Islamic University of Gaza Students' Opinions on the Light Pollution Effects on Human

Mohammed. M. Shabat

Dana N. Alhams

Mahassen H. El-Blbisie

Khoulud Kh. Abushaar

Department of Physics, Islamic University of Gaza, P.O. Box 108

Gaza Strip, Palestine

(Received: 17.08.2019, Accepted: 23.10.2019)

Abstract

Light pollution is nowadays well known all over the world and may negatively cause disturbance to human and have diverse effects. This study aims to identify the views and opinions of the Islamic University of Gaza students on light pollution and then to create awareness among them about the risky problem facing rapidly our society. The study is based on the survey questions and semi-structured interviews and then the data is collected from the survey questions and semi-structured interviews were qualitatively analyzed and quotes from the students' statements were included. Most of the students recognized that excessive lighting can adversely affect a person's health. The results also show that 40.0% of the students feel that the area outside of their residence is at night is "Fair Brightness ", 29.2% "Bright as day ", 13.8% "Pitch Black ", and 16.9% "A Little Black ". 90.8% of the sample are familiar with light pollution, but 9.2% is not. Some suggestions and recommendations will be made for controlling and reducing light pollution to have a healthy society.

Keywords: Light pollution, human health, Students' opinions.

INTRODUCTION

Light pollution is one of the most pervasive forms of environmental alteration(Blum, 1987, Feder, 2005; Inc et al. 2004; Jin et al, 2017). Light pollution is nowadays well known all over the world and may negatively cause disturbance to human and have diverse effects. Light pollution has been also considered a biodiversity threat (Walker, 2016; Luginbuhl, 2009; Walker et al., 2008& Hölker, 2010). Light pollution is simply defined as artificial, unnecessary or intrusive light. Light pollution also is known as photo pollution or luminous

pollution, which is the excessive, misdirected or invasive use of artificial outdoor lighting. Light pollution is responsible for altering the color and contrast of the nighttime sky, making it difficult or impossible to see natural starlight. It also disrupts circadian rhythms (the 24-hour pattern exhibited by most plants and animals), which affects the environment, energy resources, wildlife, humans, and astronomy. There are three main types of light pollution (Walker, 2015; Walker et al 2010); sky glow, light trespass, and glare. SkyGlow is defined as Light emitted upward into the atmosphere that is scattered by clouds of particles and clouds in the atmosphere. Light Trespass is known as spill light, occurs when illumination from a light fixture is projected beyond a property line. Light trespass unintentionally illuminates other homes, businesses, and other areas. There are no guidelines to determine when, where, or how much spill light is unwanted. Examples of light trespass include light from a nearby streetlight shining through a window and lighting up a bedroom, where the light from an outdoor wall light projecting light towards the sky rather than towards the ground, and light from a neighbor's floodlight or security light shining over the fence and lighting up your property. Glare is defined as bright lighting cause reduced light vision and viewing discomfort. Types of outdoor lighting, glare and sky glow, assessment of city lights, and task-oriented lighting have been presented and discussed (Walker & Pompea 2010). Numerous studies have been published the impacts of the large scale and rapid introduction of LED lights and the use of 'smart illumination, with the opportunity to adjust artificial light at night (ALAN) to reduce any negative environmental impacts (Gaston, 2015). There is an increasing understanding of the effects of both intensity and spectral composition of ALAN, and their side effects on populations, communities, and ecosystems. Several countries have collected information and data on some levels concerning University and school student's awareness and knowledge towards environmental issues and especially light pollution (Ivy, 1999; Walker et al, 2010; Walker, Pompea & Isbell 2009). There is also more attention (Roenneberg, 2013) to research about light and the human circadian clock, clearly showing that the human clock is entrained by light. Some Europe countries set laws and rules to limit the impact of light pollution for the protection of nighttime darkness through control the emission of light in outdoor spaces as the "Decree of 27 December 2018 on the prevention, reduction, and limitation of light pollution (Barentine, 2019; Kreger, 1973)

The lack of information on the awareness levels of light pollution in Gaza Strip, thus we must draw our assumptions based on our survey findings of the Islamic university student's opinion on the light pollution effects as the first phase of a survey of Gaza people. The problem of light pollution has not also been seriously considered so far in Palestine. Fortunately, the authority has not implemented some laws and regulations related to light pollution.

This study aims to identify the views and opinions of the Islamic University of Gaza students on light pollution and then to create awareness among them about the risky problem facing rapidly our society. The study is based on the survey questions and semi-structured interviews and then the data is collected from the survey questions and semi-structured interviews were qualitatively analyzed and quotes from the students' statements were included. Some suggestions and recommendations will be made for controlling and reducing light pollution to have a healthy society.

The rest of the paper is organized in the following sections: the method which is adopted for the collection and analysis of the data, the results of the data analysis and their interpretation and the conclusion.

METHOD

The school of Science was founded in 1980-1981, just two years after the establishment of the Islamic university-Gaza. At the inauguration, the faculty five departments (Math, Chemistry, Physics, Biology, and Geology) and later new departments were introduced (Medical technology, Computer, Environmental and Earth Sciences and Biochemistry). During the school year 2002, the faculty launched new departments (Information Technology, Optometry, and Math/Statistics). Later on, the faculty of science had established the Information Technology Faculty which included both IT and Computer departments.

A total of 65 undergraduate students at the School of Science, Islamic University of Gaza 35 female students, 30 male students, participated in this study. Questionnaires have been distributed to the research population and all questionnaires have been followed and received. The study and questioner were reviewed and agreed on by some specialists and professors of the school of education. Research methodology depends on the analysis of data of descriptive analysis, uses the polls and the main program (SPSS). The questionnaire was provided with a covering letter explaining the purpose of the study, the way of responding, the aim of the research and the security of the information to encourage a high response. The questionnaire included multiple-choice questions, which used widely in the questionnaire. The variety in these questions aims first to meet the research objectives and to collect all the necessary data that can support the discussion, results, and recommendations. The sections in the questionnaire will verify the objectives in this research related to awareness about environmental pollution, issues.

The following research Questionnaires have been designed based on questions in reference (Bashiri, Hassan, & Rosmani, 2014; Kreger,1973; Pompea, Isbell 2009: Özyürek, & Aydın, 2015& Percy, 2001), containing questions:

Table 1. *Questionnaires list*

No.	Question
1.	Do you believe excessive lighting can adversely affect a person's health?
2.	How strongly do you feel affected by excessive artificial lighting outside of your residence?
3.	If you do feel affected, please rate the affected excessive artificial lighting?
4.	Please rate how bright you feel the area outside of your residence is at night?
5.	What would be your ideal level of brightness outside of your residence at night?
6.	Have you ever considered moving elsewhere because of the level of light outside your Residence?
7.	Please rate how much you feel the following contributes to exterior excessive lighting?
8.	Do you know what light pollution is?
9.	How much do you feel the excessive light can affect plants?
10.	Do you believe that artificial lighting can harm animals?

RESULTS

A content validity test was conducted by consulting two groups of experts. The first was requested to evaluate and identify whether the questions agreed with the scope of the items and the extent to which these items reflect the concept of the research problem. The other was requested to evaluate that the instrument used is valid statistically and that the questionnaire was designed well enough to provide relations and tests between variables. The two groups of experts did agree that the questionnaire was valid and suitable enough to measure the concept of interest with some amendments. The statistical package for the Social Science (SPSS) for Manipulating and analyzing the data has effectively been used to calculate Frequencies, Percentile, and the average values (Means).

The questionnaire answers have been collected and written as:

- ***Do you believe excessive lighting can adversely affect a person's health?***

Table 2 shows that 96.9% of the sample believes that excessive lighting can adversely affect a person's health.

Table 2. *Do you believe excessive lighting can adversely affect a person's health?*

Do you believe excessive lighting can adversely affect a person's health?	**N**	**%**
Yes	63	96.9
No	2	3.1
Total	65	100.0

- How strongly do you feel affected by excessive artificial lighting outside of your residence?

Table 3 shows that 4.6% of the sample states that affected by excessive artificial lighting outside of your residence, 35.4% "A little Effect", 44.6% "Effect", and 15.4% "Highly Effected ". The mean of answers equal to 1.709 from 4 (56.93%).

Table 3. *Descriptive statistics for research questionnaire 2 (Age)*

Age	**Frequency**	**%**	**Mean**
No Effect	3	4.6	1.709
A little Effect	23	35.4	
Effect	29	44.6	
Highly Effected	10	15.4	
Total	**65**	**100.0**	

- ***If you do feel affected, please rate the following.***

Table 4 displays that the affected excessive artificial lighting of the sample showing that the Visual Fatigue has mean value, 2.22 with the first rank, Sleep loss/deprivation) has mean value,1.80, with the second rank, Weariness has mean 1.60, with the third rank, Anxiety has mean 1.48, with forth rank and Depression has mean 1.26 with fifth rank. For general, the mean of affected for all excessive artificial lighting equals 1.67 from 4 (41.75%).

Table 4. Descriptive statistics for research questionnaire 3 (Excessive artificial lighting)

Excessive artificial lighting	No Effect		A little Effect		Effected		Highly Effected		Mean	Rank
	F	%	F	%	F	%	F	%		
Anxiety	10	15.4	24	36.9	21	32.3	10	15.4	1.48	4
Depression	21	32.3	15	23.1	20	30.8	9	13.8	1.26	5
Sleep loss/deprivation	11	16.9	13	20.0	19	29.2	22	33.8	1.80	2
Visual Fatigue	3	4.6	11	16.9	20	30.8	31	47.7	2.22	1
Weariness	9	13.8	23	35.4	18	27.7	15	23.1	1.60	3
All items	54	16.6	86	26.5	98	30.2	87	26.8	1.67	

- ***Please rate how bright you feel the area outside of your residence is at night.***

Table 5 shows that 40.0% of the sample feel that the area outside of your residence is at night "Fair Brightness ", 29.2% "Bright as day", 13.8% "Pitch Black", and a16.9% " a Little Black".

Table 5. *Descriptive statistics for research questionnaire 4 (How bright you feel the area outside of your residence is at night?)*

How bright you feel the area outside of your residence is at night?	**Frequency**	**%**
Fair Brightness	26	40.0
Bright as day	19	29.2
Pitch Black	9	13.8
A Little Black	11	16.9
Total	65	100.0

- ***What would be your ideal level of brightness outside of your residence at night?***

Table 6 shows that 52.3% of the sample the ideal level of brightness outside of your residence at night “Fair Brightness ", 21.5% "Bright as day", 6.2% "Pitch Black", and 20.0% "A Little Black”.

Table 6. *Descriptive statistics for research questionnaire 5 (What would be your ideal level of brightness outside of your residence at night?)*

What would be your ideal level of brightness outside of your residence at night?	**Frequency**	**%**
Fair Brightness	34	52.3
Bright as day	14	21.5
Pitch Black	4	6.2
A Little Black	13	20.0
Total	65	100.0

- ***Have you ever considered moving elsewhere because of the level of light outside your Residence?***

Table 7 shows that 46.2% of the sample considered moving elsewhere because of the level of light outside your residence, but 53.8% is not 3.

Table 7. *Descriptive statistics for research questionnaire (Have you ever considered moving elsewhere because of the level of light outside your Residence?*

Have you ever considered moving elsewhere because of the level of light outside your Residence?	**Frequency**	**%**
Yes	30	46.2
No	35	53.8
Total	65	100.0

- ***Please rate how much you feel the following contributes to exterior excessive lighting?***

Table 8 shows that the feel of contributes to exterior excessive lighting as follows:

a. Car headlights with mean value 2.22, and first rank.

b. Spotlights with mean value 1.95, and second rank.

c. Street lights with mean value 1.85, and third rank.

d. Flashing advertising signs with mean value 1.77, and fourth rank.

e. Video Billboards) with mean value1.62 and fifth rank.

For general the mean of all contributes to exterior excessive lighting equal 1.88 from 4 (47%).

Table 8. *Descriptive statistics for research questionnaire 7 (How much you feel the following contributes to exterior excessive lighting?)*

How much you feel the following contributes to exterior excessive lighting?	**None**		**Low**		**Moderate**		**High**		**Mean**	**Rank**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
Video Billboards	7	10.8	15	23.1	39	60.0	4	6.2	1.62	5
Spotlights	1	1.5	11	16.9	43	66.2	10	15.4	1.95	2
Flashing advertising signs	4	6.2	21	32.3	26	40.0	14	21.5	1.77	4
Car headlights	5	7.7	8	12.3	20	30.8	32	49.2	2.22	1
Streetlights	7	10.8	12	18.5	30	46.2	16	24.6	1.85	3
All items	24	7.4	67	20.6	158	48.6	76	23.4	1.88	

- ***Do you know what is light pollution?***

Table 9 shows that 90.8% of the sample know light pollution, but 9.2% of the sample do not know.

Table 9. *Descriptive statistics for research questionnaire 8 (Do you know what light pollution is?)*

Do you know what light pollution is?	**Frequency**	**%**
Yes	59	90.8
No	6	9.2
Total	65	100.0

- ***How much do you feel the excessive light effects on plants?***

Table 10 shows that 4.6% of the sample do not feel that excessive light can effect on plants,15.4% " low", 44.6% "Moderate", and 35.4% "High".

Table 10. Descriptive statistics for research questionnaire 9 (How much do you feel the excessive light can affect plants?)

How much do you feel the excessive light can affect plants?	**Frequency**	**%**
None	3	4.6
Low	10	15.4
Moderate	29	44.6
High	23	35.4
Total	65	100.0

- ***Do you believe that artificial lighting can harm animals?***

Table 10 shows that the sample believe that artificial lighting can have adverse effect on animals as attraction to light) with percent 84.6% and first rank, sleepless with percent 84.6% and first rank, nesting behavior) with percent 81.5% and second rank, disorientation with percent 76.9% and third rank and mortality with percent 44.6% and fourth rank.

Table 11. Descriptive statistics for research questionnaire 10 (Do you believe that artificial lighting can harm animals?)

Do you believe that artificial lighting harms animals?	**Yes**		**No**		**Rank**
	F	**%**	**F**	**%**	
Nesting behavior	53	81.5	12	18.5	2
Attraction to light	55	84.6	10	15.4	1
Disorientation	50	76.9	15	23.1	3
Mortality	29	44.6	36	55.4	4
Sleepless	55	84.6	10	15.4	1
Total items	242	7.45	83	25.54	

We will make a comparison between the results of the questionnaire and the results of the questionnaire with a Malaysian search, (Bashiri, Hassan & Rosmani, 2014). Firstly, we have noticed that the results of our research and the results of the Malaysian research are almost identical for the effect of light on human and show a very high percentage of the awareness of people in Palestine about problems that may be caused by light pollution. Moreover, we find that the proportion of Malaysians who thought of moving from their cities due to the problem of increasing light was higher than the percentage of Palestinians. This is due to the large costs of moving to a new home. The survey also shows that the percentage of Palestinians who have information about light pollution is higher than that of Malaysians.

For us, this is a positive thing for Palestinians. It is a knowledge that there is a problem that contributes significantly to people's acceptance of solutions to light pollution.

Table 12. *Comparison between Palestinian and Malaysian opinions on light pollution*

Questions	Malaysian responses (50)	Palestinian responses (65)
1. Do you believe excessive lighting can adversely affect a person's health?	Yes 90% No 10%	Yes 96.9% No 3.1%
2- How strongly do you feel affected by excessive artificial lighting outside of your residence?	No effect 10% Effect 10% A little effect 40% Highly Effect 16%	No effect 4.6 % Effect 44.6 % A little effect 35.4 % Highly Effect 15.4%
3- If you do feel affected, please rate the following statements on a scale of 0 to 4, where 0 is No effect whatsoever and 4 is Highly affected	**Sleep loss/deprivation** No Effect 6% A little Effect 16% Effect 68% Highly Effected 70% **Visual Fatigue** No Effect 8% A little Effect 4% Affected 16% Highly Effected 72% **Weariness** No Effect 14% A little Effect 10% Effected 14 Highly Effected 62% **Anxiety** No Effect 10% A little Effect 20% Affected 10% Highly Effected 60% **Depression** No Effect 4% A little Effect 6% Affected 8% Highly Effected 82%	**Sleep loss/deprivation** No Effect 16.9% A little Effect 20 % Effect 29.2 % Highly Effected 33.8% **Visual Fatigue** No Effect 4.6% A little Effect 16.9 % Affected 30.8% Highly Effected 47.7% **Weariness** No Effect 13.8% A little Effect 35.4% Affected 27.7% Highly Effected 23.1% **Anxiety** No Effect 15.4% A little Effect 36.9 % Affected 32.3% Highly Effected 15.4% **Depression** No Effect 32.3% A little Effect 23.1% Affected 30.8% Highly Effected 13.8%
4- Please rate how bright you feel the area outside of your residence is at night.	Pitch Black 54% A Little Black 10% Fair Brightness 30%	Pitch Black 13.8% A Little Black 16.9% Fair Brightness 40%

	Bright as day 6%	Bright as day 29.2%
5- What would be your ideal level of brightness outside of your residence at night?	Pitch Black 10% A Little Black 30% Fair Brightness 10% Bright as day 50%	Pitch Black 6.2% A Little Black 20% Fair Brightness 52.3% Bright as day 21.5%
6- Have you ever considered moving elsewhere because of the level of light outside your Residence?	Yes 80% No 20%	Yes 46.2% No 53.8%

7- Please rate how much you feel the following contributes to exterior excessive lighting on a scale of 0 to 4 where 0 is "None whatsoever" and 4 are "Highly excessive"	**Video Billboards** None 10% Low 6% Moderate 4% High 80% **Spotlights** None 20% Low 16% Moderate 24% High 40% **Flashing advertising signs** None 30% Low 10% Moderate 20% High 40% **Car headlights** None 16% Low 30% Moderate 4% High 50%	**Video Billboards** None 10.8% Low 23.1% Moderate 60% High 6.2% **Spotlights** None 1.5% Low 16.9% Moderate 66.2% High 15.4% **Flashing advertising signs** None 6.2% Low 32.3% Moderate 40% High 21.5% **Car headlights** None 7.7% Low 12.3% Moderate 30.8% High 49.2% **Streetlights**

	Streetlights None 14% Low 6% Moderate 10% High 70%	None 10.8% Low 18.5% Moderate 46.2% High 24.6%
8- Do you know what is light pollution?	Yes 20% No 80%	Yes 90.8% No 9.2%
9- How much do you feel the excessive light can affect plants?	None 10% Low 16% Moderate 14% High 60%	None 4.6% Low 15.4% Moderate 44.6% High 35.4%
10- Do you believe that artificial lighting can harm animals?	**Disorientation** Yes 10% No 90% **Mortality** Yes 10% No 90% **Sleepless** Yes 50% No 50% **Nesting behavior** Yes 20% No 80% **Attraction to light** Yes 60% No 40%	**Disorientation** Yes 76.9% No 23.1% **Mortality** Yes 44.6% No 55.4% **Sleepless** Yes 84.6% No 15.4% **Nesting behavior** Yes 81.5% No 18.5% **Attraction to light** Yes 84.6% No 15.4%

CONCLUSIONS

The IUG students understanding and awareness of the light pollution on humans have been found well known. The survey also shows that the percentage of Palestinians who have information about light pollution is higher than that of Malaysians which considered a positive sign for Palestinians at the University student level. However, there is a problem that contributes significantly to the student's acceptance of solutions to light pollution. This work could widely open the door for the light pollution science education at the Palestinian Universities. We recommended that the light pollution issue should be included in the Science curriculum at the university and set up a program contributing significantly to people's acceptance of solutions light pollution. Policy initiatives towards light pollution should be initiated and implemented through laws and rules at the Palestinian land. Negative side effects of light should be minimized through awareness by starting from the university student's awareness.

Acknowledgments

We are grateful to Dr. Nafez Barakat, School of Business for statistical work and helpful comments. MMS also knowledge grant from Alexander von Humboldt for short study visit to the Institute of Energy Research and Physical Technologies, Clausthal University of Technology, Germany and hospitability of Prof. Dr. Daniel Schaadt.

REFERENCES

Barentine, J. France Adopts National Light Pollution Policy among Most Progressive in the World. Available online: https://www.darksky.org/france-light-pollution-law-2018/ (accessed on 12 February 2019)

Bashiri, Fereshteh, & Che Hassan, Che Rosmani (2014). Light Pollution and Its Effect on the Environment. International Journal of Fundamental Physical Sciences (IJFPS). IJFPS, 4(5) 08-12

Blum A. (1987). Students' Knowledge and Beliefs concerning Environmental Issues in Four Countries. The Journal of Environmental Education. 18:3, 7-13.

Feder T. (2005). Limiting Light Pollution Is an Ongoing Challenge. Physics Today 58, 6, 24.

Gaston, K.J.; Visser, M.E.; Hölker, F. (2015). The biological impacts of artificial light at night: The research challenge. Philos. Trans. R. Soc. Lond. B Biol. Sci., 370, 1–6.

Hölker, F., Wolter, C., Perkin, E. K., & Tockner, K. (2010). Light pollution as a biodiversity threat. Trends in Ecology & Evolution, 25(12), 681–.

Inci, Morgil & Arda, Seçil & Seçken, Nilgün & Yavuz, Soner & Oskay, Özge. (2004). The influence of computer-assisted education on environmental knowledge and environmental awareness. Chem. Educ. Res. Pract.. 5. 99-110.

Ivy, Tan Geok-Chin, Lee, Christine Kim-Eng & Chuan, Goh Kim. (1999). A survey of environmental knowledge, attitudes, and behavior of students in Singapore, Humanities Educators' Conference 1999 on "Humanities Teacher in a Knowledge-based Economy", Singapore, 2-6 Mar 1999

Jin X. , Li Yu, Zhang J., Zheng J., & Liu H.(2017). An Approach to Evaluating Light Pollution in Residential Zones: A Case Study of Beijing. Sustainability, 9, 65

Kreger J. (1973). Ecology and Black Student Opinion. The Journal of Environmental Education, 4:3, 30-34

Luginbuhl, C. B. Walker, C. E. & Wainscoat, R. J. (2009), Lighting and Astronomy, Phys. Today 62(12) 32-38

Özyürek, C., & Aydın, G. (2015). Students' opinions on the light pollution application, International Electronic Journal of Elementary, 8(1), 55-58.

Percy, John R. (2001). *Light pollution: the education of students, teachers, and the public Preserving the astronomical sky*, R. J. Cohen and W. T. Sullivan, III, eds, IAU Symposium, 196

Pompea, S. M. & Isbell D. (2009) The International Year of Astronomy: new approaches, novel resources for physics classrooms, Phys. Teacher, 428-433.

Roenneberg, T.; Kantermann, T.; Juda, M.; Vetter, C.; Allebrandt, K.V. (2013). Light and the human circadian clock. Handb. Exp. Pharmacol. 2013, 217, 311–331

Schulte-Römer, Nona, Meier, Josiane, Dannemann, Etta & Söding, Max. (2019) Lighting Professionals versus Light Pollution Experts? Investigating Views on an Emerging Environmental Concern. Sustainability, 9, 11, 1696.

Walker, C. E., & Pompea, S. M. (2016). The Quality Lighting Teaching Kit: enlightening our future. Optics Education and Outreach, Proc. of SPIE, 9946, IV 99460

Walker, C. E. (2015), Light pollution awareness through Globe at night, American Astronomical Society, AAS meeting, id.243.01

Walker, C.E. (2010). Our light or starlight?, Sky Tel., 86.

Walker, C. E, Pompea, S. M. & Isbell D. (2009). GLOBE at Night 2.0: on the road toward IYA2009, in C. Garmany, M. G. Gibbs, and J. W. Moody (eds.), *Education and Public Outreach–A Changing World: Creating Linkages and Expanding Partnerships*, pp. 389, 2008.

Walker, C. E., Pompea, S. M., Sparks, R. T., & Dokter, E. (2010). Teaching Illumination Engineering Using Light Pollution Education Kits, Optics Education and Outreach., Proc. of SPIE, 7783 77830H-1