The interannual variability of tropical cyclone (TC) activity over the western North Pacific (WNP) has been received increasing attention in recent years. Most studies have mainly focused on the possible effect of ENSO. However, the total annual TC genesis frequency over the WNP has no significant correlation with ENSO index. This study attempts to investigate the impact of boreal summer sea surface temperature anomaly (SSTA) in the East Indian Ocean (EIO) on the interannual variability of WNP TC frequency and the involved physical mechanisms using observations and simulations. The results show that EIO SSTA has a large control on the WNP TC genesis frequency. The EIO SSTA affects the TC genesis in the entire genesis region over the WNP and largely determines the numbers of both the total and weak TCs. The EIO SSTA affects significantly both the western Pacific summer monsoon and the equatorial Kelvin wave activity over the western Pacific, two major large-scale dynamical controls of TC genesis over the WNP. In general the warm (cold) EIO SSTA suppresses (promotes) the TC genesis over the WNP. The sensitive experiments by a regional climate model confirm that the EIO SSTA does significantly affect the TC genesis frequency over the WNP by above dynamical mechanisms. The results also reveal that the EIO SSTA contributes to the unusual TC frequencies over the WNP in extreme years. Therefore, a better understanding of the impact of EIO SSTA could help improve the seasonal prediction of the WNP TC activity.