

# **The Effect of Light Intensity on Employees' Health in Pharmaceutical Companies**

**M. W. Suleiman, M. Abu-Jafar, and I. R. Abdelraziq**

**Physics Dept., An-Najah National University Nablus Palestine**

## **Abstract**

In this study we have measured the effect of light intensity levels on the systolic and diastolic blood pressure, blood oxygen saturation, heart pulse rate and tympanic temperature of the employees of three pharmaceutical companies in Ramallah and Al-Bireh district. The employees were chosen to represent the population of the study. The companies were: Birzeit pharmaceutical company-Ramallah branch (BZPR), Dar Alshifa pharmaceutical company (DA), and Birzeit pharmaceutical company-Birzeit branch (BZPB). The sample of the study consisted of 219 employees distributed over the three companies. The parameters were measured before and after the employees work day. The results showed that there is a relation between light intensity levels and all the health parameters.

The results of measurements of systolic and diastolic blood pressure show that they are increasing with increasing light intensity levels. The values of Sig P-values were found to be 0.000 and 0.023 for systolic and diastolic blood pressure

respectively, while the results of SPO<sub>2</sub>% show that they decrease with increasing light intensity levels, with Sig P-value was calculated to be 0.000. The tympanic temperature increases when light intensity level increases, (Sig P-value = 0.002). However all changes were in normal range of the recommended standards.

## **Introduction**

Lighting has both a visual and non-visual influence on humans according to several studies (Aries, 2005). For many decades researchers studied the effect of light intensity on human health. Humans are affected both psychologically and physiologically by the different spectrums provided by the various types of light. In many places, a high intensity light is needed to serve special requirements, in these places light may be harmful for human health. Many world organizations concerned in the problem of lighting. They put forward laws and determinants for recommended lighting conditions, such as World Health Organization (WHO).

## **Previous Studies**

The exposure of human to light has been tested by several researchers. Boyce and his group studied the impact of light in buildings on human health. They concluded that exposure to light can have both positive and negative impacts on human health, these impacts can become evident soon after exposure or only after many years (Boyce *et al.*, 2003). If the human body exposure to dim light, a

hormone called Melatonin is produced by pineal gland in the brain, reduces blood pressure and body temperature (Pandi *et al.*, 2006). Uger suggested that short wavelength visible light exposures may be more efficient than traditional high intensity white light exposures for treatment of circadian rhythm sleep disorders (Uger *et al.*, 2013). In 2001 Peng and others showed that pulse rate increased and the blood oxygen saturation decreased as the intensity of light increases (Peng *et al.*, 2001). A paper published by Saito and his group showed an increase in muscle sympathetic nerve activity and heart rate in response to bright light (Saito *et al.*, 1996).

## **Research Objectives**

The objectives of the study are:

- 1- Measuring the light intensity in three pharmaceutical companies in Ramallah region and compare it with standard values.
- 2- Studying the effect of light intensity on systolic and diastolic blood pressure, heart pulse rate, body temperature, and blood oxygen saturation of the employees of these companies.

## **Results and discussion**

Light intensity was measured in three different pharmaceutical companies in Ramallah city. The range of light intensity is extended from 248 lux, which is

registered in Birzeit Company-Ramallah branch, to 2200 lux which is in Birzeit company-Birzeit branch.

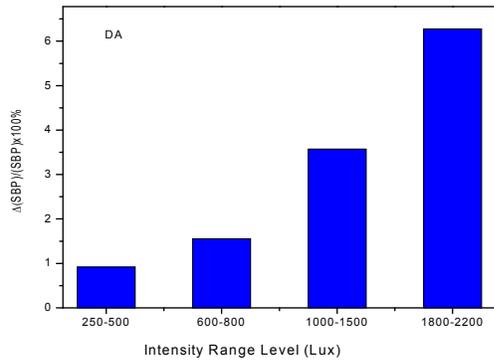
In this study the Systolic and Diastolic blood pressure, Heart pulse rate, blood oxygen saturation, and Tympanic temperature of the employees were tested before and after workday, and then a relationship between light intensity and the change of parameters were studied. Results showed that there is a relation between light intensity levels and all the health parameters.

Significant probability values (Sig P-values) between light intensity and the change in the Systolic and Diastolic blood pressure, Heart pulse rate, blood oxygen saturation, and Tympanic temperature, for all employees in all companies are shown in table 1.

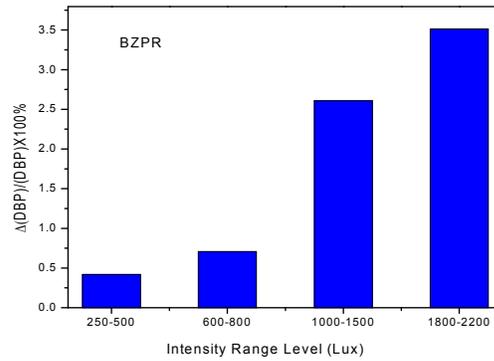
**Table 1:** Sig p-values for SBP, DBP, SPO<sub>2</sub>%, HBR, and T for the overall data

<b>Dependent variable</b>	<b>SBP</b>	<b>DBP</b>	<b>SPO<sub>2</sub></b>	<b>HBR</b>	<b>T</b>
<b>Sig P-value</b>	0.000	0.023	0.000	0.000	0.002

The results of measurement of systolic and diastolic blood pressure show that there are increases in values with an increase of light intensity in all companies for all employees. Some of these results are shown in (Figs 1-2).

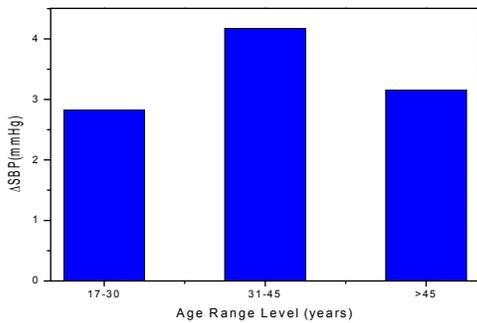


**Fig 1:**Percentage change of SBP for all employees in DA versus light intensity range level

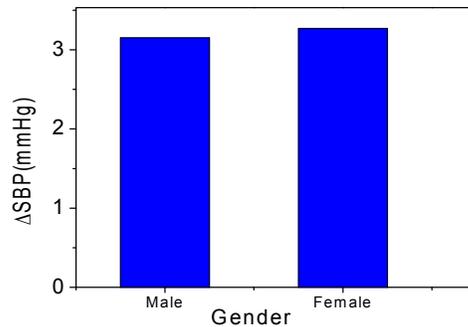


**Fig 2:**Percentage change of DBP for all employees in BZPR versus light intensity range level

The change in SBP for employees in the middle age range (31-45) years is more than (17-30) and (>45) years as shown in Fig 3. There is no significant change in SBP according to the employee gender where both males and females have the same value of change Fig 4.



**Fig3:**Change of SBP for all employees in all companies against employee ages

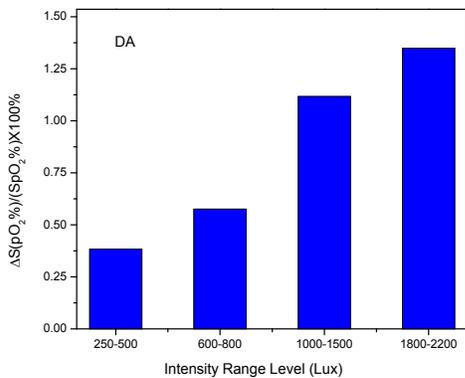


**Fig4:**Change of SBP for all employees in all companies against employee gender

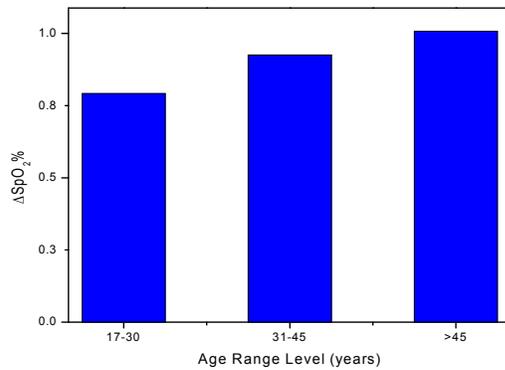
Strong relation was obtained when probability values between light intensity and (systolic and diastolic) blood pressure were measured before and after exposure to light, which is equal zero for SBP and 0.023 for DBP (Table 1). The

results are agreement with Pandi study which state that blood pressure increase when exposure to light intensity (Pandi *et al.*, 2006).

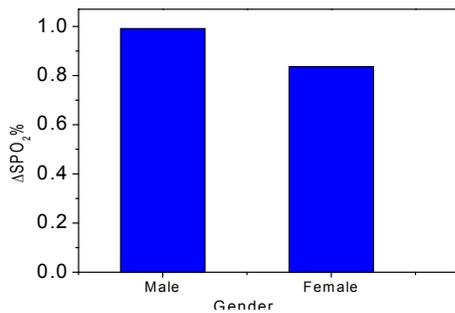
Measurement for SPO<sub>2</sub>% show that decrease of SPO<sub>2</sub>% when a light intensity increases. This result was the same for all employees in all companies (Figs 5). SPO<sub>2</sub>% increases slightly as the age increases, which affect the older employees more than younger employees (Fig 6). The male were more affected than female (Fig 7).



**Fig 5:** Absolute percentage change of SPO<sub>2</sub>% for all employees in DA versus light intensity range level



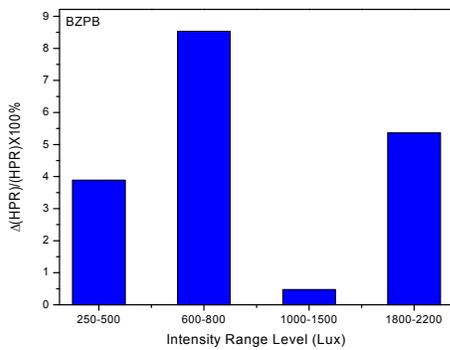
**Fig6:** Change of SPO<sub>2</sub>% for all employees in all companies against employee ages



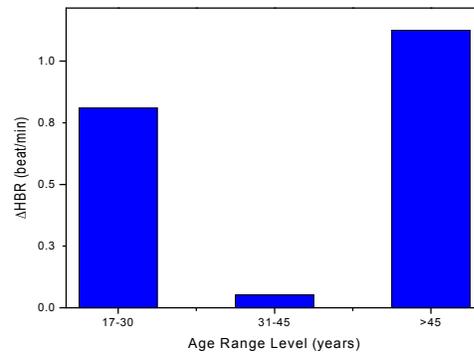
**Fig 7:** Change of SPO<sub>2</sub>% for all employees in all companies against employee gender

Probability values between light intensity and  $SPO_2\%$  were measured zero, which is strong relation. This result is agreement with Peng study which is showed that the blood oxygen saturation decreased as the intensity of light increases (Peng *et al.*, 2001).

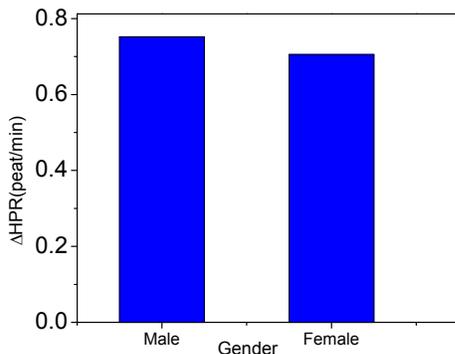
The results of measurement of heart pulse rate obtained that the exposure to light affects HPR but there is no regularity in this effect in the nature of proportionality and the sign of changes (Fig 8).



**Fig 8:** Absolute percentage change of HPR for all employees in BZPB versus light intensity range level



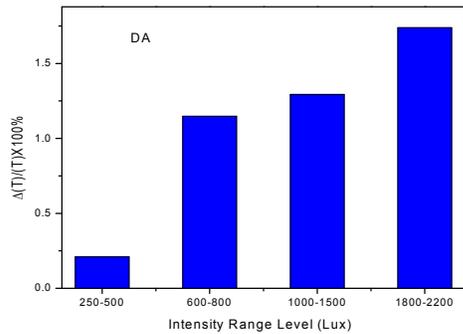
**Fig 9:** Change of HBR for all employees in all companies against employee's age



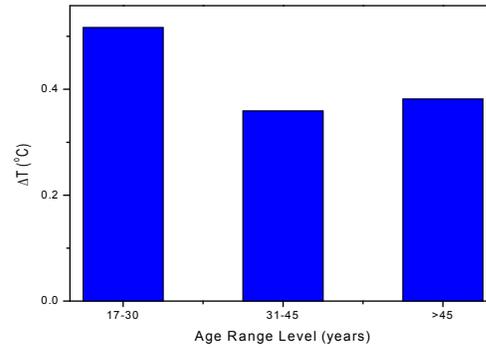
**Fig 10:** Change of HBR for all employees in all companies against employee gender

The change of HPR is clear for older persons (>45) years than middle age person (31-45) years, where the younger persons are less affected (Fig 9). There is slight difference between males and females with change in HPR (Fig 10). Zero value of Probability between light intensity and HPR was measured (Table 1). Some studies indicate that heart pulse rate increase when light intensity increases such as Tsunoda and his group were observed an increase in the low frequency-to-high frequency ratio of the heart rate variability after bright light exposure (Tsunoda *et al.*, 2001). While other studies indicate that heart pulse rate decrease as light intensity increases such as Gilbert and his group, they found a reduction of the heart pulse rate after exposure to light intensity (Gilbert *et al.*, 1999). This study showed that there is an effect to heart pulse rate but it's not regular that sometime increases and sometime decreases.

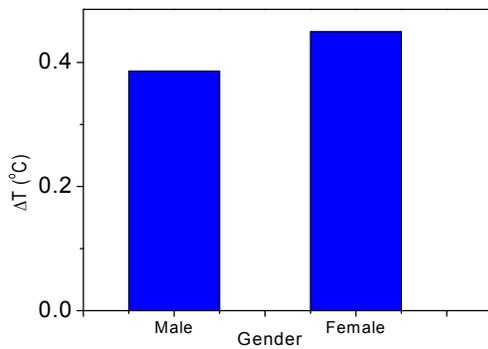
This study points out that the increase of light intensity will increase tympanic temperature. That was something for all employees in all companies (Fig 11).



**Fig 11:** Percentage change of T for all employees in DA versus light intensity range level



**Fig 12:** Change of T for all employees in all companies against employee age



**Fig 13:** Change of tympanic temperature for all employees in all companies against employee gender

The young employees were more affected than the older employees (Fig 12). And the females were more affected than males (Fig 13). Probability values between light intensity and tympanic temperature were measured to be 0.002 (Table 1) which is strong relation. This study result is agreement with Badia study which indicate that body temperature increase when light intensity increases (Badia *et al.*, 1991).

In general this study results conclude that there is a relation between light intensity levels and all the health parameters. Systolic and diastolic blood pressure and tympanic temperature are increases as light intensity increase .Where SPO<sub>2</sub>decreases as light intensity increase. While heart pulse rate affected without regularity.

#### **4.2Recommendations**

Some recommendations are carried out to reduce the effect of high light intensity on employees in pharmaceutical companies.

- 1- Inspecting and watching the light intensity levels in different working places to make sure that they do not exceed the international health organizations standards.
- 2- The light source should be localizedsuch that it lights the working area without being extended to the whole room. This will minimize the light intensity on the employees.
- 3- Following up with medical checks for all employees to avoid health risks resulting from high intense light.

## References

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