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## Addendum - Coronavirus Disease 2019: What Could Be the Effects on Road Safety?

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### ARTICLE INFO

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A Short Communication was recently published on Coronavirus Disease 2019: What Could Be the Effects on Road Safety? (Vingilis et al., 2020). However, we would be remiss in not identifying one additional COVID-19 person factor for road safety professionals to consider - the possible effects of the illness itself on the driver, driving and thus, road safety. Much is still unknown about the illness's effects on the human body; we are learning in real time (Rayner et al., 2020).

Initially, COVID-19 was thought to be a respiratory illness (COVID Symptom Study, 2020). However, current research has identified a broad spectrum of clinical manifestations for COVID-19 ranging from asymptomatic forms to severe viral pneumonia with respiratory failure, and multi-organ and systemic dysfunctions related to sepsis and septic shock that in some cases leads to death (COVID Symptom Study, 2020; Renu et al., 2020; Zaim et al., 2020). In addition to the malaise and

respiratory, gastrointestinal and neurological symptoms regularly experienced by individuals with COVID-19 (COVID Symptom Study, 2020), the virus has been implicated in damage to lung, heart, kidney, liver, and brain (Hui and Zumla, 2019; Renu et al., 2020). Moreover, those with pre-existing comorbidities, such as hypertension, diabetes, cardiovascular and renal diseases, have poorer prognosis (Renu et al., 2020; Zaim et al., 2020).

There are neither precedents nor current data about how many individuals and which domains of health will be affected by COVID-19 in the long-term. However, newly emerging research is suggesting that COVID-19 may have prolonged and debilitating effects on the health of many individuals who were admitted to hospitals, as well as those with milder symptoms who were not hospitalized (COVID Symptom Study, 2020; Grant, 2020; Mahase, 2020; Rayner et al., 2020). Curiously,

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individuals with mild cases have been found to be more likely to have a range of recurring symptoms over extended periods of time (COVID Symptom Study, 2020). Indeed, the term “long covid” is now being used to describe the illness in individuals who have either had the typical symptoms much longer than expected or who have “recovered” from COVID-19 but are still reporting lasting effects of the infection (Mahase, 2020).

Moreover, these symptoms are not uncommon. Carfi et al. (2020) followed 143 patients discharged from hospital after recovery from COVID-19 with mean length of hospital stay of 13.5 days. Follow-up period was a mean of 60.3 days after first COVID-19 symptom onset; only 12.6% were symptom free at follow-up while 32% had 1 or 2 symptoms and 55% had 3 or more. Symptoms for the majority of patients included fatigue, shortness of breath, cough, joint pain, muscle pain, headache, and loss of appetite (Carfi et al., 2020).

A number of these COVID-19 symptoms could affect driving performance, and hence, road safety. Certainly fatigue has been associated with deteriorating driving performance and road fatalities, with driver fatigue estimated as a possible contributory factor in as many as 20% of all road collisions (Jackson et al., 2011). Chronic pain has also been associated with driving difficulties. For example, Fan et al. (2012), surveying a sample of chronic pain patients (N = 223) attending a hospital rehabilitation centre, found that 41% of the sample reported experiencing quite a bit or a great deal of difficulty driving. Seventy percent reported that pain affected their driving in both preparation activities (e.g., adjusting mirrors, reaching for seatbelt) and driving activities (e.g., shoulder checks, merging with traffic), while 5.9% reported a collision in the past year (Fan et al., 2012). Moreover, medication to control symptoms could impair driving. Many medications can directly affect the central nervous system (CNS) and as such can directly affect psychomotor performance and thus, impair driving (Elvik, 2013; Pollini et al., 2017; Rapoport et al., 2009; Vingilis and MacDonald 2000). Other symptoms could also affect detection of impaired driving. Shortness of breath could possibly affect the provision of breath samples for a breathalyzer test if a COVID-19 survivor's spirometry measurements for Forced Expired Volume in one second (FEV<sub>1</sub>) was less than 2.0 litres and Forced Vital Capacity (FVC) was less than 2.6 litres (Gomm et al., 1991). However, no research has been conducted specifically on COVID-19 survivor symptoms and driving performance.

Perhaps of greatest concern for road safety is possible long-term neurological effects. Systematic reviews on the neurological effects of COVID-19 identified a limited number of studies (Asadi-Pooya and Simani, 2020; Montalvan et al., 2020; Zubir et al., 2020). One study examining all patients (N = 214) admitted between January 16 to February 19, 2020 to three designated COVID-19 care hospitals in Wuhan, China, found that 36.4% exhibited neurological symptoms (Mao et al., 2020). Specifically they identified symptoms within three neurological categories: CNS symptoms or diseases (dizziness, headache, impaired consciousness, acute cerebrovascular disease); peripheral nervous system (PNS) symptoms (pain, loss of sense of smell and taste), and skeletal muscle injury. Reports on patients infected with other coronavirus (SARS-CoV and MERS-Cov) as well as COVID-19 also identified some cases of inflammation of the brain (encephalitis), peripheral nerve damage (polyneuropathy) and strokes (Montalvan et al., 2020; Zubir et al., 2020).

However, long-term effects are unknown, although long-term neurological sequelae are anticipated (Asadi-Pooya and Simani, 2020; Montalvan et al., 2020; Renaud, 2020; Zubir et al., 2020). Cognitive neuroscientist, Adrian Owen was quoted as saying: “We’re going to see many, many people with profound cognitive impairment a year from now” associated with the damaging effect of the virus itself, the secondary effects on the respiratory system that might have reduced oxygen to the brain, and the effects of staying in an intensive care unit (Kirkley, 2020). Resultant cognitive impairment is an issue of concern for driving performance and road safety.

In summary, road safety professionals need to monitor and study COVID-19 survivors as there is increasing evidence of a “long-tail” of COVID-19 sequelae (Rayner et al., 2020) that could impact road safety. Both epidemiological and experimental studies are needed to gather ongoing data about the long-term effects of this illness on drivers, driving and road safety. This type of information will be critical for physicians and other health care providers to use in their assessment of cognitive and other impairments and their COVID-19 patients’ fitness to drive. Similarly, public (e.g., departments of transportation, police, hospitals, etc.), and private (e.g., insurance, commercial transportation, etc.) sectors will need to understand the relationship between COVID-19 and road safety for policy considerations. Finally, this information will be crucial for COVID-19 survivors and the general public. As Rayner et al. (2020) wrote: “So far, there has been much emphasis on the treatment of acute life-threatening manifestation of COVID-19... However, the dual hallmarks of prolonged illness with relapsing and remitting pattern of recurrence have significant implications for the individual, who needs care and advice.” Implications of the COVID-19 illness on road safety are unknown, but given the high international illness burden of this pandemic and the unprecedented numbers of individuals infected by COVID-19, research on the effects of the illness on road safety is needed.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.aap.2020.105712>.

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