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Differences in MERS Epidemiology in the Middle East and South Korea

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Abstract

The majority of Middle East Respiratory Syndrome (MERS) cases have occurred in the Middle East and South Korea. MERS transmission and severity has shown different patterns in those areas. Viral, host, and environmental factors may be the cause of such differences. The MERS virus in South Korea has exhibited higher genetic variability and mutation rates compared with in the Middle East. Host factors including race, population structure, and health behavior may also relate to the differences in outbreaks. Finally, characteristics of the transmission environment, including factors such as hospital systems and population density, could contribute. This article reviews the factors associated with the different attributes of MERS outbreaks in the two regions.

Keywords: Middle east respiratory syndrome; Epidemiology transmission; Environmental factors

Short Communication

Middle East Respiratory Syndrome (MERS) was first reported in Saudi Arabia [1], and most cases have occurred in the Middle East [2]. In 2015, a MERS outbreak took place in South Korea [3], which has been the only outbreak to date outside of the Middle East [2].

MERS transmission patterns and severity differed between the Middle East and South Korea outbreaks. Although Middle East studies reported 0.42-4% attack rates, attack rates in South Korea were 4-6% for patients or hospital visitors [4] and 14-16% overall [5]. However, mortality from MERS was higher in Middle East (25-40%) [6-8] than in South Korea (20.4%) [9].

Viral, host, and environmental factors may be responsible for MERS outbreak-related differences between the two regions. Therefore, in this review, the author analyzed differences in viral, host, and environmental factors related to MERS outbreak between the Middle East (focusing on Saudi Arabia, which has the highest number of MERS cases) and South Korea.

Concerning viral factors, South Korean MERS coronavirus (MERS-CoV) strains showed higher genetic variability and mutation rates [10]. Another study reported Korean MERS-CoV strains had a mutation in the receptor-binding domain, which could cause reduced affinity to the human cognate receptor [11]. Severe acute respiratory syndrome (SARS), another CoV, also showed a moderate mutation rate [12] and genetic mutations were related to temporal or geographic characteristics of disease epidemic [13]. Similarly, mutation of MERS-CoV could be responsible for differences in outbreak patterns in South Korea and the Middle East.

Host factors also varied between the Middle East and South Korea, including race, population structure, and behavior. Differences in host antiviral response according to ethnicity have been reported in several infectious diseases including hepatitis C [14] and pandemic H1N1 influenza [15]. Likewise, it is possible that differences in MERS epidemiology in the Middle East and South Korea are attributable to ethnicity, although the effect of ethnicity on MERS infection has not yet been analyzed, excluding one study that showed a significant difference in risk of MERS infection by nationality [16].

In addition, the proportion of the aged population in the two areas may explain differences in MERS epidemics. Previous studies reported that older age was related to MERS infection [16] and mortality [17,18]. Chen et al. showed that the mean age of MERS patients in South Korea was significantly older than that of MERS patients in Saudi Arabia [19]. In Saudi Arabia, the average life expectancy is 74.6 years and adults >65 years comprise only 2.8% of the total population [20]. Conversely, in South Korea, the average life expectancy is 82.4 years, and approximately 17.7% of the population is older than 65 years [21]. This difference in the proportion of aged individuals might be related to the high attack rate in South Korea compared with Saudi Arabia.

Additionally, individual behavior could affect MERS epidemiology. Choi et al. showed that preventive behaviors were associated with perceived risk, knowledge, age, and sex [22]. Individuals aware of MERS were more likely to practice preventive behavior [23], and awareness of MERS was also influenced by factors such as sex, education [24], and nationality [25]. Although no report has compared the level of awareness or preventive behaviors between Saudi Arabia and South Korea, differences in demographic characteristics and perceived risk might affect patients' preventive behavior.

Finally, the transmission environment could also contribute to differences in MERS epidemiology. Compared with MERS in Saudi Arabia, which demonstrated only 13.3% of cases were related to hospital-linked history [19], the outbreak in South Korea involved intra-hospital and hospital-to-hospital transmission [3,26]. In a previous study describing structural factors of the MERS outbreak in South Korea, overcrowding of emergency rooms and inadequate infection control in hospitals were considered the main reasons [27].

The higher population density in Korea (509 persons/km^2 overall, >16,000 persons/km^2 in Seoul) [21] compared with Saudi Arabia (15 persons/km^2) [20] also seemed to contribute to spreading of the MERS outbreak, since population density is related to infectious disease outbreak [28,29]. However, the proportion of cases linked to

community transmission was significantly lower in South Korea compared with Saudi Arabia [19]. Whether this was caused by the small effect of population density or other factors, such as quarantine and school closure, remains unclear.

Oh noted super-spreaders as a key factor of the MERS outbreak in South Korea [30]. Approximately 83.2% of MERS cases in South Korea were associated with five super-spreading events [9]. Recent studies have shown the involvement of super-spreaders in other infectious diseases such as Ebola and SARS [31]. Although a previous study demonstrated that a MERS outbreak related to a healthcare facility occurred in Jeddah, Saudi Arabia in 2014 [32], the existence of super-spreaders was not reported outside of South Korea. Several studies reported high body temperature, multiple pulmonary infiltrates, longer non-isolated in-hospital stay [33], and hospitalization or emergency room visit before isolation [34] as risk factors of a super-spreader. Factors associated with super-spreading events must be analyzed in further studies.

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