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Social Epidemiology
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Assignment 6

# Syndemic

This proposal investigates the association between exposure to air pollution (e.g. particulate matter and ozone) and risk of birth defects. It further assesses the effects of social factors (e.g. neighborhood income) on this association.

The causes of birth defects remain unknown. However, similar to other birth outcomes such as low birth weight, neonatal death, and infant death, birth defects are likely caused by a myriad of factors ranging from personal to social. In other words, a simple disease model is likely unable to sufficiently explain all the etiologic factors for birth defects and the relationship between them. For a health outcome, such as birth defects, multiple factors are involved to influence the risk. These factors often interact synergistically (syndemic) or antagonistically (counter-syndemic) with each others to produce effects that are not equal to the sum of their independent effects.[1] The relationship between the factors that are involved in the syndemic can vary and are illustrated in Figure 1. For example, the factors A and B may affect health outcome through co-occurrence by chance. Factor A may cause or predispose the individual to B and affect the outcome (red path). Factors A and B may also be effects of some common factor(s) C (blue path), or causes of a common effect(s) D (green path) (Figure 1).

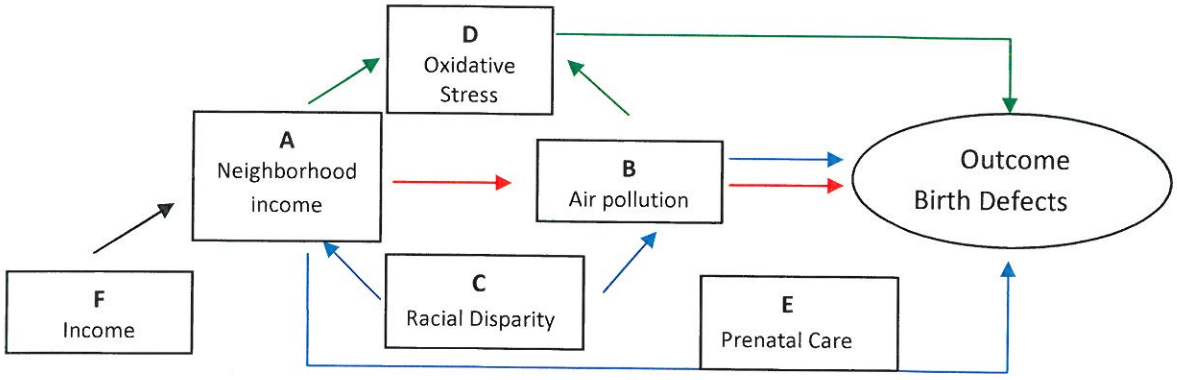


Figure 1: Possible relationships between common risk factors for birth defect.

The effects of social factors such as neighborhood income and air pollution on birth defects are complex and undoubtedly synergistic. The co-existence of social risk factors for birth defects (e.g. low neighborhood income) and high levels of air pollution is not likely due to chance. Income level would predispose families to live in certain neighborhoods with specific average neighborhood income levels. This in turn predisposes their exposure to different levels of air pollution since air pollution is not randomly distributed within space. In fact, the levels of air pollution tend to be higher in neighborhoods with lower income.[2] Therefore, low neighborhood income predisposes individuals to higher levels of pollution and these two factors can increase the risk of birth defects (red path in Figure 1).

More importantly, lower neighborhood income does not only affect risk of birth defects through high exposure of high pollution. Rather its effects can simultaneously go through other pathways. For example, neighborhood income may affect access to adequate prenatal care, which in turns predisposes individuals to higher risks of having birth defects. More specifically, a lower neighborhood may directly affect risk of birth defects by decreasing people's ability to obtain adequate prenatal care. This may be due to infrastructure, transportation, distance to prenatal care facilities, etc. Prenatal care helps get women treated for certain health problems such as infections or other health conditions that can negatively affect their pregnancy. Prenatal care has been found to inversely associate with risk of birth defects. [3,4] Overall, lower neighborhood income is a common cause of higher pollution and lower access to prenatal care. These two factors can act synergistically to increase the risk of birth defects to a greater degree than their independent effects because of the different pathways they are involved in.

good

yes

Another pathway through which neighborhood income and air pollution can affect the risk of birth defect is through a common effect: high oxidative stress. High levels of oxidative stress have been linked to many negative birth outcomes. [5] Meanwhile, exposures to high levels of air pollution have been linked to higher levels of oxidative stress.[6] In addition, people who live in neighborhoods with lower income are more likely to experience more stress due to finance, security, and many other reasons. This in turn increases stress markers in their body. Since it is clear that both neighborhood income level and exposure to air pollution can independently increase oxidative stress levels, they can interact multiplicatively to affect birth defect. High levels of oxidative stress can be counteracting by sufficient antioxidant intake through foods or supplements. Antioxidant intake has been shown to show protective effects on birth outcomes.[5] However, insufficient antioxidant intake during pregnancy is a potential problem because women who live in lower income neighborhoods are less likely to have sufficient supplements. [7,8]

perfect

Air pollution exposure and low neighborhood income may be part of the same problem (effects of a common case): racial disparity. Racial disparity may results in disparity in income. This may affect the average income of a neighborhood one lives in and therefore can ultimately affect risk of birth defects through mechanisms previously described. Racial disparity may also independently affect where one wants to live through preferences (e.g. people from the same ethnic group may prefer to live near each other irrespective of income levels). The location they live directly affects the level of air pollution, which in turn affects the risk of birth defects. Therefore, racial disparity is a common cause for both neighborhood income and the level of air pollution one is exposed to.

yes

The mechanisms that involve the effects of air pollution on birth defect are very complex and may involve many other factors which have not been discussed. It is important to elucidate these mechanisms in order to effectively prevent birth defects, which remains a serious problem in developing as well as developed countries such as the U.S. Meanwhile, it is important to first determine the association between air pollution, and investigate how a common indicator for social factor, neighborhood income, affects this association. With this knowledge, more studies can be conducted to further study the complex mechanisms.

Problems: neighborhood income disparity, access to prenatal care, insufficient antioxidant intake, racial disparity