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Short Communication

Could *Bordetella pertussis* vaccine protect against coronavirus COVID-19?



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ARTICLE INFO

Article history:

Received 17 April 2020

Received in revised form 25 June 2020

Accepted 4 July 2020

Available online 16 July 2020

ABSTRACT

According to the World Health Organization (WHO), as of today, there are 2.165.500 confirmed cases of the novel coronavirus disease (COVID-19) and 145.705 deaths in over 185 countries. Unfortunately, despite the tremendous efforts to develop a vaccine initiated by various leading health institutions all over the world, it may be 18 months before a vaccine against the coronavirus is publicly available. We are proposing a theory about testing the use of the *Bordetella pertussis* vaccine to protect against COVID-19. We deliver this theory to the scientific community, aiming to raise the concern about it, and to provide us with support by realistic and experimental evidence.

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According to the World Health Organization (WHO), as of today, there are 2 165 500 confirmed cases of the novel coronavirus disease (COVID-19) and 145 705 deaths in over 185 countries. Unfortunately, despite the tremendous efforts to develop a vaccine initiated by various leading health institutions all over the world, WHO Director-General Tedros Adhanom Ghebreyesus said it may be 18 months before a vaccine against the coronavirus is publicly available. The limitations are not only related to vaccine development but also to where phase 3 trials will be performed and who will manufacture the vaccine at scale, as no single institution has the capacity or facilities for all steps to develop, test and manufacture a vaccine by itself. As such, an ideal solution would entail identification of existing, approved therapies or a protective approach with proven safety profiles to address the immediate need to reduce the rising mortality.

Given the rapid ongoing spread of COVID-19, thousands of lives will be lost before a vaccine can be developed and tested. Therefore, an alternative solution must be found to address this crisis. We propose testing the use of the *Bordetella pertussis* vaccine

to protect against COVID-19. Herein, we summarize our observational theory, as follows:

1. It has been reported that among sample patients infected with COVID-19 in China, the share of infected patients from 0 to 19 years old was around 1% (Fig. 1) [1].
2. It has also been reported that the case fatality rates for the age groups of 0–9 years and 10–19 years are 0% and 0.2%, respectively (Fig. 1) [1].
3. Predictors of a fatal outcome in COVID-19 cases in a recent multicentre study included age, the presence of underlying diseases, the presence of secondary infection and elevated inflammatory indicators in the blood where interleukin-6 (IL-6) is significantly more elevated in non-survivors vs. survivors ($P < 0.0001$) [2].
4. It has been previously proven that BPZE1 – one of the main strains that is attenuated or detoxified in the attenuated virulent *B. pertussis* vaccine – can protect against viral infection by modifying the viral response and enhancing natural mucosal resistance [3,4]. BPZE1 has a useful immunomodulatory effect on subsequent respiratory syncytial virus (RSV) infection, yielding a polyvalent protection through both specific and nonspecific immunologic effects. After priming with BPZE1 in the neonatal period, this favourable effect can extend to adulthood.
5. It has been determined that the *B. pertussis* BPZE1 strain has inflammatory properties, and its use as a new highly effective

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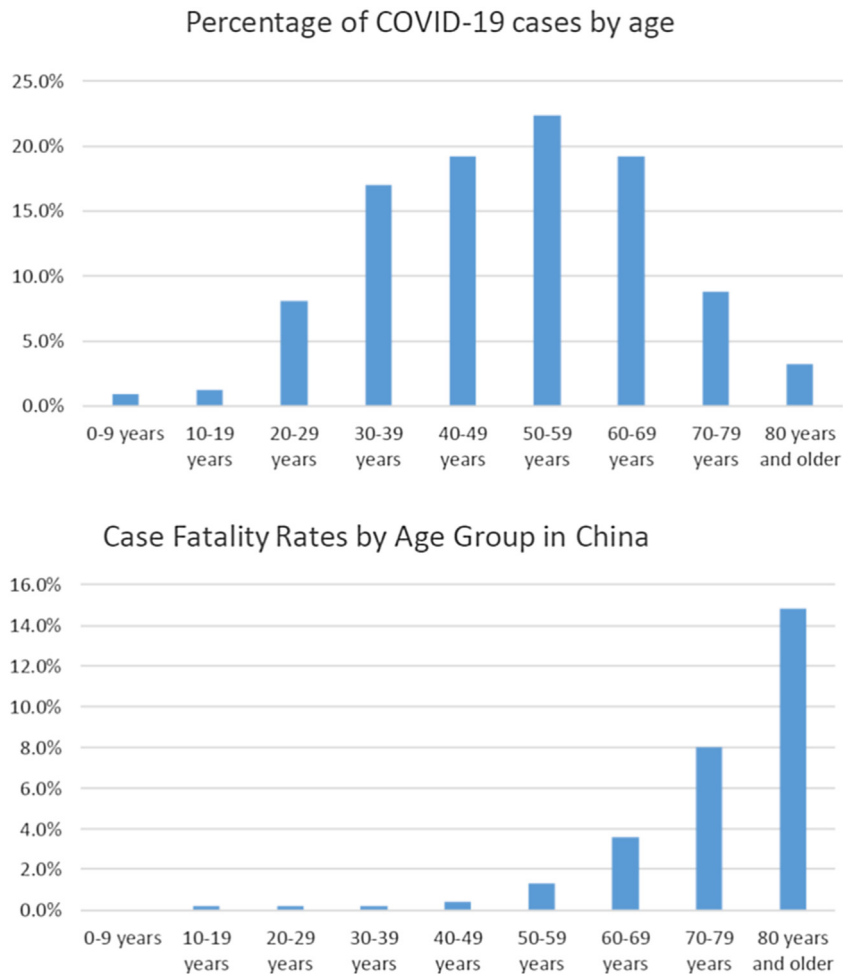


Fig. 1. Percentage of COVID-19 cases by age, and case fatality rates by age group in China.

prophylactic agent with long-lasting effects against severe and fatal pneumonitis induced by H3N2 and H1N1 influenza A viruses [5] is recommended. Li et al. showed that the protection against influenza virus-induced severe pneumonitis in BPZE1-treated animals was achieved through attenuation of exaggerated cytokine-mediated inflammation of three proinflammatory cytokines and chemokines, namely, IL-1 β , IL-6 and granulocyte-macrophage colony-stimulating factor (GM-CSF) [5].

6. According to the National Centre for Immunization and Respiratory Disease in 2019, pertussis vaccination is recommended in the United States at 2, 4 and 6 months, followed by another dose at 15–18 months, a booster dose at 4–6 years, and a final booster at 11–12 years. Pertussis vaccine offers a good level of protection within the first 2 years of getting the vaccine, but then protective immunity wanes over time. After the last dose at 11–12 years, it is followed by a booster of tetanus and diphtheria only (Td) every 10 years.
7. COVID-19 bears some similarities to severe acute respiratory syndrome (SARS). SARS demonstrated a pattern among children similar to that of COVID-19, with only few confirmed cases and no deaths reported in children. Scientists still are not sure why that was the case, but a similar concept could be suggested.
8. In 2011, the Centres for Disease Control and Prevention (CDC) recommended boosters for pertussis vaccination along with tetanus and diphtheria toxoid during each pregnancy. This may also explain the gender differences in patients with COVID-19 regarding incidence, severity and mortality [6].

In conclusion, we can hypothesize that the protective effect of the *B. pertussis* vaccine might be the cause of the low fatality of COVID-19 patients in the population under 19 years through its cytokine storm damping effect. Lower incidence in younger population could be potentially related to a mild presentation that does not need hospitalization. Moreover, attenuated *B. pertussis* can serve as an effective mucosal vaccine delivery system. This theory can be supported by the exponentially increased incidence of COVID-19 in older ages when the pertussis vaccine effect begins to fade away, which usually takes an average of 4–7 years after the last booster dose of pertussis vaccine. This theory gives hope to prevent further cases of COVID-19 and necessitates to be validated by research studies to prove the value of administering a booster dose of *B. pertussis* vaccine along with diphtheria and tetanus toxoid to protect against COVID-19 infection or at least decrease its severity and consequently improve the outcome, particularly in the older or high-risk population. We deliver this theory to the scientific community, aiming to raise the concern about it, and to provide us with support by realistic and experimental evidence.

Competing interests

None to declare.

Ethical approval

Not required.

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