

## RESULTS

### I. Health profile of Glass Industrial workers:

#### Personal characteristics:

##### 1. Age in years.

Table (1)

Number and percent distribution of age in years among the studied workers.

| Age     | No. | %     |
|---------|-----|-------|
| < 35    | 152 | 28.15 |
| 35 -    | 151 | 27.96 |
| 45 -    | 179 | 33.15 |
| 55 - 65 | 58  | 10.74 |
| Total   | 540 | 100   |

$$\bar{X} = 42.65 \pm 9.87$$

Table (1) : Clearly showed that most of the studied group had an age that ranged from (35-55 ys). and only 10.74 % had an age ranged from (55-65 ys). The mean age was  $42.65 \pm 9.87$  years.

Table (2)

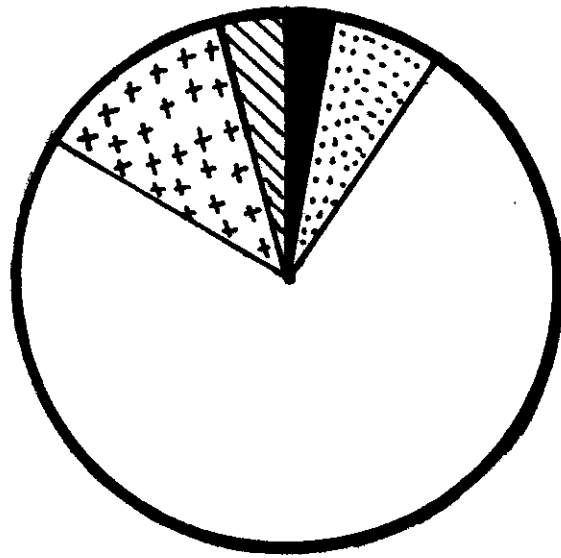
Number and percent distribution of marital status, residence and level of education of the studied group of workers:

| Personal characteristics               | No. | %     |
|----------------------------------------|-----|-------|
| <b>2. <u>Marital status</u></b>        |     |       |
| Married                                | 519 | 96.11 |
| Single                                 | 21  | 3.89  |
| <b>3. <u>Residence:</u></b>            |     |       |
| Urban                                  | 357 | 66.11 |
| Rural                                  | 183 | 33.89 |
| <b>4. <u>Level of Education:</u></b>   |     |       |
| Illiterate                             | 255 | 47.22 |
| Read and write                         | 209 | 38.70 |
| Ended 1ry schools<br>(Basic education) | 22  | 4.08  |
| Ended 2ry schools                      | 45  | 8.33  |
| University level                       | 9   | 1.67  |

# "CHART 1"

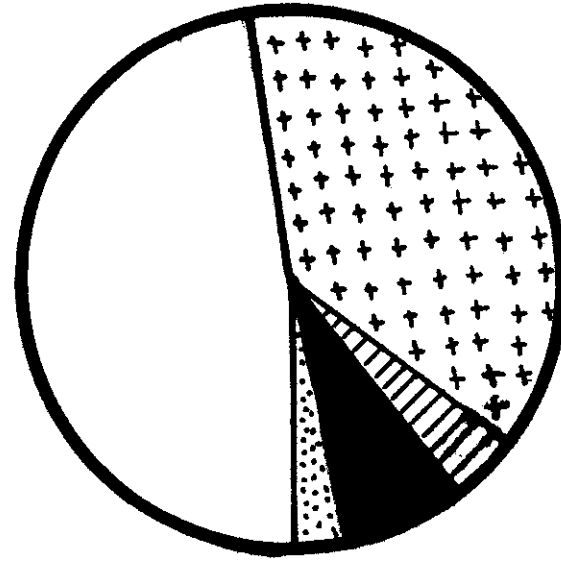
Pie Charts showing the percent distribution of occupations and level of education of the studied workers.

(A)



- Leading profession.
- Lesser profession.
- Skilled workers.
- Semiskilled workers.
- Unskilled workers.

(B)



- Illiterate.
- Read & Write.
- Basic education.
- Secondary education.
- University.

Table (2) clearly showed that (96.11 %) of the studied workers were married and only (3.89 %) were not married. On the other hand more than two thirds of the workers (66.11 %) were coming from urban areas and only (33.89%) were living in rural area.

As regards level of education, table (2) illustrated by chart (1,B) clearly showed that (47.2 %) of all studied workers were illiterate, (38.7 %) were just read and write, and (12.4 %) had completed their basic education. A minority of the workers (1.67 %) had completed University level.

Table (3)

Means and standard deviations of exposed and control group of workers according to weight, height and Age.

| Location and No. of the studied workers.     |                                   | Weight in Kgm.                    | Height in cm.                    | Age in years                     |
|----------------------------------------------|-----------------------------------|-----------------------------------|----------------------------------|----------------------------------|
| Manual loading and Crystal factory No. (186) | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 75.52<br>13.12<br>0.07<br>> 0.05  | 166.62<br>6.12<br>2.31<br>< 0.05 | 39.68<br>9.57<br>0.84<br>> 0.05  |
| Automatic factory No. (71)                   | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 74.08<br>13.20<br>0.76<br>> 0.05  | 169.74<br>6.41<br>0.82<br>> 0.05 | 41.96<br>9.00<br>0.88<br>> 0.05  |
| Sheet glass factory No. (71)                 | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 73.98<br>11.43<br>0.88<br>> 0.05  | 168.70<br>6.41<br>0.09<br>> 0.05 | 43.18<br>9.16<br>1.46<br>> 0.05  |
| Ornamental sheet glass factory No. (30)      | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 71.63<br>8.83<br>1.93<br>> 0.05   | 166.10<br>4.85<br>2.17<br>< 0.05 | 47.63<br>8.19<br>3.90<br>< 0.001 |
| Batch House No. (15)                         | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 65.80<br>7.26<br>5.73<br>< 0.001  | 166.20<br>4.88<br>1.64<br>> 0.05 | 44.53<br>9.95<br>1.41<br>> 0.05  |
| Rock Grinding department No. (27)            | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 66.37<br>10.95<br>3.74<br>< 0.001 | 163.00<br>8.31<br>3.18<br>< 0.01 | 44.00<br>11.70<br>1.36<br>> 0.05 |
| Sand Preparation Department No. (40)         | $\bar{X}$<br>S.D. $\pm$<br>t<br>P | 66.29<br>9.59<br>4.50<br>< 0.001  | 164.90<br>6.89<br>2.82<br>< 0.01 | 49.50<br>6.68<br>6.16<br>< 0.001 |
| Non-exposed Group No. (100)                  | $\bar{X}$<br>S.D. $\pm$           | 75.64<br>13.10                    | 168.60<br>7.32                   | 40.68<br>9.71                    |

Table (3): Shows means weight in kgm of the studied workers in the studied locations and there are a significant differences between weights of workers in Batch house, Rock Grinding department, Sand preparation department and control group ( $P < 0.01$ ). Regarding height in cm. There is also significant differences between workers in Rock Grinding & sand preparation departments and control group.

The same table shows the mean age in years of workers in the studied locations .

Socio-economic features:

Table (4)

Number and percent distribution of the studied workers according to family income/month in pounds.

| Socio economic feature            | No. | %     |
|-----------------------------------|-----|-------|
| 1. Family income/month in pounds. |     |       |
| < 50                              | 50  | 9.26  |
| 50 -                              | 292 | 54.07 |
| 100 -                             | 145 | 26.85 |
| 150 -                             | 38  | 7.04  |
| 200 - 250                         | 15  | 2.78  |
| Total                             | 540 | 100   |

$$\bar{X} = 95 \pm 42.83$$

Table (4): Clearly showed that the mean family income/month was  $95 \pm 42.8$  pounds. The majority of the workers (54.07 % had family income (50 - 100) pounds/month while only 9.85 % had an income of (150-250) pounds/month.

Table (5)

Number and percent distributon of the studied workers according to their family size.

| 2. Family size | No. | %     |
|----------------|-----|-------|
| < 5            | 149 | 27.59 |
| 5 -            | 351 | 65    |
| 10 - 15        | 40  | 7.41  |
| Total          | 540 | 100   |

$$\bar{X} = 6.49 \pm 2.78$$

Table (5) clearly showed that the family size of the studied group of workers ranged from less than 5 to 15 individuals with the mean value of  $6.49 \pm 2.78$  members. Less than one third (27.59 %) of the workers had family size of less than 5 members, (65 %) of the workers had family size ranged from 5-9 members and only (7.41 %) had large families formed of more than ten individuals.

Table (6)

Number and percent distribution of smoking habit,  
Drug addiction and job description among (540)  
studied group of workers.

| Socioeconomic feature               | No. | %     |
|-------------------------------------|-----|-------|
| 3. <u>Smoking habit:</u>            |     |       |
| Smokers                             | 425 | 78.70 |
| Exsmokers                           | 5   | 0.93  |
| Non smokers                         | 110 | 20.37 |
| 4. <u>Drug addiction</u>            | 50  | 9.26  |
| 5. <u>*Job Description.</u>         |     |       |
| Leading profession and<br>business: | 15  | 2.78  |
| Intermediate (Lesser<br>profession) | 35  | 6.48  |
| Skilled workers                     | 404 | 74.82 |
| Part semiskilled                    | 64  | 11.85 |
| Unskilled                           | 22  | 4.07  |

\* According to Morris, (1970) .

3. Smoking habit:

The study revealed that more than three fourths (78.70 %) of the studied workers were smokers, and (20.37 %) were nonsmokers. Only (0.93 %) were ex-smokers. (Table 6).

4. Drug addiction:

It was evident that (9.26 %) of the studied workers were using addictive drugs. (Table 6).

5. Occupations:

From table (6) and Chart (1,A), about (74.82 %) of the studied workers were skilled, (11.85 %) were semiskilled and only (4.07 %) were unskilled workers. Leading profession and business with the intermediate (Lesser profession) Constitute (9.26 %) of the studied sample.

**Table (7)**  
Means and Standard deviations of the pulse, systolic and diastolic blood pressure among exposed and control studied group of workers.

| Location and No. of the studied workers.          |            | Pulse per minute | Systolic B.P./mmHg. | Diastolic B.P./mmHg. |
|---------------------------------------------------|------------|------------------|---------------------|----------------------|
| Manual loading and Crystal factory .<br>No. (186) | $\bar{X}$  | 85.71            | 114.67              | 72.36                |
|                                                   | S.D. $\pm$ | 12.84            | 16.54               | 11.73                |
|                                                   | t          | 0.91             | 0.14                | 0.57                 |
|                                                   | P          | > 0.05           | > 0.05              | > 0.05               |
| Automatic factory<br>No. (71)                     | $\bar{X}$  | 86.23            | 118.59              | 75.07                |
|                                                   | S.D. $\pm$ | 10.21            | 20.79               | 14.52                |
|                                                   | t          | 1.11             | 1.15                | 0.82                 |
|                                                   | P          | > 0.05           | > 0.05              | > 0.05               |
| Sheet glass factory<br>No. (71)                   | $\bar{X}$  | 89.73            | 116.19              | 72.59                |
|                                                   | S.D. $\pm$ | 12.51            | 17.01               | 9.86                 |
|                                                   | t          | 2.81             | 0.42                | 0.37                 |
|                                                   | P          | < 0.01           | > 0.05              | > 0.05               |
| Ornamental sheet glass factory<br>No. (30)        | $\bar{X}$  | 83.63            | 115.05              | 72.16                |
|                                                   | S.D. $\pm$ | 15.90            | 16.34               | 8.67                 |
|                                                   | t          | 0.21             | 0.01                | 0.53                 |
|                                                   | P          | > 0.05           | > 0.05              | > 0.05               |
| Batch House<br>No. (15)                           | $\bar{X}$  | 82.20            | 115.33              | 74.66                |
|                                                   | S.D. $\pm$ | 11.77            | 21.99               | 9.90                 |
|                                                   | t          | 0.64             | 0.06                | 0.48                 |
|                                                   | P          | > 0.05           | > 0.05              | > 0.05               |
| Rock Grinding department<br>No. (27)              | $\bar{X}$  | 77.22            | 111.11              | 70.55                |
|                                                   | S.D. $\pm$ | 13.51            | 14.50               | 8.35                 |
|                                                   | t          | 2.45             | 1.14                | 1.29                 |
|                                                   | P          | < 0.05           | > 0.05              | > 0.05               |
| Sand Preparation Department<br>No. (40)           | $\bar{X}$  | 79.00            | 119.75              | 75.25                |
|                                                   | S.D. $\pm$ | 11.51            | 18.74               | 9.86                 |
|                                                   | t          | 2.41             | 1.34                | 0.95                 |
|                                                   | P          | < 0.05           | > 0.05              | > 0.05               |
| Non-exposed Group<br>No. (100)                    | $\bar{X}$  | 84.30            | 115                 | 73.27                |
|                                                   | S.D. $\pm$ | 12.30            | 19.26               | 13.61                |

Table (7): Shows that the mean value of pulse in Rock grinding and Sand preparation departments is lower in the exposed than in the non exposed control group ( $P < 0.05$ ), while on the other hand the mean value of pulse in the sheet glass factory is higher in the exposed than in the non-exposed group and the difference is statistically significant ( $P < 0.01$ ).

As regards the systolic and diastolic blood pressure there is no significant differences between the exposed and non-exposed group in all factories ( $P > 0.05$ ).

Table (8)

Number and percent distribution of the main history and symptomatology of (540) studied workers.

| Main history and symptomatology | No. | %     |
|---------------------------------|-----|-------|
| History of Bilharziasis         | 319 | 59.07 |
| Heat cramps                     | 231 | 42.78 |
| Cough                           | 191 | 35.37 |
| Joint pains                     | 178 | 32.96 |
| Expectoration                   | 172 | 31.85 |
| History of surgical operations  | 154 | 28.52 |
| Chest wheeze                    | 146 | 27.04 |
| Dyspnea                         | 143 | 26.48 |
| Emotional stress                | 103 | 19.07 |
| Retrosternal dull aching pain   | 61  | 11.30 |
| Ear troubles                    | 47  | 8.70  |
| Occupational accidents          | 40  | 7.41  |
| Diabetes                        | 23  | 4.26  |
| Bronchial asthma                | 22  | 4.07  |
| Hypertension                    | 13  | 2.14  |
| Tuberculosis                    | 11  | 2.04  |
| Coronary Heart disease          | 6   | 1.11  |

## CHART '2'

Multiple bar charts showing percent distribution of the main history  
and symptomatology of the studied workers.

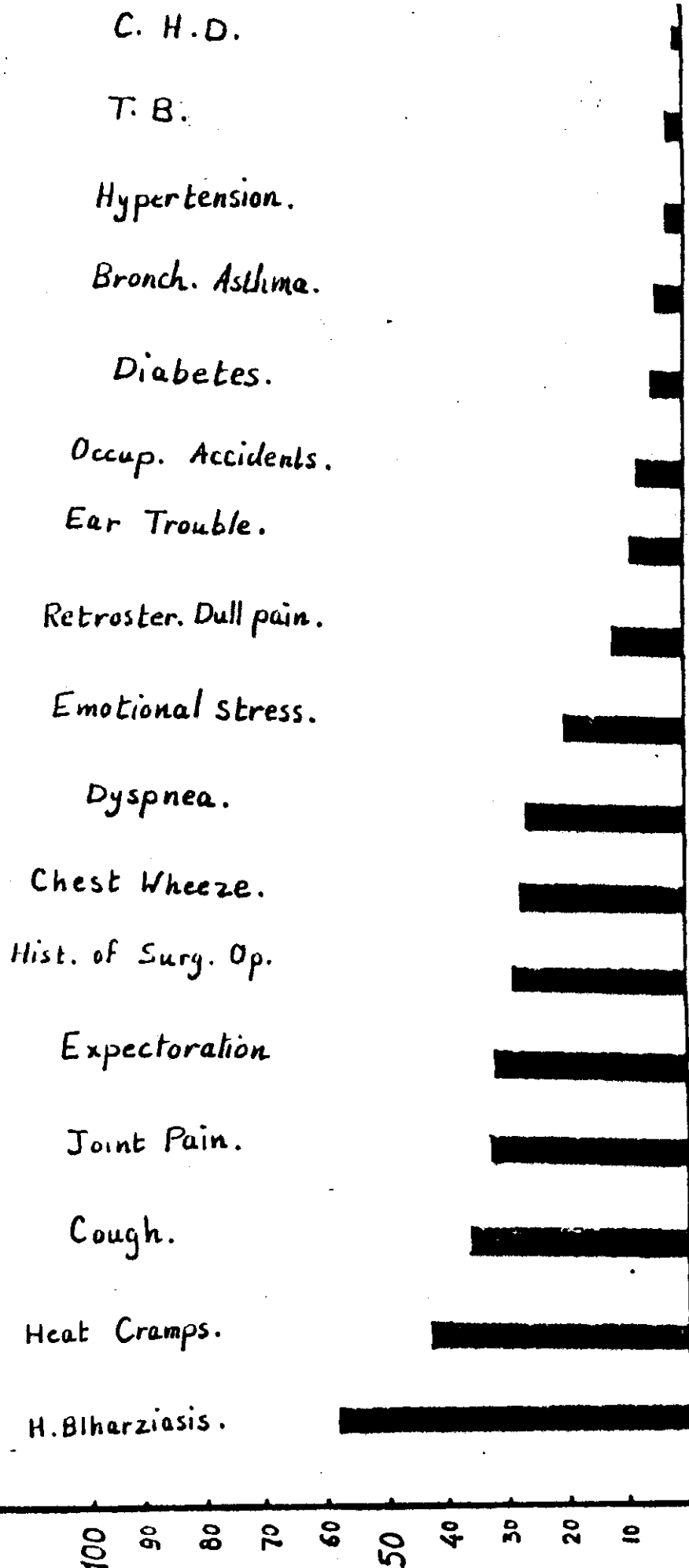


Table (8)

Table (8) , Chart (2), clearly showed that history of bilharziasis and heat cramps were the most common among the studied group. On the other hand T.B. and coronary heart disease were uncommon among the studied group. of workers.

Table (9)

number and percent distribution of the studied workers  
according to physical and laboratory examinations.

| Diseases                                    | No. | Percent |
|---------------------------------------------|-----|---------|
| * <u>Dental illness</u>                     | 408 | 75.56   |
| Dental extraction and caris                 | 199 | 36.85   |
| Dental extraction                           | 159 | 29.44   |
| Dental caris                                | 50  | 9.26    |
| * <u>Eye troubles</u>                       |     |         |
| Errors of refraction                        | 291 | 53.89   |
| Corneal opacity                             | 17  | 3.15    |
| Cataract                                    | 9   | 1.67    |
| Squint                                      | 4   | 0.74    |
| Ptrygium                                    | 2   | 0.37    |
| * <u>Anaemia</u> (<13 gm/dL) <sup>[i]</sup> | 114 | 23.08   |
| * <u>Ear traubles</u>                       | 47  | 8.70    |
| * <u>Parasitic infestations</u>             |     |         |
| Amaebic cysts                               | 86  | 15.93   |
| Giardia cysts                               | 15  | 2.78    |
| H. Nana egg                                 | 8   | 1.48    |
| Ascariasis                                  | 8   | 1.48    |
| Mixed parasitic infec.                      | 6   | 1.11    |
| Oxuriasis                                   | 4   | 0.74    |
| Intestinal Bilharziasis                     | 2   | 0.37    |
| * <u>Urine Abnormalities:</u>               |     |         |
| Sugar in urine                              | 23  | 4.26    |
| Albumin in urine                            | 10  | 1.85    |
| Urinary Bilharziasis                        | 2   | 0.37    |
| * <u>Skin Diseases</u>                      |     |         |
| Contact drmatitis                           | 12  | 2.22    |
| Taenia versicolor                           | 4   | 0.74    |
| Psoriasis                                   | 2   | 0.37    |
| Vetilego                                    | 1   | 0.18    |

[i] WHO, (1972)

# CHART - 3 -

Multiple bar chart showing the percent distribution of  
the studied workers according to Physical & Lab. examinations

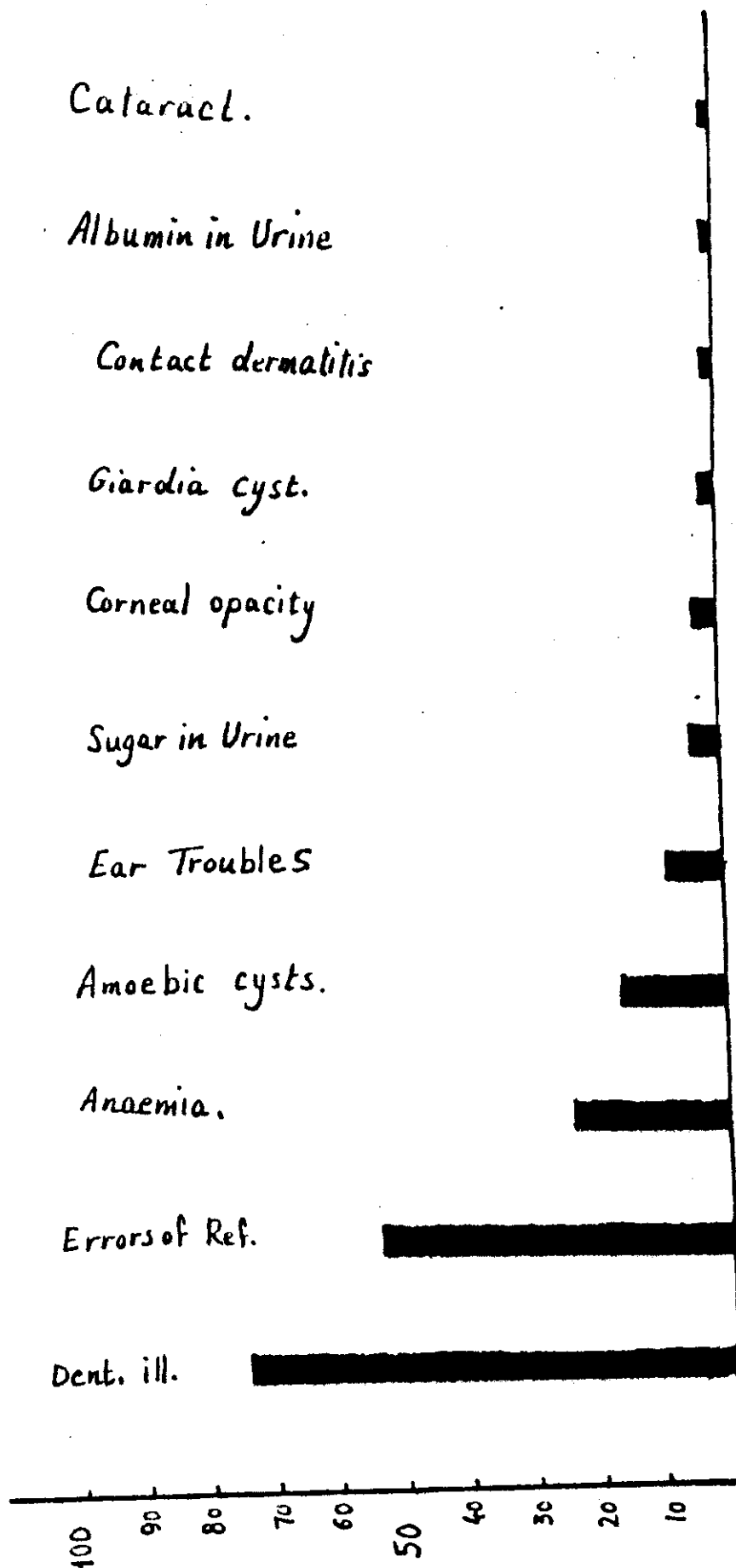


Table (9) illustrated by Chart (3) that 408 workers (75.56 %), 291 (53.89 %), 114 (23.08 %) have dental disorders, error of refraction and anaemia respectively while only 86 (15.93 %), 15 (2.78 %) of workers have gastrointestinal parasites such as amoebiasis and giardiasis respectively.

Table (10)

Means and Standard deviations of blood examination of the studied group of workers.

| Location and No. of the studied workers.             |                    | R.B.Cs. count <sub>3</sub><br>in Million/mm <sup>3</sup> | Hb. in<br>gm/dL | W.B.Cs. count <sub>3</sub><br>in 1000/mm <sup>3</sup> |
|------------------------------------------------------|--------------------|----------------------------------------------------------|-----------------|-------------------------------------------------------|
| Manual loading and<br>Crystal factory -<br>No. (169) | $\bar{X}$          | 5.03                                                     | 13.18           | 7.16                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.33                                                     | 0.39            | 0.95                                                  |
|                                                      | t                  | 1.62                                                     | 1.04            | 0.55                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Automatic factory<br>No. (61)                        | $\bar{X}$          | 4.94                                                     | 13.16           | 7.13                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.67                                                     | 0.39            | 0.65                                                  |
|                                                      | t                  | 1.77                                                     | 1.17            | 0.20                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Sheet glass factory<br>No. (69)                      | $\bar{X}$          | 5.01                                                     | 13.18           | 7.14                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.39                                                     | 0.43            | 0.64                                                  |
|                                                      | t                  | 1.55                                                     | 0.78            | 0.30                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Ornamental sheet<br>glass factory<br>No. (26)        | $\bar{X}$          | 5.13                                                     | 13.28           | 6.87                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.29                                                     | 0.36            | 0.36                                                  |
|                                                      | t                  | 0.45                                                     | 0.63            | 0.33                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Batch House<br>No. (15)                              | $\bar{X}$          | 5.04                                                     | 13.13           | 7.29                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.29                                                     | 0.54            | 0.56                                                  |
|                                                      | t                  | 0.75                                                     | 0.07            | 1.12                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Rock Grinding<br>department<br>No. (27)              | $\bar{X}$          | 5.14                                                     | 13.16           | 6.98                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.33                                                     | 0.38            | 0.84                                                  |
|                                                      | t                  | 0.57                                                     | 0.85            | 0.76                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Sand Preparation<br>Department<br>No. (35)           | $\bar{X}$          | 5.04                                                     | 13.03           | 7.29                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.32                                                     | 0.64            | 0.55                                                  |
|                                                      | t                  | 1.71                                                     | 1.81            | 1.64                                                  |
|                                                      | P                  | > 0.05                                                   | > 0.05          | > 0.05                                                |
| Non-exposed Group<br>No. (92)                        | $\bar{X}$          | 5.1                                                      | 13.23           | 7.11                                                  |
|                                                      | S.D.+<br>$\bar{X}$ | 0.34                                                     | 0.37            | 0.62                                                  |

Table (10), shows that there is no statistical significant differences between the matching variables of R.B.Cs. Haemoglobin determination and WBCs count among the exposed and non-exposed control group of workers in all studied factories.

Table (11)  
Mean and Standard deviation of pulmonary function measurements among exposed and control studied group of workers.

| Pulmonary function measurements. | Manual loading and Crystal factory No(186) | Automatic factory No. (71) | Sheet glass factory (No.71) | Ornamental sheet glass factory (30) | Batch House No.(15) | Rock Grinding department No(27) | Sand Prep. department No.(40) | Non-exposed group No.(100) |
|----------------------------------|--------------------------------------------|----------------------------|-----------------------------|-------------------------------------|---------------------|---------------------------------|-------------------------------|----------------------------|
| FEV <sub>1</sub> (Litre)         |                                            |                            |                             |                                     |                     |                                 |                               |                            |
| $\bar{X}$                        | 3.02                                       | 2.95                       | 3.07                        | 3.05                                | 2.65                | 2.60                            | 2.73                          | 3.20                       |
| S.D. $\pm$                       | 0.65                                       | 0.70                       | 0.75                        | 0.65                                | 0.86                | 0.68                            | 0.63                          | 0.66                       |
| t                                | 2.25                                       | 2.27                       | 1.30                        | 1.07                                | 2.39                | 3.33                            | 4.20                          | -                          |
| p                                | > 0.05                                     | < 0.05                     | > 0.05                      | > 0.05                              | < 0.05              | < 0.001                         | < 0.001                       | -                          |
| FVC (Litre)                      |                                            |                            |                             |                                     |                     |                                 |                               |                            |
| $\bar{X}$                        | 3.77                                       | 3.69                       | 3.64                        | 3.58                                | 3.35                | 3.37                            | 3.44                          | 3.82                       |
| S.D. $\pm$                       | 0.74                                       | 0.72                       | 0.70                        | 0.72                                | 0.75                | 0.8                             | 0.68                          | 0.76                       |
| t                                | 0.55                                       | 1.14                       | 1.60                        | 1.60                                | 2.24                | 3.00                            | 2.92                          | -                          |
| p                                | > 0.05                                     | > 0.05                     | > 0.05                      | > 0.05                              | < 0.05              | < 0.01                          | < 0.01                        | -                          |
| FEV <sub>1</sub> /FVC %          |                                            |                            |                             |                                     |                     |                                 |                               |                            |
| $\bar{X}$                        | 80.10                                      | 79.94                      | 84.34                       | 85.19                               | 79.10               | 77.15                           | 79.36                         | 83.76                      |
| + S.D.                           | 0.76                                       | 0.64                       | 0.10                        | 0.19                                | 0.42                | 0.74                            | 0.59                          | -                          |
| p                                | > 0.05                                     | > 0.05                     | > 0.05                      | > 0.05                              | > 0.05              | > 0.05                          | > 0.05                        | -                          |
| FEV <sub>1</sub> % of predicted  |                                            |                            |                             |                                     |                     |                                 |                               |                            |
| $\bar{X}$                        | 86.77                                      | 86.85                      | 87.78                       | 88.20                               | 79.77               | 85.15                           | 85.17                         | 87.02                      |
| S.D. $\pm$                       | 19.72                                      | 17.48                      | 16.13                       | 20.71                               | 16.54               | 17.05                           | 14.69                         | 16.96                      |
| t                                | 0.11                                       | 0.06                       | 0.30                        | 0.29                                | 1.58                | 0.51                            | 0.64                          | -                          |
| p                                | > 0.05                                     | > 0.05                     | > 0.05                      | > 0.05                              | > 0.05              | > 0.05                          | > 0.05                        | -                          |
| FVC % of predicted               |                                            |                            |                             |                                     |                     |                                 |                               |                            |
| $\bar{X}$                        | 87.12                                      | 87.16                      | 89.33                       | 89.07                               | 83.10               | 86.61                           | 86.69                         | 89.43                      |
| S.D. $\pm$                       | 16.13                                      | 15.24                      | 13.37                       | 15.12                               | 13.90               | 17.82                           | 16.83                         | 15.16                      |
| t                                | 1.05                                       | 0.88                       | 0.04                        | 0.11                                | 1.57                | 0.05                            | 1.15                          | -                          |
| p                                | > 0.05                                     | > 0.05                     | > 0.05                      | > 0.05                              | > 0.05              | > 0.05                          | > 0.05                        | -                          |

\* S.D. = Standard Normal Deviation.

Pulmonary Function measurements of the studied workers:

Table (11) shows that the mean value of  $FEV_1$  in automatic factory is significantly lower in the exposed group than that of the nonexposed group.  $P < 0.05$ .

Regarding workers of Manual loading and crystal, sheet glass, ornamental sheet glass factories there is no statistical significant differences between the mean values of  $FEV_1$ , FVC,  $FEV_1$  % of predicted, FVC % of predicted and  $FEV_1/FVC$  percent in both the exposed and nonexposed control group ( $P > 0.05$ ).

Again, the mean value of  $FEV_1$  and FVC are significantly lower in exposed than in non exposed control group in Batch house, Rock Grinding and in sand preparation departments.

Table (12)  
Means and Standard deviation of Peak expiratory  
flow rate among the studied workers

| Location                                          |                              | P E F R                     | P E F R %<br>of predicted        |
|---------------------------------------------------|------------------------------|-----------------------------|----------------------------------|
| Manual loading and crystal<br>factory. No. (186). | $\bar{X}$<br>S.D.±<br>t<br>P | 442<br>99<br>3.13<br><0.01  | 73.11<br>15.96<br>3.48<br><0.001 |
| Automatic fac.<br>(No. (71))                      | $\bar{X}$<br>S.D.±<br>t<br>P | 460<br>107<br>1.20<br>>0.05 | 76.55<br>17.18<br>1.22<br>>0.05  |
| Sheet glass factory<br>No. (71)                   | $\bar{X}$<br>S.D.±<br>t<br>P | 473<br>100<br>0.40<br>>0.05 | 77.61<br>16.93<br>0.99<br>>0.05  |
| Ornamental sheet glass<br>Factory No. (30)        | $\bar{X}$<br>S.D.±<br>t<br>P | 474<br>95<br>0.25<br>>0.05  | 76.83<br>19.04<br>0.73<br>>0.05  |
| Batch house<br>No. (15)                           | $\bar{X}$<br>S.D.±<br>t<br>P | 402<br>143<br>2.02<br><0.05 | 63.83<br>28.22<br>2.12<br><0.05  |
| Rock Grinding<br>Dept.<br>No (27)                 | $\bar{X}$<br>S.D.±<br>t<br>P | 310<br>92<br>8.45<br><0.001 | 57.62<br>18.38<br>5.75<br><0.001 |
| Sand. Prep. Dept.<br>No. (40)                     | $\bar{X}$<br>S.D.±<br>t<br>P | 340<br>68<br>9.78<br><0.001 | 57.55<br>11.35<br>9.58<br><0.001 |
| Control Group<br>(No. (100))                      | $\bar{X}$<br>S.D.±           | 479<br>93                   | 79.59<br>14.52                   |

Table (12) shows that the mean value of PEFR and PEFR % of predicted is lower in the exposed than in the nonexposed group in manual loading and crystal factory, Batch house, Rock Grinding Department and Sand preparation Department and the difference is statistically significant.

Table (13)

Numbers and percent distribution of exposed and control subjects according to their smoking habit.

| Smoking<br>habit | Exposed |     | Control |     | Total |       |
|------------------|---------|-----|---------|-----|-------|-------|
|                  | No.     | %   | No.     | %   | No.   | %     |
| Smokers          | 352     | 80  | 73      | 73  | 425   | 78.70 |
| Non smokers      | 88      | 20  | 27      | 27  | 115   | 21.30 |
| Total            | 440     | 100 | 100     | 100 | 540   | 100   |

$$\chi^2 = 2.38$$

$$P < 0.05$$

It is clear from this table that the percentage of smokers among the exposed group is higher than those in the control group and the difference is significant statistically.

Table (14)

Means and standard deviations of the ventilatory functions of exposed workers according to their smoking habits.

| Groups                               | FEV <sub>1</sub><br>Litre | FVC<br>Litre | FEV <sub>1</sub> /FVC<br>% | FEV <sub>1</sub> %<br>of pred. | FVC %<br>of pred. | PEFR<br>of pred. | PEFR %<br>of pred. |
|--------------------------------------|---------------------------|--------------|----------------------------|--------------------------------|-------------------|------------------|--------------------|
| Smoking exposed group<br>(No = 352)  |                           |              |                            |                                |                   |                  |                    |
| $\bar{X}$                            | 2.91                      | 3.64         | 79.95                      | 86.40                          | 87.13             | 428              | 70.37              |
| S.D.±                                | 0.67                      | 0.70         | -                          | 17.69                          | 15.14             | 99               | 16.34              |
| Nonsmoking exposed<br>group (No.=88) |                           |              |                            |                                |                   |                  |                    |
| $\bar{X}$                            | 3.12                      | 3.70         | 84.32                      | 87.13                          | 88.53             | 455              | 78.31              |
| S.D.±                                | 0.72                      | 0.80         | -                          | 19.84                          | 17.16             | 95               | 17.89              |
| Test of Significance                 | t= 2.63                   | t=0.67       | SND=0.99                   | t=0.14                         | t=0.70            | t=2.36           | t=3.78             |
| P                                    | <0.01                     | >0.05        | >0.05                      | >0.05                          | >0.05             | <0.05            | <0.001             |

SND = Standard normal deviations.

Table (15)  
Means and standard deviations of the ventilatory functions among  
the two smoking groups "exposed and control subjects".

| Groups                              | FEV <sub>1</sub><br>Litre | FVC<br>Litre | FEV <sub>1</sub> /FVC<br>% | FEV <sub>1</sub> %<br>of pred. | FVC %<br>of pred. | PEFR   | PEFR %<br>of pred. |
|-------------------------------------|---------------------------|--------------|----------------------------|--------------------------------|-------------------|--------|--------------------|
| Smoking exposed group<br>(No = 352) |                           |              |                            |                                |                   |        |                    |
| $\bar{X}$                           | 2.91                      | 3.64         | 79.95                      | 86.40                          | 87.13             | 428    | 70.37              |
| S.D.±                               | 0.67                      | 0.70         | -                          | 17.69                          | 15.14             | 99     | 16.34              |
| Smoking control<br>group (No.=73)   |                           |              |                            |                                |                   |        |                    |
| $\bar{X}$                           | 3.17                      | 3.81         | 83.20                      | 86.48                          | 88.68             | 475    | 79.30              |
| S.D.±                               | 0.67                      | 0.75         | -                          | 16.98                          | 14.80             | 94     | 15.18              |
| Test of Significance                | t=2.88                    | t=1.7        | SND = 0.67                 | t=0.04                         | t=0.81            | t=3.85 | t=4.51             |
| P                                   | <0.01                     | >0.05        | >0.05                      | >0.05                          | >0.05             | <0.001 | <0.001             |

SND = Standard normal deviations.

Table (16)

Means and standard deviations of the ventilatory functions of  
non-smoking exposed and control group.

| Groups                                 | FEV <sub>1</sub><br>Litre | FVC<br>Litre | FEV <sub>1</sub> /FVC | FEV <sub>1</sub> %<br>of pred. | FVC %<br>of pred. | PEFR<br>of pred. | PEFR %<br>of pred. |
|----------------------------------------|---------------------------|--------------|-----------------------|--------------------------------|-------------------|------------------|--------------------|
| Nonsmoking Exposed<br>group. (No. 88). | $\bar{X}$                 | 3.12         | 84.32                 | 87.13                          | 88.53             | 455              | 78.31              |
|                                        | S.D.±                     | 0.72         | -                     | 19.84                          | 17.16             | 95               | 17.89              |
| Nonsmoking control<br>group (No. 27)   | $\bar{X}$                 | 3.33         | 86.27                 | 88.42                          | 91.45             | 492              | 80.2               |
|                                        | S.D.±                     | 0.65         | -                     | 16.89                          | 16.15             | 91               | 12.86              |
| Test of Significance                   | t=1.4                     | t=0.94       | SND= 0.25             | t=0.33                         | t=0.81            | t=1.83           | t=0.61             |
| P                                      | >0.05                     | >0.05        | >0.05                 | >0.05                          | >0.05             | >0.05            | >0.05              |

SND = Standard normal deviations.

Table (14) shows that there is a significant reduction in the  $FEV_1$ /liter, PEFR % of predicted and PEFR in the smoking exposed group than those in the nonsmoking exposed group.

It is also evident from table (15) that there is a significant reduction in  $FEV_1$ , PEFR and PEFR % of pred. in smoking exposed group than those in the smoking control group.

It is clear from table (16) that there is no significant relationship in the ventilatory function in the nonsmoking exposed group and nonsmoking control group.

It is also evident from the previous results, tables, (14 - 16), that smoking habit had additional effect on the reduction of pulmonary function among the exposed group specially in PEFR data.

Table (17)

Number and percent distribution of mass miniature radiological findings among the studied workers.

| Mass miniature Findings | No. | %     |
|-------------------------|-----|-------|
| Positive findings       | 46  | 8.52  |
| Negative findings       | 494 | 91.48 |
| Total                   | 540 | 100   |

Table (17) clearly showed that (8.52 %) of the studied workers had a positive mass miniature findings among the studied workers.

Table (18)

Number and percent distribution of the studied workers with positive radiological findings.

| Radiological findings.                                  | No. | %     |
|---------------------------------------------------------|-----|-------|
| 1. Small nodular opacities<br>(suggestive of silicosis) | 18  | 3.33  |
| 2. Increased bronchovascular markings.                  | 12  | 2.22  |
| 3. Bronchiactatic changes                               | 11  | 2.04  |
| 4. Pul. T.B.                                            | 5   | 0.93  |
| 5. No. Findings                                         | 494 | 91.48 |
| Total                                                   | 540 | 100   |

Table (18) Clearly showed that the main radiological changes among the studied workers were, small nodular opacities (suggestive of silicosis) increased broncho-vascular markings and bronchiactatic changes the percentage of each was 3.33, 2.22. and 2.04 respectively.

Table (19)

Number and percent distribution of the studied workers with positive radiological findings according to their work place.

| Location                            | No. | %     |
|-------------------------------------|-----|-------|
| Sand preparation Dept.              | 16  | 34.78 |
| Batch House                         | 12  | 26.09 |
| Rock Grinding Dept.                 | 8   | 17.39 |
| Automatic Faetory                   | 3   | 6.52  |
| Manual Loading and crystal factory. | 3   | 6.52  |
| Ornamental sheet glass factory.     | 2   | 4.35  |
| Sheet glass Fac.                    | 2   | 4.35  |
| Total                               | 46  | 100   |

Table (19) clearly showed that most of the workers with small nodular opacities in their x-ray findings were working in Sand preparation department, Batch House and Rock Grinding departments. The percentage of reach was (34.78, 26.09 and 17.39 %) respectively.

Table (20)

Number and percent distribution of small nodular opacities (Suggestive of silicosis) in X-Ray according to duration among the studied group of workers.

| * Small nodular opacities in X-Ray | No. | %     | Mean duration of exposure in years. |
|------------------------------------|-----|-------|-------------------------------------|
| P                                  | 5   | 27.78 | 23.33                               |
| q (m)                              | 11  | 61.11 | 22.69                               |
| r (n)                              | 2   | 11.11 | 30                                  |
| Total                              | 18  | 100   | -                                   |

\* ILO Classification (1971)

Table (20) clearly illustrated the percentage of workers showing nodular opacities of category "P" were 27.78 % and the mean duration of exposure was 23.33 years while those workers showing opacities of category q (m) were 61.11 % and the mean duration of exposure was 22.69 years. On the other hand the percentage of workers with category "r" were 11.11 % and the mean duration of exposure was 30 years.

## **II RESULTS OF ENVIRONMENTAL MONITORING**

Table (21)

Dust count (m.p.p.c.f.) in different locations  
in the studied factories.

| Location                        | Samples No. | Dust count<br>*m.p.p.c.f. |
|---------------------------------|-------------|---------------------------|
| Manual loading and crystal fac. | 4           | 29.05                     |
| Automatic fac.                  | 2           | 29.00                     |
| Sheet glass fac.                | 2           | 20.00                     |
| Ornamental Sheet glass fac.     | 2           | 27.00                     |
| Batch House                     | 3           | 70                        |
| Rock Grinding Dept.             | 2           | 31                        |
| Sand prep. Dept.                | 3           | 47.5                      |
| Area of non-exposure            | 2           | 12.                       |

\* m.p.p.c.f. = Million particles/cubic foot of air.

Table (22)

Concentration of respirable dust (< 7 micron size) and percent of free silica in different locations.

| Location                          | Average conc.<br>mg/m <sup>3</sup> . | %<br>of free silica |
|-----------------------------------|--------------------------------------|---------------------|
| Manual loading & crystal factory. | 40.8                                 | 31                  |
| Automatic factory.                | 40                                   | 31                  |
| Sheet glass factory               | 31                                   | 25                  |
| Ornamental sheet glass factory.   | 25                                   | 29                  |
| Batch House                       | 61.3                                 | 47                  |
| Rock Grinding Dept.               | 40.8                                 | 39                  |
| Sand prep. Dept.                  | 49.8                                 | 41                  |
| Area of non exposure              | 18                                   | 18                  |

A. Dust sampling:

Tables 21 and 22 show the degree of dust exposure by count and percentage of free silica in the studied factories which used sand as a part of raw material.

Table (21) clearly illustrates that the atmosphere of the present factories were extremely dusty especially in Batch House and sand preparation departments.

The dust count in these locations were (70) and (31) m.p.p.c.f. respectively. These values are higher than the available concentration (20 m.p.p.c.f.) (Threshold limit values for 1960), Weight conc. of respirable dust (less than 7 micron) were also high reaching (61.3 mg/m<sup>3</sup>) in Batch House. Infact the Batch House atmosphere was unbearable and one could hardly breath.

Thermal Environment:

Table (23)  
Manual Loading and Crystal Factory.

| Location                              | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|---------------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around Melting Furnace. | 40.2              | 29.6                 | 19.4                 | 32.9                 | 183.8               | 70.3                  | 59                     |
| Exposure area around machines.        | 36.9              | 26.7                 | 17.8                 | 31.7                 | 197.6               | 70.2                  | 60                     |
| None exposure area                    | 21.4              | 18.9                 | 14.9                 | 22.9                 | 130                 | 69.7                  | 67                     |

Average relative humidity = 62 %

Table (24)  
Thermal environment in Automatic Factory

| Location                              | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|---------------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around Melting Furnace. | 41.9              | 34.1                 | 21.2                 | 38.0                 | 224                 | 76.9                  | 66                     |
| Exposure area around machines.        | 42.6              | 40.2                 | 25.0                 | 44                   | 220                 | 85                    | 63                     |
| None exposure area                    | 25.4              | 19.4                 | 14.1                 | 22.4                 | 129                 | 59.6                  | 60                     |

Average relative humidity = 63 %

Table (25)

Thermal Environment in Sheet Glass Factory

| Location                              | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|---------------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around Melting Furnace. | 41.13             | 26                   | 17                   | 31.6                 | 228                 | 68.8                  | 68                     |
| Exposure area around machines.        | 28.2              | 21                   | 15.2                 | 23.5                 | 180                 | 63.3                  | 70                     |
| None exposure area                    | 24                | 20                   | 15                   | 21.7                 | 110                 | 62.1                  | 62                     |

Average relative humidity = 66,67 %.

Table (26)  
Thermal Environment in Ornamental Sheet glass

| Location                              | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|---------------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around Melting Furnace. | 42                | 36                   | 22                   | 37                   | 100                 | 81.6                  | 80                     |
| Exposure area around machines.        | 37                | 35                   | 21                   | 36.4                 | 150                 | 79.8                  | 70                     |
| Non -exposure area                    | 28                | 26                   | 19                   | 29                   | 130                 | 74.4                  | 70                     |

Average relative humidity = 73.3 %

Table (27)

Thermal Environment in Batch House

| Location                       | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|--------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around machines. | 30                | 26                   | 19                   | 30.6                 | 140                 | 75.3                  | 70                     |
| Non-exposure area              | 23.1              | 19                   | 15                   | 19.2                 | 100                 | 61                    | 71                     |

Average relative humidity = 70.5 %

Table (28)  
Thermal environment in Rock Grinding Dept.

| Location                       | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|--------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around machines. | 32.9              | 26.2                 | 17.9                 | 30.3                 | 195                 | 70.4                  | 60                     |
| Non-exposure area              | 18.3              | 18.5                 | 14.7                 | 19.4                 | 125                 | 60.5                  | 67                     |

Average relative humidity = 63.5 %.

Table (29)  
Thermal environment in Sand preparation Dept.

| Location                              | Globe temp.<br>°C | Dry bulb temp.<br>°C | Wet bulb temp.<br>°C | Ordinary temp.<br>°C | Air velocity<br>F/m | Effective temp.<br>°F | Relative humidity<br>% |
|---------------------------------------|-------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|------------------------|
| Exposure area around Melting Furnace. | 37.8              | 21.7                 | 16.7                 | 28.2                 | 100                 | 66                    | 70                     |
| Exposure area around machines.        | 24                | 19                   | 15                   | 20.8                 | 110                 | 61.6                  | 71                     |
| Non - exposure area                   | 16.4              | 14                   | 13                   | 17.2                 | 60                  | 55                    | 60                     |

Average relative humidity = 67 %

Table (30)

Means and Standard deviations of thermal environment measurements in the studied locations according to exposure to heat.

| Location                                | Globe<br>temp. °C             | Dry bulb<br>temp. °C | wet bulb<br>temp. °C | Ordinary<br>temp. °C | Air velocity<br>F/m | Effect.<br>temp. f° | Relative<br>humidity % |
|-----------------------------------------|-------------------------------|----------------------|----------------------|----------------------|---------------------|---------------------|------------------------|
| Exposure area around<br>Melting furnace | $\bar{X}$ 40.61<br>S.D.± 1.73 | 29.54<br>5.84        | 19.28<br>2.37        | 33.54<br>4.01        | 167<br>63.7         | 72.72<br>6.38       | 68.6<br>7.60           |
| Exposur area<br>around machines         | $\bar{X}$ 33.09<br>S.D.± 6.28 | 27.73<br>7.49        | 18.7<br>3.48         | 31.04<br>7.74        | 170.37<br>38.48     | 72.23<br>8.47       | 66.29<br>5.06          |
| Non exposure area                       | $\bar{X}$ 22.37<br>S.D.± 4.03 | 19.4<br>3.52         | 15.1<br>1.86         | 21.69<br>3.81        | 112<br>25.68        | 61.9<br>5.96        | 65.29<br>4.61          |

## II. Thermal Environment:

Measurement of the thermal environment in different exposure and control areas in seven locations in glass factories are grouped and presented in tables (23 - 29)

These tables show the average effective temp. in exposure and control areas in each location . The average effective temp. varied in different locations and ranged from (63.8°F - 80.95°F ) .

The average relative humidity varied in different locations and ranged from (62 %) in Manual loading and Crystal factory to (73.3 %) in Ornamental sheet glass factory.

The average relative humidity in all studied factories was (66.4 %).

Table (30) shows that the means of the thermal environment measurements were higher in the exposure area (areas around melting furnace and areas around the machines), than that of the non exposure area.

### III. Noise Level Measurements:

Table (31)

Noise level at different locations in the studied factories.

| Section                         | Noise level<br>in dB |
|---------------------------------|----------------------|
| Manual loading and crystal fac. | 85.7                 |
| Automatic fac.                  | 104.3                |
| Sheet glass fac.                | 87.5                 |
| Ornamental sheet glass fac.     | 89                   |
| Batch House                     | 96                   |
| Rock Grinding Dept.             | 106.2                |
| Sand preparation Dept.          | 84.3                 |
| Non exposure area.              | 85                   |

The noise evolved from different machine, at different factories were measured. It is clearly evident from table (31) that the highest noise value was observed in Rock Grinding department (106.2 dB). The least noise level was recorded in Sand preparation department (84.3 dB).

### III. Relationship between hazardous agents and resulting disease.

Table (32)  
Association between Dust count (m.p.p.c.f.) and pulmonary functions among the exposed workers in the studied areas.

| Studied Areas                   | Dust count in (m.p.p.c.f.) | FEV <sub>1</sub> Litre | FVC Litre | FEV / FVC | FEV <sub>1</sub> % of pred. | FVC % of pred. | PEFR   | PEFR % of pred. |
|---------------------------------|----------------------------|------------------------|-----------|-----------|-----------------------------|----------------|--------|-----------------|
| Manual Loading and crystal Fac. | 29.05                      | 3.02                   | 3.77      | 80.10     | 86.77                       | 87.12          | 442    | 73.11           |
| Automatic Factory.              | 29.00                      | 2.95                   | 3.69      | 79.94     | 86.85                       | 87.16          | 460    | 76.55           |
| Sheet glass factory.            | 20.00                      | 3.07                   | 3.64      | 84.34     | 87.78                       | 89.33          | 473    | 77.61           |
| Ornamental sheet glass Factory. | 27.00                      | 3.05                   | 3.58      | 85.19     | 88.20                       | 89.07          | 474    | 76.83           |
| Batch House                     | 70.00                      | 2.65                   | 3.35      | 79.10     | 79.77                       | 83.10          | 402    | 63.83           |
| Rock Grinding Dept.             | 31.00                      | 2.60                   | 3.37      | 77.15     | 85.15                       | 86.61          | 310    | 57.62           |
| Sand Prep. Dept.                | 47.50                      | 2.73                   | 3.44      | 79.36     | 85.17                       | 86.69          | 340    | 57.55           |
| r                               | -0.68                      |                        | -0.68     | -0.47     | -0.95                       | -0.92          | -0.40  | -0.58           |
| P                               | < 0.05                     |                        | < 0.05    | > 0.05    | < 0.01                      | < 0.01         | > 0.05 | > 0.05          |

Table (33)

Association between percentage of free silica and pulmonary functions among the exposed workers in the studied areas.

| Studied Areas                   | % of free silica | FEV <sub>1</sub><br>Litre | FVC<br>Litre | FEV <sub>1</sub> /<br>FVC | FEV <sub>1</sub> %<br>of pred. | FVC %<br>of pred. | PEFR<br>of pred. | PEFR %<br>of pred. |
|---------------------------------|------------------|---------------------------|--------------|---------------------------|--------------------------------|-------------------|------------------|--------------------|
| Manual Loading and crystal Fac. | 31               | 3.02                      | 3.77         | 80.10                     | 86.77                          | 87.12             | 442              | 73.11              |
| Automatic Factory.              | 31               | 2.95                      | 3.69         | 79.94                     | 86.85                          | 87.16             | 460              | 76.55              |
| Sheet glass factory.            | 25               | 3.07                      | 3.64         | 84.34                     | 87.78                          | 89.33             | 473              | 77.61              |
| Ornamental sheet glass Factory. | 29               | 3.05                      | 3.58         | 85.19                     | 88.20                          | 89.07             | 474              | 76.83              |
| Batch House                     | 47               | 2.65                      | 3.35         | 79.10                     | 79.77                          | 83.10             | 402              | 63.83              |
| Rock Grinding Dept.             | 39               | 2.60                      | 3.37         | 77.15                     | 85.15                          | 86.61             | 310              | 57.62              |
| Sand Prep. Dept.                | 41               | 2.73                      | 3.44         | 79.36                     | 85.17                          | 86.69             | 340              | 57.55              |
| r                               | -0.89            | -0.83                     | -0.73        | -0.88                     | -0.91                          | -0.73             | -0.84            |                    |
| p                               | < 0.01           | < 0.01                    | < 0.05       | < 0.01                    | < 0.01                         | < 0.05            | < 0.01           |                    |

Table (34)

Association between average concentration of respirable dust ( $\text{mg}/\text{m}^3$ ) and pulmonary functions among the exposed workers in the studied areas.

| Studied Areas                            | Conc. of resp. dust $\text{mg}/\text{m}^3$ | FEV <sub>1</sub> Litre | FVC Litre | FEV <sub>1</sub> / FVC % | FEV <sub>1</sub> % of pred. | FVC % of pred. | PEFR   | PEFR % of pred. |
|------------------------------------------|--------------------------------------------|------------------------|-----------|--------------------------|-----------------------------|----------------|--------|-----------------|
| Manual Loading and crystal Fac.          | 40.8                                       | 3.02                   | 3.77      | 80.10                    | 86.77                       | 87.12          | 442    | 73.11           |
| Automatic Factory.                       | 40                                         | 2.95                   | 3.69      | 97.94                    | 86.85                       | 87.16          | 460    | 76.55           |
| Sheet glass factory.                     | 31                                         | 3.07                   | 3.64      | 84.34                    | 87.78                       | 89.33          | 473    | 77.61           |
| Ornamental sheet glass Factory. (No. 30) | 25                                         | 3.05                   | 3.58      | 85.19                    | 88.20                       | 89.07          | 474    | 76.83           |
| Batch House                              | 61.3                                       | 2.65                   | 3.35      | 79.10                    | 79.77                       | 83.10          | 402    | 63.83           |
| Rock Grinding Dept.                      | 40.8                                       | 2.60                   | 3.37      | 77.15                    | 85.15                       | 86.61          | 310    | 57.62           |
| Sand Prep. Dept.                         | 49.8                                       | 2.73                   | 3.44      | 79.36                    | 85.17                       | 86.69          | 340    | 57.55           |
| r                                        | -0.73                                      |                        | -0.56     | -0.72                    | -0.92                       | -0.95          | -0.52  | -0.65           |
| p                                        | < 0.05                                     |                        | > 0.05    | < 0.05                   | < 0.01                      | < 0.01         | > 0.05 | > 0.05          |

Table (32) shows that there is a negative significant correlation between dust count (m.m.p.p.c.f.) and  $FEV_1$ /litre, FVC/litre,  $FEV_1$  % of pred., FVC % of pred.

Table (33) shows a significant negative correlation between the percent of free silica and  $FEV_1$ /litre, FVC/litre,  $FEV_1$  % of pred., FVC % of pred.  $FEV_1$ /FVC %, PEF and PEF % of pred. in the studied areas.

Table (34) shows a significant negative correlation between concentration of respirable dust in  $mg/m^3$  and  $FEV_1$ /litre,  $FEV_1$  % of pred. FVC % of pred.,  $FEV_1$ /FVC % i.e. with the increase of average conc. of respirable dust and percent of free silica there is a reduction in the studied pulmonary functions.

Table (35)  
Association between duration of exposure (in years) and pulmonary functions among the exposed workers in the studied areas.

| Studied Areas                   | Average duration in years | FEV <sub>1</sub> Litre | FVC Litre | FEV <sub>1</sub> / FVC | FEV <sub>1</sub> % of pred. | FVC % of pred. | PEFR   | PEFR % of pred. |
|---------------------------------|---------------------------|------------------------|-----------|------------------------|-----------------------------|----------------|--------|-----------------|
| Manual Loading and crystal Fac. | 19.04                     | 3.02                   | 3.77      | 80.10                  | 86.77                       | 87.12          | 442    | 73.11           |
| Automatic Factory.              | 19.26                     | 2.95                   | 3.69      | 79.94                  | 86.85                       | 87.16          | 460    | 76.55           |
| Sheet glass factory.            | 16.78                     | 3.07                   | 3.64      | 84.34                  | 87.78                       | 89.33          | 473    | 77.61           |
| Ornamental sheet glass Factory. | 18.73                     | 3.05                   | 3.58      | 85.19                  | 88.20                       | 89.07          | 474    | 76.83           |
| Batch House                     | 18.20                     | 2.65                   | 3.35      | 79.10                  | 79.77                       | 83.10          | 402    | 63.83           |
| Rock Grinding Dept.             | 22.6                      | 2.60                   | 3.37      | 77.15                  | 85.15                       | 86.61          | 310    | 57.62           |
| Sand Prep. Dept.                | 22.03                     | 2.73                   | 3.44      | 79.36                  | 85.17                       | 86.69          | 340    | 57.55           |
| r                               | - 0.66                    |                        | -0.24     | -0.69                  | -0.04                       | -0.19          | -0.87  | -0.79           |
| p                               | < 0.05                    |                        | > 0.05    | < 0.05                 | > 0.05                      | > 0.05         | < 0.01 | < 0.01          |

Table (35) Shows that there is a negative correlation between average duration of exposure in years and  $FEV_1$  (in litre),  $FEV_1/FVC$  %, PEFR (in litre) and PEFR % of predicted.

Table (36)

Relationship between exposure to heat and the development of heat cramps in the studied workers

| Studied Locations                     | Heat cramp |       |     |       | total |       |
|---------------------------------------|------------|-------|-----|-------|-------|-------|
|                                       | Yes        |       | No  |       |       |       |
|                                       | No         | %     | No  | %     | No    | %     |
| Exposure area around melting furnace. | 63         | 27.27 | 35  | 11.32 | 98    | 18.15 |
| Exposure area around machines         | 155        | 67.19 | 187 | 60.52 | 342   | 63.33 |
| Non-exposure area                     | 13         | 5.63  | 87  | 28.16 | 100   | 18.52 |
| Total                                 | 231        | 100   | 309 | 100   | 540   | 100   |

$$\chi^2 = 55.53$$

$$P < 0.01$$

Table (36) shows that there is a significant differences between exposure to heat and the development of heat cramp in the studied workers.

Table (37)

Relationship between noise level in (dB) and  
hearing defect in the studied workers

| Mean noise<br>level in (dB)                      | History of hearing defect |       |     |       | total |       |
|--------------------------------------------------|---------------------------|-------|-----|-------|-------|-------|
|                                                  | Yes                       |       | No  |       |       |       |
|                                                  | No.                       | %     | No. | %     | No    | %     |
| Exposed workers<br>( $\bar{x}$ = 93.29 dB)       | 55                        | 91.67 | 385 | 80.21 | 440   | 81.48 |
| Nonexposed work-<br>ers.<br>( $\bar{x}$ = 85 dB) | 5                         | 8.33  | 95  | 19.79 | 100   | 18.52 |
| Total                                            | 60                        | 100   | 480 | 100   | 540   | 100   |

$$\chi^2 = 4.64$$

$$P < 0.05$$

$$\text{Relative risk} = \frac{91.67}{8.33} = 11 \%$$

$$\text{Attributable risk} = 91.67 - 8.33 = 83.34$$

Table (37) clearly showed that the percentage of hearing defect in the exposed group (93.92 dB) is higher than those in the nonexposed group (85 dB) and this difference is statistically significant.

Also it is evident that the relative risk of noise level in the induction of hearing defects is 11% and the attributable risk is 83.34 %.