

Linkages of the Epstein-Barr Virus in Developing Nations

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Abstract

The Epstein-Barr Virus (EBV) is a member of the herpesvirus family, more specifically the gamma herpesviruses. While there are a multitude of other diseases that have been singled out for their direct impacts and have received extensive research, such as AIDS, malaria, and tuberculosis, and polio, not nearly as much research has been conducted on the Epstein-Barr Virus and its effects on global health. Research that has been conducted focuses on the comorbidity often associated with Epstein-Barr Virus and other diseases found in developing countries. Some recent research goals have recently increased the focus on developing effective methods for studying the effects of Epstein-Barr Virus on health and methods of identifying the virus. Although many people become infected with the Epstein-Barr Virus, it typically remains in the body in a latent form, rather than active, but often presents a relationship with other illnesses.

To better understand how Epstein-Barr Virus affects the health of populations in developing countries, the goal of this paper will focus on investigating the prevalence and impacts of Epstein-Barr Virus on the health of populations in developing countries. As with most developing countries, diseases and illnesses often have higher effects on all members of different age classes within a country. This investigation will also include determining effective methods for identifying the presence of viral loads in target populations in developing countries. The paper will focus on the countries of India and Zambia because of the increasing identification of Epstein-Barr related associated malignancies in these countries. Research will also look at different areas of possible treatments and remedies related to Epstein-Barr related malignancies that can potentially eliminate high rates of comorbidity in developing countries.

Introduction

Although many diseases have been studied extensively in relation to global health, the Epstein-Barr virus has not received a similar level of research or public health aid campaigns as some other diseases, such as tuberculosis, HIV, and malaria. While Epstein-Barr Virus might not be as detrimental to a person's health as some of the other mentioned diseases, it is still important to understand the implications and impacts of the disease. While the prevalence of other diseases has been either greatly reduced or nearly eliminated, the Epstein-Barr Virus is often discussed because it "is one of the most successful viruses, infecting over 90 percent of humans and persisting for the lifetime of a person" (Cohen 481). Although Epstein-Barr doesn't have as serious direct impacts on health as other diseases, it is easy to understand the importance of better understanding the disease because of the large portion of the population that will eventually encounter the disease.

When investigating the impacts of diseases on global health, it is always important to also investigate factors besides the biomedical sciences that might be affecting the occurrence of the disease within a population. There are other indirect factors, such as socioeconomic status, culture, and religion, that can have a strong influence on an individual's overall health. One common comparison is the inequality between developing and developed countries in terms of diseases the different populations suffer from and the distribution of the disease. For example, a common trend is that "in developing countries in sub-Saharan Africa, EBV-related malignancies occur at a fairly early age, which might be due to infection with EBV early in life" (Orem et al. 1797). In developing countries, younger populations are more vulnerable to overall disease and infection compared to developed countries where older members are more susceptible, which indicates why Epstein-Barr should be more studied with its high infection rates in developing countries. Two continents worth noting are Africa and Asia with certain countries,

such as India and Zambia, providing significant research to examine. Promising methods for better understanding Epstein-Barr involve elucidating the virus' relationship to other diseases within different populations. Many researchers are currently focused on effective ways to treat or suppress the virus. Comparing the different research efforts in Africa and Asia can lend some insights towards decreasing the impacts of Epstein-Barr in afflicted countries and reaching levels similar to other developed nations.

The Epstein-Barr Virus

For impactful solutions to be developed, a general understanding of the basic characteristics and biological functions of the virus is first necessary. As it is a virus, the Epstein-Barr virus, for the most part, functions similarly to other viruses by infecting a host cell and using exploiting the cell for replication processes. The viral genome of Epstein-Barr is “encased within a nucleocapsid, which is in turn surrounded by the viral envelope” (Cohen 481) In addition, the viral genome contains about 100 proteins that are necessary in “regulating the expression of viral genes, replicating viral DNA, forming structural components of the virion, and modulating the host immune response” (Cohen 481). Much of the available research conducted on Epstein-Barr has focused on characterizing these viral genes and proteins and continues to find ways to modulate the virus by manipulating different target proteins.

Next, it is important to consider how Epstein-Barr's route of infection, typical symptoms that it can cause, permanence within infected host cells. The process of Epstein-Barr infection first starts with its entry through “oropharyngeal epithelium through unidentified receptors, where replication occurs, followed by infection of resting B cells in the pharynx” (Tsuchiya 228). One of the notable aspects of the Epstein-Barr Virus is that plays a role in manipulating the immune response capacity of its host by infecting B cells.

Primarily, Epstein-Barr virus is most often noted as the cause of infectious mononucleosis: “EBV was shown to be the etiologic agent of heterophile-positive infectious mononucleosis” (Cohen 481). Although Epstein-Barr does cause infectious mononucleosis, its relationship to other diseases and role in comorbidity is often overlooked and not paid as much attention. The potential Epstein-Barr to be much more detrimental to a person’s health is a serious concern that is guiding possible methods for identifying the virus in infected individuals. To produce impactful solutions to Epstein-Barr related illness, many researchers understand that, “since EBV already infects most health individuals, it is quite important to demonstrate whether EBV has a casual relation to a specific disease or is just a passenger” (Tsuchiya 228). Epstein-Barr virus is especially dangerous in developing countries because its impact can be amplified when it creates a relationship with another disease in an individual. Epstein-Barr often becomes associated with other cancers, making it a cancer-related malignancy, and serious area of concern for many populations in impoverished areas.

India

One of the biggest obstacles in identifying ways to combat the effects of Epstein-Barr often first involves creating ways to detect the virus in afflicted patients. Epstein-Barr is often hard to detect in individuals because “EBV infects >95% of the human population by adulthood and is maintained latently in a small fraction of memory B cells” (Sinha 9). The maintained latency of EBV is a significant factor that presents a source of questions for many researchers. Latency of the virus profoundly increases the difficulty associated with developing effective procedures for detecting the Epstein-Barr virus. The latent aspect of the virus has pushed research firstly towards developing identification methods that can effectively and accurately return results of infection status. Research on detection methods is important for studying the

virus in developing countries where healthcare resources are often lacking, nonexistent, or inaccessible to vulnerable populations. For developing countries, detection methods need to maintain effectivity while also incorporating cost-effectiveness, easy administration, and reliability. In order to ensure relatively widespread implementation in developing nations, successful detection methods should preferably be through non-invasive routes of collecting samples and methods that do not require extensive medical resources. Better research on detection methods will allow for more focus on the Epstein-Barr virus itself and allow research to shift on ways of reducing its effects in developing countries.

While Epstein-Barr is difficult to detect in healthy individuals, there are many populations in developing countries that still suffer from poor health and high rates of comorbidity between multiple diseases. Although the virus often exists in its latent form in healthy individuals, the Epstein-Barr virus also displays an active form like any other virus where it is actively replicating inside of cells. In the active form, researchers have begun looking at more promising detection methods because “EBV DNA can be detected in the serum or plasma of most patients with EBV-associated malignancies” (Sinha 9). The indication that individuals can possibly display a linkage between the Epstein-Barr virus and other related malignancies can help elucidate the role that Epstein-Barr plays in their comorbidity. While EBV has been increasingly linked to many malignancies, cancer diseases, such as breast cancer and Hodgkin lymphoma, have proven to be the highest areas of interest for studying Epstein-Barr in developing countries (Pai 16; Sinha 8). Studying linkages between breast cancer and Epstein-Barr is important because of its potential to help improve maternal health in countries that still display poor maternal health outcomes and high rates of maternal mortality. Breast cancer research in India studying Epstein-Barr association has utilized the in-situ hybridization method

to locate complementary DNA targets of Epstein-Barr in sample tissue from patients (Pai 21). Understanding the association of Epstein-Barr with cancers like lymphomas is also important because of the effects of both the virus and the lymphoma on the immune system and the potential impacts on the overall health of an individual.

Resulting from lacking research and studies, India is an important area to investigate because of the role its infrastructure, healthcare system, and economy play in affecting population health how the Epstein-Barr virus can make individuals even more vulnerable. The disparity between knowledge of Epstein-Barr in developed and developing nations is highlighted in that “although the Western literature focusing on EBV association with BC is rampant, there is very scant literature from India addressing this issue” (Pai 17). This inequality illustrates the need and importance of studying the effects Epstein-Barr in developing countries to understand the influence of Epstein-Barr on public health trends in specific areas.

Africa

In addition to the differences between latent and active forms of the virus, another factor to consider differences between age of infection with the virus. In developed countries, the proportion of individuals suffering from diseases and illness is usually older, whereas in developing nations the proportion of the population suffering from poor health is often younger. This fact is highlighted by the trend where “in developing countries in sub-Saharan Africa, EBV-related malignancies occur at a fairly early age, which might be due to infection with EBV early in life” (Orem et al 1797). Infection with Epstein-Barr at early stages in life can increase the vulnerabilities of individuals with respect to their immune response capacity later in life when dealing with different diseases and infections. Infection early in life increases the risk factors associated with other non-health related factors: “Poor socioeconomic conditions, malnutrition,

co- infections, poor hygiene, and overcrowding are risk factors for early EBV infection, and are associated with aberrant anti-EBV immune responses” (Orem et al 1797). The role of social factors that indirectly affect health are even more important in developing nations because of the detrimental and compounding effects that they can have on populations. Early infection with Epstein-Barr can also prove troublesome for later in life because “most EBV infections of infants and children are asymptomatic or have nonspecific symptoms” compared to “infections of adolescents and adults [that] frequently result in infectious mononucleosis” (Cohen 484). The absence of specific and unique symptoms in many children and infants infected with Epstein-Barr only increases the current difficulty of identifying Epstein-Barr in infected individuals. Undetected Epstein-Barr can later go on to develop an association with another malignancy and cause significant damage to the health and immune response capacity of an individual.

In Africa, it is easier to look at more than one country because of the geographical spread and significant lack of research with respect to Epstein-Barr. In determining Epstein-Barr associated malignancies in Africa, investigations into cancers, such as childhood non-Hodgkin’s lymphoma in Uganda and gastric cancer in Zambia, is uncovering more information about effects of Epstein-Barr on health in African populations (Orem et al 1797; Kayamba 2). Like other developing nations, developing countries in Africa experience some similar issues that play direct and indirect roles in health outcomes and trends. Lymphomas are important because of the effects they have on the immune system. Epstein-Barr’s effects and manipulation of the immune system present a serious threat in developing countries where large proportions of the population experienced higher rates of immunosuppression or vulnerability.

Conclusion

With the scientific advances made on many diseases that previously had severe impacts on global health, it is now time to begin shifting focus on the lesser known effects of diseases, such as Epstein-Barr, in developing nations. While there have always been differences in the health issues and outcomes experienced by developing and developed nations, it is important to better understand how exactly Epstein-Barr is contributing to comorbidity and health life years lost in developing nations. Many studies note the lack of Epstein-Barr virus research as a key source of where problems stem from when trying to develop new methods for identifying the disease in infected individuals.

While more studies have begun to show associations between the Epstein-Barr virus and other cancer malignancies, one of the next areas for concern regarding further Epstein-Barr virus is the creation of reliable and effective protocols for detecting the linkages between infected patients suffering from other illnesses that are exacerbated by the virus. Promising methods of Epstein-Barr virus have included serological sampling for target antibodies of Epstein-Barr and in-situ hybridization to locate target Epstein-Barr DNA. Both techniques rely on the trend where the active form of the virus displays and association to other cancer malignancies and diseases. The potential impact of the Epstein-Barr virus to manipulate the immune systems of infected individuals has serious implications for populations in developing countries. In areas that already present high rates of infections and prevalence of other diseases, Epstein-Barr can increase the vulnerability and susceptibility of populations at risk to improved chances of exposure to other diseases. Future studies should look at potential therapeutic treatments for the Epstein-Barr virus. Research on ways to detect the virus and establish linkages to other illnesses should make it easier to develop new treatments or adapt current treatments towards combatting the Epstein-Barr virus in developing countries. As more research on the Epstein-Barr virus in developing

countries becomes available, the health of populations in these countries can be improved and other health issues can also begin to get increased attention.

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