

The Health Effects of Light on Worker’s Health

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Citation this Article: Seyedeh Negar Assadi, “ The Health Effects of Light on Worker’s Health”, IJMSIR- April - 2020, Vol – 5, Issue -2, P. No. 79 – 85.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Exposure to lighting could be caused many health and unhealthy conditions. If lighting was in suitable limit, it was been useful and harmless. Objective of this study was to determine the health effects of light on workers’ health.

Methods: It was a historical cohort study. The people who were employed in general industries were participated in this study. Groups were followed for eye, psychological, neurological and heart symptoms and signs. These groups were exposed to different levels of lighting; according to work site, 4 groups were participated: work site 1, work site 2, work site 3 and work site 4. Symptoms and signs were determined. Data were analyzed with SPSS 16. and considering $P < 0.05$ as significant level.

Results: Work site 4, had the most lighting levels; 950.10 ± 1.05 Lux. Eye, psychological, heart and neurological symptoms and sign were determined. Sleep disorders and headaches were more in group 4 and the relative risks were $2.32(1.20-2.70)$ and $1.27(1.09-1.67)$. Sleepiness, fatigue and chest discomfort were more in group 1 and the relative risks were $2.51(1.51-3.20)$, $2.22(1.24-20.56)$ and $2.20(1.34-$

$20.91)$. Eye discomfort was the most in both groups of 1 and 4 and relative risks were $2.70(1.06-3.82)$ and $2.30(1.10-2.81)$.

Conclusions: Lighting had health effects in low and high levels and might be caused sleepiness, sleep disorder, eye discomfort, chest discomfort, fatigue and headaches.

Keywords: Light, Intensity of light, Occupational exposure.

Introduction

Exposure to lighting could be caused many health and unhealthy conditions. If lighting was in suitable limit, it was been useful and harmless.

Exposure to light was been in the all environment. If lighting was in low or high intensity might be caused disorders. But researches were followed until finding the results.(1)

One of the most effective physical factors in the workplaces was light.(2) The employees need some lighting for doing the works.(3) But the needing light intensity was related to type of work.(4) Other studies showed the importance of brightness and color of the light.(5,6)

The main etiology for many of some symptoms and signs in the building and workplaces was physical hazards (7). Light, noise, temperature, air velocity and etc. were from physicals. (8) light need to controlled as the same as other physical risk factors in the work place and environment. (9,10) If it was lower than or more than standards, for example less than 200 lux and more than 2000 lux, occupational health worked on for modifying . (11,12) But in recent years researchers showed injury with lower and higher intensity.(8,9)

Chepesiuk R showed the health effects of light pollution.(1)Harris DD demonstrated the influence of flooring on environmental stressors, it was related to lighting.(2)Holzman D studied about the color of light and its effects.(3) Some studies worked on lighting and its effects on the human circadian clock.(4,5) It was an important subjects specially for night workers and shift workers.

Cajochen C and coworkers studied about the sensitivity of human melatonin, alertness, thermoregulation, and hear rate to short wavelength light.(6) Dowling GA and coworkers demonstrated the effect of Melatonin for sleep disturbances in Parkinson's disease.(7)

Boivin DB and coworkers showed a dose–response relationships for resting of human circadian color by light.(8) Falchi F and coworkers demonstrated the the impact of light pollution on human health and environment.(9) Other study found the important effects of light on Circadian Rhythms, those were controlled body and human healthy. (13)

Workers need to exam in periodic examinations for light effects(14,15) Researches were worked on periodic examination of workers those exposed to physical and chemical risk factors.

Control of physicals and chemicals was necessary and occupational health team must be worked on. (16-19)

Physicals could be affected on cardiovascular systems,(20,21) as the same as psychological and neurological. Lighting could be discussed in ergonomics or human factors engineering.(22-24)

In ergonomics, there were many items, (25,26) those need to worked in the work places and all environments.(27-29) The researchers studied about the lighting and standardizations in ergonomics.(30)

Health programs for workers and employees were necessary and measuring the risk factors were important subject in this situation. There were some ambiguis factors about light effects and researcher wanted to find the facts.

Objective of this study was to determine the health effects of light on workers' health.

Methods

Study Setting; different industries.

Study design and Study population; It was a historical cohort study. The people who were employed in general industries were participated in this study. Groups were followed for eye, psychological , neurological and heart symptoms and signs. These groups were exposed to different levels of lighting; according to work site, 4 groups were participated: work site 1, work site 2, work site 3 and work site 4. Symptoms and signs were determined.

Simple random sampling method was used with $\alpha=0.05$, power= 80 , P1=35% and P2= 55%, the calculated study population was 987 for each group (4groups), and about 4000 in total.

These groups were exposed to low concentration of carbon dioxide; according to working sector the population was divided to four groups. Symptoms and signs were determined by using questionnaire and physical examinations.

Symptoms and sign were eyes, psychological, cardiovascular and neurologic; sleep disorder, sleepiness, chest discomfort, arrhythmia, eye discomfort, headache, fatigue, mood changes and loss of concentration.

The Inclusion criteria were people who worked in different industries with at least 5 years work experience. The exclusion criteria were having the related diseases in eyes, mental or psychological, cardiovascular and neurological systems before beginning this job and having the positive family history of eye, psychological, cardiovascular and neurological disorders.

Exposure assessment; all exposures assessed and calculated the risks. Other work exposures were kept in the standard levels. Lighting density measured and calculated according to standards of occupational safety and health administration by using a lux meter according to Standard A11.1-1965, R1970, Practice for Industrial Lighting, for recommended values of illumination.

The validity and reliability of questionnaire were checked with specialists' opinions and also with performing a pilot study with correlation coefficient 94%. The participants were examined by author using a questionnaire, physical exams and tests.

For statistical analysis, data were analyzed with SPSS 16. Chi-2, Exact test, ANOVA, P value less than 0.05 was considered for significant levels and relative risks were calculated with confidence interval 95% .

Ethical consideration the study was implemented with the consent that was obtained from all the participants.

Results

The study participants were divided into 4 groups based on psychological stresses; group 1: n= 1000, group 2: n=1000, group 3: n=1000 and group 4: n=1000.

Work site 4, had the most lighting levels; 950.10 ± 1.05 Lux. Eye, psychological, heart and neurological symptoms and sign were determined. Sleep disorders and headaches were more in group 4 and the relative risks were 2.32(1.20-2.70) and 1.27(1.09-1.67). Sleepiness, fatigue and chest discomfort were more in group 1 and the relative risks were 2.51(1.51-3.20), 2.22(1.24-20.56) and 2.20(1.34-20.91). Eye discomfort was the most in both groups of 1 and 4 and relative risks were 2.70(1.06-3.82) and 2.30(1.10-2.81). Table 1 showed the minimum, maximum and means of lighting intensity in four groups. Group 4 had the highest level and group 1 had the lowest level of light intensity. There were significant differences between four groups.($P < 0.05$)

The highest number of symptoms and signs were in group D: Symptoms and sign were eyes, psychological, cardiovascular and neurologic; sleep disorder, sleepiness, chest discomfort, arrhythmia, eye discomfort, headache, fatigue, mood changes and loss of concentration.

The lowest number of symptoms and signs was from group 1. There were significant differences. These items were demonstrated in table 2.($P < 0.05$)

The relative risks for symptoms and signs were determined, group 4 had the highest risks. Relative risk in group 4 for sleep disorder was 2.32(1.20-2.70) and for eye discomfort was 2.70(1.06-3.82). Relative risk in group 3 and 2 for sleep disorder were 2.12(0.18-2.85), 1.62(0.19-2.93) and for eye discomfort were 1.05(0.15-2.77), 1.52(0.06-2.73). Table 3 shows the relative risks in different groups. By using the logistic regression, these were had significant differences.

Discussion

According to our findings, Work site 4, had the most lighting levels; 950.10 ± 1.05 Lux. Eye, psychological,

heart and neurological symptoms and sign were determined.

According to the finding; group 1 and 4 had the highest number of symptoms and signs for eye, cardiovascular, psychological and neurological systems: sleep disorder, sleepiness, chest discomfort, arrhythmia, eye discomfort, headache, fatigue, mood changes and loss of concentration. The lowest number of symptoms and signs was from groups 2,3. Groups 2,3 had the average levels of light. There were significant differences.

The relative risks for symptoms and signs were calculated, group 1 and 4 had the highest relative risks. Relative risk in group 4 for sleep disorder was 2.32(1.20-2.70) and for headaches was 1.27(1.09-1.67) there were significant. Relative risk in group 1 for sleepiness was 2.51(1.51-3.20),for fatigue was 2.22(1.24-20.56) and for chest discomfort was 2.20(1.34-20.91). There were significant too. Eye discomfort in groups 1 and 4 were 2.70(1.06-3.82) and 2.30(1.10-2.81). By using the logistic regression, these were had significant differences. It mean symptoms and signs were not related to age, other occupational exposure and environmental exposures. Body mass index.

Other studies showed the same as these results and demonstrated the special effects of light on neurological, psychological and cardiovascular systems. (6,7). Light in low or high level of intensity had effects on different part of the body, from eye to heart.(20)

It seems that light was affected on several organ systems, because of circadian rhythms disturbances.(10,11) In this study author showed that group 4 had the most frequency of headaches, arrhythmia and sleep disorders and group 1 had the most frequency of sleepiness, fatigue, chest discomfort,

mood changes and loss of concentration. Eye discomfort was the most in group 1. Group 4 had the highest level of light intensity and group 1 had the lowest level of light intensity. Other studies had demonstrated the harmful effects of lighting on well being and health.(10,11).

After deleting the effects of age, other exposures and body mass index the risk of diseases had significant difference. The risk of neurological and psychological symptoms and related diseases was demonstrated in other studies too. (7) Neurological symptoms and mental disorders could be caused by exposure to lower or higher light level. (6,7) This study showed the effects of low gas and high level on neurological symptoms and signs and mental or psychological symptoms disorders.

The occupational physician must not ignore this important item in occupational health system. Modifying the workplace for lighting was necessary. (22,25)

According to the results of this study, researcher thought that specific job analysis must be done for all workers and must be measured all of risk hazards in the work place. In other studies were worked on determination of risk factors by emphasized on physicals in related industries. (21, 22)

Frequency of symptoms and signs were important and were gathered by reliable and valid questionnaires.

Author found that the light was an important risk factor for cardiovascular and neurological disorders in high or low levels. Low or high level might be followed by neurological, mental such as Parkinsonism, mood changes, cardiovascular disorders such as arrhythmia and eye disorders.

Examinations in occupational medicine had an important situation. Visual, Psychological,

cardiovascular and neurological disorders should be prevented by periodic examinations and tests. The author of this article recommended to assessment and measurement the risk factors in the workplaces specially physicals such as lighting and tried to modify the workplaces, they should be examined personnel in as soon as possible.

Light exposure could be resulted from environmental exposures, occupational health team might be paid attention.

Conclusions

Lighting had health effects in low and high levels and might be caused sleepiness, sleep disorder, eye discomfort, chest discomfort, fatigue and headaches.

Acknowledgement: The author appreciated the supports of vice research of Mashhad University of Medical Sciences (research no. 86407) and a lot of thanks from respectful journal.

Sources of funding: Vice research of Mashhad University of Medical Sciences.

Competing interests: Author declares no conflict of interest.

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Legends Tables

Table 1: Means of light illuminance in Lux and comparison between working sections.(P<0.05)

Group Variable	work site 1	work site 2	work site 3	work site 4
light illuminance Minimum	200.1 ±1.01	450.01±1.02	650.20±1.05	900.50±1.06
light illuminance Maximum	400.01±0.12	600.02±0.03	850.40±0.02	1000.50±1.03
light illuminance Mean ± SD	300.05±0.06	525.01±0.64	750.30±0.53	950.10±1.05
P value	0.001			

Table 2: Frequencies of symptoms and signs and comparison between working sections.(P<0.05)

Groups Symptoms and signs	Work site 1 N(%)	Work site 2 N(%)	Work site 3 N(%)	Work site 4 N(%)	P value
Sleep disorder	5(0.5)	5(0.5)	15(1.5)	20(2.0)	0.001
Sleepiness	22(2.2)	10(0.5)	7(0.7)	15(1.5)	0.004
Chest discomfort	12(1.2)	7(0.7)	10(1.0)	10(1.0)	0.03
Arrhythmia	1(0. 1)	3(0.3)	5(0. 5)	7(0.7)	0.04
Eye discomfort	25(2.5)	10(1.0)	15(1.5)	20(2.0)	0.01
Headache	3(0. 3)	6(0.6)	8(0. 8)	15(1.5)	0.02
Fatigue	20(2.0)	12(1.2)	10(1.0)	15(1.5)	0.01
Mood changes	15(1.5)	10(1.0)	6(0. 6)	10(1.0)	0. 02
Loss of concentration	10(0. 4)	8(0.8)	5(0.5)	2(2.0)	0. 01

Table 3: Relative risk of symptoms and signs between working sections. (P<0.05)

Groups Symptoms and signs	work site 1RR(CI)	work site 2 RR(CI)	work site 3 RR(CI)	work site 4 RR(CI)
Sleep disorder	1.11(0.10-2.01)	1.62(0.19-2.93)	2.12(0.18-2.85)	2.32(1.20-2.70)
Sleepiness	2.51(1.51-3.20)	1.44(1.03-2.03)	1.54(1.02-2.40)	1.80(1.20-2.43)
Chest discomfort	2.20(1.34-20.91)	1.12(1.01-3.23)	1.15(0.15-2.35)	1.30(1.15-2.13)
Arrhythmia	1.25(1.10-1.30)	1.40(1.01-3.01)	1.05(0.06-2.46)	1.38(0.16-1.44)
Eye discomfort	2.70(1.06-3.82)	1.52(0.06-2.73)	1.05(0.15-2.77)	2.30(1.10-2.81)
Headache	1.01(0.15-1.24)	1.10(1.01-2.02)	1.13(0.17-2.55)	1.27(1.09-1.67)
Fatigue	2.22(1.24-20.56)	1.05(1.01-3.05)	1.06(0.14-2.84)	1.21(1.12-1.55)
Mood changes	1.22(1.12-1.53))	1.07(1.05-2.53)	1.04(0.16-2.44)	1.01(0.17-2.34)
Loss of concentration	1.18(1.02-4.20)	1.08(1.10-2.23)	1.09(0.07-1.14)	1.05(0.18-2.84)