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Review Article

Effect of climate change on road traffic accidents in the UAE: a narrative review

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ABSTRACT

Road traffic accidents (RTA) is a major cause of death and disability all over the world. It is the leading cause of death in children and young adults aged 5-29 years. Worldwide, it is a growing public health concern as, approximately, 1.3 million people die every year due to RTA. It is also taxing on a country's GDP as at least 3% of the GDP is spent on RTA's annually. In 2020, there were 3.14 deaths per 100,000 in the UAE and this number increased by 20% in 2021. It also happens to be the second highest cause of death after cardiovascular diseases. There are many factors like speeding, driving under the influence, distracted driving, nonuse of seatbelts etc. which can cause accidents. Weather phenomenon is an overlooked factor which can cause an increase in the number of RTAs. Climate change has resulted in a global increase of temperature and an increase in weird weather phenomenon like increased rainfall, fog, smog, snowfall etc. Very limited studies have been conducted to see the relationship between the two and none have been conducted in the UAE. This review was done based on articles selected from PubMed and SpringerLink, to see whether the results could be applicable in this region. In countries like Saudi Arabia and Pakistan, increased rainfall and fog has resulted in an increase in the number of fatal accidents whereas in the USA, it was observed that the warmer temperatures have resulted in a higher number of fatal accidents. Hence, there is a need to assess the impact of climate change on RTA.

Keywords: Climate change, RTA, UAE

INTRODUCTION

Climate change refers to the long-term shifts in temperatures and weather patterns.[1] Human activities has been the main driver of climate change. These effects have caused problems globally in the environment, humans, animals etc. Alterations in the frequency, intensity, spatial extent, duration and timing of extremes in weather changes have affected mortality rates.[2,3] RTAs are one of the events that form part of the increase in mortality rates due to climate change. RTAs have been declared the leading cause of human loss globally.[4] Nearly 1.2 million people die in RTAs annually and it is projected to increase by 65% in the next 20 years.[5] RTAs happen as a result of an interaction between the environment, vehicles and vehicle users. Some of the human causes include, speeding, driving under influence, nonuse of seatbelts among others.[6] Environmental interactions are mostly due to the weather. Weather changes have a big impact on the occurrence of RTAs. The injuries and fatalities that happen during RTAs have been associated with both high and low temperatures, precipitation, sunshine, wind speed and sandstorms.[2] RTA are a burden to the economy of the country as well as a burden on the healthcare system. At least 3% of a country's GDP is spent on RTA annually. In 2020, there were 3.14 deaths per 100,000 due to accidents and it increased by 20% in 2021.[7] There are limited studies done around the globe to check the relation between these two variables and none are done in the UAE. There has been a 20% increase in the fatality rate associated with RTA.[8] This review was written to illuminate the gap of

knowledge in this area and see whether the results can be applied here.

MATERIALS

In order to get a list of suitable studies for this narrative review, two teams were made. Both teams searched the following databases (PubMed and SpringerLink) using keywords "Climate change and RTA" for peer-reviewed articles that were relatively recent. The teams shortlisted the articles and compared the lists. The redundancies were removed and five articles, published in different parts of the world (Europe, America, Middle East, and South Asia) were selected.

RESULTS

In Pakistan and Saudi Arabia, the studies showed a significant relation between RTA and heavy rainfalls, cold weather, fog/sandstorm, temperature with an increasing number of traffic accidents in the younger age group compared to older drivers in Pakistan.[4,9] This could be due to the maturity of drivers, better manoeuvring when driving in difficult conditions. Subsequently, in Saudi Arabia, it was found that deaths due to RTA are significantly more in cities than outside.[9]

Studies from Germany showed an increase in RTA in all seasons other than winter, especially where there is a lot of tourist drivers that are either not familiar with the traffic rules in the region and crowdedness while in the USA it was found that there was a moderate decline in non fatal accidents in the warmer temperatures however there was an increase in fatal accidents.[2,10] In all countries with harsh winters it was found that RTAs increase with the temperature falling below freezing point which is mostly associated with reduced visibility and road slipperiness.

DISCUSSION

The objective of this narrative review was to see the impact of climate change on RTA across the globe. All studies confirm the fact that climate change has resulted in changes in the pattern of rainfall, temperature, sandstorms, snowfall etc. There has also been sharp increase in the number of vehicles on the road. All of this has resulted in changes in the rate of RTA.

Since the 19th century, the temperature of the land and ocean increased by 0.08 degrees C or 0.13 degrees F per decade. However, the rate of increase has doubled since 1981.[11] This is due to the rate of carbon emissions. Since 2000, there has been a sharp increase in the amount of carbon emissions due to burning of fossil fuels and land use change. In 2000, 29.77 billion tonnes of carbon dioxide was emitted and this increased rapidly to 38.02 billion tonnes by 2020.[12] Due to the COVID 19 pandemic there was a slight dip in the rate of carbon emissions but this could change once everything goes back to pre-pandemic normalcy. Models project that if the rate of carbon emissions continues at the same rate the global mean temperature will increase by at least 5 degrees F. Even if the rate of emissions decreases and start to fall by 2050 there will still be increase by at least 2.4 degrees F.

Therefore, it is important to analyze how this increase in temperature will affect the rate of RTA. Across all the studies it was found that an increase in temperature resulted in an increase in RTA. In Saudi Arabia, increase in temperature results in more accidents within the city as compared to outside cities.[9] In USA and Germany, it was noted there was an increase in mortality associated with accidents occurring in higher temperatures.[2,10] This could be explained by a few factors. The increased accidents could be attributed to the physiological effect of heat on the body. It results in altered emotions, increased irritability, increased reaction time and overall decreased concentration. This contributes to a higher rate of mistakes being made by drivers. The increased mortality in USA and Germany is mainly due to the fact that during warmer temperatures the number of pedestrians and cyclists increase. The latter also experience an increased number of tourists in its alpine regions. All of these factors result in an increased mortality rate.

Climate change also affects the rate of precipitation. This includes both rainfall and snow fall. Increase in temperature will result in increased evaporation of water. Areas which experience frequent rainfall will have more episodes of rain whereas dry areas can expect more droughts. However, rainfall models do point out that when it will rain, it can be expected to be intense.[13]

There was a statistically significant increase in RTA during the rain. This can be easily be explained by wet roads which leads to decreased friction between the wheel and the road. Visibility will be low as well especially during the night when headlights can cause glares from the water all around. Leard and Roth reported that in USA while there was an increase in the rate of RTA's there is no increase in mortality.[10] They attributed this to cautious driving behavior exhibited by the drivers or they avoid trips during this type of weather. However, during snowfall, the overall mortality rate is higher than during rainfall. This suggests that the behavioral changes are not enough to compensate for the snowfall. Sandstorms which occur frequently in desert areas are another major factor causing accidents.[9] Poor visibility is the main reason for accidents occurring during sandstorms.

In the West Midlands in the United Kingdom, climate change models indicate that there will be shorter winters and lower freezing temperatures. This means less frost on the roads and in theory there should be a 43% decrease in RTA's that occur on days with frost.[14]

Fog is an important factor when it comes to road safety. It decreases the visibility on the road and glare is also present due to the reflection of the light. In the recent past

there has been a decrease of fog trends around the world. This is mainly due to climate change. According to Klemm et al a 0.1 degree C increase in temperature can result in the decrease of fog to the same extent that a decrease of aerosols by 10% would cause.[15] Therefore, it would be safe to assume that as the global temperature rises, the incidence of fog may decrease in some parts of the world. This may result in decrease of RTAs due to fog.

Car density also plays a role. More and more people are buying and using cars on a daily basis. In Saudi Arabia, they found that more accidents due to adverse weather conditions occur within cities as compared to outside cities.[9]

CONCLUSION

Overall, different countries will have different changes in their weather due to climate change. It can cause an increase of accidents during the summer and a decrease during the winter. The decrease during the winter would be due to less severe winters and less frost on the roads. However, there could be a confounding factor in this scenario. Due to rising temperatures during the winter there could be more pedestrians, cyclists and motorbikes on the road. They could contribute to RTA.

Recommendations

Climate change is real and constantly affecting our surroundings. From the reviewed articles it has been established that climate change has its own effects on the roads and driving conditions. However, climate change affects different countries in different ways. Quantitative and qualitative research has to be conducted in order to ascertain how climate change will affect each country's road and driving condition. This is of great importance especially in UAE where no such study has been conducted and drivers from different countries drive here. A study conducted here will give information to policy makers which will help them enact policies that could reduce the rate of RTA

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