



Ergonomic evaluation of the working environment of Ganesh murtikaars

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Abstract

Ganesh Utsav is a spectacular festival honouring Lord Ganesh. It is celebrated with maximum grandeur in Mumbai. The working environment of 30 ganeshmurti making workshops/kharkhanas was ergonomically assessed for illumination and noise levels. 98.9% reported that the enclosed work place had fine dust particles in the air. These are dispersed in the air due to task of rubbing the idols with sand paper for a smooth finish before painting. The noise levels in the workplace of only 47.2% murtikaars was within the acceptable level of 85dB. The noise level experienced was dangerously high, i.e., above 120 dB for 29 (16.1%) murtikaars. They complained of frequent headaches and inability to concentrate while painting fine facial details. Most workshops were found to have poor illumination levels, due to which the artists adopted awkward postures which was also the main cause for bodily discomfort experienced by them.

Key Words: Ganesh murtikaars, Illumination, Mumbai, Noise level, Workplace Ergonomics.

Introduction: An artist is a person who does fine arts particularly a painter or sculptor. Their primary task is to create aesthetically appealing art forms. This may include sculptures, paintings, mural, floor designs etc.

India has a remarkable tradition of making religious sculpture and clay articles. Most workshops that make beautiful sculptures of Gods and Goddesses are found in major cities and centres of religious interests. These sculptures are valued and admired for their beauty, ethnicity and aesthetics.



Ganesh Utsav is one of the spectacular festivals honouring Lord Ganesha. It is celebrated all over India but maximum grandeur is witnessed in Maharashtra and especially in Mumbai. Ganesh Chaturthi, also known as Vinayaka Chaturthi is the Hindu festival that reveres Lord Ganesha. The ten-day festival, starts on the fourth day of Hindu luni-solar calendar month Bhadrapada. The festival is marked with installation of Ganesha clay idols privately in homes and publicly on elaborately designed pandals (temporary stage). Devotees chant Vedic hymns and Hindu texts, offer daily prayers and prasads, which include sweets such as modak believed to be a favourite of the elephant-headed deity. The festival ends on the tenth day, after which the deity is carried in a public procession with music and group chanting of vedic hymns and prayers, then immersed in nearby water body such as a river or ocean. Lord Ganesha is believed to return back to his homely abode in Mount Kailash to his parents Goddess Parvati and God Shiva.



The festival is known to be celebrated in Pune since the era of Chhatrapati Shivaji Maharaj (1630–1680, founder of the Maratha Empire). After the start of the British Raj, the Ganesha festival lost state patronage and became a private family celebration in Maharashtra until its revival by Indian freedom fighter and social reformer Lokmanya Tilak. In 1893, the Indian freedom fighter Lokmanya Tilak recognized Ganesha appeal as "the God for everybody." He indicated Ganesha as the single God that bridged the gap between Brahmins and non-Brahmins, thereby building unity to oppose British colonial rule. In 1893, he helped expand Ganesh Chaturthi festival into a mass community event.

Small idols (by individual families at home) and large idols (by youth groups or local associations in pandals) are installed for worship. Mumbai city and its suburbs itself witnesses over 3 lakhs idols every year (www.mid-day.com retrieved on 7.11.18). There are big pandals of Lord Ganesh in almost every lane in Mumbai city. 6400 sarvajanik Ganpati pandals were set in Mumbai city and its suburbs in September 2018, with an additional 1.5 lakh households. Ganesh Idol makers or Ganesh Murtikaars as they are locally known work meticulously under abnormal work conditions to meet this whooping demand from June every year. This kind of art requires extreme physical efforts and skills from the Murtikars.

Most murtikars are men who devote their entire life to this tradition which continues from many generations. Although the work includes diverse health hazards, stress and does not fetch adequate income, the artists create the idols with great passion, especially to continue their ancestral tradition, ignoring the pains and aches so experienced. The exquisiteness of each idol is much spoken about, but the work-related problems faced by the murtikaars while creating them has not been studied so far. The aches experienced while creating big idols and decorating the smaller ones is mainly due to awkward postures adopted by them. Inconvenient facilities and lack of proper working space causes postural discomfort which leads to long lasting health issues.

Ergonomics is a branch of science that aims to learn about human abilities and limitations and then apply this learning to improve people's interaction with systems, and the profession that applies theory, principles, data and methods to design in order and environment. Ergonomics aims to improve workspaces and environment to minimize risk of injury or harm.

Ergonomics is concerned with the prevention of Musculoskeletal Disorders (MSDs). MSDs are injuries and disorders that affect the human body's movement or musculoskeletal system. The risk factors are categorised into two: Ergonomic Risk factors (Force, Repetition, Posture and Duration) and Individual Risk Factors (poor work methods, practices/habits, poor fitness and poor health). Prevention of MSDs relies upon identification of risk factors, either by self-report, observation on the job, or measurement of posture which could lead to MSDs. Once risk factors have been determined, there are several intervention methods which could be used to prevent the development of MSDs. The target of MSD prevention efforts is often the workplace in order to identify incidence rates of both disorders and exposure to unsafe conditions. The application of the vast knowledge base of ergonomics can help reduce stress and MSDs among the Ganesh murtikaars.

Methodology: A study was conducted among 180 Ganesh murtikaars belonging to 16 workshops in Mumbai city and its suburbs with the aim to evaluate the work-related challenges faced by them. The specific objectives of the study being to: (i) learn about the demographic profile of the



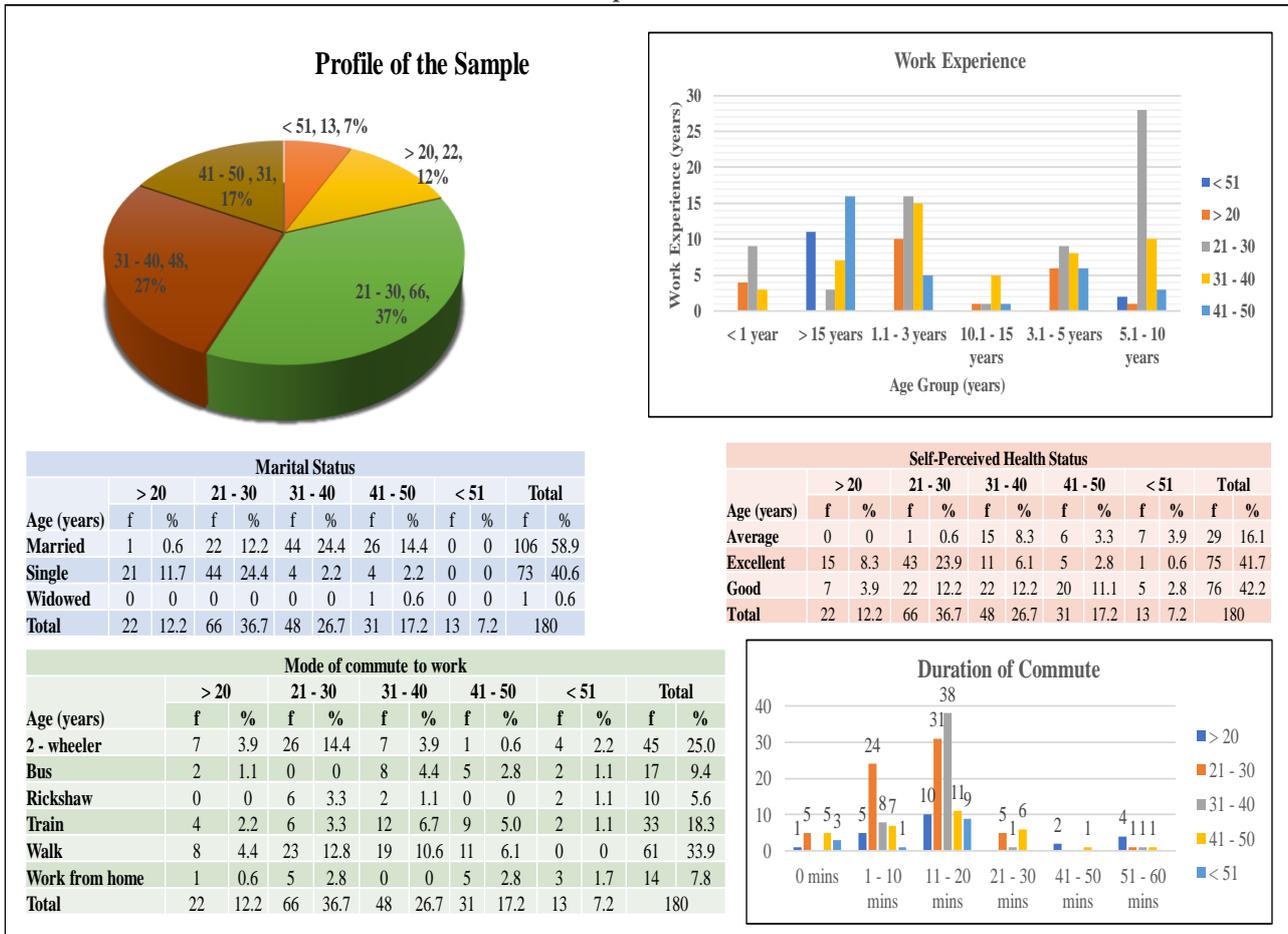
murtikaars in Mumbai city and its suburbs, (ii) assess the working environment on two parameters viz., illumination and noise levels.

The primary data was collected by using a self-constructed and validated questionnaire was used to collect the data. The questionnaire was divided into four parts: Part A consisted of 9 questions on general information; Part B included work-related questions; Part C collected information on risk factors to occupational injuries; Part D assessed the working environment for illumination and noise levels. It also evaluated the layout and other facilities included in the workshop. The sample was selected using convenience sampling technique. The data was coded and analysed using simple percentage, mean and standard deviation. Graphs, tables, figures and bar diagrams are used, as it helps in presenting quantitative facts in a simple, clear and effective way.

Results and Discussion:

180 murtikaars were interviewed from 30 workshops/kharkhanas in Mumbai city (Lalbaug, Lower Parel, Worli) and its suburbs (Kalyan, Vasai, Borivali and Mulund). The working environment of the workshops were ergonomically assessed. 22 (12%) of the murtikaars were below 20 years of age, who got involved only during the pre-festive season because they are passionate about the family profession. Most in the age group of 41 – 50 years [31 (17%)] and above 51 years [13 (7%)] worked solely as murtikaars. The average age of the sample is 32.8 years.

106 (58.9%) were married whereas 73 (40.6%) were single and 1 murtikaar aged 43 years was widowed. 37 (20.6%) had more than 15 years of work experience, of which 27 murtikaars are above 41 years. The older men were involved more as compared to the younger folks.



61 (33.9%) stayed near their place of work and hence walked to their place of work. 60 (33.3%) used public transportation such as city buses [17 (9.4%)], local trains [33 (18.3%)] and autorickshaws [10 (5.6%)]. 45 (25%) owned two-wheeler vehicle, such as bicycles and scooter/motorbike which they used to commute to work daily. 14 (7.8%) work from home. 99 (55%) take 11 – 20 minutes to reach the workplace and 45 (25%) reach their kharkhanas in less than 10 minutes.

151 (83.9%) self-rated their general health as either excellent or good and 29 (16.1%) as average. Interestingly no one rated their health as poor or very poor.

Tasks done:

The work place is established with sticks inserted to the ground firmly and topped with a tarpaulin or asbestos sheet that protects the craftsmen from sunlight and rain.

Clay is collected from various parts of the city, but most of the time these days, clay is supplied by a contractor. The clay is kneaded thoroughly to make it smooth and lump free. They crush it with hands. This job is strenuous; it generally takes about 2 – 2.5





hours. The soil is then mixed with water before pouring it into the moulds and allowed to dry.

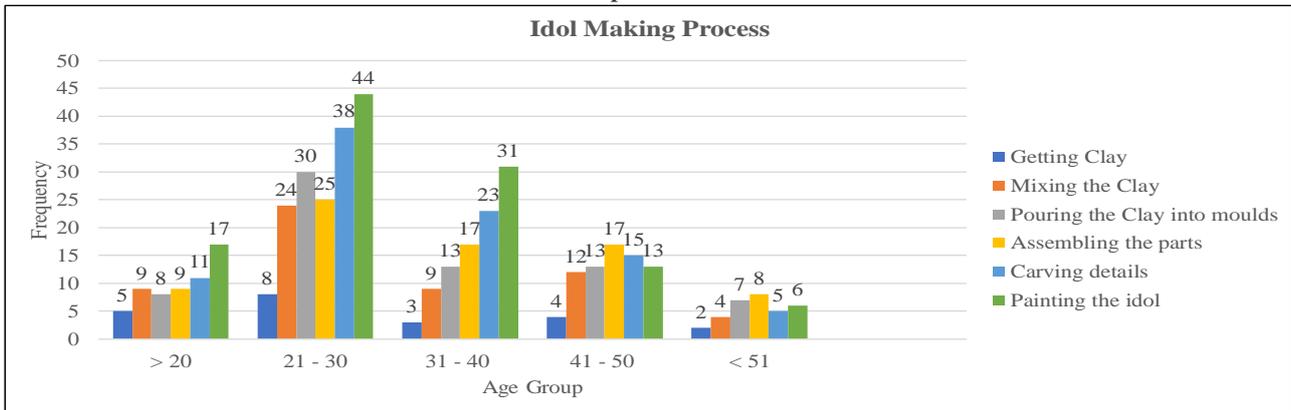
Some of the idols are made using the traditional method, wherein the outline is first tied with the bamboo for small and the bigger ones with bamboo and sticks. The base structure is made with hay tied with the rope to the required shapes to which the clay is placed as per the shapes. After this is dried the coat of the clay mixed with hay is applied that gives the final outline to the idols. The face of the idol made with the POP mould and clay. The pole part of the face is covered with freshly mixed clay and the face is fixed firmly, then the head portion is covered.

Painting includes applying the base coat which is done by spray guns and then painting the finer details with a brush. Before the final touch ups, jewellery, precious and semi-precious stones are added. The hands and the feet are separately made by either hand or mould and then placed firmly, tied in few cases to obtain the required shapes. They are then left for drying in shade and then sunlight.

After the idol is completely dried it is painted either by hand or by the hand gun with required colours. Water colours are usually preferred for painting on the idol. The eye of the idol is painted with either acrylic or poster colours as preferred by the crafts person.

The main tasks of the Ganesh murti making thus includes: getting clay, mixing clay, pouring it into the moulds, assembling parts, carving, drying and painting the finer details.





| Tasks done | > 20 | | 21 - 30 | | 31 - 40 | | 41 - 50 | | < 51 | | Total | |
|------------------------------|------|-----|---------|------|---------|------|---------|-----|------|-----|-------|------|
| | f | % | f | % | f | % | f | % | f | % | f | % |
| Getting Clay | 5 | 2.8 | 8 | 4.4 | 3 | 1.7 | 4 | 2.2 | 2 | 1.1 | 22 | 12.2 |
| Mixing the Clay | 9 | 5.0 | 24 | 13.3 | 9 | 5.0 | 12 | 6.7 | 4 | 2.2 | 58 | 32.2 |
| Pouring the Clay into moulds | 8 | 4.4 | 30 | 16.7 | 13 | 7.2 | 13 | 7.2 | 7 | 3.9 | 71 | 39.4 |
| Assembling the parts | 9 | 5.0 | 25 | 13.9 | 17 | 9.4 | 17 | 9.4 | 8 | 4.4 | 76 | 42.2 |
| Carving details | 11 | 6.1 | 38 | 21.1 | 23 | 12.8 | 15 | 8.3 | 5 | 2.8 | 92 | 51.1 |
| Painting the idol | 17 | 9.4 | 44 | 24.4 | 31 | 17.2 | 13 | 7.2 | 6 | 3.3 | 111 | 61.7 |

111 (61.7%) of the artisans are involved in painting the idol especially the finer details and 92 (51.1%) are involved in carving the details. Colouring or painting the idols takes over 12 hours per idol. The larger the idol, more the time required to paint as well as embellish the idol. The artisans usually spend 6 – 7 hours at a stretch on this task. Artisans belonging to age group above 51 years were involved into the entire process of idol making. Murtikaars working on bigger idols adopted dangerous positions and awkward postures to be able to reach the top of the idol. Also, majority of younger people who are working part-time in this profession are interested in the creative work (embellishment of the idol) only.



It was reported that amongst the tasks done, painting finer details was the most stressful task as the artisans adopted awkward postures for long duration. The murtikaars also emphatically stated that pouring the clay into moulds was mentally very tiring because the task requires to be done patiently. Drying the product in the sun is also laborious and generally takes about 1 to 1.5 days. This chore also requires special care because any tiny disturbance can also damage the idol.



Working Environment:

Workplace dangers are not always apparent, hence carefully watching for tell-tale signs such as emergency lighting, suitable and safe flooring, safe traffic routes, windows and doors will help achieve good physical work environment. Working practices and conditions that seem harmless can eventually lead to serious illness.

178 (98.9%) reported that the enclosed work place had fine dust particles in the air. These are dispersed in the air due to task of rubbing the idols with sand paper for a smooth finish before painting. The fine dust is also released in the work environment when spray guns are used for the base coat. They are regularly exposed to hazardous substances such as paint thinners and removers. The artisans are exposed to two types of hazards:

- **Mechanical Hazards:** Mechanical hazards are those involving damage to body tissue from objects, heat or electrical sources (www.cpsc.gov retrieved on 07.10.18). The most common injuries include cuts, scrapes, crush injuries, and burns. Such injuries are caused by distractions, using a tool for an inappropriate function, improper handling, modification of a tool, using a tool that is worn out or functioning improperly, or using a tool that is not appropriate for the age of the user. Dull, worn, partially broken, or repaired tools can behave in unexpected ways and often require more effort to get the job done, placing a user at risk.
- **Chemical Hazards:** Chemical exposures can occur through breathing fumes and vapours, absorption through the skin, or by swallowing. For example, the artisans may 'point' their brushes by placing them in their mouth; artists may be exposed to vapours from a work environment that has inadequate ventilation. Such conditions may seem like small exposures, but over time, many small exposures to some chemicals may combine to damage one's health (www.cpsc.gov retrieved on 07.10.18). Chronic or repeated exposures to chemicals or short exposures to high doses of chemicals allow the body less time to detoxify and excrete the substances that have been absorbed. Known medical conditions, such as asthma, may make someone more susceptible to the effects of certain chemicals. Combining chemicals can also have synergistic health effects (i.e., one chemical may amplify the negative effects of another).

None of the artisans use any Personal Protective Equipment or Clothing(PPE), mainly because they are not aware about it. Some PPEs which are highly recommended are:

1. **Respirators:** Respirators must fit well, sealers can be used to ensure a good fit. Type of filter must be chosen according to the chemical dust exposed to. Filters must be replaced regularly. Paper dust masks are not effective for chemical vapours and gases.
2. **Eye Protection:** Appropriate eye protection in form of goggles must be provided. Goggles are also available for covering over prescription glasses. Glasses for protecting against chemical splashes are different from impact protection glasses.
3. **Face shields** are a good alternative to glasses, but may require safety glasses worn beneath them if splashing can occur. Fogging of glasses and goggles must be ensured to keep vision clear.
4. **Gloves:** Using insulated gloves to protect the artisan's hands from thermal burns as well as cuts/bruises from use of sharp tools is essential. Use of fabric or leather gloves must be avoided because they cause blisters when performing repetitive actions.



- Hearing Protection: Pliable ear plugs can be worn by the Ganesh murtikaars. These can be used for protection up to 120 dB. Earmuffs provide more protection than ear plugs (up to 135 dB). Combining ear muffs with earplugs provides maximum protection.

Noise Levels in the workplace:

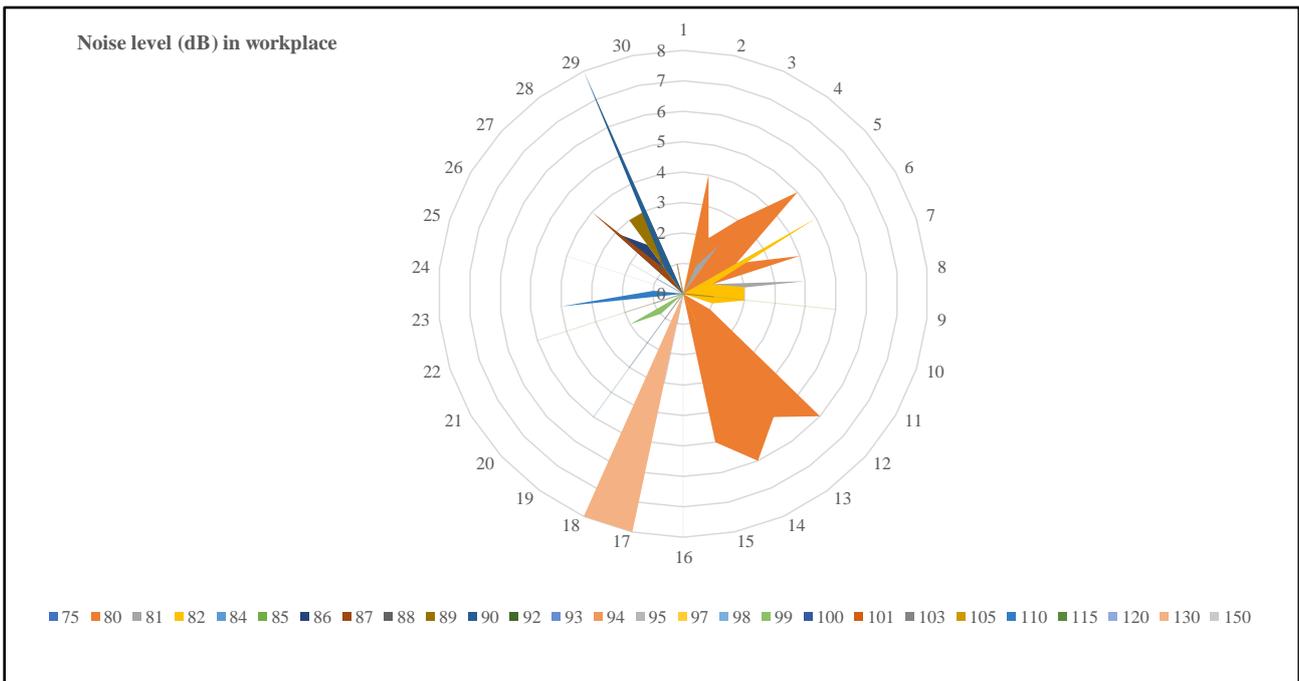
High noise levels at work can have serious repercussions, including emotional stress and reduced productivity. Excessive noise levels can interfere with communication and concentration, making it hard to hear warning signals or even someone shouting a warning, resulting in workplace accidents or injuries. It is evident that a quiet workplace is healthier to work in, but for many murtikaars, noisy workplace is a way of life.

Any noise levels above 85 dB should be a cause for concern, especially with extended exposure that occurs over an eight-hour workday.

Other factors that affect the murtikaars with respect to noise levels include: Duration of exposure, Impulsiveness - noises with abrupt starts and stops (such as hammering) and Periods of intermittence.

| Noise Level measured in workshop | | |
|----------------------------------|----|------|
| Noise (dB) | f | % |
| 75 - 79 | 2 | 1.1 |
| 80 - 84 | 70 | 38.9 |
| 85 - 94 | 38 | 21.1 |
| 95 - 99 | 10 | 5.6 |
| 100 - 104 | 3 | 1.7 |
| 105 - 109 | 1 | 0.6 |
| 110 - 114 | 8 | 4.4 |
| 115 - 119 | 2 | 1.1 |
| 120 - 124 | 1 | 0.6 |
| 125 - 129 | 0 | 0.0 |
| 130 - 134 | 16 | 8.9 |
| 135 - 139 | 0 | 0.0 |
| 150 - 154 | 12 | 6.7 |

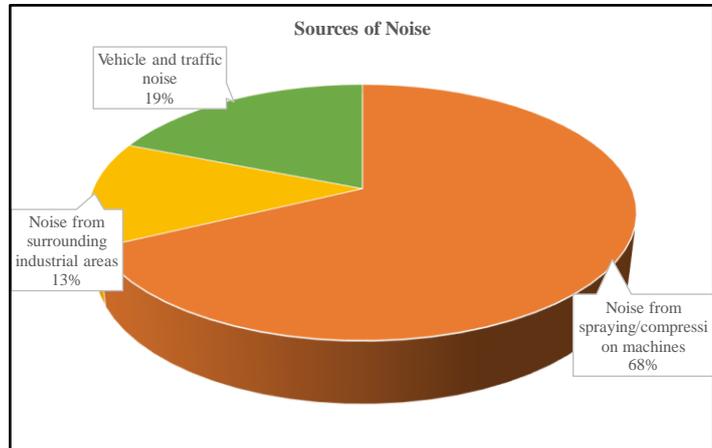
The loudness of noise is measured in decibels. Sensitivity to noise differs from one individual to the next, damage to hearing occurs when noise levels are higher than 85 decibels. The risk of hearing loss increases as the noise becomes louder. Length of exposure is important too. For example, it is not recommended to listen to noises of 109 decibels for any longer than two minutes at a time. Noise induced hearing loss is irreversible damage to the ears caused by exposure to high levels of noise.





The noise levels in the workplace of only 85 (47.2%) murtikaars was within the acceptable level of 85dB. The noise level experienced was dangerously high, i.e., above 120 dB for 29 (16.1%) murtikaars. They complained of frequent headaches and inability to concentrate while painting fine facial details.

Occupational exposure limits (OELs) for noise are typically given as the maximum duration of exposure permitted for various noise levels. ≥ 25 minutes of exposure is recommended at 115 dB, whereas some [31 (17.2%)] murtikaars are exposed to noise levels above 115 dB for more than 8 hours at a stretch.



Noise at work can cause hearing loss which can be temporary or permanent. People often experience temporary deafness after leaving a noisy place. Although hearing recovers within a few hours, this should not be ignored. Permanent hearing damage can be caused immediately by sudden, extremely loud, explosive noises. But hearing loss is usually gradual because of prolonged exposure to noise. It may only be when damage caused by noise over the years combines with hearing loss due to ageing that people realise how deaf they have become. Hearing loss is not the only problem. People may develop tinnitus (ringing, whistling, buzzing or humming in the ears), a distressing condition which can lead to disturbed sleep. Noise is a stressor. Occupational health experts have stated repeatedly that exposure to excessive noise levels stimulates our nervous system – raising blood pressure and releasing stress hormones.

Workplace noise must be controlled (i) at the source; (ii) through the use of barriers; and (iii) at personal level.

- At source: The best method of prevention is to eliminate the hazard. Therefore, controlling noise at its source is the best method of noise control. It can also often be cheaper than other methods of noise control. This method of control may require that some noisy machinery be replaced. Noise can be controlled at the source by the manufacturer, so that noisy devices never reach your workplace (training.itcilo.it retrieved on 07.11.18).
- Through the use of barriers: If it is not possible to control the noise at the source, then it may be necessary to use a barrier between the source of noise and the artists. The main source of noise in the ganeshmurti making workshops/kharkhanas is the traffic noise. These workshops are located on prominent roads or highways, for visibility. This unfortunately is also the main source of noise. The tarpaulin flaps are kept open for better ventilation and internal air changes, adding to the increase in noise levels.
- At personal level: Controlling noise at the worker, by using hearing protection is the most common yet least effective form of noise control. Forcing the worker to adapt to the workplace is always the least desirable form of protection from any hazard. There are two types of ear protection: earplugs and earmuffs. Both are designed to prevent excessive noise from reaching the inner ear.



- Earplugs are worn inside the ear and come in a variety of materials, including rubber, plastic, or any material that will fit tightly in the ear. Earplugs are the least desirable type of hearing protection because they do not provide very effective protection against noise and they can cause ear infection if pieces of the plug are left in the ear or if a dirty plug is used. Cotton wool should not be used as ear protection (training.itcilo.it).
- Earmuffs are more protective than earplugs if they are used correctly. They are worn over the whole ear and protect the ear from noise. Earmuffs are less efficient if they do not fit tightly or if glasses are worn with them

Illumination Levels:

Lighting at work is very important to the health and safety of everyone using the workplace. The quicker and easier it is to see a hazard, the more easily it is avoided. The types of hazard present at work therefore determine the lighting requirements for safe operation. Poor lighting can not only affect the health of people at work causing symptoms like eyestrain, migraine, headaches, lethargy, irritability and poor concentration.

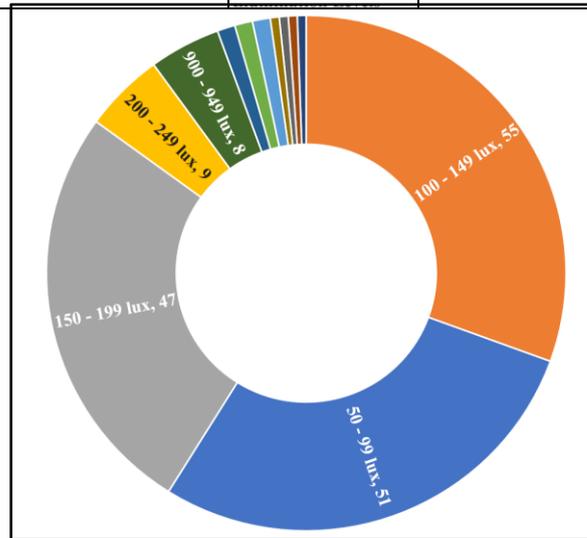
The recommendations for minimum illuminations levels at workplace as stated by the occupational health experts are as follows:

| Activity | Typical Location | Illuminance (Lux) | |
|--|--|-------------------|---------|
| | | Average | Minimum |
| Movement of people, machines and vehicles. | Lorry park, corridors, circulation routes. | 20 | 5 |
| Work requiring limited perception of detail. | Kitchens, factories assembling large components, potteries. | 100 | 50 |
| Work requiring perception of detail. | Offices, sheet metal work, book binding. | 200 | 100 |
| Work requiring perception of fine detail. | Drawing offices, factories assembling electronic components, textile production. | 500 | 200 |

According to the given recommendations,

| Tasks | Classification of the tasks | Illuminance (Lux) | |
|---|--|-------------------|---------|
| | | Average | Minimum |
| Mixing the clay and pouring clay into moulds | Work requiring limited perception of detail. | 100 | 50 |
| Assembling parts | Work requiring perception of detail. | 200 | 100 |
| Carving, painting details, embellishment work | Work requiring perception of fine detail. | 500 | 200 |

The minimum illumination required for making of the ganesh idols is 100 lux to a maximum of 500 lux. 51 (28.3%) artisans work in 50 – 99 lux light levels, making them susceptible to adopt awkward postures for completing the fine intricate details of the idol. 11 (6.1%) working in over illuminated workshops.





| Light levels | f | % |
|---------------|----|------|
| 50 - 99 lux | 51 | 28.3 |
| 100 - 149 lux | 55 | 30.6 |
| 150 - 199 lux | 47 | 26.1 |
| 200 - 249 lux | 9 | 5.0 |
| 250 - 299 lux | 2 | 1.1 |
| 300 - 349 lux | 2 | 1.1 |
| 350 - 399 lux | 1 | 0.6 |
| 400 - 449 lux | 1 | 0.6 |
| 500 - 549 lux | 1 | 0.6 |
| 550 - 599 lux | 1 | 0.6 |
| 600 - 649 lux | 2 | 1.1 |
| 900 - 949 lux | 8 | 4.4 |

Poor lighting (Under or over illumination) can cause several problems such as:

Insufficient light - not enough (too little) light for the need; Glare - too much light; Improper contrast; Poorly distributed light and Flicker.

Common health hazards of poor lighting include: headaches; eyestrain; neck, back, and shoulder strain (due to awkward postures adopted); falling, tripping, slipping; dropping materials or tools and depression (due to insufficient or gloomy lighting).

The highlights of the illumination level survey are:

- It was observed that most of the work place (28 workshops) had poor illumination level, which lead to eyestrain as the workers were exposed to such conditions for longer period of time. At most workshops the illumination levels were poor.
- Recommended illumination level for fine/precision work such as painting and embellishing is 300 - 500 lux, the Workers need more light for minute detailing but only some work places had adequate illumination levels. In most workshops, the average illumination level at the artist's workstation was 172.5lux.
- The artists adopted awkward postures due to poor clarity during painting, which was the prime reason for them experiencing bodily discomfort, pains and aches.



Conclusion:

Idol making is a strenuous job. Most artists are passionate about their profession and motivate their children to continue the tradition. The temporary tents that are set up pre-festive season to meet the huge demand for ganeshmurtis make a poor workstation for the murtikaars. The noise levels are high to very high due to the compression spray guns used and also because the workshops are located on national highways or main roads. The work area, if organised can be adequate and will increase efficiency. Most workshops had poor illumination, which was the key reason for awkward postures that were adopted by the artists. The artists were suggested that they must take short rest periods every 25 – 30 mins to break the cumulative stress of continuous awkward posture. A few stretching exercises were demonstrated. Getting up and walking around for a few minutes was also suggested. Use of PPEs will further reduce the discomfort experienced and also safeguard them against cuts and other related injuries. It is the challenge to design health programs for these artists that encourage creativity within a safe and healthful environment.



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