Long-term exposure to air pollution and mental health[1]

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INTRODUCTION

Globally, mental illness is the leading cause of years lived with a disability. There is now increasing evidence that mental health and wellbeing may be associated with environmental conditions, including poor air quality. One of the most damaging forms of air pollution is fine particulate matter ($PM_{2.5}$), which in Ireland is caused by the burning of solid fuels (coal, peat and wood) for heating. While levels of $PM_{2.5}$ in Ireland are low by international standards, levels in many cities and towns are still above World Health Organization (WHO) air quality guidelines.

$PM_{2.5}$ can penetrate the lungs, causing chronic lung disease and cancer, but there is also emerging evidence that these particles may enter the bloodstream, leading to other health conditions. The ways in which air pollution may affect mental health include inflammation, chronic stress exposure, and adverse effects on cognition and brain function.

While much previous research has examined how short-term exposure to air pollution (less than six months) affects health, less is known about how long-term exposure to poor air quality affects mental health and wellbeing. In this study, we linked data on local levels of ambient (outdoor) $PM_{2.5}$ over a 17-year period to survey data that measured individuals' mental health and wellbeing, allowing us to test for an association.

DATA AND METHODS

Data on individuals' mental health and wellbeing were sourced from the Irish Longitudinal Study on Ageing (TILDA), a nationally representative study of people aged 50 and over in Ireland. Five measures of mental health and wellbeing were available: depression, anxiety, worry, stress and overall quality of life. Data on annual average $PM_{2.5}$ levels for each of the years from 1998 to 2014 were sourced

from a global database of $PM_{2.5}$ levels at 1km-grid resolution. Because respondents in the TILDA survey supplied their current and previous residential addresses, the research team could match annual average $PM_{2.5}$ data to each respondent and calculate a long-term (17-year) average of $PM_{2.5}$ levels in their locality.

Statistical methods were then used to examine whether this long-term $PM_{2.5}$ average was associated with the five measures of mental health and wellbeing, taking account of other characteristics that may also be associated with mental health and wellbeing, such as age, sex and various measures of socioeconomic status.

RESULTS

Over the 17-year period 1998-2014, the average annual $PM_{2.5}$ level for TILDA respondents was 7.7 $\mu g/m^3$ (range 5-12), with over half the sample experiencing levels between 5 and 7 $\mu g/m^3$. To put these levels in context, the WHO air quality guideline level for annual $PM_{2.5}$ exposure is 5 $\mu g/m^3$, and EU countries such as Poland and Bulgaria had annual average levels greater than 25 $\mu g/m^3$ in 2014.

The statistical modelling showed that higher annual average $PM_{2.5}$ levels were significantly associated with higher depression and anxiety. The effect sizes were large, and comparable with effect sizes for other factors linked to depression and anxiety, such as sex.

We found no evidence of associations between long-term $PM_{2.5}$ air pollution and other indicators of mental health and well-being: stress, worry and quality of life. Understanding why long-term $PM_{2.5}$ concentrations were associated with depression and anxiety, but not other indicators of mental health and wellbeing, is challenging and worthy of further research. It is possible that different dimensions of mental health may be influenced by the length of exposure, the specific type of pollutant and/or omitted confounding variables.

CONCLUSIONS

The study results add to the body of evidence that suggests that the health-damaging effects of air pollution can operate at low levels of exposure. In Ireland, the recent Clean Air Strategy commits to the achievement of the WHO air quality guidelines by 2040. Hitting this target will require substantial measures to decarbonise home heating, alongside measures to reduce pollution from industry, transport and agriculture.