Invited Article

Epidemiological and Environmental Factors on Immunity and Diseases – Role of Vaccination

https://doi.org/10.47210/bjohns.2022.v30i1.690

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ABSTRACT

This article tries to highlight the past, present and future trends of emergence of Infectious Diseases. Elucidation of origins of emerging infectious threats, recent patterns of disease emergence and future disease pattern will enable early detection and response in the event of an outbreak. It will also predict its occurrence especially in Indian scenario.

Infections, transmissible OR communicable diseases usually occur in the presence and growth of pathogens. The body of the host is the area where symptoms and sign will appear, however infectivity is the ability of an organism to infect, incubate and multiply. But there are occasions transmission of pathogen and also been inhibited or disappeared by epidemiological or environmental factors.

This article throws light on how some diseases have become extinct whereas some others have changed in aetiology. The present Pandemic of COVID-19 (Novel Corona Virus) has made all of us to ponder on ways of preventing and increasing immunity towards it. This article tries to highlight the Pros and Cons of the vaccine as a preventive treatment and also discusses about the "hygiene hypothesis" especially applicable to the first world countries where the virulence and infectivity of Corona has been much more than the third world countries.

Keywords

Infectious Diseases; Prevalence; Host Interference; Host Immune Response; Vaccination

Infectious disease in 1940 was so different than that of todays.[1] People heard and had seen endemic and epidemic of small Pox and Cholera, the dreaded viral disease and other infective diseases. In those days, during the war period, people had died due to starvation, malnutrition and many other deficiency diseases.

The infective disease and incidence can be sporadic, epidemic or pandemic. The disease can be spread from one infected individual to others through transmission of pathogen by physical contact, contaminated food and water, body fluid transmission, fomites, inhalation or through carriers and vectors.[2] The disease H1N1 (swine flu), measles, pertussis even TB are all contagious diseases. All these diseases are either endemic or pandemic status and also far-reaching impact in the society.

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Observations

People used to move about with huge swollen leg (Filariasis) or huge swollen scrotum (Hydrocele) on the streets of Kolkata and the Out Patients Department of general hospital. OT lists were flooded with hydrocele and Filaria surgeries. There were Filaria OPD treating filariasis and malaria only.[3]

During the 1960's, Infectious Diseases Hospital Beleghata had 6 wards of diphtheria, 3 wards of Cholera

and 1 ward of Tetanus and Rabies each. Almost 10 to 20 patients were admitted everyday. Many of them died of the disease. Children also usually died of acute dehydration related symptoms and above diseases.

Diphtheria infection started in the throat (mostly tonsil one or both sides) and then spread to other adjoining pharyngeal part. Respiratory distress and respiratory bypass surgery were not uncommon. The sequela of these dreaded diseases were toxic and quite a few had developed myopathy and failure of heart, there are hardly any filariasis, diphtheria or even Cholera now a days.[4,5]

In recent years very few cases have presented with features of faucial diphtheria and are referred to Infectious disease hospital for confirmation. Surprisingly there are no diphtheria wards and Anti diphtheria serum is not available in the market. It is only available in Infectious Disease Hospital, Beleghata, India.

There is a possibility that environmental causes like global warming, ecological changes have great influence in the aetiology of these conditions. Antiseptic spraying in the community by health care personal contributes significantly in controlling of these diseases being another possibility.[4]

Discussion

There are many factors or causes in the etiology of the disease, it cannot be explained on the basis of the germ theory. Social, economic, genetic, environmental and psychological factors are equally important. The incidence and infectivity of the diseases may be sudden and severe affected as pandemic like Black death 1347, Spanish flu (1918-20), Covid 1919 or affected in sporadic forms H1N1, H2N2, H2N1 (2009), Mars 2012 Ebola 2014, Hongkong flu and swine flu.[6,7]

It is the normal and natural dynamics of the diseases where mutation will ever factual. These viruses come in newer forms and infect a susceptible population. It will take off no matter what the season is or the country. The really important things are high level of particular immunity in the population, to get as herd immunity or by vaccination. The COVID 19 pandemic highlights the value of effective public health and the health care system and the importance of the environment and its components- air, water, land and biosphere. Daily, seasonal and annual climate variability can often produce vector/pathogen to adopt and shift on expand their geographical ranges. Such a shift can modify disease prevalence that depends on the vector–host interference, host immune response and evaluation of pathogens.

North America still reports various vector borne diseases like lyme disease, dengue fever, zika virus, west nile virus, chikungunya, yellow fever, rocky mountain spotted fever, plague and tularaemia. Vector borne pathogens that are not presently found in the USA such as chickungunia, Chaga's disease, rift valley fever can be a risk soon. The average increase in mosquito abundance is projected to be 8.2% per 1°C warming over this century. Dengue incidence increased 30 times during the past fifty years approximately 390 million infections annually. From this above fact it can said that daily, seasonal, annual or centurial climate variability had vector–pathogen shift to a large extent to diminish the incidence of filariasis hydrocele in general OPD and in ENT diseases diphtheria, atrophic rhinitis or rhinosporidiosis etc. like others.[4]

The discovery of vaccines is an important milestone in the preventive medicines. Discovery of viral vaccines of corona or influenza, no doubt, has helped reducing incidences and control of reinfection. Can we stop it by giving full courses of vaccinations itself ?

Vaccinations have provided vital protection from diseases like Polio, diphtheria, cholera, small pox, measles whooping cough etc. Vaccination has achieved over-all immunity and good enough protection against diseases like mumps, polio, measles (once upon a time an endemic, had resulted in 1.64 lakh childhood deaths in 2008). Now-a-days vaccination has achieved good passive immunity development. Whooping cough once causing spasmodic harassing cough that lasted for up to 3 months (also called the 100 day cough) has now been reduced to having a negligible incidence.

In other words, universal immunisation Programme (U.I.P) for DTP, measles, tetanus toxoid, Polio and BCG

have significantly reduced the burden of the common infectious childhood diseases.[8]

Bacterial vaccines and antisera at the turn of the century led to the conquest of a wide spectrum of specific diseases. Declines took place in the morbidity and mortality from diphtheria, tetanus, typhoid fever and others in the turn of last century. The eradication of small pox is the greatest milestone triumphs of preventive medicine. Another glorious chapter is discovery of synthetic insecticide such as DDT, HCH, malathion and others. They have brought about fundamental changes in the strategy of the control of vector borne diseases e.g. malaria, leishmania, plague, rickettsial diseases which have been among the most important worldwide health problems for many years. The discovery of sulfa drugs, antimalarial, antibiotic, anti-tubercular and anti-leprosy drugs have all enriched preventive medicine.

It is good that vaccination is a blessing in modern society reducing the above conditions significantly. But few facts need a mention here. Allergic chronic conditions are now being noticed and noticed even in the first year of life amongst children. It is also prevalent in 15% of 6 to7 years old and 40% of 13 to 14 yrs old children. Allergic, spasmodic lower airway disease in children has increased significantly, by many folds. These hyper-responsiveness reactions are said to be because of many factors contributing to these diseases. Air pollution is one of the top reasons (global burden disease). These chronic conditions impact quality of life exacerbate co-morbid condition and result in a significant economic burden.[9,10]

One of the many explanations for asthma being the most common chronic disease in the developed world is the 'hygiene hypothesis'.[8] This hypothesis suggests that the critical postnatal period of immune response is derailed by the extremely clean household environment often found in the developed world. In other word, the young child's environment can be "too clean" to pose an effective challenge to a maturing immune system.[11]

An old school of thought is that vaccinations will eliminate the body's ability to fight off other germs and hence make a vaccinated person more prone to infection. According to the 'hygiene hypothesis'[12,13], the problem with extremely clean environments is that they fail to provide the necessary exposure to germs required to 'educate' the immune system so it can learn to launch its defense responses to infectious organisms. Instead, its defense responses end up being so inadequate that they actually contribute to the development of asthma. It has been noticed specially in 3rd world population, COVID exposure related disorder were less both in infectivity and virulence.

However, it has been found that vaccines act as immune-modulator and increase the effectiveness of T cells and T Helper cells to fight off micro-organisms and increase the over-all immunity of an individual. Now deaths due to Tetanus, whooping cough, diphtheria, are unheard of. However we need to develop a more effective BCG vaccine that would give more protection.

Vaccines for flu (Influenza) are more to reduce disease transmission and mortality but cannot eliminate disease altogether. It should be given yearly to susceptible population. Indian Academy of Paediatrics are recommending vaccination for chickenpox, Hepatitis A, Typhoid Pneumonia; Japanese Encephalitis to be given to children. This is to reduce disease load in the community rather than eradicating these diseases altogether.

Conclusion

As for infective or contagious diseases, very low incidences or disappearance are no doubt due to epidemiological, environmental influencing factors as was seen during last centuries i.e., Malaria, Hydrocele, Filariasis and many other infectious and non-infectious diseases. Presently in this century, the biggest challenge that lies in front of the community is to develop a safe and effective COVID Vaccine for children of all age groups.

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