











Review Article

Burden and distribution of dengue infection in Pakistan (2000-19): a review

Carga e distribuição geral de infecção por dengue no Paquistão entre 2000 e 2019: uma revisão

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Abstract

The goal of this study is to review the overall prevalence, burden, and distribution of the dengue disease in Pakistan from 2000 to 2019. Literature was searched using different search engines like Google scholar, PubMed, etc. providing the keywords “Dengue disease/infection, Dengue virus, DENV, DF/DHF/ DSS Pakistan”. All the published research papers/reports on the dengue virus over the period 2000 to 2019 were studied and selected data were summarized using MS Excel for windows such as total cases, age wise, gender, DENV serotype distribution, total DHF, and DSS patients. The literature providing insufficient data was excluded. The total number of cases reported during 2000-19 were 201,269. The maximum number of cases during the mentioned literature survey period was reported in Khyber Pakhtunkhwa (KP) (23.3%) followed by Punjab (3.8%) and Sindh (1.9%). The majority of dengue-infected cases were reported as Dengue fever (74.4%) followed by DHF (24.1%) and DSS (1.5%). Overall the deaths during the mentioned literature survey were 1082, of which the maximum mortalities were reported from KP (N=248) followed by Punjab (N=220).

DENV remains a major public health problem in Pakistan and seems to remain endemic for a long time. The total prevalence of dengue infection is increased accordingly with time from 2000 to 2019. Moreover, all the four serotypes exist in Pakistan with increased mortalities.

Keywords: dengue disease/infection, dengue virus, DENV, DF/DHF/DSS Pakistan.

Resumo

A literatura foi examinada através de diferentes mecanismos de pesquisa, como *Google Acadêmico*, *PubMed*, etc., fornecendo as palavras-chave “Dengue disease/infection, Dengue virus, DENV, DF/DHF/ DSS Pakistan”. Todos os trabalhos/relatórios de pesquisa publicados sobre o vírus da dengue no período de 2000 a 2019 foram analisados e os dados selecionados foram coletados e resumidos usando o MS Excel para janelas como total de casos, idade, sexo, distribuição de sorotipos, total de DHF e pacientes com DSS. A literatura que forneceu dados insuficientes foi excluída. O número total de casos notificados de 2000 a 2019 foi de 201.269. O número máximo de casos durante o período de levantamento da literatura mencionado foi relatado em KP (23,3%), seguido por Punjab (3,8%) e Sindh (1,9%). A maioria dos casos de infecção por dengue foi relatada como Dengue (74,4%), seguida por FHD (24,1%) e DSS (1,5%). No geral, as mortes durante a pesquisa de literatura mencionada foram 1.082, das quais as morbidades máximas foram relatadas em KP (248), seguidas por Punjab, com um total de 220 mortes. O DENV continua sendo um grande problema de saúde pública no Paquistão e é considerado endêmico agora e provavelmente permanecerá por muito tempo. A prevalência total de infecção por dengue foi aumentada conforme a pesquisa de literatura publicada entre 2000 e 2019. A mortalidade por DENV também aumentou. Todos os 4 sorotipos, bem como em várias formas, existem no Paquistão.

Palavras-chave: dengue/infecção, vírus da dengue, DENV, DF/DHF/DSS, Paquistão.

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1. Introduction

Dengue is an infectious disease caused by the dengue virus (DENV) of the family *Flaviviridae* through *Aedes* mosquitoes. DENV is a sense RNA virus of 11kb having three structural proteins (capsid, a precursor of the membrane, and an envelope protein), and seven non-structural proteins (NS1, NS2a, NS2b, NS3, NS4a, NS4b, NS5). The virus is classified into four different serotypes known as DENV-I, DENV-II, DENV-III, DENV-IV (Iqtadar et al., 2017a; Rafique et al., 2015; Ali et al., 2016; Koo et al., 2013).

Dengue infection can be febrile known as Dengue Fever (DF) that may lead to Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS) in case of secondary infection of different dengue serotypes (Khan et al., 2007). The symptoms of DF are mild while that of DHF are severe and can be fatal (Yousaf et al., 2018; Hasan et al., 2013). DF is prevalent in many countries of Asia, Africa, and America. The DF occurs about 50-100 million cases per year while that of DHF is reported about 0.2-0.5 million cases annully worldwide with a total death rate of 2.5% (Ali et al., 2016; Yousaf et al., 2018). According to WHO, about 2.5 billion people are at risk of dengue (Khan et al., 2010).

In Pakistan, all four different serotypes have been reported in different outbreaks (Haroon et al., 2019). DENV-I, DENV-II, and DENV-III, DENV-IV were found that co-circulated in outbreaks in 1998 and 2006 respectively while in the 2011 the leading serotype reported was DENV-II (Rehman et al., 2017). Of the four serotypes, in Pakistan the predominant types were DENV-I and DENV-II (Khan et al., 2007). The serotypes distribution in Pakistan in not even and in dengue outbreak, DENV-II was reported in 1994, subsequently in 2005 and 2006 DENV-II and III were found that leads to about 52 deaths (Raza et al., 2014). A large number of dengue cases were reported during 2005-06 with a majority of cases from Karachi where about 37 out of 40 deaths were reported Sindh province only (Khan et al., 2007). An overwhelming dengue outbreak was reported in 2011 from Lahore where >23000 individuals were admitted

to various hospitals and about 365 deaths were reported (Ali et al., 2016). A study reported >50 thousand dengue cases in Lahore (2011) and about 8546 cases with 33 deaths (2013) in Swat (Haroon et al., 2019). The situation could be worsening as there is no vaccine available that cover all dengue serotypes and no antiviral treatment yet (Fatima et al., 2011; Iqtadar et al., 2017b).

Dengue epidemics are reported at different times from various parts of Pakistan with a large number of morbidities and mortalities but lack of comprehensive data analysis the epidemiology of dengue in the country is unclear. This review analyzed a 20-year (2000-19) data and highlights the prevalence of dengue, serotype distribution, and frequency of DF, DHF and DSS.

2. Methods

2.1. Search strategy and inclusion/exclusion criteria

The data was searched through different search engines (Google scholar, PubMed etc) providing the keywords “Dengue virus, Dengue infection/Serotypes, DHF/DSS Pakistan. All the published research articles/reports on the dengue virus/infection from 2000 to 2019 were downloaded and selected for this study. The data were extracted and summarized using Microsoft Excel for Windows for different variables like total positive cases, patients’ age, gender, serotype distribution, DHF and DSS patients, death cases.

The general review of dengue, single case studies and literature with insufficient information were excluded. Moreover, articles regarding KAP (knowledge, attitude, practices) studies, treatment, diagnosis, control and prevention, seasonal effects and dengue vectors were also excluded. Articles with same data but different aspects were considered once. The detail of articles included in this study are summarized in Figure 1.



Figure 1. Result of literature survey.

2.2. Geography

Pakistan is situated in temperate zone with a total area of about 79.61 million hectares (Ahmed et al., 2007). The country has importance in South Asia and creates links among different regions of the world. Pakistan's border lies with two highly populated states China in the northeast and India in the east. Afghanistan and Iran lie in the west and southwest consequently. The Arabian Sea paved the way for the gulf region and the Middle East located in the south of Pakistan (Chaudhry et al., 2009; Daud et al., 2017; Qureshi et al., 2003). The climate of the country is varied due to topography. Furthermore, due to climate change and rainfall, the chances of dengue infection increases as the availability of suitable breeding sites for the vector such as *Aedes aegypti* and *Aedes albopictus* are widely available (Atique et al., 2016) (Figure 2).

3. Results

3.1. Overall prevalence

A total of 201269 suspected cases were reported from Pakistan in the selected research articles (77) included in this study and 62780 were found positive for dengue infection. The overall prevalence was 31.2%. The data were grouped into two decades i.e. decade I (2000-2010) with

28 articles and decade II (2011-2019) with 49 articles. One of the articles i.e. Koo et al. (2013) contained data of 2006 to 2011, the data of 2011 was added in decade II. The total cases reported were 10.5% and 89.5% in during decade I and decade II respectively. It is found that the number of dengue cases were increased in decade II as compared to decade I i.e. from 21151 to 180118. The incidence rate of dengue infection was constantly high in decade II. Of the total dengue cases 31.2% were confirmed by serological or PCR methods except a few that was declared positive through WHO criteria for dengue fever (Table 1). Two (2) of the research articles with an unknown year of study were added to the decade in which the articles were published (Rafique et al., 2017; Parkash et al., 2010).

Male were more infected [38915 (62%)] as compared to female [17541 (27.9%)] (References are given in Province wise distribution). In some articles the gender distribution was not given therefore the number of male and female are not equal to the total confirmed value. The cases reported during decade II were higher as compared to decade I (Table 1).

3.2. Province-wise distribution

The dengue cases were analyzed provinces wise and the maximum number of cases were reported from Khyber Pakhtunkhwa (KP) (23.3%) followed by Punjab (3.8%) and



Figure 2. Map of Pakistan showing various geographical locations.

Sindh (1.9%) (Table 2). The minimum number of cases (N=38) were reported from KP (Usman et al., 2011) while the maximum number of cases (N=3342) were reported from Sindh during decade I (Khan et al., 2007, 2008; Hasan et al., 2013, Ahmed et al., 2008; Riaz et al., 2009; Shamim, 2010; Wasay et al., 2008a, b; Khalil et al., 2014; Baqi et al., 2010; Ali et al., 2011; Jahan et al., 2011). Of all the cases from KP, high number of cases (N=22740) were reported from district Swat during 2013 which are 48.6% of the total dengue cases reported from the province (Ali et al., 2016; Khan and Khan, 2015; Chaudhry et al., 2017; Lutfullah et al., 2017; Suleman et al., 2016; Khan et al., 2017a; Khan, 2018; Khan et al., 2018; Khan and Bari, 2018). Similarly, 58.5% (4475/7649) of the total cases reported from Punjab were from the capital city Lahore only during 2011 (Iqtadar et al., 2017b; Khan et al., 2013a, b; Ahmed et al., 2013; Rashid et al., 2012; Mahmood et al., 2013; Saqib et al., 2014a, b; Asghar and Farooq, 2011; Idrees et al., 2012; Raza et al., 2017; Naeem et al., 2018; Assir et al., 2014a, b; Sheikh et al., 2012; Chaudhry et al., 2018).

Of the total dengue cases, 15124 were confirmed for dengue infection from multiple cities of the country including Islamabad, Rawalpindi, Lahore, Faisalabad, Peshawar, Karachi (Rafique et al., 2015, 2017; Ali et al., 2016; Koo et al., 2013; Khan et al., 2010; Atif et al., 2016; Munir et al., 2014; Suleman et al., 2017a; Shahid et al., 2019; Zamir et al., 2012; Zafar et al., 2010, 2013; Bhatti et al.,

2015), Azad Jammu and Kashmir (Tariq et al., 2006) and Swat (Ali et al., 2016).

3.3. Prevalence of DF, DHF, and DSS

The data regarding the DHF/DSS were available in 39 articles (Ahmed et al., 2008, 2013; Asghar and Farooq, 2011; Assir et al., 2014a, b; Baqi et al., 2010; Humayoun et al., 2010; Hasan et al., 2013; Iqtadar et al., 2017a; Ishtiaq et al., 2018; Khalil et al., 2014; Khan et al., 2007, 2008, 2010, 2013a, b, c, 2017a, 2018; Khurram et al., 2014; Koo et al., 2013; Mahboob et al., 2012; Mahmood et al., 2009, 2012, 2013; Munir et al., 2014; Parkash et al., 2010; Perveen et al., 2016; Quadri et al., 2015; Rafique et al., 2015; Rashid et al., 2012; Raza et al., 2014, 2018; Rehman et al., 2017; Riaz et al., 2009; Saqib et al., 2014a, b; Shamim, 2010; Usman et al., 2011; Wasay et al., 2008a, b). The majority of dengue-infected cases were reported with Dengue fever (74.4%) while DHF was reported in 24.1% cases (N=5022) and DSS in 1.5% (N=309) cases. The DHF cases were increased from 1162 in decade I to 3776 in decade II while the DSS cases were decreased from 700 in decade I to 225 in decade II (Table 3, Figure 3). The prevalence of DF was high as compared to DHF/DSS.

3.4. Serotype distribution

In Pakistan, all four serotypes of DENV are reported. Data from 2000–2005 are not known while the prevalent

Table 1. Prevalence of dengue positive cases during 2000–19.

| Year of study | Number of cases (N) | Confirmed cases N (%) | Gender | |
|---------------|---------------------|-----------------------|--------------|--------------|
| | | | Male N (%) | Female N (%) |
| 2000- 2010 | 21151 | 9096 (43.0) | 4897 (53.8) | 2813 (30.9) |
| 2011- 2019 | 180118 | 53684 (29.8) | 34018 (63.4) | 14728 (27.4) |
| Total | 201269 | 62780 (31.2) | 38915 (62.0) | 17541 (27.9) |

Table 2. Province wise distribution of total confirmed dengue cases (2000–19).

| Year of study (N) | Province / territory | | | | | | | | | | | |
|---------------------|----------------------|-------|-------------|------|---------------|--------|--------------|-----|------------|------|---------------|-------|
| | Punjab | | Sindh | | KP | | Azad Kashmir | | Twin city | | Miscellaneous | |
| | N (%) | +ve | N (%) | +ve | N (%) | +ve | N (%) | +ve | N (%) | +ve | N (%) | +ve |
| 2000-10 (N=21151) | 1208 (5.7) | 906 | 3342 (15.8) | 2962 | 38 (0.2) | 38 | 52 (0.2) | 38 | 600 (2.8) | 346 | 15911 (75.2) | 4806 |
| 2011-19 (N=1,80118) | 6,441 (3.6) | 5,416 | 494 (0.3) | 347 | 46,766 (26.0) | 36,853 | - | - | 798 (0.4) | 750 | 125619 (69.7) | 10318 |
| Total (N=2,01,269) | 7649 (3.8) | 6322 | 3836 (1.9) | 3309 | 46804 (23.3) | 36891 | 52 (0.02) | 38 | 1398 (0.7) | 1096 | 141530 (70.3) | 15124 |

Table 3. Prevalence of DF/DHF/DSS in various dengue epidemics.

| Year of study (N) | DF N (%) | DHF N (%) | DSS N (%) |
|-------------------|--------------|-------------|-----------|
| 2000-2010 (4142) | 2910 (70.3) | 1162 (28.1) | 70 (1.7) |
| 2011-2019 (16017) | 12016 (75.0) | 3776 (23.6) | 225 (1.4) |
| Unknown (699) | 601 (86.0) | 84 (12.0) | 14 (2.0) |
| Total (20858) | 15527 (74.4) | 5022 (24.1) | 309 (1.5) |

genotype in 2006 was DENV-II and DENV-III (Khan et al., 2008). From 2007 to 2019 different serotypes were found in different epidemics from various regions of Pakistan (Table 4). In 2006-2011, all the serotypes were reported from Karachi and Lahore and DENV- II the most prevalent (Hasan et al., 2013; Mahmood et al., 2013; Koo et al., 2013). In Lahore the prevalent serotype was DENV II, III, and multiple serotypes were reported from 2007-09 (Fatima et al., 2011). While some reported all four serotypes from Lahore in 2008 (Javed et al., 2009; Humayoun et al., 2010). During 2011 all the four serotypes as well as mixed infections were reported from Punjab and KP (Ali et al., 2016) while some studies reported only II, III (Atif et al., 2016; Assir et al., 2014a; Idrees et al., 2012). The prevalent serotype in 2013 was DENV-II in the country (Shahid et al., 2019). In 2015 all the four serotypes were reported from Rawalpindi and Malakand (Ghani et al., 2017; Suleman et al., 2017b). The prevalent serotypes in Faisalabad in 2011 were DENV-II, DENV-III, and DENV-IV while during 2014-17, DENV-I, DENV-II, DENV-III were reported (Ahmed et al., 2017; Raza et al., 2018).

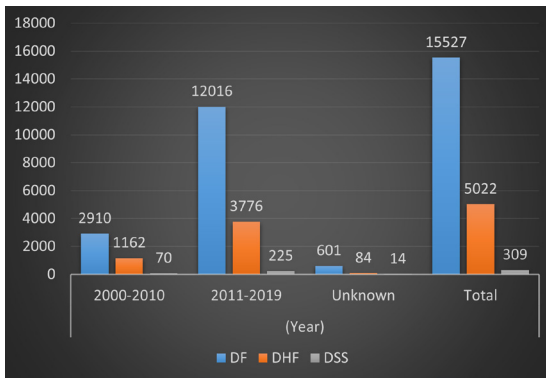


Figure 3. Prevalence of DF, DHF, and DSS during dengue outbreaks (2000-19).

Table 4. Various Serotypes identified during 2000-19.

| Year of study | Serotype detected | References |
|---------------|--|--|
| 2000-06 | DENV-II, DENV-III | Khan et al. (2008) |
| 2007-11 | DENV-I, DENV-II, DENV-III, DENV-IV, multiple | Ali et al. (2016); Koo et al. (2013); Hasan et al. (2013); Fatima et al. (2011); Humayoun et al. (2010); Atif et al. (2016); Ahmed et al. (2017); Javed et al. (2009); Idrees et al. (2012); Assir et al. (2014a); Mahmood et al. (2012) |
| 2012-19 | DENV-I, DENV-II, DENV-III, DENV-IV, multiple | Ghani et al. (2017); Raza et al. (2018); Suleman et al. (2017a); Shahid et al. (2019) |

Table 5. Overall mortalities during 2000-19.

| Year of study (N) | Punjab N (%) | Sindh N (%) | KP N (%) | Twin cities N (%) | Miscellaneous N (%) |
|-------------------|--------------|-------------|------------|-------------------|---------------------|
| 2000-10 (63) | 4 (6.3) | 48 (76.2) | 1 (1.6) | 5 (7.9) | 5 (7.9) |
| 2011-19 (1001) | 216 (21.6) | 15 (1.5) | 247 (24.7) | 9 (0.9) | 514 (51.3) |
| Unknown (18) | - | 18 (100.0) | - | - | - |
| Total (1082) | 220 (20.3) | 81 (7.5) | 248 (22.9) | 14 (1.3) | 519 (48.0) |

3.5. Overall mortalities

Over all death toll due to dengue complications were 1082 (Ahmed, 2009; Ahmed et al., 2008, 2013; Akhtar et al., 2014; Ali et al., 2011, 2013; Assir et al., 2014a, b; Baqi et al., 2010; Chaudhry et al., 2017; Iqtadar et al., 2017b; Khalil et al., 2014; Khan, 2018; Khan et al., 2007, 2013a, b, 2017a, b, 2018; Khurram et al., 2014; Mahboob et al., 2012; Munir et al., 2014; Nazeer et al., 2009; Parkash et al., 2010; Quadri et al., 2015; Rashid et al., 2012; Rehman et al., 2017; Riaz et al., 2009; Saqib et al., 2014b; Shamim, 2010; Suleman et al., 2017a; Usman et al., 2011; Wasay et al., 2008a, b; Zamir et al., 2012).

The maximum number of mortalities were reported in KP (N=248) with the majority of deaths reported from District Swat in 2013 (Khan and Khan, 2015; Akhtar et al., 2014; Chaudhry et al., 2017; Khan et al., 2017a, b, 2018; Ali et al., 2013; Usman et al., 2011). A total of 220 deaths were reported (majority from Lahore) in 2011 dengue outbreak from Punjab province (Iqtadar et al., 2017b; Ahmed et al., 2013; Mahboob et al., 2012; Rashid et al., 2012; Assir et al., 2014a; Nazeer et al., 2009; Saqib et al., 2014b). The twin cities (Islamabad, and Rawalpindi) of the country also added in the total death toll of 14 (1.3%) individuals (Tables 3 and 4).

Overall deaths during decade I were 5.8% (63/1082) (Khan et al., 2007; Ahmed et al., 2008; Ahmed, 2009; Mahboob et al., 2012; Munir et al., 2014; Riaz et al., 2009; Shamim, 2010; Wasay et al., 2008a, b; Khalil et al., 2014; Usman et al., 2011; Baqi et al., 2010; Nazeer et al., 2009; Ali et al., 2011) while during decade II 92.5% (1001/1082) deaths were reported (Table 5, Figure 4) (Iqtadar et al., 2017b; Rehman et al., 2017; Ahmed et al., 2013; Khan and Khan, 2015; Rashid et al., 2012; Akhtar et al., 2014; Chaudhry et al., 2017; Khan, 2018; Khan et al., 2013a; Khan et al., 2017a, b; Khan et al., 2018; Quadri et al., 2015; Suleman et al., 2017a; Ali et al., 2013; Saqib et al., 2014a; Khurram et al., 2014; Zamir et al., 2012; Assir et al., 2014a).

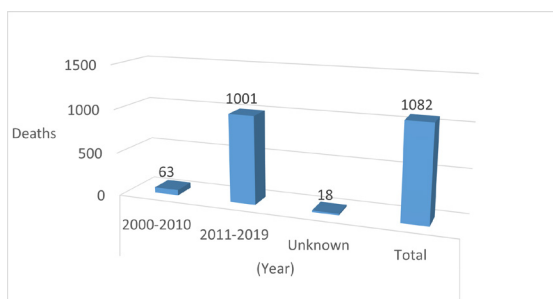


Figure 4. Number of deaths in various outbreaks during 2000-19.

The deaths reported in Karachi during an unknown period were 18 (Parkash et al., 2010).

4. Discussion

Dengue is a life-threatening viral infectious disease and is a major health problem in tropical regions worldwide (Khan et al., 2010). Every year 50 to 100 million morbidities and about 24,000 mortalities are reported and according to World Health Organization dengue is endemic in south Asia (Jahan et al., 2011). The disease is present in >125 countries (Murray et al., 2013), and different DENV serotypes are circulating in neighboring countries of Pakistan like India (Gupta et al., 2006), Bangladesh (Aziz et al., 2002), and Iran (Aghaie et al., 2014). This review provides a wide overview of the growing epidemiology of dengue infection in Pakistan over the period 2000-2019. This analysis supports an overall rise in the yearly number of reported cases and deaths over the decade.

In Pakistan dengue infection was first reported from Karachi in 1994 and Punjab in 2003 (Hasan et al., 2013) and then, regular outbreaks are reported since 2005 (Ahmed et al., 2013). The DENV became endemic in Pakistan, found throughout the year mainly after the monsoon rainy season (Rehman et al., 2017; Khan et al., 2010). The main reason of emergence of the infection after monsoon rains are the availability of ultimate breeding sites of the mosquito vector, (*Aedes aegypti* and *Aedes albopictus*), and the environmental and climatic conditions, humidity, and the introduction of a new viral strain (Raza et al., 2014; Ahmed et al., 2013; Akhtar et al., 2014). The worst outbreak of dengue in KP (Swat) was reported in 2013 and then in the following years the infection rate decreased rapidly and might be due to awareness among people to deal with the mosquito vectors (Khan et al., 2018). In some areas the infection is spreading and may be it is due to increased population, urbanization, uncontrolled vector growth, traveling, unawareness, and failure of public health departments (Ahmed et al., 2013; Atif et al., 2016). Similar situations were faced by developed countries also like Germany (Murray et al., 2013).

The data obtained shows that in Pakistan males population are more infected as compared to females. Due to customs of the region females are restricted to houses and their dresses protect them from the mosquito bites as compared to males (Rehman et al., 2017; Raza et al.,

2014; Saqib et al., 2014a, b; Khan et al., 2018; Rafique et al., 2017; Assir et al., 2014a). Similar factors are also observed in other countries with similar customs and conditions (Anker and Arima, 2011).

According to the study of Saqib et al. (2014a, b) male predominance was reported during the 2011 outbreak in Lahore but according to Ali et al. (2016) gender was affected equally during the 2011 outbreak in Punjab that was the most severe outbreak resulting in a large number of deaths. There was a significant difference between gender distribution during 2013 in dengue outbreak in district Swat KP. The difference of infection in gender in these two provinces may be due to the same reason as male are more exposed and spend more time outside homes and are not that much covered as females in KP where the situation is almost opposite in Punjab where most of the female are working women. Male predominance is also reported in other countries like India, Singapore, Malaysia etc but in America, both genders are found equally affected (Guha-Sapir and Schimmer, 2005).

The sever form of dengue infection i.e. DHF and DSS has increased in the study period (Ahmed et al., 2017). The increasing number of DHF could be related to the virulence of the virus and also with co-infection with other pathogens (Raza et al., 2014). DHF and DSS can also result due to a severe response of the immune system to the incoming pathogen. DHF is mostly the result of secondary infection but primary infection of DENV can also lead to DHF/DSS (Khurram et al., 2014).

Although all four serotypes are found in different dengue epidemics and the most predominant serotypes found were DENV-I and II (Fatima et al., 2011; Atif et al., 2016). A study (Khan et al., 2018) suggested that serotypes that circulate in KP were having ancestral linkage with those previously found in Karachi and Lahore. In District Swat KP during 2013 epidemic, DENV-III was found widely distributed and some researchers associate it with mosquito spp. (*Aedes albopictus*) there (Ali et al., 2016).

The death toll can be reduced if proper care of dengue patient is taken. However, mortality rate in DHF and DSS cases is high due as platelets count reduced and the patient needs transfusions and enhanced healthcare facilities which are not widely available in Pakistan (Hasan et al., 2013). The factor responsible for a large number of morbidity and mortality during the 2011 and 2013 outbreaks is being susceptibility to infection and lack of diagnostic facilities in an early stages of infection (Suleman et al., 2016). Due to the lack of vaccine availability and specific antiviral treatment besides the symptomatic treatment and taking preventive measures, deaths are increasing. Early detection and prevention can decrease the risk of developing further complications (Sulaiman et al., 2015).

There is a need of vaccine against DENV to prevent the infection (Sulaiman et al., 2015). In Pakistan, dengue is also moving towards non-endemic and rural areas and more care is needed in those regions as there are fewer facilities in rural areas. Mosquito vector control should be taken that alternatively will help in control of dengue infection (Fatima et al., 2011). The large number of outbreaks that result in huge morbidities and mortalities in Pakistan are due to uncovered fresh water sources that provides

dwelling for mosquitoes, poor hygienic conditions, lack of vaccines, increasing number of immigrants, and increased urbanization.

5. Conclusion

It is concluded that DENV is highly prevalent and the number of cases is increased decade-wise. All the serotypes are reported and DENV-II and DENV-III are widely distributed in Pakistan. The death toll is high and found to be increased according to the published literature survey 2000–2019.

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