Identifying Temporal Instability in Factors Causing Work Zone Crash Occurrences Using Fast Causal Inference

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ABSTRACT
Finding effective countermeasures of work zone crashes require identifying the causes of work zone crashes. Recently, several researchers have identified some evidence that the influence of factors determining crash severity change over time (year to year), which is referred as temporal instability. So far, this phenomenon has been identified for factors determining crash severity and not studied for occurrence of work zone crashes. This paper focuses on investigating possible temporal instability in factors causing work zone crash occurrences. Three research gaps are identified: (1) Current models focus on statistical associations rather than causal relations. But causal relations are required for implementing work zone countermeasures; (2) Crash records cannot cover all variables defining crash risk such as human behavior, which induces unobserved observation-specific variations (unobserved heterogeneity) on safety impacts of observed variables; (3) Current studies usually use work zone crash records in low spatio-temporal granularity, which cannot capture effects of fast-changing factors (weather conditions, traffic speed) on crash risk. In this paper, the Fast Causal Inference (FCI) model is applied to data including work zone crashes and environmental conditions (weather conditions, traffic speed, and roadway characteristics) in high granularity to identify temporal instability in factors causing work zone crash occurrence. The proposed method is tested on the Pennsylvania work zone crash data from 2015 to 2017. Among forty-five pairs of factors, the proposed model identified four pairs of factors whose causal relations changed across 2015 and 2016, and ten pairs of factors whose causal relations changed across 2016 and 2017.