On the text book, biological robustness [1] is simply referring to how easy a biological system can maintain its overall integrity when suffering the external perturbations. While fragility [2], in contrast, is defining how easy the biological system to fail when encountering the disruption or stress from the environment.

Just like light and shadow often present together, every biological system has its robustness coupled with fragility and human body is a great example. When travelling from Singapore to Moscow, it is a robustness for the body to maintain its temperature around the magic number of 37 degree Celsius, despite the crossing of summer and winter. However, as soon as the oxygen level in the air drops a little to below 19.5% [3], the consequences can be hypoxia or even more seriously, death.

It is often thought that the biological robustness is an integral part of survival, but this may not be quite true. According to the famous concept that suggested in Charles Darwin's "On the Origin of Species", Survival of the fittest [4], neither the strongest nor the most robust. Why? Because the definition of robustness (as well as fragility) is subjected to specific environmental conditions that the biological system is in. The definition evolves with the environment instead of staying constant.

Revisit the above-mentioned examples: human body will no longer be robust in keeping its temperature within a narrow range in absence of adequate cloth or heat source during winter time. Does it trigger a reclassification of it to fragility? For the fragility of the body which demanding a minimal oxygen level in the air, it may become an strength when the oxygen level in the air elevates due to climate changes. As biological systems such as anaerobic bacteria which cannot take in more oxygen will be eliminated by this change in the environment.

Therefore, it is recognised that the borderline between robustness and fragility is not always clearly distinguished. In addition, it is not robustness the integral part of survival but more appropriately, the adaptability. Adaptability enables the biological system to better fit into the ever-evolving environment, in the motivation of survive. It can be improved via avoiding fragility which human beings are doing well even we are never the strongest spices that living in earth's cradle.

The secret can be summarised to: always embrace the change, unite and act on it as one. The most recent successful story is the overcome of the covid-19 pandemic. When the virus was rapidly spread across the world, instead of panic and doing nothing, scientists have thoroughly identified its genetic sequence. This genetic information is quickly used to develop different types of vaccines that would trigger an immune response to the virus [5][6]. Subsequently, governments and publics have taken their part to swiftly completed the vaccination which helped to reduce the fragility of the immune system and built up the barrier among individuals to shut the spread.

Beyond the scope of biological system, the pandemic has also challenged the fragility of the world's functioning. In response, many traditional ways of working have been reinvented, such as contactless delivery, work from home and etc as an effort of the society. This proves that the same strategy does fit to our day-to-day routines stay in this dynamic world.

Reference

1. Kitano, H. (2004). Biological robustness. Nature Reviews Genetics, 5(11), 826-837.
2. Scheffer, M., Carpenter, S. R., Lenton, T. M., Bascompte, J., Brock, W., Dakos, V., ... & Vandermeer, J. (2012). Anticipating critical transitions. Science, 338(6105), 344-348.
3. U.S. Occupational Safety and Health Administration (OSHA). (2010). Respiratory Protection Standard (29 CFR 1910.134).

4. Darwin, C. (1859). On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. John Murray.
5. World Health Organization (WHO) - "How COVID-19 vaccines are developed" - https://www.who.int/news-room/feature-stories/detail/how-are-vaccines-developed-and-approved-for-use
6. Centers for Disease Control and Prevention (CDC) - "Understanding How COVID-19 Vaccines Work" - https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/how-they-work.html