



ELSEVIER

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: <http://www.elsevier.com/locate/jth>

HotM2 article

Syndemic frameworks to understand the effects of COVID-19 on commercial driver stress, health, and safety

Michael Kenneth Lemke^{a,*}, Yorghos Apostolopoulos^b, Sevil Sönmez^c

^a University of Houston-Downtown, Department of Social Sciences, One Main St., Ste. N1025, Houston, TX, 77002, USA

^b Texas A&M University, Complexity & Computational Population Health Group, 2929 Research Pkwy, College Station, TX, 77845, USA

^c University of Central Florida, College of Business Administration, 12744, Pegasus Dr., Orlando, FL, USA

ARTICLE INFO

Keywords:

COVID-19
Commercial drivers
Syndemics
Stress
Health
Safety

ABSTRACT

Introduction: U.S. commercial drivers are entrenched in a stressogenic profession, and exposures to endemic chronic stressors shape drivers' behavioral and psychosocial responses and induce profound health and safety disparities. To gain a complete understanding of how the COVID-19 pandemic will affect commercial driver stress, health, and safety over time, and to mitigate these impacts, research and prevention efforts must be grounded in theoretical perspectives that contextualize these impacts within the chronic stressors already endemic to profession, the historical and ongoing forces that have induced them, and the potentially reinforcing nature of the resulting afflictions.

Methods: Extant literature reveals how an array of macro-level changes has shaped downstream trucking industry policies, resulting in stressogenic work organization and workplace characteristics. Emerging evidence suggests that the COVID-19 pandemic exacerbates existing stressors and introduces novel stressors, with potentially exacerbatory impacts on health and safety disparities.

Results: As COVID-19 exerts an array of multi-level stressors on commercial drivers, syndemic frameworks can provide the appropriate theoretical lens to guide research and prevention. Syndemic frameworks can provide the grounding to allow foregoing commercial driver COVID-19 research to transcend the limitations of prevailing research frameworks by contextualizing COVID-19 stressors holistically within the complex system of endemic chronic stressors and interrelated health and safety afflictions. Syndemic-informed prevention efforts can then be implemented that simultaneously tackle multiple afflictions and the macro-level forces that result in the emergence of commercial drivers' health and safety disparities over time.

Conclusions: The impacts of the COVID-19 pandemic on commercial drivers cannot be adequately understood or acted upon in isolation from the endemic chronic stressors and interrelated health and safety disparities that characterize the profession. Instead, commercial driver COVID-19 research and prevention needs syndemic frameworks to holistically understand the impacts of COVID-19 on commercial driver stress, health, and safety, and to identify high-leverage preventive actions.

* Corresponding author.

E-mail addresses: lemkem@uhd.edu (M.K. Lemke), yaposto@tamu.edu (Y. Apostolopoulos), sevil@ucf.edu (S. Sönmez).

<https://doi.org/10.1016/j.jth.2020.100877>

Received 5 May 2020; Received in revised form 15 May 2020; Accepted 18 May 2020

Available online 23 May 2020

2214-1405/© 2020 Elsevier Ltd. All rights reserved.

1. Introduction

Over the past 40 years, major policy changes have fundamentally altered the structure and organization of the work and workplaces of U.S. commercial drivers. As a result, the nearly two million U.S. long-haul truck drivers (LHTD) (Bureau of Labor Statistics, 2018) currently find themselves entrenched in an increasingly stressogenic (Apostolopoulos et al., 2013) profession due to the downstream, interacting, dynamic, and evolving impacts of such macro-level changes. Exposures to the chronic stressors that are now endemic within the long-haul trucking profession shape drivers' behavioral and psychosocial responses (Apostolopoulos et al., 2016a) and induce health and safety disparities that are among the worst of any occupation (Bureau of Labor Statistics, 2018; Apostolopoulos et al., 2016b; U.S. Bureau of Labor Statistics, 2018).

Although empirical research is not yet available regarding the impacts on coronavirus 2019 (COVID-19) on commercial driver stress, health and safety, emerging evidence suggests that the current pandemic simultaneously exacerbates existing stressors and introduces novel stressors (Premack, 2020), with potentially profound consequences that may exacerbate disparities. However, to gain a complete understanding of how the COVID-19 pandemic will affect commercial driver stress, health, and safety over time – and to be able to ascertain how to best take action to mitigate these impacts – research and prevention efforts must be grounded in theoretical perspectives that contextualize these impacts within the chronic stressors already endemic to profession, the historical and ongoing forces that have induced them, and the potentially reinforcing nature of the resulting afflictions. Thus, using U.S. long-haul truck drivers as an illustrative example, we advocate for using *syndemic frameworks* to guide research and prevention regarding the effects of the COVID-19 pandemic on commercial driver stress, health, and safety.

2. Multi-level forces and commercial drivers' stress, health, and safety

An array of macro-level changes has increased chronic stress exposures among LHTD. Macroeconomic forces related to declines in manufacturing wages, which are strongly correlated with truck driver wages, have eroded earnings over time (Belman and Monaco, 2001). Federal policy changes have generated downstream impacts on the work organization of LHTD – in particular, the passage of the Motor Carrier Act of 1980, which deregulated the trucking industry (Belzer, 2000) and led to reduced LHTD union presence and protections and intense trucking industry competition, resulting in declines in wages and working conditions (Belman and Monaco, 2001). Even federal policies intended to protect roadway safety have had counterintuitive impacts that have increased LHTD stress. For example, federal hours-of-service (HOS) laws create a regulatory environment where drivers are subject to the intense competitive pressures in the current trucking industry and yet are liable for HOS violations as they try to meet these demands (Belman and Monaco, 2001).

These macro-level forces have shaped downstream trucking company policies and practices, resulting in numerous stressogenic work organization characteristics and workplace experiences for LHTD. The intense competition ushered in by deregulation has resulted in rigorous and erratic work schedules, often characterized by long work hours and shift work (Apostolopoulos et al., 2013; Lemke et al., 2017). “By-the-mile” pay, the most common form of LHTD compensation, is illustrative of competition-driven wage declines and only provides drivers with income when their vehicles are moving and does not fairly compensate for non-driving tasks that constitute a significant portion of their working time (Belzer, 2000; Farrell et al., 2016; Williams et al., 2017). Other trucking industry-relevant corporate policies also induce LHTD chronic stress. The unique nature of the profession requires drivers to be away from home for weeks at a time, which effectively makes their worksites their “homes” for prolonged periods of time (Apostolopoulos et al., 2014). As a result, drivers are particularly dependent on the amenities available in these locales; however, these environments are notorious for lacking medical services or opportunities for physical activity and healthy eating (Apostolopoulos et al., 2013, 2016c; Williams et al., 2017). The mandatory prolonged periods away from family and friends, exacerbated by scheduling and financial pressures, lead to chronic social isolation (Apostolopoulos et al., 2016a; Williams et al., 2017; Jensen and Dahl, 2009) that is compounded by a pervasive lack of respect for LHTD that is manifest through their numerous daily interactions with general public and, due to inherent job requirements to act as a boundary spanner, customers, dispatchers, and even the government (Williams et al., 2017).

These multi-level chronic stressors often induce detrimental behavioral and psychosocial responses by LHTD and significantly contribute to their excessive health and safety disparities. As chronic stress results in the accumulation of allostatic load (AL) (Sun et al., 2007; Read and Grundy, 2012), workplace environments provide drivers with few means to cope with stressors in healthful ways (Apostolopoulos et al., 2013; Shattell et al., 2010). Instead, the coping behaviors that are exhibited, such as unhealthful eating and drug/alcohol use (Apostolopoulos et al., 2013, 2016a; Williams et al., 2017; Shattell et al., 2010), reduce the physiological capability of LHTD to handle AL in the long-term and perpetuate AL accumulation (Suvarna et al., 2019), leading to health afflictions including immune system dysfunction, cardiovascular disease, and diabetes (Suvarna et al., 2019; Taylor et al., 1997; Mocayar Marón et al., 2019; Bellingrath et al., 2009). Further, these stressors can lead to emotional exhaustion and burnout (Williams et al., 2017; Kemp et al., 2013) and can induce unsafe driving behaviors, such as driving while fatigued, committing HOS violations, and speeding (Belman and Monaco, 2001; Farrell et al., 2016), that have been associated with roadway crashes (Lemke et al., 2016; Cantor et al., 2010; Khattak et al., 2003).

3. How COVID-19 can exacerbate health and safety disparities of commercial drivers

There is a dearth of empirical investigation into the impacts of the COVID-19 pandemic on commercial drivers, including LHTD, which is due to both the recency of this public health emergency and long-standing neglect in the literature regarding these

populations. However, emerging anecdotal evidence affords us clues into key COVID-19 stressors and their plausible consequences. These stressors can be broadly categorized as either *exacerbatory* or *novel*.

Several aspects of the COVID-19 pandemic can *exacerbate* endemic chronic stressors. Drivers are under immense pressure from to maintain critical supply chains and accommodate demand surges for consumer and healthcare goods (Premack, 2020), and these pressures have been exacerbated by concerns about travel restrictions (Garsten, 2020; Hensley, 2020) and enabled by the relaxation of HOS rules for the transportation of essential goods (Federal Motor Carrier Safety Administration, 2020). However, these pressures are now combined with freight volatility, as overall trucking volumes are expected to slow down and demands for other goods, such as those related to manufacturing, have already declined (Garsten, 2020; Costello, 2020). Impending declines in freight volumes are expected to threaten drivers' wages and potentially their livelihoods (Garsten, 2020). Further, as the result of physical distancing mandates, worksite amenities have become even more sparse; as a result, many drivers have struggled with finding meals, safe parking, restrooms, and showers (Thomas, 2020; Norton, 2020).

The COVID-19 pandemic also presents an array of *novel* stressors for LHTD. One new source of stress is worrying about getting sick from COVID-19, which is compounded due to the fact that they may fall ill thousands of miles from home and without any practical means for testing, treatment, or quarantine (Premack, 2020; Norton, 2020; – 9-1-1 [pr, 2020]). Drivers expose themselves to infection as they move in and out of areas with outbreaks (– 9-1-1 [pr, 2020]), and as they interact with various social contacts they pose acquisition and transmission risks to themselves and others (Premack, 2020; Apostolopoulos and Sonmez, 2007). These worries are made worse by the absence of personal protective equipment available to them (– 9-1-1 [pr, 2020; Alcock, 2020]), as well as a lack of corporate policies to protect them from infection, such as workplace physical distancing protocols and open and prompt communication about possible workplace infection cases (Alcock, 2020).

The potential consequences that these COVID-19 stressors pose to LHTD health and safety are numerous. One consequence may be strains on supply chains due to labor fluctuations. The trucking industry was experiencing a labor shortage before the onset of the COVID-19 pandemic (Costello, 2018), and the lack of PPE or other policies to prevent LHTD infection may result in walk-outs, absenteeism, and leave (Alcock, 2020). Drivers may leave the profession altogether due to increased levels of burnout or alienation as the result of these stressors (Williams et al., 2017; Kaynak et al., 2016). Supply chain strains may create greater pressures on the remaining labor pool to fulfill demand surges, resulting in a vicious cycle of even greater LHTD chronic stress. Increases in chronic stressors may perpetuate another vicious cycle related to LHTD health: Due to corresponding increases in AL accumulation, immune suppression may render them more likely to get sick if they are exposed to the virus, and cardiometabolic dysfunction may make them more likely to experience COVID-19 morbidity/mortality (Dietz and Santos-Burgoa, 2020; Li et al., 2020; Caramelo et al., 2020; Zhou et al., 2020; Vardavas and Nikitara, 2020); further, COVID-19 morbidity and sequelae may perpetuate existing health disparities; for example, by exacerbating cardiovascular dysfunction due to damage to the heart (Li et al., 2020) and/or worsening metabolic dysfunction through pancreatic injury or acute kidney injury (Wang et al., 2020; Pan et al., 2020; Hung et al., 2018). Because cardiometabolic dysfunction is associated with increased likelihood of sleep disorders, fatigue, and roadway crashes (Anderson et al., 2012; Kales and Straubel, 2014), the impacts of COVID-19 stressors may manifest as safety declines.

4. Syndemic frameworks for commercial driver COVID-19 research and prevention

As the COVID-19 pandemic exerts an array of multi-level stressors on commercial drivers, researchers need an adequate 'lens' through which to view these dynamically complex relationships and how they may induce multiple interrelated health and safety outcomes. However, prevailing research frameworks are grounded in reductionist and linear assumptions of cause and effect (Salmon et al., 2012) and pursue identifiable risk factors (Hettinger et al., 2015; Singer et al., 2017). This focus on variable isolation (Salmon et al., 2012) to tease apart the influence of individual risk factors is antithetical to understanding the dynamic, multi-level, and interacting array of stressors and downstream consequences that altogether constitute a complex system. Further, these frameworks tend to overlook both the macro-level forces that lead to the clustering of adverse outcomes in populations and the interrelated and potentially reinforcing nature of these outcomes (Singer et al., 2017). This means that the consequences of the COVID-19 pandemic for LHTD cannot be adequately understood – or acted upon – in isolation from the inherently stressogenic context of the profession, the historical and ongoing forces that have induced the chronic stressors and health and safety disparities endemic to the profession, and the potentially reinforcing nature of these afflictions. Instead, *commercial driver COVID-19 research and prevention needs theoretical frameworks that contextualize COVID-19 stressors holistically within the complex system of endemic chronic stressors and interrelated health and safety outcomes.*

In our view, *syndemic frameworks* can provide the appropriate theoretical lens to guide commercial driver COVID-19 research and prevention. The term 'syndemic' is defined as the clustering, due to sociostructural forces, of two or more interacting and exacerbatory afflictions within a population (Singer et al., 2017). The dual emphasis of syndemic frameworks on the clustering of health and safety within populations due to macro-level forces and on the reinforcing nature of these afflictions can provide the grounding to allow foregoing COVID-19 commercial driver research to transcend the limitations of prevailing research frameworks (Singer et al., 2017; Mendenhall, 2017). This understanding can then embody the emergence of interrelated health and safety afflictions due to the endemic stressogenic nature of long-haul trucking, how they are continually shaped by the dynamic macro-level policies and forces that have unfolded over time, and how these afflictions may perpetuate extant disparities and shape morbidity/mortality vulnerabilities (Singer et al., 2017). In the case of COVID-19, those macro-level policies and forces that perpetuate disparities can be expected to similarly induce detrimental outcomes to novel pandemic stressors, along with a worsening of related endemic stressors and corresponding stress responses. The consequences can be expected to synergistically interact with existing disparities and unfold across heterogeneous timeframes – for example, short timeframes for consequences associated with acute COVID-19 infection and full

recovery (e.g., temporary loss of labor supply), and longer timeframes for consequences associated with inadequate trucking company policies to protect workers from COVID-19 infection (e.g., workforce burnout and alienation).

As the complete picture of the impacts of COVID-19 on commercial drivers' stress, health, and safety emerges through research grounded in syndemic frameworks, prevention efforts could then be implemented that simultaneously tackle multiple afflictions and the macro-level forces that resulted in the emergence of commercial drivers' health and safety disparities over time. In contrast to the limitations of individual-focused, single-component or multi-component interventions (Singer et al., 2017; Tsai et al., 2017) that are most commonplace and most likely to be characteristic of foregoing COVID-19 programming, syndemic frameworks inherently inform large-scale public policy interventions that target macro-level drivers of disparities within populations, while also incorporating the presence of interrelated afflictions and vulnerabilities (Singer et al., 2017). As a result, these prevention efforts would constitute holistic multi-level interventions that both modify the macro-level forces that have led to the clustering of disparities and also address and treat health and safety vulnerabilities and outcomes at the driver-level (Singer et al., 2017; Mendenhall, 2017; Tsai et al., 2017).

5. Conclusion

Major policy changes have fundamentally altered the structure and organization of the work and workplaces of U.S. commercial drivers. Due to the impacts of these changes, U.S. LHTD are entrenched in a stressogenic profession, where endemic chronic stressors shape drivers' behavioral and psychosocial responses and contribute significantly to profound health and safety disparities. The impacts of the current COVID-19 pandemic cannot be adequately understood or acted upon in isolation from the inherently stressogenic context of the profession. Instead, commercial driver COVID-19 research and prevention needs syndemic frameworks to provide the appropriate theoretical lens to holistically understand the impacts of COVID-19 on commercial driver stress, health, and safety and to identify high-leverage preventive actions.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Financial disclosure

The Authors did not receive any specific funding for this work.

CRedit authorship contribution statement

Michael Kenneth Lemke: Conceptualization, Writing - original draft. **Yorghos Apostolopoulos:** Conceptualization, Writing - review & editing. **Sevil Sönmez:** Writing - review & editing.

References

- HELP - MAYDAY - 9-1-1 [press Release]. Grain Valley, MO, April 3 2020. Owner-Operator Independent Drivers Association, INC.
- Alcock A. reportTrucking Company Reports 300 on Pandemic Leave. KSHB-TV. April 6, 2020.
- Anderson, J.E., Govada, M., Steffen, T.K., et al., 2012. Obesity is associated with the future risk of heavy truck crashes among newly recruited commercial drivers. *Accid. Anal. Prev.* 49, 378–384, 0.
- Apostolopoulos, Y., Sonmez, S. (Eds.), 2007. *Population Mobility and Infectious Disease*. Springer, New York, NY.
- Apostolopoulos, Y., Sonmez, S., Shattell, M., Gonzales, C., Fehrenbacher, C., 2013. Health survey of U.S. long-haul truck drivers: work environment, physical health, and healthcare access. *Work* 46 (1), 113–123.
- Apostolopoulos, Y., Lemke, M., Sonmez, S., 2014. Risks endemic to long-haul trucking in North America: strategies to protect and promote driver well-being. *New Solut.* 24 (1), 57–81.
- Apostolopoulos, Y., Sönmez, S., Hege, A., Lemke, M.K., 2016a. Work strain, social isolation and mental health of long-haul truckers. *Occup. Ther. Ment. Health* 32 (1), 50–69.
- Apostolopoulos, Y., Lemke, M.K., Hege, A., et al., 2016b. Work and chronic disease: comparison of cardiometabolic risk markers between truck drivers and the general U.S. population. *J. Occup. Environ. Med.* 58 (11), 1098–1105.
- Apostolopoulos, Y., Lemke, M.K., Sönmez, S., Hege, A., 2016c. The obesogenic environment of commercial trucking: a worksite environmental audit and implications for systems-based interventions. *Am. J. Health Educ.* 47 (2), 85–93.
- Bellingrath, S., Weigl, T., Kudielka, B.M., 2009. Chronic work stress and exhaustion is associated with higher allostatic load in female school teachers. *Stress* 12 (1), 37–48.
- Belman, D.L., Monaco, K.A., 2001. The effects of deregulation, de-unionization, technology, and human capital on the work and work lives of truck drivers. *Ind. Labor Relat. Rev.* 54 (2A), 502–524.
- Belzer, M.H., 2000. *Sweatshops on Wheels: Winners and Losers in Trucking Deregulation*. Oxford University Press, New York, NY.
- Bureau of Labor Statistics, 2018. *Occupational Outlook Handbook: Heavy and Tractor-Trailer Truck Drivers*. US Department of Labor. Published. <https://www.bls.gov/oooh/transportation-and-material-moving/heavy-and-tractor-trailer-truck-drivers.htm>. (Accessed 8 March 2020).
- Cantor, D.E., Corsi, T.M., Grimm, C.M., Özpölat, K., 2010. A driver focused truck crash prediction model. *Transport. Res. E Logist. Transport. Rev.* 46 (5), 683–692.
- Caramelo, F., Ferreira, N., Oliveiros, B., 2020. Estimation of Risk Factors for COVID-19 Mortality-Preliminary Results medRxiv.
- Costello, R., 2018. Reports, Trends & Statistics. American Trucking Associations. Published. http://www.trucking.org/News_and_Information_Reports_Industry_Data.aspx.
- Costello, R., 2020. ATA truck tonnage index rose 1.8% in February. American Trucking Associations. Published. <https://www.trucking.org/news-insights/ata-truck-tonnage-index-rose-18-february>. (Accessed 15 April 2020).
- Dietz, W., Santos-Burgoa, C., 2020. Obesity and its implications for COVID-19 mortality. *Obesity* 28 (6), 105.
- Farrell L, Soccolich S, Hanowski RJ. Assessing daily driving and working hours within the context of hours-of-service regulations. Paper presented at: 17th International Conference Road Safety On Five Continents2016; Rio de Janeiro, Brazil.

- Federal Motor Carrier Safety Administration, 2020. Expanded Emergency Declaration under 49 CFR § 390.23 No. 2020-002 (Relating to COVID-19). U.S. Department of Transportation. Published. <https://www.fmcsa.dot.gov/emergency/expanded-emergency-declaration-under-49-cfr-ss-39023-no-2020-002-relating-covid-19>. (Accessed 15 April 2020).
- Garsten, E., 2020. COVID-19 Poses Uneven Challenges for Commercial Truckers. *Forbes*. Published April 13. <https://www.forbes.com/sites/edgarsten/2020/04/13/covid-19-poses-uneven-challenges-for-commercial-truckers/#873eb5777915>.
- Hensley, N., 2020. Texas to enforce quarantine orders at Louisiana border with coronavirus crisis 'getting worse'. *Houston Chronicle*. Published March 29. <https://www.houstonchronicle.com/news/houston-texas/houston/article/Texas-Louisiana-quarantine-coronavirus-border-covid-15164996.php>.
- Hettinger, L.J., Kirlik, A., Goh, Y.M., Buckle, P., 2015. Modelling and simulation of complex sociotechnical systems: envisioning and analysing work environments. *Ergonomics* 58 (4), 600–614.
- Hung, A.M., Siew, E.D., Wilson, O.D., et al., 2018. Risk of hypoglycemia after hospital discharge after acute kidney injury in patients with diabetes. *Diabetes Care* dc171237.
- Jensen, A., Dahl, S., 2009. Truck drivers hours-of-service regulations and occupational health. *Work* 33 (3), 363–368.
- Kales, S.N., Straubel, M.G., 2014. Obstructive sleep apnea in north American commercial drivers. *Ind. Health* 52 (1), 13–24.
- Kaynak, R., Toklu, A.T., Elci, M., Toklu, I.T., 2016. Effects of occupational health and safety practices on organizational commitment, work alienation, and job performance: using the PLS-SEM approach. *Int. J. Bus. Manag.* 11 (5), 146–166.
- Kemp, E., Kopp, S.W., Kemp Jr., E.C., 2013. Take this job and shove it: examining the influence of role stressors and emotional exhaustion on organizational commitment and identification in professional truck drivers. *J. Bus. Logist.* 34 (1), 33–45.
- Khattak AJ, Schneider RJ, Targa F. Risk factors in large truck rollovers and injury severity: analysis of single-vehicle collisions. Paper Presented at: 82nd Annual Meeting of the Transportation Research Board 2003; Washington, DC.
- Lemke, M.K., Apostolopoulos, Y., Hege, A., Sönmez, S., Wideman, L., 2016. Understanding the role of sleep quality and sleep duration in commercial driving safety. *Accid. Anal. Prev.* 97, 79–86.
- Lemke, M.K., Hege, A., Apostolopoulos, Y., Wideman, L., Sönmez, S., 2017. Work and sleep among transport operators: disparities and implications for safety. *Journal of Transport & Health* 7 (B), 298–309.
- Li, B., Yang, J., Zhao, F., et al., 2020. Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. *Clin. Res. Cardiol.* 1–8.
- Mendenhall, E., 2017. Syndemics: a new path for global health research. *Lancet* 389, 889–891.
- Mocayar Marón, F.J., Ferder, L., Saravi, F.D., Manucha, W., 2019. Hypertension linked to allostatic load: from psychosocial stress to inflammation and mitochondrial dysfunction. *Stress* 22 (2), 169–181.
- Norton, J., 2020. Truck Drivers Navigate COVID-19 Hurdles. WGLT NPR from Illinois State University. Published April 9. <https://www.wglt.org/post/truck-drivers-navigate-covid-19-hurdles#stream/0>.
- Pan, X., Da Xu, H.Z., Zhou, W., Wang, L., Cui, X., 2020. Identification of a potential mechanism of acute kidney injury during the COVID-19 outbreak: a study based on single-cell transcriptome analysis. *Intensive Care Med.* 1.
- Premack, R., 2020. Terrified Truckers Have No Idea How They'll Get Home if They Catch COVID-19 on the Road - and Major Trucking Companies Don't Either. *Business Insider*. Published April 7. <https://www.businessinsider.com/coronavirus-trucking-giants-sick-truck-drivers-home-2020-4>.
- Read, S., Grundy, E., 2012. Allostatic Load – a Challenge to Measure Multisystem Physiological Dysregulation. National Centre for Research Methods, University of Southampton, Southampton, UK.
- Salmon, P.M., McClure, R., Stanton, N.A., 2012. Road transport in drift? Applying contemporary systems thinking to road safety. *Saf. Sci.* 50 (9), 1829–1838.
- Shattell, M., Apostolopoulos, Y., Sönmez, S., Griffin, M., 2010. Occupational stressors and the mental health of truckers. *Issues Ment. Health Nurs.* 31 (9), 561–568.
- Singer, M., Bulled, N., Ostrach, B., Mendenhall, E., 2017. Syndemics and the biosocial conception of health. *Lancet* 389, 941–950.
- Sun, J., Wang, S., Zhang, J.-Q., Li, W., 2007. Assessing the cumulative effects of stress: the association between job stress and allostatic load in a large sample of Chinese employees. *Work. Stress* 21 (4), 333–347.
- Suvarna, B., Suvarna, A., Phillips, R., Juster, R.-P., McDermott, B., Sarnyai, Z., 2019. Health risk behaviours and allostatic load: a systematic review. *Neurosci. Biobehav. Rev.* 108, 694–711.
- Taylor, S.E., Repetti, R.L., Seeman, T., 1997. Health psychology: what is an unhealthy environment and how does it get under the skin? *Annu. Rev. Psychol.* 48 (1), 411–447.
- Thomas JL. Truckers Warn Supply Chain in Jeopardy if They Don't Get Better COVID-19 Protection. *Portland Press Herald*. April 7, 2020.
- Tsai, A.C., Mendenhall, E., Trostle, J.A., Kawachi, I., 2017. Co-occurring epidemics, syndemics, and population health. *Lancet* 389, 978–982.
- U.S. Bureau of Labor Statistics, 2018. National Census of Fatal Occupational Injuries in. US Department of Labor. Published 2019. (Accessed 12 March 2020).
- Vardavas, C.I., Nikitara, K., 2020. COVID-19 and smoking: a systematic review of the evidence. *Tob. Induc. Dis.* 18.
- Wang, F., Wang, H., Fan, J., Zhang, Y., Wang, H., Zhao, Q., 2020. Pancreatic injury patterns in patients with COVID-19 pneumonia. *Gastroenterology*.
- Williams Jr., D.F., Thomas, S.P., Liao-Troth, S., 2017. The truck driver experience: identifying psychological stressors from the voice of the driver. *Transport. J.* 56 (1), 54–76.
- Zhou, F., Yu, T., Du, R., et al., 2020. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 395 (10229), 1054–1062.