful for improving the coal production as well as the quality life of the miners in the country. Nevertheless, some of the activities to be promoted among the workers, which would be discussed in this dissertation work, may be fruitful for improving the working culture among the employees.

7.0 Conclusion

Analysis of data pertaining to socio-economics, health, sanitation, living environment and working environment has been carried out for computing quality of life indices using

a mathematical approach of integrating the effect of seventy five parameters on the QoL of the miners. An attempt has been made to study the mathematical relationship of indices of QoL of miners with the productivity but no correlation could be established from presently available data. Perhaps, the data of five mines may not be adequate to establish reliable linear or non-linear equation. Consideration of more mines may play a vital role to establish such a relation with more consistency. The present approach is unique and very much useful for authorities of mines to improve their QoL, which may ultimately accelerate the production. The approach may also be useful to the concerned government agencies, departments of rural development such as District Rural Development Agencies (DRDA) for planning various socio-economic development activities by assessing the QoL of the people or families.

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ANNUXRE-A.1

CRITERIA APPLIED FOR DEFINING SENSITIVITY FUNCTION

	PARAMETER'S CODE	*l*	r_1	r_2	*u*
A.	**SOCIO-ECONOMIC**				
1	What is your marital status?: a) bachelor, b) widow(er), c) married but not living together, d) married	0	8	8	8
2	What is your monthly salary?	0	91000	91000	91000
3	What is the total income from other sources as such as business / agriculture / salary of other members	0	80000	80000	80000
4	What is the no.. of earning members in the family including you	0	4	4	4
5	What is the no. of members in the family	0	0	0	15
6	What is the no.. of senior citizens	0	0	0	2
7	What is the no.. of sons in the family	0	0	0	6
8	What is the no.. of daughters in the family	0	0	0	6
9	What is the no. of unmarried daughters in the family	0	0	0	4
10	What is the sex ratio in the family? (No. of female / No. of male): _____/ _____ = _____	0	0	0	6
11	What is the average amount of saving from your monthly income?	0	15000	15000	15000
12	Do you have conveyors in the family? a) bicycle , b) motor cycle, c) van, d) car, e) jeep or others	0	30	30	30
13	Residential status: a) rented house, b) company quarters, c) own house	0	6	6	6
14	Electronic items in the house if any: a) TV, b) VCD, c) CD Player, d) Mobile phone, e) Radio andothers	0	30	30	30
15	Do you have any types of land as family property? a) no, b) <1 bigha, c) >1 bigha but < 1 acre, d) > 1 acre	0	6	6	6
B.	**HEALTH**				
1	Did you or any of your family members have an attack of malaria in the last five years?	0	0	1	1
2	Did you or any of your family members have an attack of typhoid in the last five years?	0	0	1	1
3	Patients in the family: a) Asthma /allergy, b) TB, c) Leprosy, d) Cancer	0	0	20	20
4	Do you have any hearing problem? a) no, b) slight deafness, c) d) deafness but no device used	0	0	6	6
5	Do you have any eye related disease? a) no, b) using specs, c) other problem specify:----------	0	0	6	6
6	Do you have the habit of smoking or taking tobacco? a) no, b) only alcohol, c) only tobacco, d) both	0	0	6	6
7	Do you have the habit of drinking alcohol? a) no, b) sometimes in the parties, c) every week, d) every day	0	0	6	6
8	Are you addicted with tobacco or any other kind of this? If yes specify ----------	0	0	1	1
9	Are you using any mask while working during coal excavation? a) no, b) sometime c) always	0	4	4	4
10	Do you have sugar problem? a) no, b) more than >120 mg/l but < 200 mg/l, c) >200 mg/l	0	0	4	4
11	Do you have any BP problem? a) no, b) low BP, c) high BP	0	0	4	4
12	Did you have any heart attack in the last five years? a) yes, b) no	0	0	1	1
13	Did you have an attack of paralysis in the past? a) yes, b) no	0	0	1	1
14	Do you have any other major diseases? a) no, b) lungs problem, c) liver problem , d) kidney problem	0	0	12	12
15	What is your body mass index (BMI)? Weight (W): ---------- kg, Height (H) : ---------- m (BMI=: W / H2)	15	20	25	40

	PARAMETER'S CODE	*l*	r_1	r_2	*u*
C.	**SANITATION**				
1	What is the source of drinking water in the family? a) supplied water, b) well, c) tube well / boring water	0	12	12	12
2	Are you using any water filter? ? a) no, b) yes	0	1	1	1
3	Do you have the facility of toilet/ latrine? ? a) no, b) yes	0	6	6	6
4	What do you use to kill mosquitoes / insects? a) nothing, b) heating of liquid chemical, c) burning of coils	0	2	2	2
5	Is there any open septic tank? a) no, b) yes	0	1	1	1
6	Is there any cowshed within the peripheral of 100 m? a) no, b) yes	0	1	1	1
7	Is there any water logging within the peripheral of 100 m? a) no, b) yes	0	1	1	1
8	Is there any waste storage system / dust bin? a) no, b) yes	0	1	1	1
9	Does the sunlight enter in all the rooms of your house? a) not at all, b) some rooms only c) all the rooms	0	4	4	4
10	Whether the walls have been properly white-washed? a) no, b) yes	0	1	1	1
11	Is there any area/land adjacent to your house being used by public as open toilet ? a) no, b) yes	0	1	1	1
12	Do you keep poultry within house? a) no, b) yes	0	1	1	1
13	Do you keep cattle inside the house? a) no, b) during rainy, c) always	0	4	4	4
14	Are you having piggery in your house?	0	1	1	1
15	Whether anyone does keep piggery in your residential area?	0	1	1	1
D.	**LIVING ENVIRONMENT**				
1	What is the concentration of PM2.5 in the ambient air?	0	3	3	3
2	What is the concentration of PM10 in the ambient air?	0	3	3	3
3	What is the concentration of NO_X in the ambient air?	0	3	3	3
4	What is the concentration of SO_2 in the ambient air?	0	3	3	3
5	What is the status of drinking water quality? a) poor, b)) good, c) very good, d) excellent	0	8	8	8
6	What is the status of cleanliness of residential area? a) poor, b) good, c) very good, d) excellent	0	8	8	8
7	Is there greenery environment around your residential area? a) no, b) fair, c) good, d) excellent	0	6	6	6
8	Is there any water body within 1 km from your home? a) no, b) pond, c) lake, d) river	0	12	12	12
9	Do you have good relation with your neighbours? a) no, b) yes	0	1	1	1
10	Are there any basic facilities within 2 km from your residence? a) hospital, b) school, c) market, d) nothing	0	12	12	12
11	Do you have connective road to market place? a) no, b) haul/kachcha road c) metal road	0	4	4	4
12	Do you have connective road for children going to school? a) no, b) haul/kachcha road c) metal road	0	4	4	4
13	Do you have connective road for patients going to hospital? a) no, b) haul/kachcha road c) metal road	0	4	4	4
14	Do you have connective road to your office? a) no, b) haul/kachcha road c) metal road	0	4	4	4
15	Is there any other infrastructure? a) library, b) community centre, c) youth club, d) none of these	0	12	12	12
E.	**WORKING ENVIRONMENT**				
1	What is the concentration of PM2.5 in the ambient air of surface environment?	0	3	3	3
2	What is the concentration of PM10 in the ambient air of surface environment?	0	3	3	3
3	What is the concentration of NO_X in the ambient air of surface environment?	0	3	3	3

	PARAMETER'S CODE	*l*	r_1	r_2	*u*
4	What is the concentration of SO_2 in the ambient air of surface environment?	0	3	3	3
5	Is working place properly ventilated? a) no, b) fair, c) good, d) very good, e) excellent	0	8	8	8
6	Whether the norms of DGMS pertaining to miners' health are followed properly? a) no, b) yes	0	1	1	1
7	Did any accident occur with you during last 5 years? a) no, b) yes	0	1	1	1
8	What is the source of drinking water in the working place? a) mine water, b) keep own water, c) other	0	6	6	6
9	Are you using ear muff, to protect your ear? a) no, b) yes	0	1	1	1
10	Are you using mask to protect your lungs? a) no, b) yes	0	1	1	1
11	Are you using hand gloves to protect you from vibration of machineries? a) no, b) yes	0	1	1	1
12	Are you using helmet while working in the mines? a) no, b) yes	0	1	1	1
13	How does your senior officer behave with you? a) very bad, b) bad, c) good, d) very good	0	8	8	8
14	How do you maintain relationship with your colleagues? a) very bad, b) bad, c) good, d) very good	0	8	8	8
15	Do you have job satisfaction? a) no, b) yes	0	1	1	1