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Short Communication

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Was the *Zika virus* Outbreak in 2015 Triggered by Cosmic Events?

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Abstract

The *Zika virus* outbreak in 2015 posed a serious public health threat, particularly in view of its association with congenital abnormalities. We point out that this outbreak may have been linked to a systematic increase in the flux of cosmic rays and a general decline of sunspot activity that has been observed over the period 2010-2017. Future surveillance efforts should in our view take account of such events.

Keywords: *Zika virus*; Sunspot activity; Cosmic rays

Short Communication

The rapid spread of the *Zika virus* (ZIKV) in the Americas and its association with congenital abnormalities such as microcephaly and Guillain Barré syndrome has led the World Health Organization to declare an international public health emergency on 1 February 2016. ZIKV was first detected in Brazil in May 2015 and subsequently in several countries of South and Central America and the Caribbean. The cases of microcephaly in Brazil, potentially associated with ZIKV infection, were identified in November 2015. RT-PCR analyses on RNA extracted from *Aedes aegypti* mosquitoes captured from January to March 2015 in Mexico showed the presence of ZIKV thus strongly suggesting that the mosquito vector was already carrying the virus at the start of 2015 [1]. The ZIKV outbreak of 2015 was possibly the largest and deadliest since the disease was first recognized in 1947, so it is reasonable to surmise that some special or unusual factors played a role.

ZIKV is classified as an arthropod-borne, single-stranded RNA virus of the Flaviviridae family and genus *Flavivirus*. Mosquitoes, especially the species *Aedes aegypti* mosquitoes, can be infected by different Zika viruses in nature. The viruses first reproduce in the mosquito's intestines, and then enter other tissues through the blood, ultimately multiplying in the salivary glands from which they can enter the blood stream of a mosquito-bitten victim.

With the eventual control of the 2015 ZIKV outbreak, this infectious disease can be expected to remain endemic posing a considerable challenge for the foreseeable future. The global community will be well served if criteria can be discovered that might help predict a possible future onset and hence minimise the ravages caused by similar outbreaks in the future. Virus mutation and/or recombination events are likely to be the main possibilities for the emergence of enhanced ZIKV disease severity in 2015, so it is necessary to discover possible factors that may have led to such events.

A recent study published in the Lancet argued that exceptional climatic conditions arising from the strong El Niño event in 2015 in North Eastern South America might have contributed, albeit in a poorly defined way, to the rapid dispersal of ZIKV [2]. It is of interest to note in this context that the primary cause of the 2015/16 El Nino event itself might possibly have been linked to solar activity [3].

Recent studies have shown that sunspot numbers and cosmic ray activity can play a role in the emergence of influenza pandemics, extremes of sunspot activity to within plus or minus 1 year being identified as an important risk factor for influenza pandemics [4].

The sunspot cycle (No. 24) that peaked in 2014 showed the lowest sunspot numbers recorded since 1906 with a steady weakening trend of solar activity from 1980 to the present day (Figure 1). These conditions are ideal for facilitating ingress of high energy galactic cosmic rays which could have mutagenic effects.

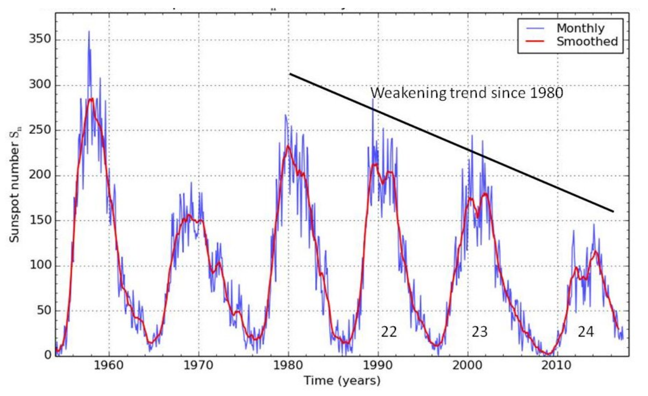

Figure 1: Sunspot numbers from 1956 to the present from data compiled and supplied by the Royal Observatory of Belgium. Envelope shows weakening trend from 1990.

A systematic increase of cosmic rays in the stratosphere has been recorded throughout the period 2015-2017 alongside with the general decline of solar activity (Figure 2).

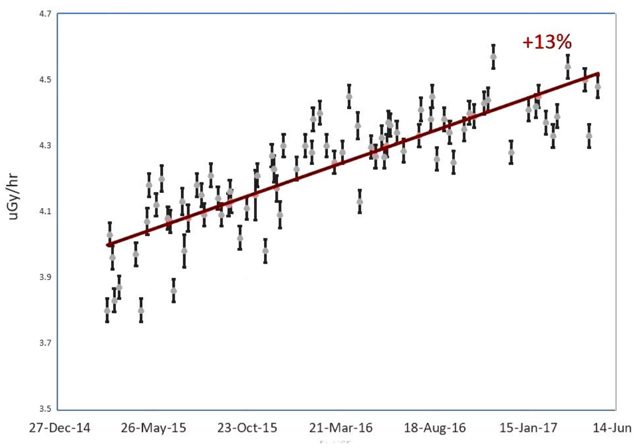

Figure 2: Cosmic ray counts per hour recorded from balloons flown into the stratosphere. Courtesy of T. Phillips et al. (spaceweather.com).

Whilst a general decline in sunspot numbers can provide an open gateway for mutagenic cosmic rays, coronal ejections of charged particles from the sun that reach the stratosphere, can additionally set up electric fields (Eg: Aurorae) that bring down extraterrestrial viral-sized particles (including virions) to ground level [5-7]. It is worth noting that both virion-sized particle transport as well as galactic cosmic rays could be localised with respect to their points of arrival on the Earth's surface. Thus an emergence of a new recombinant virus could be a highly localised event- for example the start of the new ZIKAV appearing in Mexico.

Recombination and re-assortment of genes in an endemic virus with compatible new virions are known to occur at highly variable frequencies in RNA viruses for example for Influenza A. Recent genetic studies reveal that ZIKAV in the 2015 outbreak is probably a recombinant virus [8-10] the recombination involving a component that may have undergone a cosmic ray-induced mutation in 2015, and/or a virion arriving from an extraterrestrial source.

In conclusion we make the bold suggestion that a surveillance of cosmic ray activity on the ground, stratospheric sampling as well as monitoring coronal discharges may serve as a potential warning of future pandemics. Such measures combined with other epidemiological and genetic data might prove a useful factor for strategic disease-control planning in the case of ZIKV as well as of other pandemic-causing viruses.

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Author Contributions

These authors contributed equally to this work.

Competing Interests

The authors have declared that no competing interests exist.

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