IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 7, Issue 3 Ver. I (May. - June. 2017), PP 36-41
www.iosrjournals.org

Impact of Harmattan Sun and Dust of the Eye in a Nigeria City

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Abstract: *This work reports Studies that were carried out to investigate the impact of harmattan sun and dust on the eye. These includes ocular media absorbance, ocular related disease incidence, Sun intensity and amount of atmospheric dust during harmattan and non harmattan periods in Jos Nigeria. This is because the eye is the essential organ of sight. It functions by way of refraction of light (from objects) by the refracting media (the cornea, aqueous and vitreous humours and the lens) onto the retina. The brain which is connected to the eye through the optic nerve does the interpretation. Vision loss/blindness could result if any these parts fails to function from damage. The study showed that the harmattan season has hazardous effects on the eye. This might be because the harmattan wind from the Sahara desert is always laden with dust which coupled with increased intensity of the sun cause irritation, lacrination and burning sensational type of pains. This may later lead to other degenerative conditions of the eye especially the cornea because it highly absorbs the energy rich Ultra-violet rays which might destroy its epithelial cells. It seems that it is due to the high intensity of the sun and the high quantity of the dust during the harmattan season (as compared to the non-harmattan seasons), that are responsible for the high percentage incidence of conjunctivitis and cornea as revealed by the cases reviewed in the patients' records of the Jos University Teaching Hospital. It was therefore recommended that people should wear suitable sun glasses outside during this period.*

Keywords*: Harmattan sun, Dust, Human eye*

I. Introduction

Minto, (1966) describes harmattan as a strong easterly or north-easterly wind experienced in west Africa blowing direct from the sahara.It is hot, very dry and dusty so hot and dry that sometimes splits the trunk of trees. When it penetrates areas like guniea cost, it provides a welcome relief from to the most heat, and is beneficial to health. Itt is relatively cool wind to the area, in fact, for by reason of its extreme dryness it promotes evaporation and therefore cooling. On the other hand, it carries with it abundant dust from the desert and thick haze is sometimes formed and impedes rivers navigation. it may cause severe damage to crops and farmland. It is so dry and dusty as to be often injurious to health. Its average southern limit in mid-winter, when the equatorial belt of low pressure is along or just south of the Guniea cost, at about 5on. In mid-summer it is about 18on . it has thus a much qrater duration in the north of the sea than in the south. N Minka,(2016) who also said, Harmattan season is usually a dry and dusty period associated with low humidity. As a result, the weather is harsh to the hair as well as the skin. Also studies have shown that some micro-organisms that cause diseases increase during harmattan period. According to experts, harmattan can be described as a hot, dry and dusty wind that blows over West Africa.

In Jos, this harmattan is experienced in more or less the same way as it has been descried for the Guniea coast by virture of its hilly mountainous surrounding and its topography(Jos which is on a plateau of about 4,ooft or about 1,450m). Also the atmospheric dust and fog produced by the harmattan gets so high that craft navigation is impossible and homes and trees are covered with dust. The period usually starts from November (or October late) and lasts till early March but is more severe in the months of December and January. This period in other words marks the ''Dry season'' experience in Jos.

Moreover, during this period, there really seem to be an increase dust quantity in the air carried by fast moving winds or breezes. The air seems to be very dry as well (|but cold to the skin) and the sky is virtually devoid of clouds as there are no rains (through this period). Above all, during this period people seem to complain more of eye troubles especially the burning sensational and irritative types – and many use to wonder what really was responsible for this.

It was speculated however, that the dusts might probably be etiologic in the production of the eye complaints. It has to be reasoned, anyway that certain rays from the sun (especially the invisible rays Ultra-violet and infra-red rays) could also be responsible for these eye complains if they are left unchecked (by nature or otherwise) and is scattered reflected from plainer objects spectacularly in the eyes.

This supposed to be true because people who work with sources of light (like welders) emitting ultra-violet in great intensity use to complain of severe pains on the eye leading to the disease known as kerato-conjuctivities.

Furthermore, water which forms the rain clouds is known to be a good absorber of the ultra-violet as well as the infra-red rays and therefore naturally moderates their intensities form the sun, when the sky is laiden with clouds. But during this season the sky is very much cloudless. In the light of the above therefore, the following hypothesis were advanced:- ''There is more ultra-violet light during harmattan in jos''
''There is more dust during harmattan in jos'' (because of the dryness of atmosphere, Winds and dust particles from sahara desert).
''There are more eye troubles'' (especially the irritating types) because of the above 2 in Jos during the harmattan.
In order words, the number of eye irritating type of eye troubles is proportional to the amount of U.V light plus dust'' during harmattan.

Hence to put to proof the above hypotheses, the following experiments were detailed to be carried out. Firstly, an absorption spectrum experiment with the various ocular media (i.e. conea, aqueous humour, lens, vitrous humour and retina) to know to what extent each medium absorbs especially the U.V. rays (since a high absorption would be to the medium) and the intensities of the sun (the violet and U.V. regions) during the two seasons taking and the maximum and mean intensities obtained compared. Since the higher the intensity, of the U.V, rays, the more deleterious it would be. Secondly, an experiment to determine the magnitude of dust in the air during the harmatan and the rainy seasons. (in order to find out which period really has more dust in the air).

Also an incidence study research into irrational cases like conjunctivitis, keratitis and the like of the number of patients that come to the muritala Mohammed or Jos University Teaching Hospital during harmattan and non-harmatan periods.

II. Materials And Methods

Absorbance Studies

When light passes through an absorbing material, a constant fraction of the light is absorbed or transmitted in a given thickness of materials, and obeys the relation given as (de Alarnberts). This experimentally absorbed behavior is described by the equation.

$$dI = a\ I\ Dl$$

dI = Io – I is the change in intensity as the light passes through the material sample. Where Io is the incident intensity, dI is the thickness of the sample of the material. a is called the absorption coefficient.
By integrating the above equation from Io to I yields the law of absorption which is:
$I = Io \times e^{-al}$.

Absorption spectrophotomentry

When the absorbance of a sample is measured and plotted as a function of wavelength, an absorption SPECTRUM (or SPETRA) is obtained. The use of this absorption spectra under controlled laboratory conditions is called ABSORPTION SPECTROPHOTOMENTRY and the instrument used is known as Absorption spectrophotometer.

Absorption Spectrum Studies

The study was carried out to determine degree of absorption of a particular higher wavelength of a particular region of the eye (viz, the cornea,Lens, retina etc.) and to determine if two solutions of retina, one kept in the dark and the otherexposedto sunlight would give different readings for a particular radiation. This was done using the instrucment absorption spectrophometer available in the institute of vetinary research Jos

Materials and Methods

Spectrophotometer (model C E 137), Cuvette (of dimension 1cm x 1cm x 3cm), cow's eyes and water (cow's eye obtained freshly from the Jos Abattoir). And the vetinary research institute Kurii Jos.
The eyes were dissected to get out the various region which are the cornea, aqueous, vitreous and retina. Then the cornea, lens, and vitreous were solubilized with $10cm^3$ of water each, for each eye. The retina was also solubilized with $10cm^3$ of water, then it was divided into two equal portions of which one part was exposed to sunlight and the other kept in the dark for a period of one hour. After this they were renoned and turned into the cuvette and the percentage absorption read from the spectrophotometer. Six experiments were carried out in all with standardized procedure. Finally, the absorption spectra were obtained by plotting the mean ± S.D for the 300nm wavelength absorption value (U.V. wavelength against the wavelengths.).

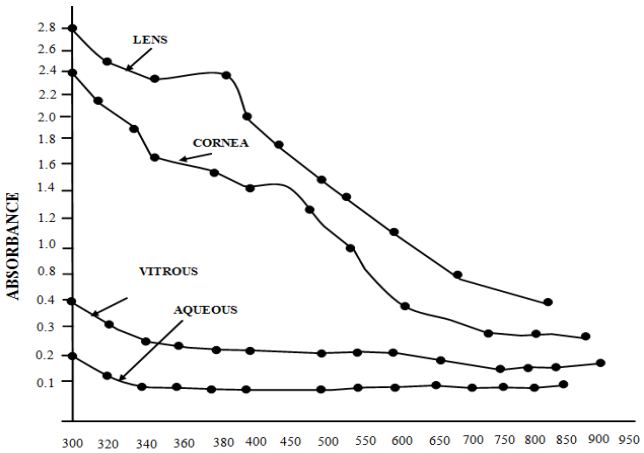

FIG. 1: Plot of Absorbance against Wavelenght in mm.

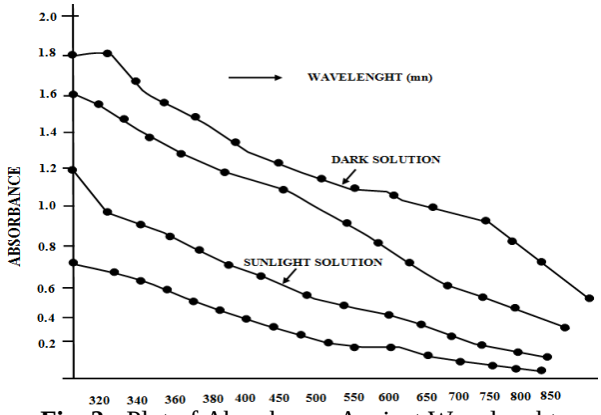

Fig. 2: Plot of Absorbance Against Wavelenght

Dust Particle Studies

To estimate the dust quantity in the atmosphere during the harmattan and non-harmattan seasons (rainy season) in Jos.

Materials and Methods

Cello tape, hard paper sheets and standard travelling microscope. (available in the Physics Laboratory, Some lengths of cello tape of which 1cm was stuck to a hard paper sheet (of dimensions 15cm x 10cm) and the whole system posted to an outside wall (about 1.8m from the ground).One system was posted to the back wall of block B at Naraguta hostel and the other at the side wall of the library in the faculty of Natural Science premises.These were exposed for a period of one hour (from 12-1pm) after which they were moved and the travelling microscope was used in counting the dust particles sticking to the cello tape.

Counting System

Each cello tape was ruled into three (3) regions as shown in the fig below, each of the regions was of dimension 1cm x1cm. Using the travelling microscope, the number of dust particle in each of the four sides of each square was counted. The mean of these was taken by dividing the total obtained from sides by four and the result was squared again to estimate the number then the mean was obtained. This was done for fourteen days during the harmattan season (starting from 16th January to 31st January) and the same length of time during the non-harmattan season (from April 22nd to 7th may).

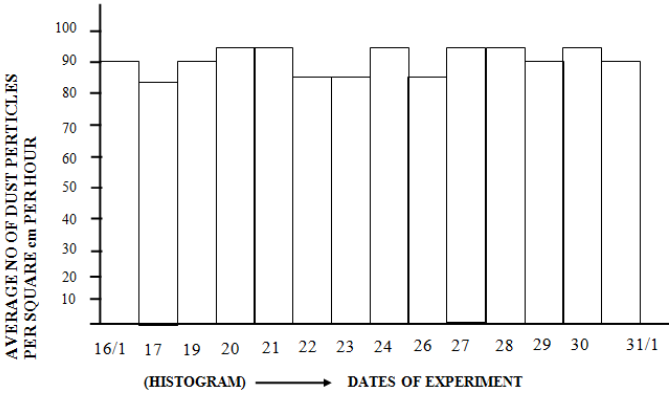

FIG. 3: SHOWING NUMBER OF DUST PARTICLES COLLECTED DURING HARMATTAN SEASON

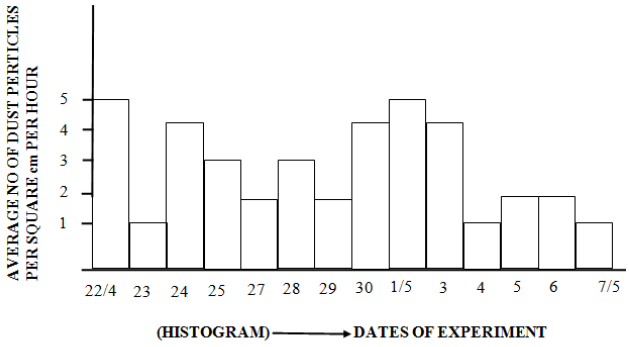

FIG. 4: SHOWING NUMBER OF DUST PARTICLES COLLECTED FOR NON HARMATTAN SEASON

Determination of Ultraviolet Radiation Intensity in Jos During Hamarttan

The aim of this work is to compare the intensity of ultraviolet rays due to a hamarttan and non hamarttan.

Materials and Methods

Photocell (selenium photocell which is sensitive to violet and U.V. region).The photocell was connected to the galvanometer using insulated copper wires. It is then focused directly to the direction of the sun and the readings obtained (in current units-mili amp) was recorded. This was done for two(2) weeks for the harmattan season and two weeks for the non harmattan seasons (not on consecutive days). The intensity was taken at 9.a.m, 12noon and 4.p.m. each day but it was the 12noon intensities that are used to plot the graph (fig 3and 4).

Incidence Studies

This study was carried out to determine the number ofirritational type of eye cases like conductivities and corneal cases during harmattan season and non-harmattan seasons for comparison purpose.

Materials and Methods:

The record cards of all new patients that attended the eye clinic and who were examined by the doctors were revived retrospectively, for some four years.

For the harmttan season, cases diagnosed in previous years were studied. For the non harmattan season cases seen between May and June were believed and continued thus.

YEAR	HARMATTAN	NON HARMATTAN
Year 1	December – June	May – June
Year 2	December – June	May – July
Year 3	December – June	May –June

Usually the number of cases diagnosed were computed against the total number of patients that attended the clinic within the period of interest.

It was noted however that, that being a solely eye clinic, some degree of selection bias will inevitably occur. The data obtained are presented in fig. 1,2,3.

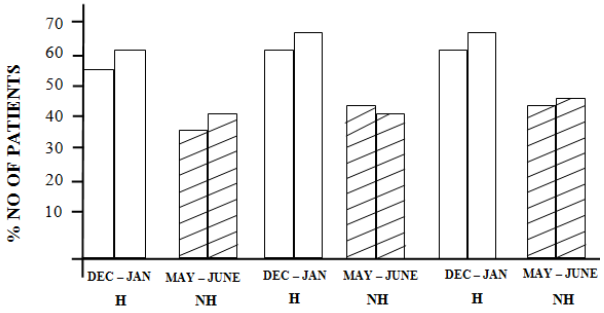

FIG. 4: INCIDENCE OF CONJUNCTIVITIS DURING (H) HARMATTAN AND (NH) NON – HARMATTAN PERIODS.

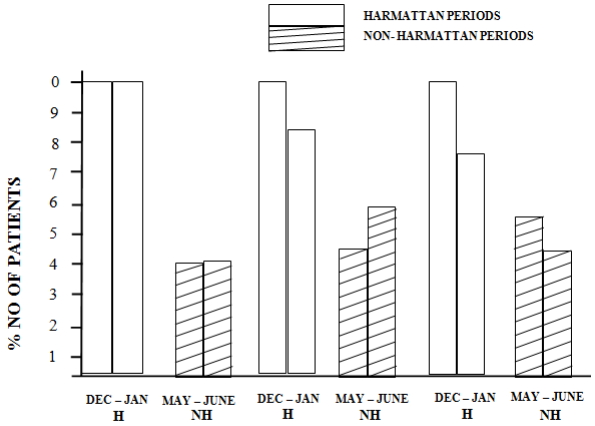

FIG. 5: INCIDENCE OF CORNEA DISEASES DURING (H) HARMATTAN AND (NH) NON – HARMATTAN PERIODS.

III. Results And discussion

The results obtained from the absorption spectrum experiment reveals a high absorption for both the cornea and lens, showing the highest absorption followed by the cornea, especially for the ultraviolet rays. These results are really in agreement with what was obtained in by Cameroun and skofronick (1978)

The other media of the eye, the vitreous humour, aqueous humour and retina also showed highest absorption for the ultraviolet (U.V.) rays, (although under normal condition these rays never get to the retina in the eye.). The results from the experiment with ‘‘dark and sun light’’ retina solutions show that the retina solution kept in the dark absorbs more than that exposed to sun light for any particular ray. This is understandable because the one kept in the sun light has already been saturated with the rays (which are present in the sunlight) and so should absorb less from the spectrophotometer absorption value. This could be confirmed from the Beer Alembert relation for absorption.

(I=Io euexx) where E is the extinction coefficient. So the solution exposed to sun light approaches the extinction coefficient for the particular wavelength and this should be true because when some two similar solutions were exposed to sunlight for 30 minutes and one for two hours, the ‘‘30 minutes solution’’ showed a greater absorption than the standard one of one hour exposure time and the ‘‘2 hours solution’’ showed lesser absorption values than all above two solutions for a particular rays.

Secondly, the results obtained from measurement of intensity of the sun (the violet and U.V. regions) at noon show the intensities were always higher during the harmattan season. There is really a stark difference between the highest intensity obtained in January and that in May. For example, the mean intensity obtained for the harmattan season is 4.5 mili ampere with a standard deviation of 0.58, whereas the mean obtained for non-harmattan season was 2.25 mili ampere with a standard deviation of .72.

The above results also agree with triete’s publication. TRIETE (1977) stated that ‘‘the principal extra-terrestrial variation in the energy supply arise from the variation in the distance between the earth and the sun that are consequence of the earth elliptical orbit. The extra-terrestrial solar irradiance normal to the beam at mean solar distance known as solar constant is about 1353W/m^2, the extra-terrestrial intensity varies by 13.3% being greatest in 1st January and least on 5^{th} July. ‘‘The direct beam intensity is substantially reduced as it passes through the atmosphere. The lower the sun, the greater the reduction due to absorption and scattering. Some radiation is absorbed by gases in the atmosphere mainly ozone, oxygen and carbon dioxide, some by water vapour and cloud droplets, some by aerosol, man-made and natural. The predictable water held generously in the atmosphere varies considerably from area to area and is greatest in the equatorial region where it may reach 100mm. In high latitudes in winter about 5mm is typical.

Thirdly, the ‘‘dust experiment’’ results during harmattan and non harmattan season (fig.1 (e) and fig.1 (f)) show a significant difference in the quantity of dust in the air during the two seasons. The mean dust quantity in the air during the harmattam is about 90.0 particles per square centimeter with a standard deviation of (1.5) while the mean value for the non-harmattan season is 3.0 particles per square centimeter with a standard deviation of 1.7, (P=0.001), using the student’s T-test. These results support the hypothesis that there are more dust particles during the harmattan season in Jos.

The results from the incidence studies carried out in the ophthalmic department of Jos University Teaching Hospital into the irritational type of eye disease such as conjunctivitis and cornea ulcers showed that the percentage of such eye complains are quite higher in the harmattan seasons than for the non-harmattan seasons periods for all the three periods considered.

The mean percentage incidence for the harmattan seasons is 60% with a standard deviation of 0.5 while for the non-harmattan season it is 40% with a standard deviation of 0.4 (for the cases of conjunctivitis) the difference is highly significant (P=0.001). Furthermore, the mean percentage cornea disease incidence for the harmattan season is 9.3% with a standard deviation of 0.22 whereas for the non-harmattan season it is 4.48% and the standard deviation is 0.21. The difference here also is significant, (P=0.001).

These results suggest a cause effect relationship between the higher intensity ultraviolet ray and higher quantity of dust during the harmattan and incidence of the irritational diseases at this season.

IV. Conclusion And Recommendation

The results obtained from the experiments and their interpretations support the hypothesis that the percentage incidence of eye diseases (of the irritational or burning sensational types) correlates with the intensity of ultra-violet light and quantity of dust in harmattan.

In order words, it seems that the percentage rise of these eye cases during the harmattan periods (as compared to a non-hamarttan period is a direct consequence of the increase in ultra-violet light intensity and the dust in the air. It is tempting also to speculate that the high absorption of the ultraviolet rays by the lens may be contributed to the development of cataracts (lens opacity) in some patients. Moreover, there are a number of ocular diseases (or symptomatic conditions) which have electromagnetic rays (e.g. ultraviolet ray and infra-red rays) and dust as a etiological factors or associated etiological factors. In view of this finding in this study residents of the city are advised to wear sun shades prescribe by a qualified eye specialist when outside during this period.

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