

Mortality at the Kedarnath Pilgrimage Trek in 2022: A Possible Interplay between Post-COVID Syndrome and High-Altitude Mountain Sickness

Sir,

The “Kedarnath” pilgrimage, one of the four “Char Dham” pilgrimage sites, is located in the Himalayas, about 3584 m (1755 ft) above sea level. The “Kedarnath” temple stands the highest among the 12 “Jyotirlingas” (devotional representation of the Hindu Lord Shiva). Around 30–50 lakh pilgrims participate in the visit (yatra) each year. The height above sea level predisposes the travelers to acute mountain sickness which may contribute to mortality and morbidity in some patients. Acute mountain sickness is less common under 2500 m or presents with very mild symptoms, however, around 75% of nonacclimated travelers face it at heights equal to or above 3000 m.^[1]

The deaths during the Kedarnath pilgrimage visit (“Kedarnath yatra”) in 2022 have shown an unusual rise, amounting to 120 deaths in just 27 days. This mortality is not at par with the previous years’ records which had 90,102 and 112 deaths in the 6-month travel window for the years 2019, 2018, and 2017, respectively.^[2] This acute unexpected rise in deaths is concerning and has invited medical and political attention. This year, the significant factor that cannot be ignored is the presence of post-COVID effects among travelers. With the past three waves of COVID-19, the major population had a COVID-19 infection in some form and was subject to post-COVID changes to the cardiorespiratory system in different amounts.

It becomes peremptory to understand that being reopened after 2 years of COVID-19 travel restrictions, the pilgrimage was always expected to invite a large footfall of pilgrims this year. Furthermore, owing to the sudden weather changes, extreme cold, inadequate hydration, altered food availability, lodging in outdoors, and strenuous trekking in the limited infrastructure, people at extremes of age or with comorbidities of cardiac or respiratory disease or hypercoagulable states were pushed to the verge of precipitating ischemic stroke, arrhythmias, diabetic ketoacidosis, electrolyte imbalance, and pulmonary embolism.

COVID-19 had a multisystemic effect, with the major systems affected being the cardiovascular and respiratory systems. Recent evidence has suggested that most patients have preserved left ventricular systolic function,^[3] whereas only 3% have reduced ejection fraction.^[4] In about half of patients with a history of severe COVID-19, persistent cardiac symptoms such as chest pain, palpitations; abnormalities in

cardiac imaging, and abnormal biomarker levels have been reported. It has been seen that the duration and severity of the hyperinflammatory state, both contribute significantly to the risk of thrombotic complications in the post-COVID phase. The most common mechanisms for cardiovascular damage include but are not limited to direct virus-mediated cytotoxicity, angiotensin-converting enzyme 2 receptor downregulation, and immune-mediated inflammation.^[5] COVID-19 and its persistent post-COVID effects may manifest as arrhythmias, heart muscle inflammation, thrombotic disorders, stroke, myocardial infarction, and heart failure. Interestingly, the raised risks were evident even among those who were not hospitalized with acute COVID-19.^[6] COVID-19 patients have also shown an increased risk of pulmonary hypertension and alterations in carbon monoxide diffusion capacity for carbon monoxide.^[7,8] The increased pulmonary artery pressure and pulmonary vasoreactivity play a critical role in the pathogenesis of high-altitude pulmonary edema (HAPE), which suggests that patients with pulmonary hypertension may face an increased risk of HAPE with an ascent to high altitudes, which may be true as sequelae of COVID-19 as well. Furthermore, the inflammatory uphaul produced by COVID-19 acute illness has been seen to be persistent as chronic low-grade inflammation evident by the inflammatory markers not reaching the normal range, this perhaps multiplies the risk of venous thromboembolism, thus indirectly reducing the tolerance to hypoxia.^[8] It may also be considered that despite the observed radiological recovery of lungs after COVID-19 infection, the return to normal lung structure and function is not absolute.^[9] Post-COVID syndrome, therefore, poses to affect the physiological response to high altitudes. The above post-COVID sequelae/complications have been shown to vary with disease severity and have contributed to a significant rise in 12-month mortality. Experts have therefore recommended cautious planning before the ascent. They have suggested follow-up with pulse oximetry, electrocardiogram, echocardiography, and perhaps cardiopulmonary exercise testing in select individuals to identify and address cardiopulmonary issues.^[10]

CONCLUSIONS

The mortality at the Kedarnath pilgrimage in 2022 so far has been unusual, resulting from the interplay between the post-COVID syndrome and the acute mountain sickness. Although the generalizability of this surmise is not possible without detailed individual investigations and biopsy

data from the deceased, one cannot ignore the speculated etiopathogenesis either. This warrants for health promotion, pretravel cardiorespiratory assessment, and adequate public health legislation.

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Conflicts of interest

There are no conflicts of interest.

Nidhi Uniyal, Yashendra Sethi

Departments of Medicine, Government Doon Medical College, HNB Medical Education University, Dehradun, Uttarakhand, India

Address for correspondence: Dr. Yashendra Sethi,
67/31 Tyagi Road, Dehradun, Uttarakhand, PIN-248001, India.
E-mail: yashendrasethi@gmail.com

REFERENCES

1. Luks AM, Swenson ER, Bärtsh P. Acute high-altitude sickness. *Eur Respir Rev* 2017;26:160096.
2. Uttarakhand Official Data as Reported in Media Reports; 2022. Available from: <https://www.udayavani.com/english-news/high-death-toll-during-char-dham-yatra-this-year-cause-of-concern-say-experts>. [Last accessed on 2022 Jun 16].
3. Catena C, Colussi G, Bulfone L, Da Porto A, Tascini C, Sechi LA. Echocardiographic comparison of COVID-19 patients with or without prior biochemical evidence of cardiac injury after recovery. *J Am Soc Echocardiogr* 2021;34:193-5.
4. Sonnweber T, Sahanic S, Pizzini A, Luger A, Schwabl C, Sonnweber B, *et al.* Cardiopulmonary recovery after COVID-19: An observational prospective multicentre trial. *Eur Respir J* 2021;57:2003481.
5. Huang L, Zhao P, Tang D, Zhu T, Han R, Zhan C, *et al.* Cardiac involvement in patients recovered from COVID-2019 identified using magnetic resonance imaging. *JACC Cardiovasc Imaging* 2020;13:2330-9.
6. Abbasi J. The COVID heart-one year after SARS-CoV-2 infection, patients have an array of increased cardiovascular risks. *JAMA* 2022;327:1113-4.
7. Daher A, Balfanz P, Cornelissen C, Müller A, Bergs I, Marx N, *et al.* Follow up of patients with severe coronavirus disease 2019 [COVID-19]: Pulmonary and extrapulmonary disease sequelae. *Respir Med* 2020;174:106197.
8. Luks AM, Grissom CK. Return to high altitude after recovery from coronavirus disease 2019. *High Alt Med Biol* 2021;22:119-27.
9. Grist JT, Chen M, Collier GJ, Raman B, Abueid G, McIntyre A, *et al.* Hyperpolarized ¹²⁹Xe MRI Abnormalities in Dyspneic Patients 3 Months after COVID-19 Pneumonia: Preliminary Results. *Radiology*, 301(1), E353–E360. doi: 10.1148/radiol.2021210033.
10. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, Stevens JS, *et al.* Post-acute COVID-19 syndrome. *Nat Med* 2021;27:601-15.

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