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Occupational Health Hazards of Artists

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SUMMARY Artists may be exposed to a variety of potentially noxious materials. The modern techniques they use imply exposure to environmental hazards. Occupational health was evaluated in individuals engaged in different arts such as sculpture, painting, printmaking, restoration photography, glass-work and ceramics, because of exposure to toxic chemicals in art materials, tools and methods used in their work. This evaluation demonstrated that artists sustain extensive exposure to toxic substances similar to occupational exposure of workers in different industrial settings. Hazards for artists are numerous and therefore it is important to identify the noxious materials and techniques used. Preventive measures should include basic safety, precautions, education and preventive medical surveillance.

KEY WORDS: artists, environmental hazards, occupational disorders, art material, prevention

INDRODUCTION

Artistic expression has been documented throughout human history. Artists from the Paleolithic times used a variety of naturally occurring materials in their work including animal bones, teeth and horns as well as turtle and mollusk shells. Later, they worked with palm leaves, tree bark, animal skins, baked clay, plates, textiles, ivory and glass (1-4). The diversity of these materials and the techniques used suggest that, from the beginning, creating art was a potentially dangerous enterprise.

HEALTH AND SAFETY HAZARDS: THE ART COHORT

Research has demonstrated that artists may sustain extensive exposure to potentially toxic substances, indicating that they may benefit from occupational health education and prevention programs (5). The occupational health of artists is of unique concern because of the potential exposure of these workers to toxic chemicals in art materials, the tools and methods they use, and the unregulated settings in which they frequently perform their work (6). Artists often work for many

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hours using art materials in small and intensely contaminated work spaces, thereby exposing themselves and their families to potentially toxic materials (6,7).

Artists and craftspeople are exposed to many of the same hazardous materials that cause injuries in industrial workers (8-10). Because of these exposures, artists may be considered a high-risk group for occupational injury (11-14).

WHO IS AN ARTIST?

While this may be a philosophical question, the Bureau of Labor Statistics (BLS) reports that the "artist" labor force (as defined by employed people listing their occupation as painter, sculptor, craft artist or printmaker) increased by 54% between 1980 and 1990, from 1,085,245 to 1,671,278. By 2000, over 2,000,000 people listed their occupation as "artist". While most of these artists create art in their primary employment, 298,000 are artists in secondary jobs. Since 1970, the number of women listing themselves as artists has increased. The 1986 census reported that approximately 100,000 women were employed as part of the art industry. More generally, in 1925 Waller (15) estimated that as many as one out of every four Americans was involved with arts and crafts.

HISTORICAL BACKGROUND

In the early eighteenth century, Ramazzini (16) described diseases among various occupational groups, including artisans. Many classic art-works as well as self-portraits provide us with physical clues about past artists' diseases, an informal health record lacking for most other professions. For example, Michelangelo suffered from gouty arthritis and probably obstructive nephropathy (17); the painters Rubens, Renoir and Dufy suffered from rheumatoid arthritis; and the painter Paul Klee suffered from scleroderma (18). The etiologies of these rheumatologic conditions are, in general, poorly characterized but some investigators attribute their high prevalence rates among artists to toxic metals in paints.

Psychiatric illness has been recognized among artists since Aristotle noted that artists were prone to melancholy. Van Gogh suffered from depression, insanity and suicide attempts (19-21). Arnold (22) reports that Van Gogh had many episodes in which he attempted to eat paint. Since some of Van Gogh's paints are known to have contained lead, it is possible that this ingestion may have contributed to his illness (although it is also possible that his psychopathology preceded his paint ingestion). Turpentine has also been suggested as a possible toxin contributing to his madness (23).

Francisco Goya suffered from a debilitating neurologic illness with loss of vision, tinnitus, disorientation and weakness. Vargas (24) has speculated that it was at the height of his illness that he created his "Black Paintings". McCann (25) suggests that Goya's mysterious mid-life illness was probably the result of lead toxicity due to the lead present in his white paints.

Rembrandt's life has been documented in a series of self-portraits illustrating progressive depression (26). This pathology has been attributed to the toxic effect of the different solvents he used (5,26). It has been suggested that these same solvents may also affect vision and may have had a role in the illnesses of other artists such as in El Greco's reported astigmatism (27).

SPECIFIC HEALTH HAZARDS OF ARTISTS: MORBIDITY

Health problems associated with art range from trauma (e.g., vibration injury, flying objects) and heat (heated metal or glass) to exposure to heavy metals, radiation, solvents and dust (5,9). Adverse health effects are usually related to exposures to multiple noxious agents since artists deal with different toxic materials and exposures simultaneously (5,13). Lesser and Weiss (5) suggest that a large number of artists with acute health problems present to emergency rooms for diagnosis and treatment of poorly defined illness.

Poisoning

Among the earliest modern reports of potential health hazards faced by artists was a 1963 Art News article describing a flu-like illness in painters associated with kidney and liver damage (5). Since then, a wide range of occupational poisonings have been described and documented among artists and craftsmen.

The consequences of these poisonings may be insidious, difficult to diagnose, and often confused with life style issues (e.g., drug abuse, ethanolism) (5). Central nervous system effects due to mercury poisoning in mural painters (28,29), and lead poisoning in stained glass artists, potters, enamelists, and in ceramic hobbyists are notable examples (30,31). Manganism with dementia has been described in painters using powdered pigments containing this metal (5).

There have been reports of chronic respiratory problems, neurologic, gastrointestinal and der-

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matologic symptoms in photographers (5,32), as well as respiratory, neurologic and eye problems in glass-blowers associated with a wide variety of toxins (33-35). Aplastic anemia secondary to benzene ingestion in painters (36,37), angiosarcoma of the liver due to carbon tetrachloride and methyl butyl ketone (used as a solvent by painters) (38), and reactive airway dysfunction as well as throat and eye irritation and flu-like symptoms due to exposure to chlorine (used by painters) have also been reported (39,40). Irritation of nose and skin, drowsiness, dizziness and tremors of the hands have been described in fingernail sculptors exposed to organic vapors and methacrylate dust (41). Renal dysfunction, such as occurs in cadmium smelters, may also develop in painters as a result of the presence of this metal in pigments (42). Chromium, another agent frequently used in pigments, is associated with perforation of the nasal septum and diseases of the mucous membranes of the upper respiratory tract (43). Finally, Williams and Spain (44) have reported on the potential for arsine poisoning during restoration of a large cyclorama painting depicting the battle of Atlanta.

Dermatologic injuries

Occupational dermatitis has been diagnosed in workers producing binders for paints and glues (13) or using strong soaps to clean the skin after the use of solvents (e.g., turpentine) (5). Occupational dermatitis is also described as the result of mechanical irritation due to abrasive agents such as fiberglass (used by sculptors) (45,46). When the sculpture is finished it is usually sanded and polished to form the final product. The fragments which are released can cause dermatitis, or if inhaled, pneumoconiosis (5).

Cardiopulmonary damage

Cardiopulmonary disease can result from exposure to art materials, in particular methylene chloride, a solvent used as a paint remover by furniture workers, which is metabolized to carbon monoxide in the body (47). This metabolite can result in the formation of carboxyhemoglobin (COHb) at levels that may stress the cardiovascular system (48). Cardiomyopathy in painters has been described as the result of exposure to barium and cobalt (11,12). Cadmium inhalation which occurs in the setting of paint fumes may result in metal fume fever (5,6). Inhalation of fumes from cadmium-related metals may also cause damage to the lower respiratory tract (7,9,49). Forastiere *et al*. (50) and McCann (51) report that women artists and photographers experience a significant association between respiratory disease (chronic bronchitis and asthma symptoms) and occupational factors.

Teratogenic and carcinogenic risks

Heidam (52) reports that among painters there was an elevated odds ratio for spontaneous abortion suggesting that exposure to painting materials increases the risk of fetal injuries. Driscoll *et al*. (53) describe clustering of malignant mesothelioma in jewelers from a Native American Pueblo. They identified that the use of asbestos mats for the purpose of sanding silver into jewelry was the source of the inhaled asbestos.

Nervous system

A number of reports suggest that painters with prolonged occupational exposure to organic solvents may develop “organic solvent disease”, an illness of the central nervous system characterized by impairment of memory and co-ordination, and deterioration in personality (54). A syndrome with severe psychological symptoms was also described by Behen and Anable (55). They found in their analysis that women reported more severe symptoms than men. Prockop described generalized weakness due to neuropathy, visual loss, incoordination and impairment of memory in a 30-year-old silk screen artist, attributed to a solvent containing neurotoxins used to clean silk screens (56).

Allergy

Lu (57) describes a high incidence of allergic reactions among arts and crafts students who had exposures to art materials for less than 70 hours within a period of 7 weeks. Balich (58) describes similar health risks among medical illustrators associated with art materials used in this profession.

SPECIFIC HEALTH HAZARDS OF ARTISTS: MALIGNANCY AND MORTALITY

A mortality study of professional artists based on 1607 obituaries published in Who’s is Who in American Art (1947 through 1969) was conducted by the National Cancer Institute. This study by Miller *et al*. (14) found a significantly increased risk of death from arteriosclerotic heart disease, leukemia, cancers of the bladder, kidney and colorectum, and brain in artists compared to the general population (14,58). Similarly, Miller *et al*.

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(59) report an association between bladder cancer and employment as an artist painter. Wingren and Axelson (60,61) demonstrated an excess risk of stomach cancer, colon cancer, and cardiovascular deaths related to glasswork. An excess in cancer mortality, particularly for leukemia, esophageal and stomach cancer, as well as lung cancer has been described by Chen and Seaton in workers exposed to paints (62). Similarly, excess cancer mortality due to cancer of the esophagus, stomach and bladder as well as melanoma among women in the Russian printing industry has been reported by Bulbulyan *et al*. (63). Specific mortality patterns among jewelry workers are described by Dubrow and Gute (64), who found significantly elevated cause-specific mortality rates for nonmalignant kidney disease, liver and peptic cancers, and diseases of the skin and subcutaneous tissue.

HEALTH RISKS OF SPECIFIC ART MATERIALS

One explanation for the increased rates of mortality and morbidity among artists is that art materials contain a wide variety of potentially toxic chemicals (6). The usual routes of entry of these materials into the body are by inhalation, skin absorption, and ingestion (7). Table 1 lists some of the toxic materials commonly used by artists.

Pigments

Several pigments contain potentially toxic metals, such as antimony, chromium, manganese, uranium, cadmium, and vanadium lead, cobalt, manganese, zinc and cadmium.

Inhalation of “chrome yellow” powders, which contain hexavalent chromium compounds, is associated with asthma and bronchitis as well as

Table 1. Some hazardous materials in different art forms

Technique	Hazards
Painting	Pigments, acrylic, lead, cadmium, mercury, oil, cobalt, manganese, solvents (toluene, benzene, xylene, acetone, methanol, trichloroethylene, carbon tetrachloride, methanol, turpentine), mineral spirit, ammonia, formaldehyde, arsenic, barium, chromates, cadmium, alkydes, acrylics, titanium, zinc, uranium, vanadium
Photography	Developing bath, stop bath, fixing bath, formaldehyde, solvents, lead, acids, oxalates, intensifier, toner, acetic acid, sulfur dioxide, dichromates, hydrochloric acid, selenium, hydrogen sulfide, uranium nitrate, gold salts, color developers, oxalates, platinum salts, sodium hypochromite, sodium sulfate, sodium thiosulfate, cyanide, oxalate, hydroquinone, alcali, ammonia
Sculpture	Carbon monoxide, dust, epoxy resins, polyester resins, hydrogen chloride, polyurethane resins, acrylic resins, plastics, hydrogen cyanide, asbestiform materials, noise, clay, marble, soapstone, granite, sandstone, silica, wood dust, glues, glazes, methylene chloride, toluene, methyl and ethyl alcohol, mineral spirits, turpentine, preservatives (copper, arsenic, creosote), talc, diglycidyl ethers, styrene, isocyanates, amines, nonionizing radiation
Ceramics	Clay dust, glazes, silica, lead, cadmium, other toxic metals, talc, asbestiform materials, sulfur dioxide, carbon monoxide, fluorides, infrared radiation, arsenic trioxide, antimony trioxide, beryllium, boric acid, cadmium oxide, calcium carbonate, cobalt, copper, chromates, lead, lithium carbonate, manganese dioxide, nickel oxide, titanium dioxide, tin oxide, zinc oxide, alumina, diatomaceous earths, iron oxide kaolin, barium carbonate
Glassblowing	Lead, silica, arsenic, infrared radiation, metal fumes, hydrofluoric acid, flouride salts
Printing	Solvents, pigments, photoemulsions, mineral spirits, lead, cadmium, magnesium
Woodworking	Metal fumes (copper, zinc, lead, nickel), wood dust, glues, formaldehyde, epoxy, methylene chloride, toluene, methyl alcohol, turpentine, ethyl alcohol, chromated copper arsenate, creosote
Stained glass	Lead, solder, zinc chloride fumes
Welding	Carbon monoxide, ozone, nitrogen oxides, ultraviolet and infrared radiation, metal fumes (zinc, copper, lead, nickel, etc.), oxyacetylene arc
Weaving	Dyes, acids, dichromates
Jewelry	Cadmium fumes, fluoride fluxes, acids, sulfur oxides

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lung cancer (65,66). Significant exposure to cadmium can result in renal and peripheral nervous system dysfunction (49). Plate painters exposed to cobalt blue dye complain of irritation of the buccal mucous membranes as well as cough and expectoration (67,68) Dyes made with benzidine have been linked to a high incidence of bladder cancer among silk kimono workers in Kyoto, Japan (69).

Solvents

Solvents are liquid organic chemicals used as cleaning materials and paint removers (54). All solvents, natural or synthetic, are toxic (47). Solvents can damage the skin, respiratory tract, internal organs such as the liver and kidney, and may have a narcotic-euphoric effect on the central nervous system (70-73). They also have a potential for inducing malignancy. They have been associated with leukemia (e.g., benzene) (74). Toluene and xylene can cause eye irritation and central nervous system damage. A specific neurotoxic action due to organic solvents has been described by Vliet *et al*. (75) and Axelson *et al*. (76).

Dick *et al*. (77) describe a syndrome in solvent-exposed painters, which includes a blue-yellow color vision deficit, coarse tremor, impaired vibration sensation in the legs, and cognitive impairment. In addition to painters, exposure to organic solvents may be frequent among artisans involved in silk screen printing and reinforced polyester casting (12). These artists often “form” the point of their brushes with their lips, thereby ingesting toxic materials (“pointing”).

Stones and clay

Sculptors working with stones are at a risk of developing mesothelioma, lung cancer and pleural abnormalities following work with these agents. White *et al*. (78) describe silicosis in workers processing semiprecious gemstones. Clay components may also be responsible for pulmonary diseases such as aluminosis, asbestosis, siderosis, kaolinosis, and talcosis (79).

Grinding and handling raw materials in colors and glazes may also be hazardous to sculptors. Fischbein *et al*. (80,81) describe increased lead absorption in a potter. In porcelain factories, cobalt-related diseases are described, leading to severe lung function impairment, including hard metal lung disease and occupational cobalt-related asthma as well as contact dermatitis and cardiovascular disease (67). Occupational exposure to cement containing tungsten carbide may also impair pulmonary function and cause the development of hard metal disease (81).

Metals

Because metals are used as the basis for many art materials, artists working with diverse media are exposed to the toxic effects of various metals including lead, antimony, arsenic, uranium, chromium, cadmium, vanadium, and mercury (82-84).

Metalworking may cause physical trauma and is associated with numerous medical syndromes. For instance, scrap metal cutters may suffer from symptoms such as foul taste and dryness of the mouth, nausea, vomiting, fever, headache, cough, rhinitis, muscular aches, painful eyes, and skin burns (82).

Lead is a component in ornamental glass and solders used for metal sculpture, jewelry and stained glass. Scrap metal cutting is hazardous and associated with significant lead exposure (85). Painters and photographers working with lead may develop lead poisoning characterized by nervous system damage, gastrointestinal problems and changes in red blood cells (5). A case of acute lead poisoning from the ingestion of paint in an amateur painter is described by Chiba *et al*. (86).

HEALTH RISKS BY SPECIFIC ART FORM

Each art form has specific risks. Not only as a result of the materials used by the artists, but also

Table 2. Toxic injury to specific organ systems associated with artists

Artists	Respiratory	Cardiovascular	Dermatologic	Neurologic	Eye problems
Painters	+	+	+	+	+
Sculptors	+		+		
Glassblowers	+		+		+
Photographers	+		+		
Ceramists	+		+		+
Restorers	+		+		
Printmakers	+		+		
Jewelers	+	+	+	+	+

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as a result of the techniques and the environment in which they are performed. Table 2 shows toxic injuries to specific organ systems, associated with art forms.

Sculpture

Sculptors are exposed to dust, metal fumes, nitrogen oxides, ozone, solvents, heavy metals, metal droplets, fiberglass, polymer resins and high ambient temperatures. In addition, the vibrations of modeling stone or other materials can lead to traumatic injury (11,12).

Stone sculptors are exposed to silicon dioxide (in the free state, SiO_2). High concentrations of free silica are found in quartz (100%), sandstone, granite, and onyx. Other stones such as soapstone and serpentine contain lower concentrations of free silica (78). Metal casting uses bronze, brass, pewter, copper, iron, lead, aluminum and stainless steel. The casting process includes exposure to metal fumes and carbon monoxide. Welding is associated with metal fume fever following inhalation of toxic fumes and gases (zinc oxide, copper, iron, magnesium, cadmium, or other metal oxides, nitrogen oxides). Acids that are used in cleaning, grinding and sandblasting may expose the artist to metal dust and silica, respectively. Exposure to radiant energy (ultraviolet, infrared and visible light), electric sparks and fire also occurs with the risk of trauma and eye injuries.

Soldering and brazing, used to fuse joints and to coat surfaces, exposes artists to bronze, copper, aluminum, and other metals (8,87).

Painting

Painters are exposed to heavy metal and solvents. Heavy metals are used to make different color paints (magnesium, barium, titanium, lead, cobalt, manganese, zinc and cadmium). Painter's palsy due to lead poisoning has been described by Graham *et al*. (88).

Wieslander *et al*. (89) report that water-based paints cause less discomfort and airway irritation than the earlier solvent-based paints. Although acrylic paints are water-based, their toxins are similar to those in oil-based paints, since they use the same pigments and release ammonia fumes as they dry. These fumes may be irritating to the respiratory system, especially the nose and throat (90).

Formaldehyde (present in acrylic paint) inhalation has been associated with nasopharyngeal cancers (91). Mucous membrane absorption can occur due to the artist's "pointing" the brush or by paint transfer to food or drinking vessels. The accelerators and catalysts used in the manufacture of polyesters are also potent toxins. Recently, painters use fiberglass as an art medium which may lead to mechanical irritation of the skin (45).

Printmaking

Artists who make prints are exposed to copper, aluminum, zinc, organic and inorganic acids, pigments, oils, organic solvents, alkali, hydrofluoric acid, nitric acid, hydrochloric acid, anti-skinning agents, reducers, thinners, tack reducers, stiffeners, stabilizers, surface agents, and dryers. Some of the dryers contain lead or magnesium (63). A study from Moscow examining women in the Russian printing industry indicates that they are at an increased risk of numerous malignancies including those of the upper gastrointestinal tract, the bladder, and melanoma (63).

Restoration

Artists who restore old paintings or sculptures are exposed to wood particles, textiles, stone and paper as well as to solvents (xylene, acetone, alcohol, toluene, benzene etc.), metals and synthetic or natural resins (92-94). In addition, they use disinfectant agents (fungicides), frequently methyl bromide the ingestion of which may cause vertigo, tremor, brain damage and neuropathies. Retouching is performed with pigments and dyes, dissolved in water, oil and acrylic mediums (9-12). Frequently, restorers as well as other arts and crafts museum personnel are exposed to inorganic and organic dust which has collected on old art works, or textile materials. Similarly, they may be exposed to different kinds of organic materials such as those derived from insects, molds and mites (92-94). A case of lead poisoning from art restoration of an antique Peruvian tapestry is described by Fischbein *et al*. (94,95). Bellotto *et al*. (96) report on lead poisoning caused by stonework treatment in architectural restoration.

Photography

Statistical abstracts reported 136,000 photographers in the United States as of 1991 (US Bureau of Census, 1992). The number of amateur photographers processing film is unknown. Photographers use a number of toxic chemicals such as developers, including "stop bath" and fixers. Stop baths are usually weak solutions of acetic acid, and fixing baths contain sodium thiosulfate, acetic acid, preservatives, exotic pigments, and developing substances, as well as salt, silver nitrate and potassium bichromate, which produce a

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yellowish image (97). Dermatologic problems have been associated with exposure to film processing chemicals (98). Respiratory injury has also been reported (99).

Glass-working

Glassblowers are exposed to pure silica in a fine powdered form, to heat, and to the minerals used as glass colorants. Injuries can also be caused by the inhalation of mercury vapors or ozone generated by an electrical arc. In making crystal, glassblowers are exposed to metals such as lead, manganese, antimony and arsenic. Anderson *et al*. (100) report that glass-works producing heavy crystal glass usually had higher concentrations of lead in the air than the semi-crystal glass-works with similar concentrations of arsenic and manganese.

Ceramics

Clay, which is composed chiefly of hydrous aluminum silicate mineral, is the basic common ingredient of ceramic products. Pneumoconiosis, however, is relatively uncommon among ceramists unless exposure to high concentrations has occurred or quartz admixture is great (101).

Ceramists are exposed to pigment agents in glazes, high temperature, sulfur dioxide emitted during the initial firing of clay, and heavy metals, such as arsenic, antimony and cadmium. Clay may also contain free silica (SiO_2) (78). A case of lead poisoning associated with pottery work has been described by Fischbein *et al*. (95).

PROTECTING ARTISTS FROM THEIR CREATIONS

Identifying the injury

Toxic materials are used to create art or are generated as a result of the techniques used to form the end product. Once identified the materials and techniques used need to be characterized and the relationship to the existing symptoms and findings explored.

Basic protective measures

Artists who work with hazardous materials must learn to observe basic safety precautions, such as washing hands after working and before eating, eliminating smoking from the workplace, using solvents only in areas with local exhaust ventilation, and wearing gloves and protective equipment. Never wash hands with solvents or solvent-containing hand-cleaners. Artists should also be educated about safe substitutes for toxic art materials (102).

Artists' work hours need to reflect rules limiting exposure time (hours *per* week) and lifetime exposures (years) in order to control the potential toxic effects and prevent the development of acute and/or chronic diseases.

Medical surveillance

In targeting a health prevention program for artists, particular attention should be paid to the most vulnerable groups which include smokers, pregnant women and people with respiratory problems (such as asthma or chronic obstructive pulmonary disease) or allergies.

Because artists are often self-employed and therefore do not have access to group health insurance plans, a high percentage of artists are uninsured. A study of the American Council for the Arts (1991) found that 30 percent of artists in large cities were uninsured, and that many artists remain uninsured because they cannot afford to purchase individual health insurance (Study of Health Coverage and Health Care Needs of Originating Artists in the U.S.) (103,104). Since the lack of health insurance is correlated with diminished health care access, disseminating health education and prevention programs for artists will pose additional challenges.

CONCLUSION

Art has long been considered a haven for the creative individual. The last century has offered artists a multitude of new materials and techniques to develop their ideas. It is the challenge of occupational medicine to design health programs for artists that encourage creativity within a safe and healthful environment.

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