



Effects of Blue light Emission from Different Digital Devices on Human Eyes

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This study focuses on estimating the risk of using electronic devices such as Television, Laptop, and Smart phones and the effects of blue light emitting from such devices on human eyes. Illuminance and intensity of common selected electronic devices tested with a blue background for its high energy in a dark room at different distances by means of multimeter and photocell detector. The average intensity was found to decrease with increasing distance. Most peoples watching those electronic devices nearly at a distances (100-300)cm for television, (15-40)cm for smart phone, and (50-100)cm, while the normal vision distance for smart phone was (30.5-45.7)cm and for laptop was (60.9-121.9)cm. Different kinds of eye disorders (farsightedness, nearsightedness, and astigmatism) were diagnosed among the asked individuals which relates to the spend time in front of such devices. The results showed that the myopic is more famous in younger and adults than other age groups, and the people who use two or more devices simultaneously report experiencing symptoms of eye strain compared to peoples whom use just one device at a time **Keywords:** Electronic devices, blue light, human eye, eye disorder.

1. Introduction

Light made up of electromagnetic particles that travel in waves. The human eye responds to only a small part of the entire electromagnetic spectrum [1,2,3]. Blue light is an important element in “natural” lighting, and it may also contribute to psychological health [4,5]. Whether it is computer monitors, smart phones, TV, tablets, or other electronic devices, the people views liquid crystal display (LCD) screens every day. With the increasing amount of public exposure to these devices, health specialists are becoming concerned with the possible adverse effects associated with long term use. Light is everywhere, and it is important for society to understand the advantages and disadvantages associated to its exposure each day. Some benefits to light include hazard prevention or eyestrain reduction, but it mainly used for the ease of viewing objects especially at night. Computer monitors, phones, and laptops are all products that emit visible light for the human eye to perceive. While these products are beneficial to our everyday activities, visible light can pose health risks which the public may not be aware of. An example could be something simple like eye dryness or, in some severe cases as shown in several studies discussed later, an increase risk for the development of cancer [6]. Light at night is bad for health, and exposure to blue light emitted by electronics and energy-efficient light bulbs may be especially so. At night, light throws the body’s biological clock—the circadian rhythm—out of whack. But not all colors of light have the same effect. Blue wavelengths—which are beneficial during daylight hours because they boost attention, reaction times, and mood—seem to be the most disruptive at night [7]. According to studies done in USA (EYES OVEREXPOSED: THE DIGITAL DEVICE DILEMMA 2016) [8], 76% of Americans look at their digital devices in the hour before going to sleep. Adults under 30 experiences the highest rates of digital eye strain symptoms (73%) compared with other age groups. 41% of women report experiencing back pain or text neck symptoms compared to 30% of men. Thus, due to the lack of investigations in this field in our region, it is important to perform such kind of studies to educate not only ourselves but to increase the public’s awareness on the effects of light. The main aims of the present work are: the following study focuses on estimating the risk of using digital devices (laptop, smart phone and television) in Hawler to determine effects of light emission from digital devices on human eyes. While light has its benefit to society in many ways, it is suspected to be associated with few adverse health effects. Some of these effects include anxiety, stress, headaches, and fatigue [7]. The high intensity emitted from digital devices causes eye disorders in different layer of society, especially in young and adults due to watching and using different kinds or types of light emitting devices. So, in this work the intensity of light emitted from the common digital devices were measured by using the device of intensity meter and photo cells. Subsequently, the attached eye disorders for each studied group have been identified and analyzed according to different effective factors.

2. **Material and method** Illuminance and light intensity emitted from digital devices such as television, laptop and cell phone were measured by using the multi meter (VOLT CRAFT PLUS-VC920) and a photo cell detector (PS-2106 light sensor) as shown in “Figure 1”.

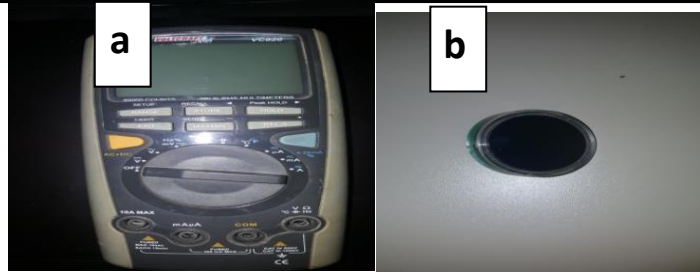


Figure 1 a) multimeter and b) photocell.

For television several kinds of different size were selected for light measurement such as (LED/42 , LCD/42 , Plasma/60 , and CRT). For cell phone several more common types of them were measured for light illumination such as Galaxy (S22ultra, S10 & Note 20ultra) and Iphone (14pro max, 14 pro, 14mini). Different type laptops were also measured for light illumination such as (hp, dell, Toshiba, Asus, Viao and Samsung), all of them were measured at different distances. All the studied digital devices were tested for their emission of UV light using the UV-A light sensor shown in “Figure 2”. Fortunately all of them do not reveal any UV light emission.



Figure 2 The UV-A sensor.

3. Illumination measurements

The Data of this study were collected by measuring both illuminance and intensity of the selected electronic devices cell phone, television, and laptops with a blue background for its high energy in a dark room at different distances for all of them. If the room is not very dark the bright background interferes with the intensity of the electronic devices.

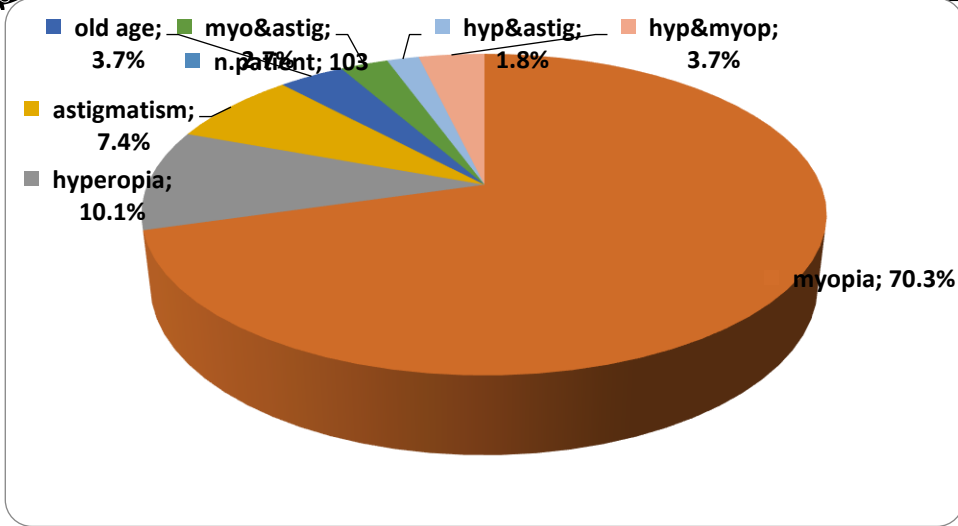
4. Patients attending hospitals (questionnaire)

In this study data were taken considering the time spend by peoples on watching the electronic devices depending on a prepared questionnaire, “Table 1”. The data were taken in different places in our region such as (Rizgare Hospital, Laela Qasim hospital, Okhuz khan school, Hawler school, Optical test places and college of science) for different patients having nearsightedness, farsightedness, and astigmatism. Then the patients were asked for the type of digital devices most frequently used by him, how much time he spend in watching, in a dark or bright room he commonly watch and at what distances they used it. All of these factors were included in the questionnaire due to their effects on the digital eye strain.

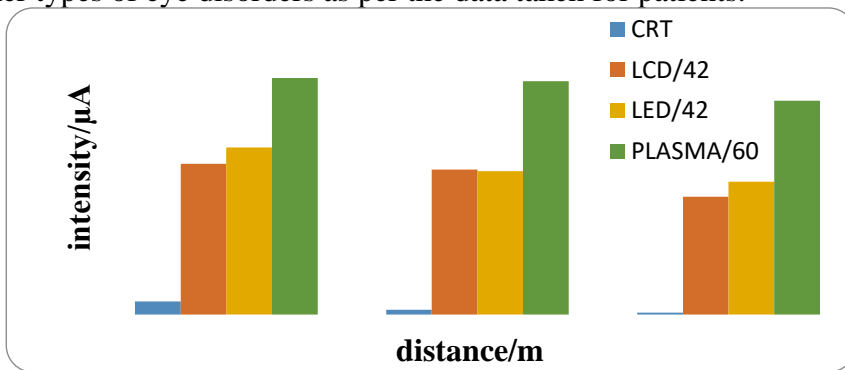
3. Results and Discussion

In this study the intensity of six type mobiles were measured and their average intensities were presented in “Table 2”: Galaxy S22ultra=12.8 μ A, Galaxy S10=16.3 μ A, Galaxy Note 20ultra=23.3 μ A, Iphone 14promax=10.9 μ A, Iphone 14pro=10 μ A, and Iphone 14mini=17.9 μ A. The Intensity of six types of laptops were measured too, and their average intensities were listed in “Table 2”: hp=22.5 μ A, Toshiba=24.4 μ A, Viao=8.5 μ A, Asus=14.3 μ A, Dell=25.2 μ A, and Samsung=16.7 μ A. The Intensity of four types of Television for a different size was measured, and their average intensities were listed in “Table 2”: CRT=2.6 μ A, LCD in size 42=56 μ A, LED in size 42=60.2 μ A and Plasma in size 6=92.7 μ A.

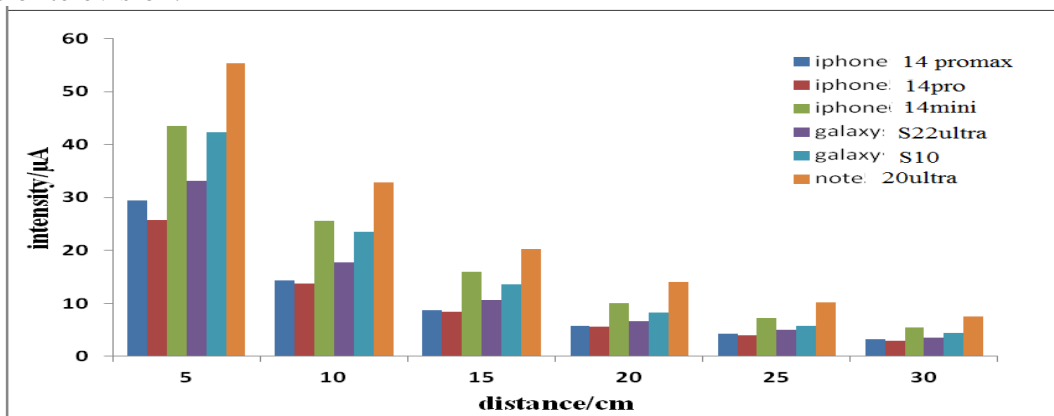
Patient survey statistics



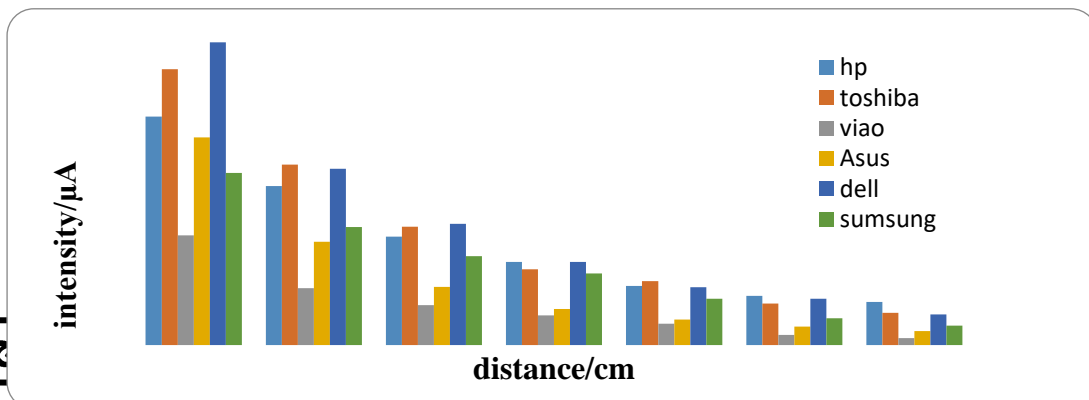
“Figure 4.1” Rate of Eye disorders from 103 patients Figure 4-1 shows that the patients have more myopic eye disorders than the other types of eye disorders as per the data taken for patients.



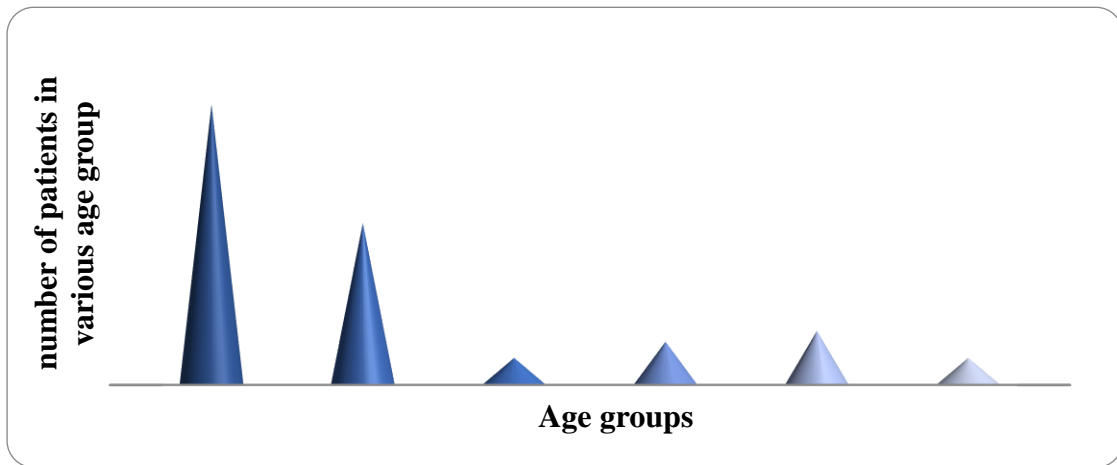
“Figure 4.2” Intensity of blue light emitted from several kinds of televisions “Figure 4-2” shows that the intensity of light decreases with increasing distance, so the eyes are more affected in near distances; plasma in size 60 has more illuminance and intensity in different distances than the other types of television.



“Figure 4.3” Intensity of blue light emitted from several kinds of smart phones “Figure 4.3” shows that the intensity decreases with increasing distance. Galaxy Note 20Ultra has more intensity than other types of smart phones in different distances.

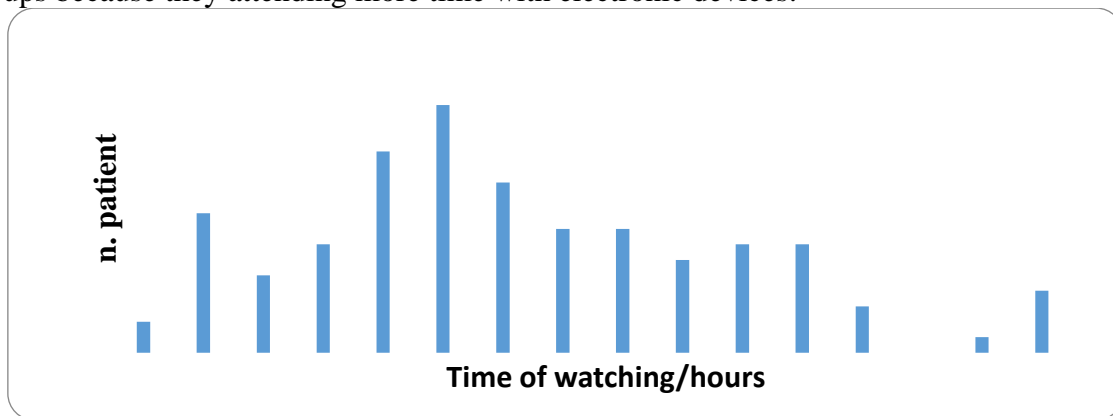


“Figure 4.4” Intensity of blue light emitted from laptops screen with distance Figure 4.4 shows that the intensity decreases with increasing distance as per the square inverse law which governs the decrease of light intensity [9].



“Figure 4.5” Number of patients in various age groups.

“Figure 4-5” shows that the age groups of (15-20) is more affected by eye disorders than another age groups because they attending more time with electronic devices.



“Figure 4.6” number of patients according to time of watch

On average, people who use two or more devices simultaneously report experiencing symptoms of eye strain compared to people who use just one device at a time. The longest time spend by peoples in front of the digital devices was between (6-8) hours

“Table 1”: questionnaire template for patients attending hospitals.

Gender		
Age		
Kinds of eye disorder		
Kinds of TV		
Size		
Distance		
Time of watching Night or day		
Light in outside		
Kinds of pc		
Distance		
Time of watching Night or day		
Light in outside		
Kinds of mob		
Distance		
Time of watching Night or day		

"Table 2" intensity of light emitted from digital devices at different distances.

Kinds of devices	Intensity (in μA) at different distances												
	5cm	10cm	15cm	20cm	25cm	30cm	40cm	50cm	60cm	70cm	1m	2m	3m
galaxy S22ultra	33.2	17.7	10.7	6.7	5	3.6							
galaxy S10	42.4	23.6	13.6	8.3	5.7	4.4							
galaxy Note	55.4	32.9	20.3	14	10	7.6							
Iphone 14pro	29.4	14.3	8.7	5.8	4.3	3.2							
Iphone 14pro	25.7	13.7	8.4	5.6	4	3							
Iphone 14mini	43.5	25.6	16	10	7.3	5.5							
Laptop/hp		49.4		34.4		23.4	18.1	12.8	10.6	9.6			
Laptop/Toshiba		59.6		39		25.6	16.9	13.8	9	7			
Laptop/Viao		23.7		12.3		8.6	6.4	4.6	2.2	1.5			
Laptop/Asus		44.9		22.3		12.6	7.8	5.5	4	3			
Laptop/Dell		65.4		38.1		26.2	18	12.5	10	6.6			
Laptop/Samsung		37.2		25.5		19.2	15.5	10	5.8	4.2			
TV/CRT											5.3	1.9	0.8
TV/LED/42											68	58.4	54.2
TV/LCD/42											61.3	59	47.9
TV/PLASMA/60											96.3	95	87

Conclusions

The Illuminance and intensity of blue light emitted from the studied digital devices decreases with increasing distance and causes different kinds of eye disorders depending on the spend time in front of such devices. The results showed that the myopic is more famous in younger and adults than other age groups. It is important for consumers to be proactive about their vision health and to monitor if constant exposure to digital devices is impacting their eyes.

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