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Estimating COVID-19 prevalence in Sri Lanka

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Throughout the ages, man has had to face numerous crises and diseases. Among them, the COVID-19 virus can be considered as one of the most fatal diseases ever, and it has caused significant damage to the entire world. Moreover, due to the nature of the virus transfer modes, controlling the COVID-19 infection among people is a challenging task, and thereby, the spread of the virus still persists globally with less severity. Hence, an effective and accurate controlling measure is essential. The profile of the coronavirus progression in a sub-region can be changed due to numerous factors such as population density, public mobility, and available health facilities. Thus, at a time, diverse prevalence status of virus spread on different sub-regions is highly probable. This study attempts to construct a suitable sampling design to capture the prevalence of COVID-19 by modifying the stratified sampling technique to estimate the sample size adapting to the changing population of infected cases. This adaptation is essential as the increase of infected cases boosts the virus spread, and the standard sampling techniques do not address such dynamic population conditions in determining the sample size. Further, the study bridges the gap between the reported and actual infections per day, thereby giving accurate estimates of virus distribution and prevalence. The coronavirus progression over a region has a skewed pattern, and it should also be considered in the weight allocation method. Thus, the weights are determined based on the first derivative of reported infected cases. This derivative information is based on the recent dynamics of the infected cases. Consequently, larger weights were assigned when the virus progression increased, and smaller weights were assigned when the virus progression decreased. After that, the sample size for each sub-region was calculated by the modified stratified sampling method. To illustrate the accuracy of the sampling design, simulated data from different epidemic scenarios, such as community spread, cluster spread, and border spread, was used. This simulation allowed us to test the robustness of the techniques for the different states of the virus progression based on the infected cases. The sample size obtained through this dynamic sampling technique exhibits a direct correlation with the fluctuations in the number of infected cases, increasing as the infection cases rise and decreasing as they decline. In conclusion, the study results in a novel sampling technique that is sensitive to the dynamic nature of population sizes, and it can be straightforwardly applied to real-world data as well. Thus, this modified stratified sampling technique can be considered as an accurate sampling technique to capture the actual prevalence of COVID-19.

Keywords: Community spread, COVID-19, Epidemic scenarios, Stratified sampling technique, Virus progression.