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Assessment of Solar Ultra-Violet Radiation Exposure at Major Commercial Centers in Makurdi Metropolis, North Central-Nigeria.

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Abstract: *Assessment of Indoor and Outdoor Solar Ultra-violet (UV) radiation at commercial centers in Makurdi metropolis was carried out with the aim of ascertaining the UV Irradiation doses received by traders and the general public in market places within North central Nigeria and to contribute to the baseline data for UV Index forecast in Nigeria and Africa at large. This was achieved through measurement of indoor and outdoor solar UV radiation exposure at commercial centers in Makurdi metropolis in February, 2016 using a portable digital Solar Power meter (TM-206). The temperature and coordinates of sampling sites were measured using digital thermometers (NEDA1604 IEC 6F22) and Extrex GPS meter (GARMIN). Outdoor and indoor UV irradiance and exposure measurements were made at seven (7) sites between 9:00am - 5:00pm at a regular one hour interval. The result showed the Outdoor mean UV irradiance of 697.24± 8.74w/m^2 with corresponding exposure of 2510.18 ± 0.61kJ/m^2 and indoor UV mean irradiance of 77.87 ± 6.50w/m^2 with corresponding exposure of 280.34 ± 0.48 kJ/m^2 respectively. Both exposures are higher than the ICNIRP (2007) recommended exposure of 30J/m^2. The high UV exposure values implies that traders / buyers and some materials (such as fabrics) displayed for sale are prone to health related hazards such as skin, cancer, primitive aging of the skin conjunctivitis, cataract and immune depression and material degradation effects. Avoidance of outdoor activities during high sunshine hours, wearing of protective clothing/ topical photo-protection and construction of roofed walkways between shops; planting of trees with thick canopies along walkways and open spaces within market settings in North central Nigeria is recommended.*

Keywords*: UV radiation, Exposure, Health effect, 0zone depletion, physical effects, Irradiance.*

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I. Introduction

The Ultraviolet (UV) radiation is part of the non-ionizing electromagnetic radiation spectrum emitted by the sun that has influence on major processes in the biosphere (Foyo-marenoet al;. 1995; Kanelet al., 1999; AFSSAPS 2005; Kuman and Viawanathann, 2013). A large part of the UV-A radiation and about 10% of UV-B radiation reaches the earth's surface from the sum while UV-C is completely absorbed by the atmospheric ozone, water vapour and gasses (Fleischmann, 1989; Karel et al., 1999; INTERSUN, 2003 and Barbero et al., 2006).

Several researches have reported the rise in solar flux of UV -B at certain locations over the earth surface which has the effect of changing the global climate, affecting both biotic and abiotic compound of the environment (Vincent and key 1993; Meinander et al., 2006, Igbawua et al., 2013). This increase has been attributed to the continuing destruction of the Ozone layer by atmospheric pollutants such as chlorofluorocarbon (CFCs) (Vincent and Roy 1993).UV radiation have beneficial effects to human health and Agriculture. However, over exposure to UV radiation plays a major role in the development of Photoconjunctivities, Skin cancers, Pterygiun, Cortical Cataract, Photo-ageing, Carcinoma of cornea, immune depression in humans, plant susceptibility to diseases and great threat to crops and ecological system (Igbawua et al., 2013 and Welska, 2013). Despite the recognized effects of UV radiation, its measurement has received little attention and the observational data available are few and sporadic (Foyo-Moseno et al., 1998). According to Fleischamnn, (1989) quantification of the amount of radiation the organism receives is paramount in examining the effects of UV radiation on living organisms. Hence, this research. This study seeks for a way to complement the National and international UVR protection programs such as WHO-INTERSUN on global UV project and in so doing contribute to the baseline data that would enable a successful UV Index forecast.

II. Methodology

Ultraviolet radiation measurements were taken on hourly basis at each site from 9:00am – 5:00pm on each day of the month of February, 2016 using digital Solar UV radiation power meter (TM-206) held at 1.5m above ground level with its sensor positioned to face directly in the position of the sun. Measurements were carried out at the seven (7) commercial markets in the metropolis after which the mean irradiance was computed. Exposure and the Cumulative exposures were calculated using equation (i) and (ii) below:

$$\epsilon = \sum_{t_1}^{t_2} I \times \Delta t \qquad \text{(i)}$$

Where
$\epsilon$is the Exposure (Dose or Radiance)J/M^2
I is the Irradiance (W/M^2) and
Δtis the Exposure time.

$$\hat{\epsilon} = \sum \epsilon \qquad \text{(ii)}$$

Where
ϵ is the exposure per site
$\hat{\epsilon}$ is the cumulative exposure

Table 1: Coordinates of sampling sites

S/NO	SITES	ELEVATION	COORDINATES
1	A-North bank Market	116.0m	Lat $07^0$45'14.2"N Long 008^0"32'46.0"E
2	B-Wurukum Market	79.0m	Lat $07^0$43'29.3"N Long 008^0"32'59.1"E
3	C-Fiidi Market	80.0m	Lat $07^0$42'48.1"N Long 008^0"37'13.9"E
4	D-Modern Market	84.0m	Lat $07^0$43'27.7"N Long 008^0"29'55.6"E
5	E-Wadata Market	75.0m	Lat $07^0$44'40.2"N Long 008^0"30'45.5"E
6	F-High Level Market	110.0m	Lat $07^0$43'03.2"N Long 008^0"31'36.4"E
7	G-Railway Market	84.0m	Lat $07^0$43'35.2"N Long 008^0"31'51.8"E

Table 2: Outdoor Measurement of UVR .

SITES	Altitude	Δt(s)	Irradiance (J/M^2)	Exposure (KJ/M^2).
North Bank Market	46.9	3600	627.4±26.7	2258.64
Wurukum Market	47.1	3600	704.2±4.2	2535.12
Fiidi Market	51.3	3600	777.7±6.1	2799.72
Modern Market	47.7	3600	653.0±1.6	2350.80
Wadata Market	48.2	3600	811.6±17.4	2921.76
High Level Market	48.4	3600	672.4±2.2	2420.64
Railway Market	48.6	3600	634.6±3.0	2284.56

Table 3: Indoor measurement of UVR.

SITES	Altitude	Δt(s)	Irradiance(J/M^2)	Exposure (KJ/M^2).
North bank Market	46.9	3600	148.3±19.9	533.88
Wurukum Market	47.1	3600	28.9±0.7	104.04
Fiidi Market	51.3	3600	56.6±5.3	203.76
Modern Market	47.7	3600	93.9±5.1	338.04
Wadata Market	48.2	3600	54.7±3.8	196.92
High Level Market	48.4	3600	88.1±7.5	317.16
Railway Market	48.6	3600	74.6±3.5	268.56

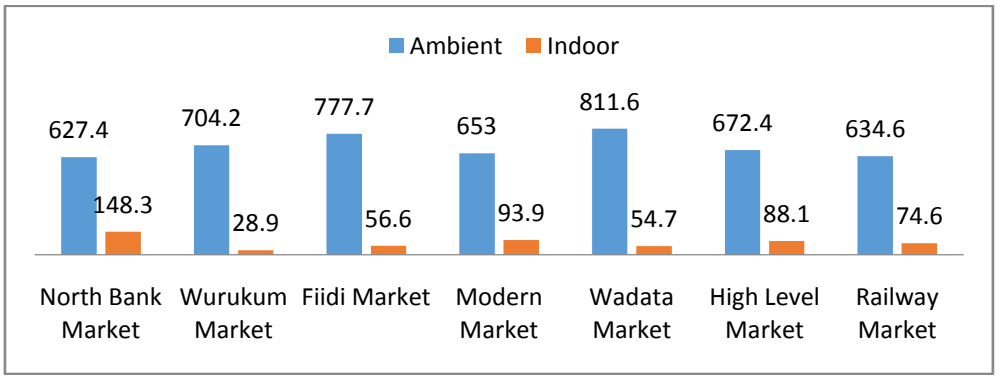

Fig. 1: Mean Exposure versus Sites.

III. Discussion

Indoor and outdoor uv exposure at seven (7) major markets (commercial centres) in Makurdi metropolis are presented in table 2 and 3. The mean indoor and outdoor UV exposure in all the markets were found to reach its peak values at noon (between 11:30 am to 3:00pm) after which it decreased till sunset. The highest mean outdoor UV exposure was obtained at Wadata market followed by Fiidi and Wurukum markets. The other markets had UV exposure values in the range of 2258.64kJ/m^2 – 2420.64 kJ/m^2. The mean outdoor UV exposure for all the markets was estimated to be 2510.18 ± 0.61kJ/m^2. The variations in the mean outdoor UV exposure in the markets may be due to non-uniformity in environmental factors such as deviation of the sites, presence of ground reflecting sources, cloud cover and haze conditions experienced during measurements. This is in agreement with works of other researches who have earlier reported that the UV exposure in an environment depends on the above mentioned factors (Igbawua et al., 2013 and Karel et al.,1999).

The highest values of mean indoor UV exposure were recorded at Modern market followed by High level market and Railway Market. The mean UV exposure for indoor measurements was 280.34 ± 0.48 kJ/m^2. This UV exposure values are lower than the outdoor values which suggests that most of the direct UV-rays are alternated by the shades, shop roofs and walls. However some diffused (or scattered) UV rays find its way into the shops (shades).

Recent research Igbawua et al., (2013) on the average solar UV radiation dosimetry in central Nigeria reported that mean UVR exposure of 432 ± 47J/m^2. Offiong, (2003) in his research on Assessment of Economic and Environmental Prospects of Stand-by Solar powered system in Nigeria reported that the average solar radiation received in Nigeria per day is as high as 20MJ/m^2. This may be due to her proximity to the equator (tropical region) as explained by INTERSUN (2003). The results of the indoor and outdoor UV exposure measurements revealed that the mean UV exposures are above the ICNIRP, (2017) recommended limit of 30J/m^2 for occupational exposure except for the indoor UV exposure at Railway market. This explains why health effects such as Skin cancer, Cataracts and Pterygium are predominant in North Central Nigeria, especially within the age bracket of 50years above as reported by CBM, (2001) and ICNIRP, (2007). Traders who spend all their days trading in the open sun are at risk of developing UVR related illnesses and deterioration of their openly displayed fabrics.

IV. Conclusion

The results of this research have shown that Indoors and Outdoor UVR levels in the metropolis are above the ICNIRP (2007) recommended safety limit for occupational exposure except, indoor exposure levels at Railway market. The mean UV exposure for both measurements were found to be 2510.18 ± 0.61 kJ/$m^2$and 280.34±0.48kJ/m^2. In order to avoid UVR effects, the traders and buyers should avoid outdoor activities during high sunshine hour; wear protective clothing and use of topical photo- protection are recommended.

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References

[1]. Foyo Moreno, I., Vida J. and AladosArboledas L. (1998). Ground Based Ultraviolet (290-385nm and Broad and Solar Radiation Measurements in Sourth –Eastern Spain. Int. J. climated 18.1389-1400.
[2]. Fleischmann e.M (1989). The measurement and penetration of ultraviolet radiation into tropical marine water. Limol.Oceannogr., 34/8 :1623-1629.
[3]. Barbero F.J., Lpez G. and Battles F.J. (2006). Determination of daily solar ultraviolet radiation using statisitical models and artificial neural networks. Ann. Geophy., 24. 2105-2114.
[4]. Wolska A. (2013): Occupational Explosive to Solar Ultraviolet Radiation of Polish Outdoor Workders. : Risk Estimation Method and Criterion. Int. J. Of occupational Safety and Ergonomic Vol. 19 (1)
[5]. Igbawua T., Ikyo B. and Agba E. (2013). Average solar uv radiation dosimeter in cetral Nigeria. International Journal of EnvironmentalMonitoring and Analysis Vol. 1 No 6 pp. 323-327.
[6]. Meinander O., Kazadzis S. Blumthaler M., Ylianttila., JohnsenB., Lakkala K., Koskela T. and Josefsson W. (2006). Diurnal discrepancies in Spectral solar uv radiation measurements. Applied Optics Vol;. 45,No 21.

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