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Interpreting mortality trends in the GCC countries: The healthy migrant effect

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Background In the last two decades, unique demographic changes have occurred in the Gulf Cooperation Council (GCC) countries, namely Bahrain, Kuwait, Oman, Qatar, United Arab Emirates (UAE), and Saudi Arabia. In these countries, population growth was primarily boosted by the influx of young migrants. Therefore, immigration in the GCC countries has led to two consequences: a shift in the population age pyramid and a dramatic increase of the proportion of migrants in the GCC population reaching >80% in Qatar and the UAE. This study evaluated whether massive immigration of young and/or healthy people within a short span of time in the GCC countries, was one of the major causes of the generalized decline in age-standardized mortality rates. Methods For the period 1990-2015, publically available population data were retrieved from the World Population Prospect 2015 Revision by United Nations Population Division; and mortality data were retrieved from Global Burden of Disease 2015 study (GBD 2015). Causes of death utilized in our study were all causes and GBD 2015-defined death causes with the codes: A1-A7, B1-B10, and C1-C3. We estimated annual population growth and annual percent change in all-cause age-standardized and age-specific rates. The association between all-cause age-standardized death rates and population sizes for each of the GCC countries was evaluated using simple linear and polynomial regressions. In Qatar, we also assessed the association between all-cause age-specific death rates and age-specific population sizes; and the association between cause-specific age-standardized death rates and population sizes. The associations were tested using the F-test. Bonferroni method was used to correct the association statistical significance threshold at 0.05 to address multiple testing problem. Hence, the

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significance threshold was at 0.0016. Multiple R-squared statistics were used to assess the goodness-of-fit of the models. We used R-3.3.1 software for our analyses. Results and discussion In the GCC countries, all-cause age-standardized mortality was inversely proportional to national population size (p-values between 0.0001 and 0.0457) during the period 1990-2015. Taking into account Bonferroni correction, the association between all-cause age-standardized mortality and population size was statistically significant for Bahrain (p-value = 0.0001, R2 = 0.99), Qatar (p-value = 0.0004, R2 = 0.97), and Saudi Arabia (p-value = 0.0004, R2 = 0.99). Remarkably, the effect of differences in population age structures observed over time should not affect mortality trends when using age-standardization method. Hence, this association between age-standardized mortality and population size suggests a strong healthy population effect attributed to migrants, which represent a substantial proportion of the GCC countries' population. In Qatar, annual population growth was below 4% until 2000. Thereafter, during the period 2005-2010, population growth increased rapidly reaching a peak at 22.2%. Then, during the period 2010-2015, the population growth decreased reaching 5.3%. Interestingly, the decrease in all-cause age-standardized mortality was the highest during the period 2005-2010. In Bahrain, Oman, and Saudi Arabia, when the annual population growth was the highest, the highest annual decrease in all-cause age standardized mortality was also observed. In Qatar, all-cause age-specific mortality was inversely proportional to age-specific population size. In the age groups with the largest population size (5-14 and 15-49 age groups), this association was statistically significant (p-values<0.001). Additionally, in all age groups, when the annual population growth was the highest, the highest annual decrease in all-cause age-specific mortality was also observed. This decrease in mortality cannot be accredited only to enhancement in healthcare system since this has been observed at a gradual pace in the country. However, the large increase in population within a short span after 2000 could explain the decline in mortality rates due to a substantial growth in the population (denominator), while number of deaths (numerator) remained minimally affected. Therefore, one of the main drivers of declined mortality appears to be population growth due to immigration of young and/or healthy individuals. Similarly, cause-specific age-standardized mortality was inversely proportional to population size. This association was statistically significant for about 50% of the GBD 2015-defined causes of death such as "cirrhosis and other chronic liver diseases" (B4, p-value<0.001, R2 = 0.97) and "HIV/AIDS and tuberculosis" (A1, p-value<0.01, R2 = 0.94). Remarkably, incoming migrants to Qatar have to be negative for HIV, hepatitis B and C, and tuberculosis. Our findings demonstrate a strong healthy migrant effect that influences mortality rates in the population of the GCC countries. The limitation in our analysis was that GBD 2015 and UN data do not provide data by sub-populations (short-term resident versus Qataris and long-term residents). As such, we were not able to compare mortality in the total population with mortality in the subpopulations to further demonstrate our hypothesis of healthy migrant effect. Yet, mortality decrease in the GCC countries' total population (nationals and short-term and long-term residents) should not be considered as a positive indicator for population health status. In order to elucidate changes in mortality trends due to health-based interventions and improvement in the healthcare system, stratification—nationals and long-term residents versus short-term residents should be considered. Conclusion In conclusion, our findings demonstrate that the increase in GCC countries' population over the last two decades have decreased mortality rates. Healthy migrant effect appears to influence these mortality trends. Mortality rates might have varied if the current migration strategy in the GCC countries were different. In general, researchers and policymakers in the GCC countries should be cautious to not exclusively attribute this decrease in mortality rates to the positive effect of health-based interventions or improvement in the healthcare system. Our findings have relevance and significance for developing and monitoring population health programs.