The impact of naturally generated particulate matter -emanating from desert dust storms- and cardiovascular pathophysiology: An alarming worldwide reality.

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We recently read the interesting article by Münzel et al¹. They provide an overview of the impact of particulate and gaseous pollutants on endothelial function from human and animal studies. However, we would like to point out an important aspect in relationship with the impact of naturally generated particulate matter (PM) emanating from dust storms and the adverse health effects on human populations.

Studies based on time-series analysis of daily mortality have shown an association between PM and total, cardiovascular and respiratory mortality. Most of them have been performed in cities located at mid-latitudes (40-55°N), where urban PM composition (soot, hydrocarbon, sulfur and nitrogen fine particles) is linked to combustion emissions (globally $200\text{--}250 \text{ T}\cdot\text{y}^{-1}$)². Large desert regions occur in the subtropics (12-35°N, North Africa, Middle East to Asia), where large dust (clays and other minerals) emissions ($1500\text{--}2500 \text{ Tg}\cdot\text{y}^{-1}$)² occur. North African dust is regularly transported over the Atlantic, and episodically over the Mediterranean and Europe, where associations between dust and cardiovascular mortality has been observed². There is an increasing interest on the environmental impacts of such events due to the potential shift of the subtropical desert conditions to higher latitudes linked to climate change and desertification². An illustration of such concern is the Sand and Dust Storm Warning Advisory and Assessment System (SDSWAS) launched by the World Meteorological Organization (WMO) to provide to the global community with daily dust forecasts (Figure 1). The increased risk associated with Saharan dust exposure may be partially linked to pathogens transported with dust, since dust particles are a suitable medium for the survival of microorganisms³. Saharan dust may also contain toxic biological allergens^{2,3}. This, along with change in the composition of PM present in the

atmosphere, brings with it an increased oxidative stress, inflammation, endothelial dysfunction and subsequently cardiovascular disease.

In summary, dust toxicity may differ from combustion-PM, raising further questions about mechanisms and implications on human health. PM concentrations in North Africa and the Middle East are among the highest in the World due to dust events, and the implications on health effects remain unknown². How can the available daily dust forecasts contribute to protect human health? Research focused on the identification of the cardiovascular effects of inhaling dust particles is needed, especially in the subtropics. What is the profile of the susceptible population? Combustion emissions may decrease in the next decades due to air quality legislations, an issue that will convert to desert dust to the prevailing PM component in large parts of the World.

References

1. Münzel T, Gori T, Al-Kindi S, Deanfield J, Lelieveld J, Daiber A, Rajagopalan S. Effects of gaseous and solid constituents of air pollution on endothelial function. *Eur Heart J* 2018;**39**:3543-3550.
2. Karanasiou A, Moreno N, Moreno T, Viana M, de Leeuw F, Querol X. Health effects from Sahara dust episodes in Europe: literature review and research gaps. *Environ Int* 2012;**47**:107-114.
3. Griffin DW. Atmospheric movement of microorganisms in clouds of desert dust and implications for human health. *Clin Microbiol Rev.* 2007;**20**:459-77

Figure 1 Surface dust concentration modeling forecast by the Sand and Dust Storm Warning Advisory and Assessment System (SDSWAS).