Road crashes and meteorological conditions in Porto, Portugal: An analysis with lagged effects

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BACKGROUND
Meteorological conditions are widely referenced as a major factor affecting the operation of transport systems. In general, the performance of road, rail, water and air transport decreases under adverse weather, as the systems become more exposed to the risk of congestion, delays, and accidents. In the context of climate change, the research community has been focused on the impact of adverse and extreme weather on diverse modes of transport. However, the weather effects on road transport has received a special attention, given that this model of transport accounts for the highest share of fatalities, injuries, and property damages among the whole transport sector. In urban settings, the increase of crash frequency is particularly accentuated, since the higher number of conflict points and heavier traffic represent a higher exposure to risk.

AIM
This study is focused on the impact of meteorological conditions on the frequency of road crashes in urban environment, using the city of Porto, Portugal as a case study. The analysis includes the evaluation of current and lagged weather effects on the frequency of property-damage-only and injury crashes.

METHOD
First, an analysis of property-damage-only crashes, which represent the great majority of urban crashes, is conducted, distinguishing between single-vehicle and multi-vehicle crashes. Then, injury crash counts are also investigated with the aim of evaluating the contribution of adverse weather to the occurrence of more severe crashes. The analysis is based on negative binomial regression models that consider the effects of daily precipitation and average temperature, as well as the lagged effects of the precipitation accumulated during the previous month. Those variables were selected to characterize weather conditions in the day of the crash and the accumulated precipitation during the previous 30 days. The hierarchical classification of urban roads, divided into four categories, is used as a proxy for traffic exposure.

RESULTS
The results show that rainy days are more prone to the occurrence of traffic crashes, but such effect may be attenuated by the precipitation accumulated during the previous month. The average daily temperature tend to present a negative effect. The results are consistent for single- and multi-vehicle property-damage-only crashes, as well as for injury crashes.

CONCLUSIONS
The results obtained in this research comply with the majority of previous studies, demonstrating that inclement weather increases the risk of road users being involved in a traffic crash. Particularly, being Porto located on one of Europe’s wettest regions, the rainfall effects on road crashes are aligned with those observed in other wet regions. However, the lagged effects of precipitation show that the effect of a rainy day may be smaller if it was preceded by a wet month. This may be essentially attributed to two factors associated to wet periods: (i) the precipitation washes the road surface, cleaning the oil and grime accumulated during dry spells, and (ii) drivers have enough time to readjust their behaviour to wet conditions. The temperature effects denote that less accidents occur in hotter days, being aligned with the rainfall effects in the context of the Portuguese climatic characteristics.