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Hazards to Go-Go Dancers from Exposures to "Black" Light from Fluorescent Bulbs

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No significant clinical evidence of skin or eye damage was found among a group of nightclub employees, dancers, and musicians who were exposed to fluorescent "black" light bulbs. The potential eye and skin hazard from the light emitted in the erythemogenic frequencies can be reduced by the interposition of ordinary glass between the light source and employees without diminishing the visual effects. Noise levels were found to range from 90 to 107 dB on the "A" network. The duration of the exposure time of customers is not of sufficient duration to present any noise or ultraviolet hazards.

Introduction

DURING THE SUMMER OF 1966 a complaint was filed with the New Jersey State Department of Health that "go-go" dancers and band members in a nightclub on the South Jersey shore were developing eye irritation and redness of the skin while working directly under special lights. The lights used were of the fluorescent "black" light bulb type (BLB)—that is, emission in the long ultraviolet range with a peak intensity at about 365 nm (nanometers). Such bulbs have had widespread sale and usage in commercial establishments such as cafes and nightclubs, sometimes as the only source of illumination. Their purpose is to provide dim light and to induce dramatic visual effects by causing light-colored objects to glow. When brief and revealing light-colored garments are worn by go-go dancers—who perform on or near a bar or stage—their rhythmic gyrations, accompanied by loud, brassy, and tympanitic, cacophonous band music lures customers.

There were 55 nightclubs, cabarets, and go-go bars in the State of New Jersey presumed to use BLB's, according to the various local health departments. Twenty of these clubs were visited during August 1967. Six of these (30%) did not use them. Another five nightclubs (25%) used BLB's only as ceiling lights, or directed on wall posters or pictures colored with luminous paint. The remaining nine clubs (45%) had BLB's over the band and/or go-go dancers and, in some cases, over the audience. An estimated 100 to 150 go-go dancers and band members were exposed to BLB's in New Jersey.

Methods

Energy measurements of ultraviolet light output were made by using a Weston footcandle meter (Weston Electrical Instrument Corp., Newark, New Jersey), a black-ray ultraviolet meter with a sensing filter (Ultraviolet Products, Inc., San Gabriel, California), and an IL-600 research photometer with sensing filters (International Light, Inc., Newburyport, Massachusetts). Measurements were made at 253.7 nm, 296.7 nm, and 365

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TABLE I
Clinical Features of Go-Go Dancers Exposed to Blacklight Fluorescent Bulbs

Case	Age (years)	Duration of Such Work (months)	Weekly Exposure (hours)	Complexion	Eye Color	Hair Color	Average Outdoor Exposure (hours/day)	Ability to Tan	Subjective Symptoms	Clinical Findings
1	19	24	22½	Fair	Blue	Dark brown	3	Sunburns easily	None	Uniformly tanned; no erythema; no eye lesions
2	32	30	6	Medium	Dark brown	Black	0–2	Tans easily	None	No eye nor skin abnormalities
3	29	12	8	Medium	Blue	Dark brown	0–2	Tans easily	None	No eye nor skin abnormalities
4	19	1	17½	Medium	Blue	Dark brown	0–1	Tans moderately	None	No eye nor skin abnormalities
5	20	1½	38½	Fair	Green	Dark brown	0–2	Sunburns easily	None	No eye nor skin abnormalities Exposed parts were tanned
6	19	4–5	38½	Fair	Dark brown	Light brown	3	Tans easily	None	Skin tanned except for part of bathing suit area exposed by costume; no erythema or eye lesions
7	23	36	15	Dark	Green	Light brown	3–5	Tans easily	None	No eye lesions; no erythema on the skin
8	25	48	35	Fair	Green	Light brown	6–8	Tans moderately	None	Outer arms and torso sunburned; other areas tanned; no eye lesions.

nm. Spectral response curves supplied by the manufacturers were used for comparison with field measurements (General Electric, Sylvania, and Westinghouse).

Noise levels were recorded on the "A" network using a Type 1565A sound level meter (General Radio Company, West Concord, Massachusetts).

Clinical inspection was carried out on the skin and eyes of go-go dancers and hostesses who worked under the BLB's.

Results

An estimated 35 to 50 go-go dancers and band members were exposed to the BLB's in the nightclubs visited.

The maximum levels of exposure of entertainers to ultraviolet energy measured were: 0.2 microwatt/sq cm at 253.7 nm; 1.4 microwatts/sq cm at 296.7 nm; and from less than 20 to 210 microwatts/sq cm at 365 nm.

The BLB's used varied from 18 to 48 inches in length and were rated either 20 watts or 40 watts. They were located from 6 to 18 inches to several feet above performers and audience. At the nightclub that first reported skin and eye irritation (in 1966), the BLB's were about 6 inches above the heads of band members. The estimated energy output of these bulbs was 20 to 120 microwatts/sq cm at 253.7 nm and 365 nm.

The highest intensities of ultraviolet exposure were found at the head level of go-go dancers in their square cages.

Head level measurements of band members under 40-watt BLB's no closer than 18 inches from their heads were: 0.1 microwatt/sq cm at 253.7 nm; 0.2 microwatt/sq cm at 296.7 nm; and 40 microwatts/sq cm at 365 nm.

Twenty percent of the clubs placed BLB's over the audience. Exposures at customer tables ranged from 20 to 200 microwatts/sq cm at 365 nm. At the other two wavelengths, energy output was lower: up to 0.2 microwatt/sq cm at 253.7 nm and 0.4 microwatt/sq cm at 296.7 nm. Illumination levels were as low as 0 to 5 footcandles. Noise levels varied from 90 to 107 dB on the "A" weighting network when the show was in progress.

A summary of the clinical findings in eight representative go-go dancers is given in Table I.

Discussion

The fluorescent effects of long-wave ultraviolet (or "black") light bulbs are striking when reflected by gyrating and costumed go-go dancers. In some clubs the BLB's were the only source of light; the others used a

combination of black light, normal fluorescent, and incandescent lamps.

Light in the visible spectrum is also produced by the phosphors lining the inside of these tubes, although the illumination is poor.[1] Ultraviolet energy emitted from BLB's can vary in frequency and intensity, depending on the variation in the wall thickness of the glass tube, and the amount and uniformity of phosphor coating the inside of the lamp.[2]

The maximum output of BLB's is at about 365 nm. The intensities recorded (20 to 210 microwatts/sq cm) would not necessarily cause a perceptible effect on normal tissue (skin).[3-5]

About 1 to 4 percent of the output of BLB's falls below 320 nm in the erythemogenic range (290 to 320 nm).[2] This is the zone of sunburn and carcinogenesis, in which degenerative changes from wrinkling to epithelioma may be induced.[6-8] However, levels at the ultraviolet frequencies of 253.7 nm and 296.7 nm were found at only very low levels (under 1.4 microwatts/sq cm).

In all nightclubs visited the distance between performer and BLB was at least 1 foot, and often several feet. The bulbs were closer to the heads of the performers in the club that precipitated this study (about 6 inches).

There were no skin complaints made by any performers. Most were tanned, and one case (No. 8) had an acute sunburn. However, the latter dancer also spent over six hours a day outdoors "sleeping on the beach." It was not possible to distinguish tanning induced by the BLB's and by natural sunlight. Since this study was conducted in the summer at seaside resorts, the performers usually spent their off-duty hours (daytime) outdoors at the beach for variable periods. No active dermatitis was seen among the performers.

Although no gross eye lesions (hyperemia or conjunctivitis) were seen in performers, some complained that staring at the bulbs was annoying. (No slit-lamp examinations were made for cataracts.) Some people are known to develop a "tired feeling" or sense of burning when looking at BLB's.[9] This is due to high photon acceptance of blue light by their eyes.[2] The lens of the eye does fluoresce under these lights and may thereby give a blurred effect.[10] It should be noted that the cornea responds to sunlight identically as skin and can "sunburn." The peak wavelength of light to induce keratitis is 288 nm and requires 250 microwatts/sq cm (0.15×10^6 ergs/sq cm).[11] The amount required to produce cataracts (as has been shown experimentally in rabbits and guinea pigs) in the 290- to 310-nm band is twenty times this amount, or 5000 microwatts/sq cm (3×10^6 ergs/sq cm).[11] In humans only 2% of total light energy under 300 nm incident on the cornea reaches the lens.[11]

Although no cases of dermatitis were seen in this study, it is still a theoretical possibility. Exposure for several hours at short distances (for example, under 3 feet) could conceivably cause erythema and dermatitis as well as eye irritation.[2] In performing light testing with BLB's in the laboratory, window glass has been recommended for screening all wavelengths under 320 nm.[2] This is accomplished by interposing the window glass between the BLB's and the patient (or laboratory animal). It can be attached to an enclosure about the bulbs.

Another hazard posed by ultraviolet lights —given adequate duration of exposure at critical target-to-skin distances—is the development of contact photodermatitis.[12] This may occur in normal or photosensitized individuals. There are many soaps, toiletries, and perfumes used today that can induce this reaction. These chemicals (psoralens or halogenated salicylanilides) are activated by light in the 280- to 400-nm range.[12] In addition, many drugs that are taken orally may lead to photosensitivity, with toxic or allergic skin eruptions following coincident light exposure in the ultraviolet or visible spectrum. Such drugs include antibiotics, antihistamines, diuretics, phenothiazines (tranquilizers), and sulfonamides.[13] It is conceivable that workers or patrons in go-go clubs might be photosensitive to fluorescent light, rendered that way by virtue of having taken such drugs, or having applied (quite innocently) photosensitizing chemicals.

A logical and simple barrier to the potentially harmful effects of BLB's would be ordinary window glass (3 mm or thicker) placed in a frame surrounding such bulbs. Increasing the distance from light source to worker—over 3 feet—would also be of benefit.

Noise intensities measured on the "A" weighting network of the sound level meter were quite high (90 to 107 dB).[14] Although these levels may be considered of sufficient magnitude to suggest the need for protection against possible hearing loss, the exposure—at least to the customer—is not of sufficient duration to recommend the use of personal protective devices. Their use by the workers is unlikely, though desirable. A reduction in the amplification of the band music would be of benefit.

Summary

An investigation was conducted in August 1967 at summer resort areas in the State of New Jersey on possible eye and skin hazards of nightclub workers exposed to fluorescent "black" light bulbs, following complaints of skin and eye irritation. No significant clinical evidence was revealed of eye or skin damage from exposure to such bulbs.

The maximum energy levels recorded at worker levels were: 0.2 microwatt/sq cm at 253.7 nm (nanometers); 1.4 microwatts/sq cm at 296.7 nm; and 210 microwatts/sq cm at 365 nm. Illumination levels varied from 0 to 5 footcandles. Noise levels determined on the "A" weighting network ranged from 90 to 107 dB. The visual effects created by these lamps have been heartily endorsed by the public and accepted by the performers.

In view of potential eye and skin irritation from light emitted under 320 nm (in the erythemogenic zone), the enclosure by, or interposition of, regular window glass under the black light fluorescent bulbs would eliminate such wavelengths of light. Such a measure would not diminish the dramatic visual effects produced by long-wave ultraviolet light and desired by club owners and performers.

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Mention of commercial products in this report does not indicate endorsement by the U.S. Public Health Service.

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