

11-2021

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### Recommended Citation

Duan, William R. and Hand, Dennis J., "Patterns in Change of Opioid Overdose Death Rate with the Day of the Week and Their Implications" (2021). *Department of Psychiatry and Human Behavior Posters*. 3.  
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# Patterns in Change of Opioid Overdose Death Rate with the Day of the Week and Their Implications

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## Background:

The objective of this study was to investigate the dependencies of opioid overdose death rates on the day of the week and understand the implications of the dependencies. Understanding and presenting the dependencies is useful for first responders and for health care system resource planning. It can provide additional insights in the opioid epidemic and should be considered in prevention efforts.

Opioid-overdose deaths in the US from 2003 to 2018 were analyzed using the mortality multiple cause files published yearly by the Center for Disease Control and Prevention. Population data from the American Community Survey 1-Year Estimate Detailed Tables from the US Census Bureau were used for age-adjusted death rate (AADR) calculations.

## Results and Discussion:

Opioid overdose deaths during weekends (Saturdays and Sundays) were higher than during weekdays. The lowest number of deaths happened near the middle of the week (Fig. 1). In contrast, AADR of all deaths and deaths related to diseases (ICD-10 code A00 through R99) did not show a weekend-to-weekday difference (Fig. 2), indicating that any differences in medical response was not a main factor in the weekend-to-weekday delta in opioid overdose deaths. This delta was observed consistently from 2003 to 2018 (Fig. 3a and 3b). The consistent trend is likely an indicator that working and schooling environment in weekdays discourage or curtail opioid abuse.

The difference in opioid overdose death rates between weekends and weekdays is defined as the peak-to-valley delta (PVD). The change of PVD from 2003 to 2018 is plotted in Fig. 4. All PVD had positive values, indicating a higher opioid overdose deaths in weekends. However, PVD value decreased from 2003 to 2018. One possible explanation is that the structure of working on job sites in weekdays / staying off jobsites in weekends was becoming less well defined over the years, such as with increasing adoption of working-from-home arrangements.

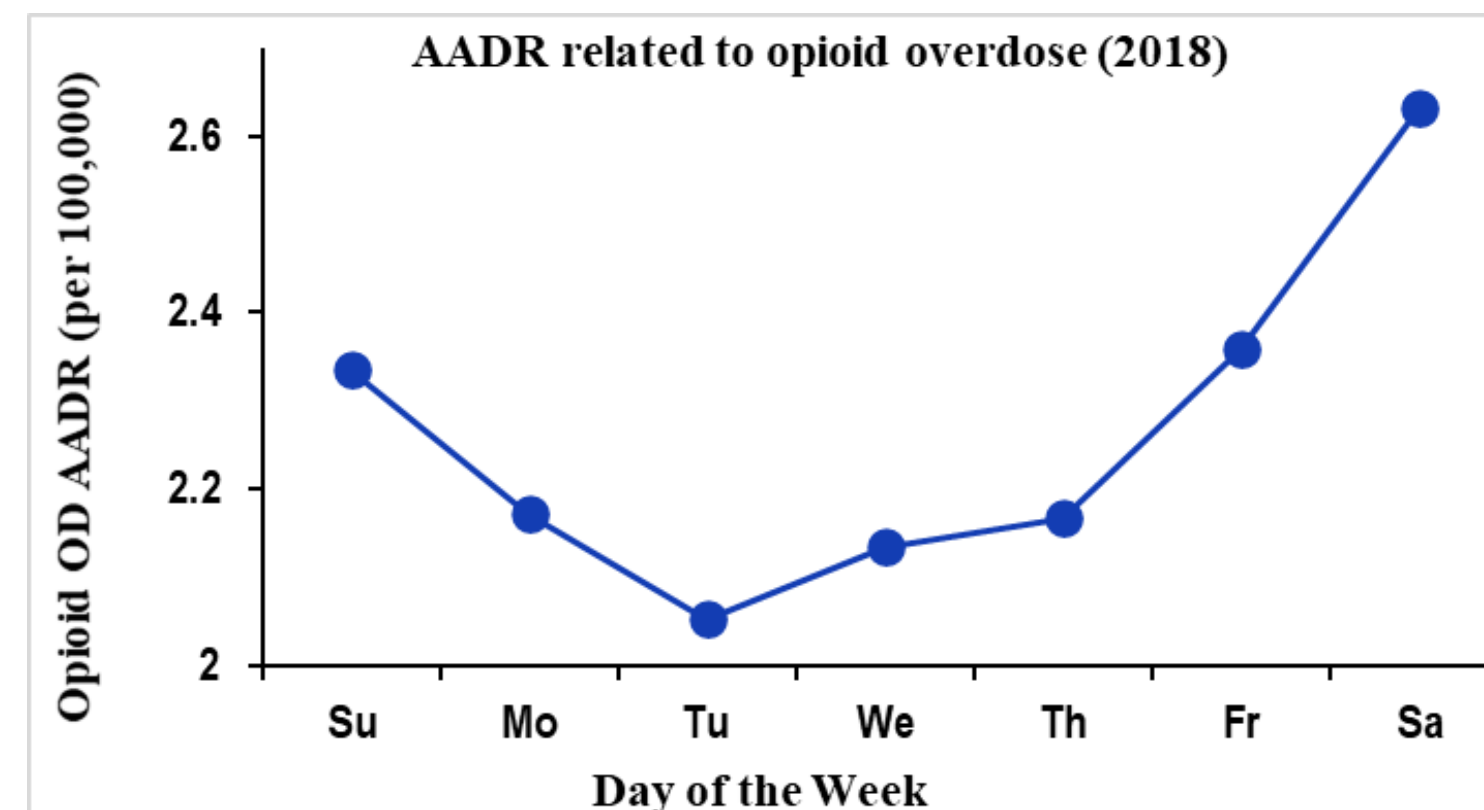


Fig. 1: AADR Due to Opioid Overdose

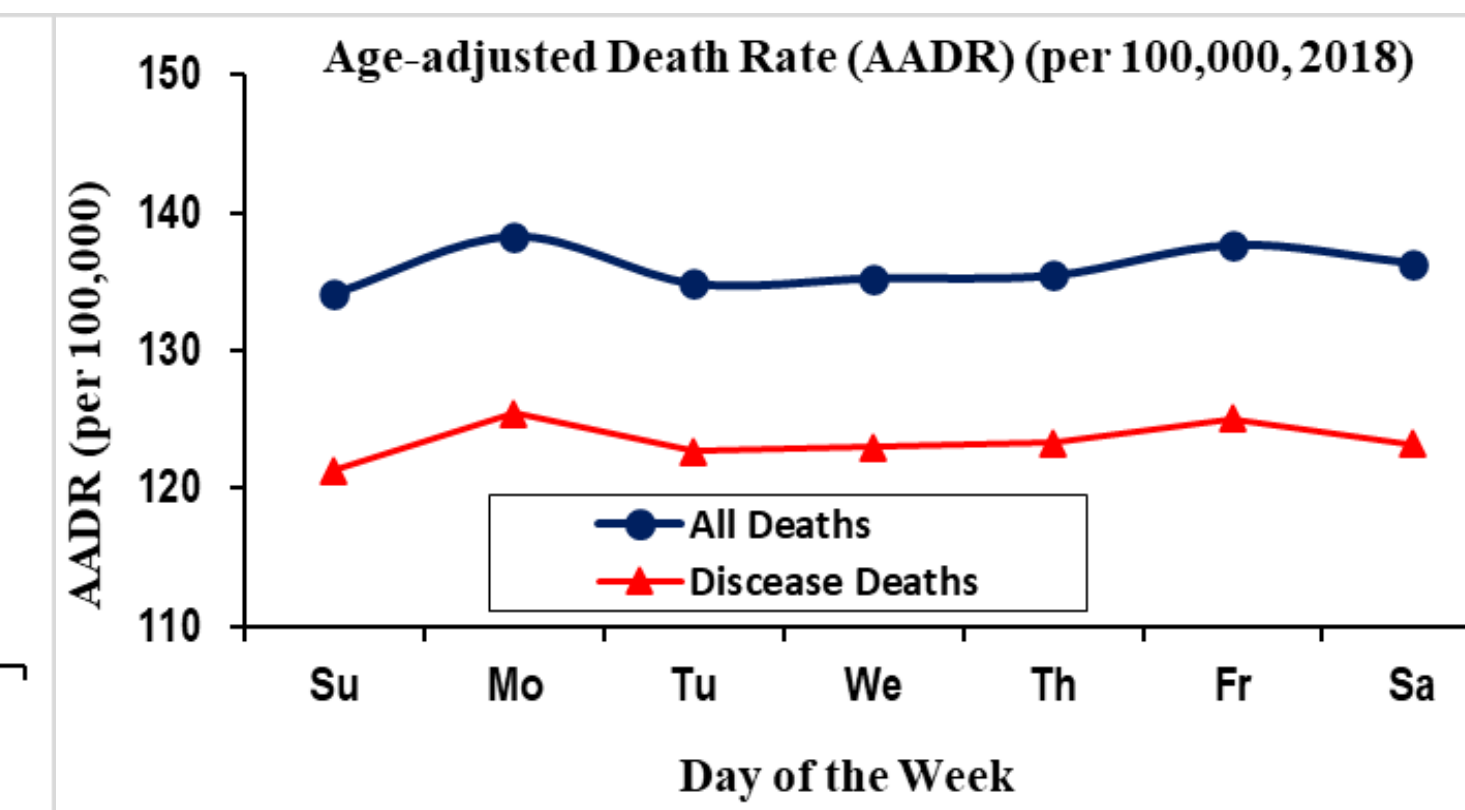


Fig. 2: AADR: all deaths and certain disease deaths

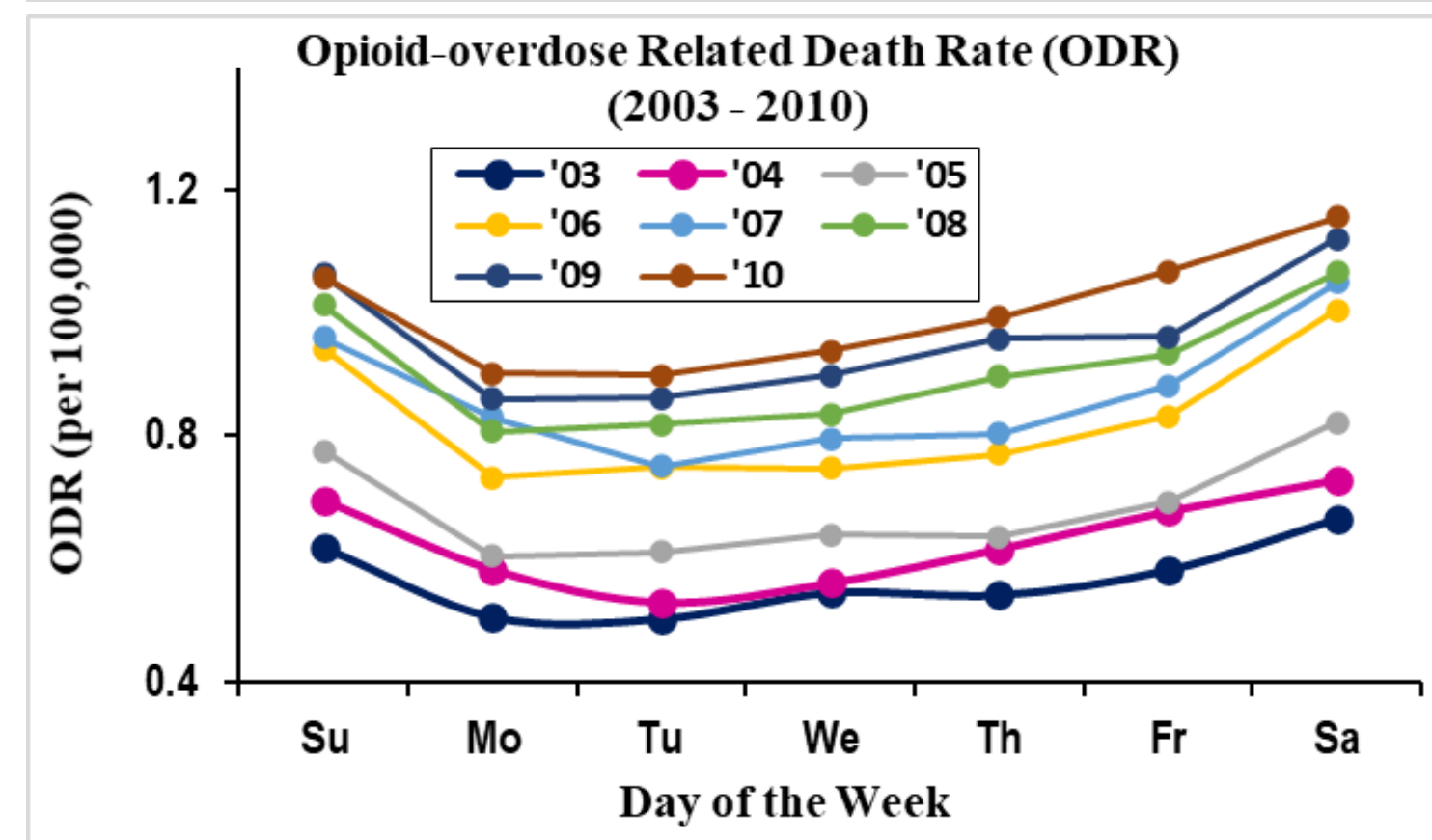


Fig. 3a: ODR vs. day of the week

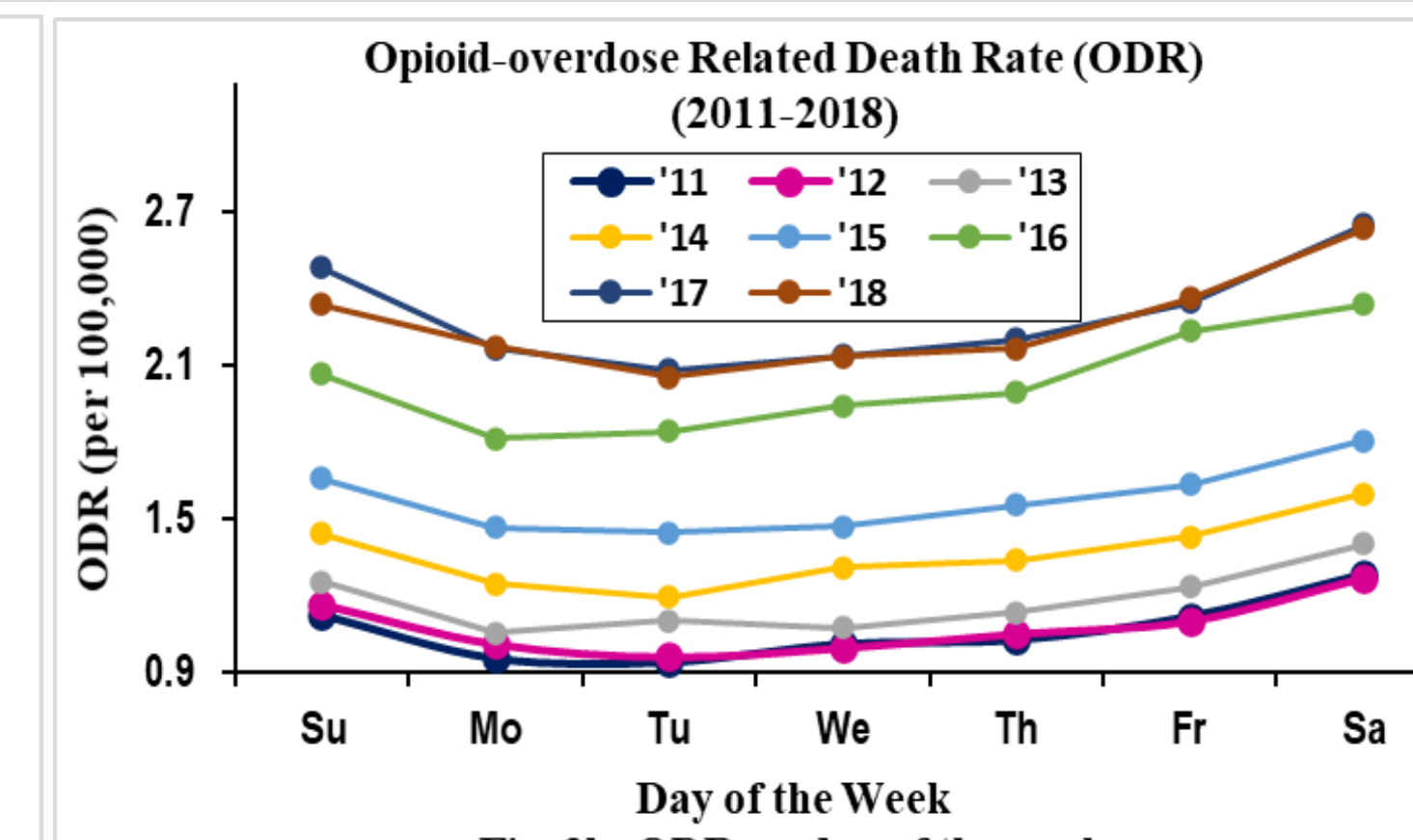


Fig. 3b: ODR vs. day of the week

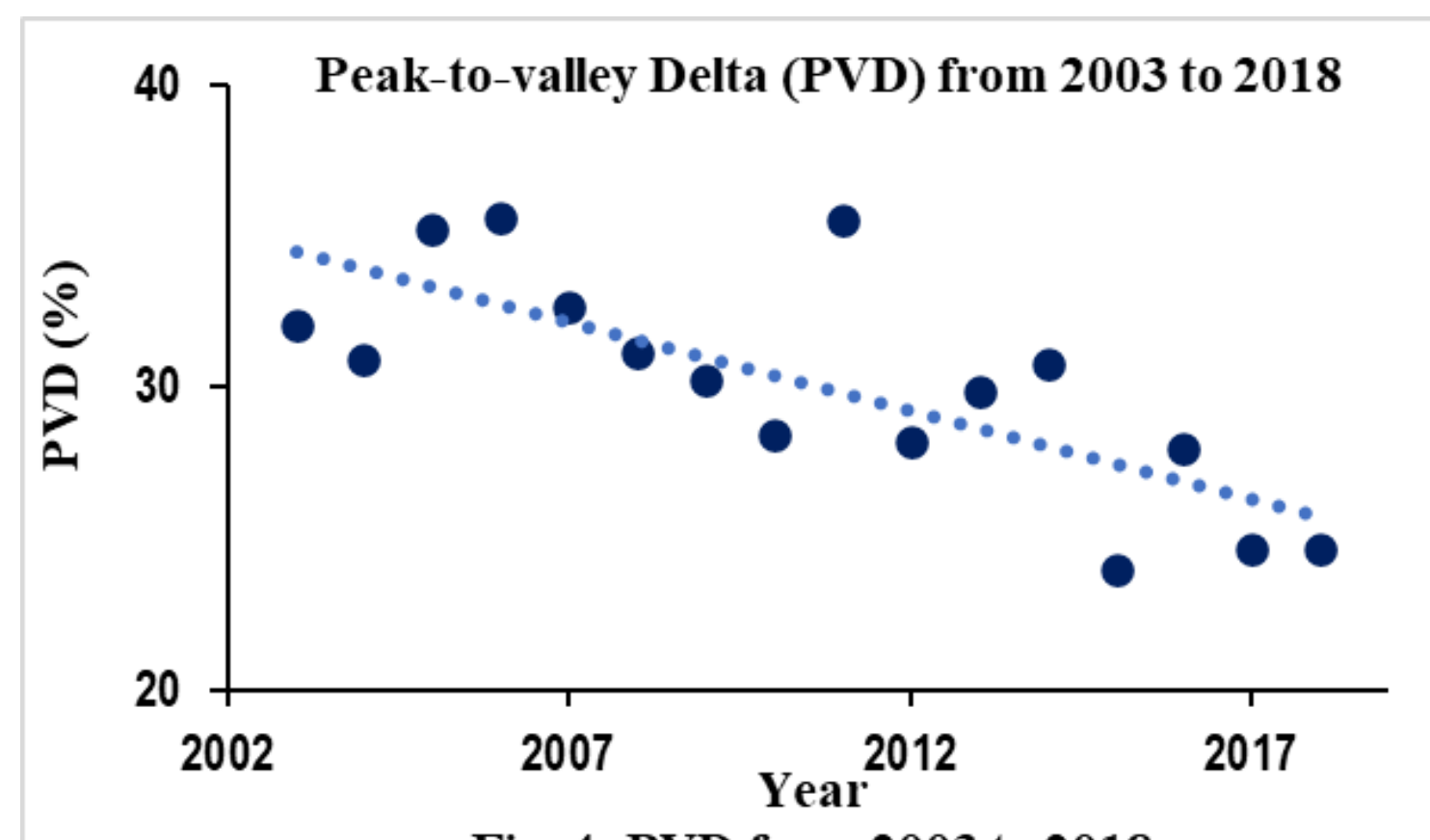


Fig. 4: PVD from 2003 to 2018

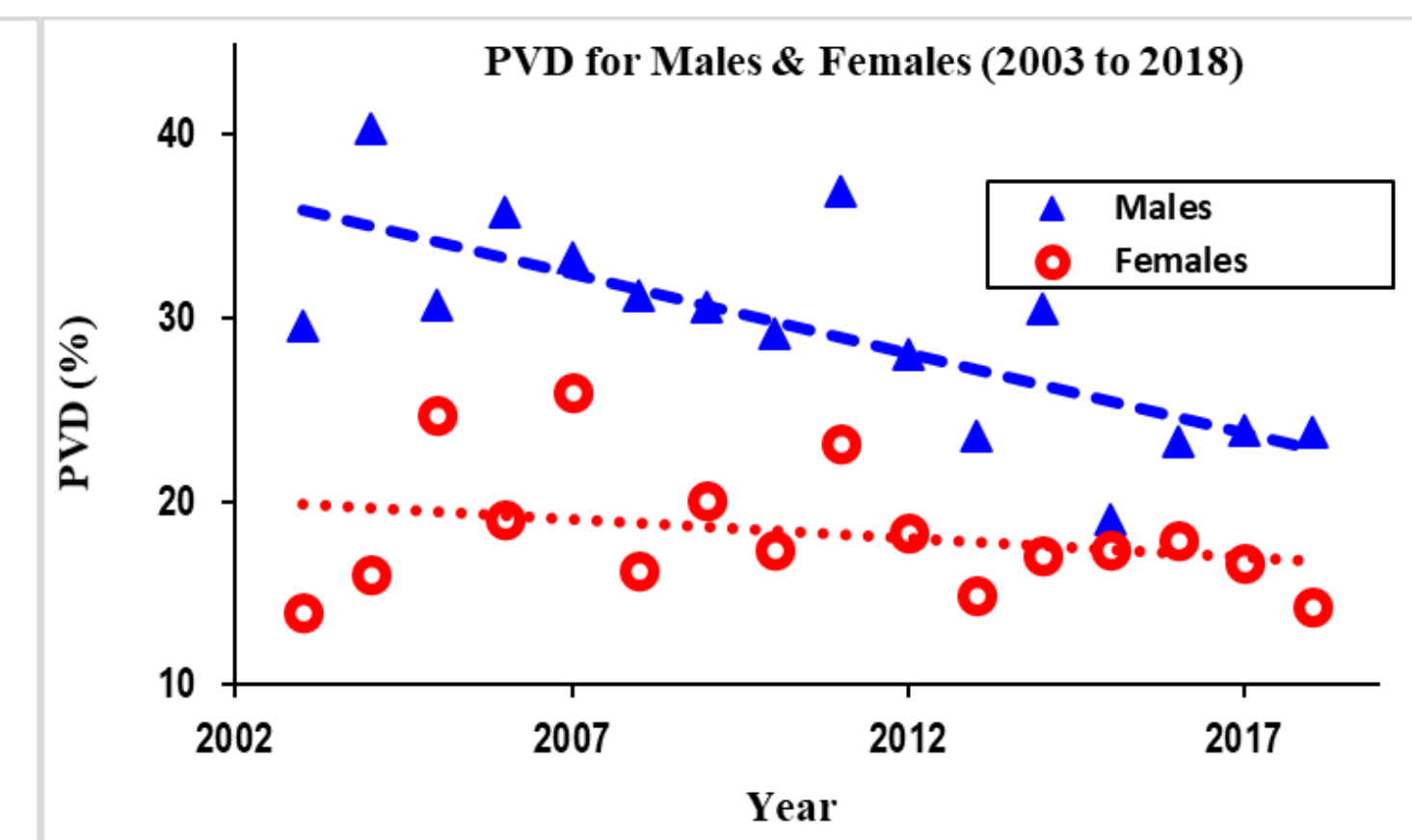


Fig. 5: Peak-to-valley delta 2003 - 2018, by sex

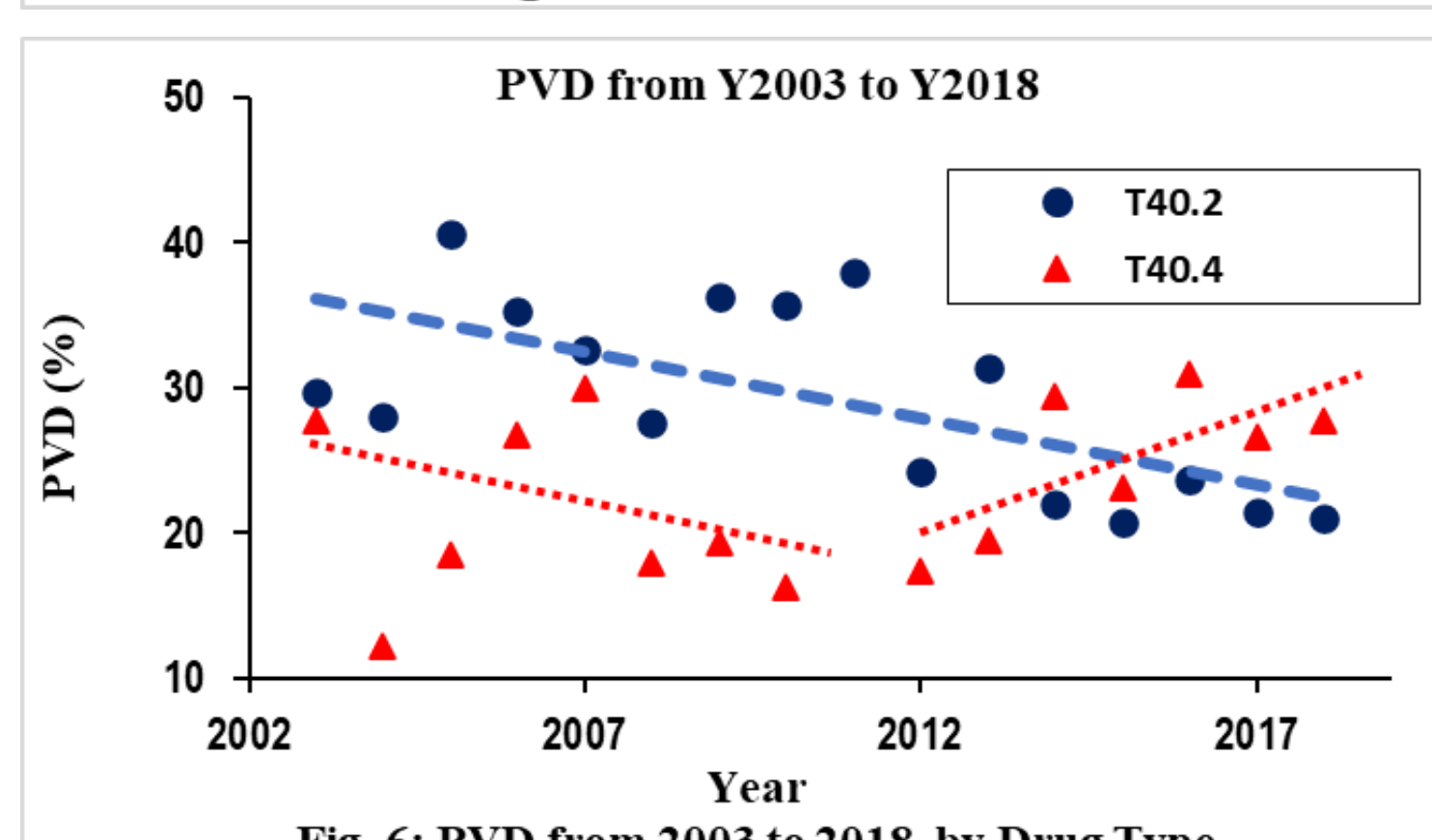


Fig. 6: PVD from 2003 to 2018, by Drug Type

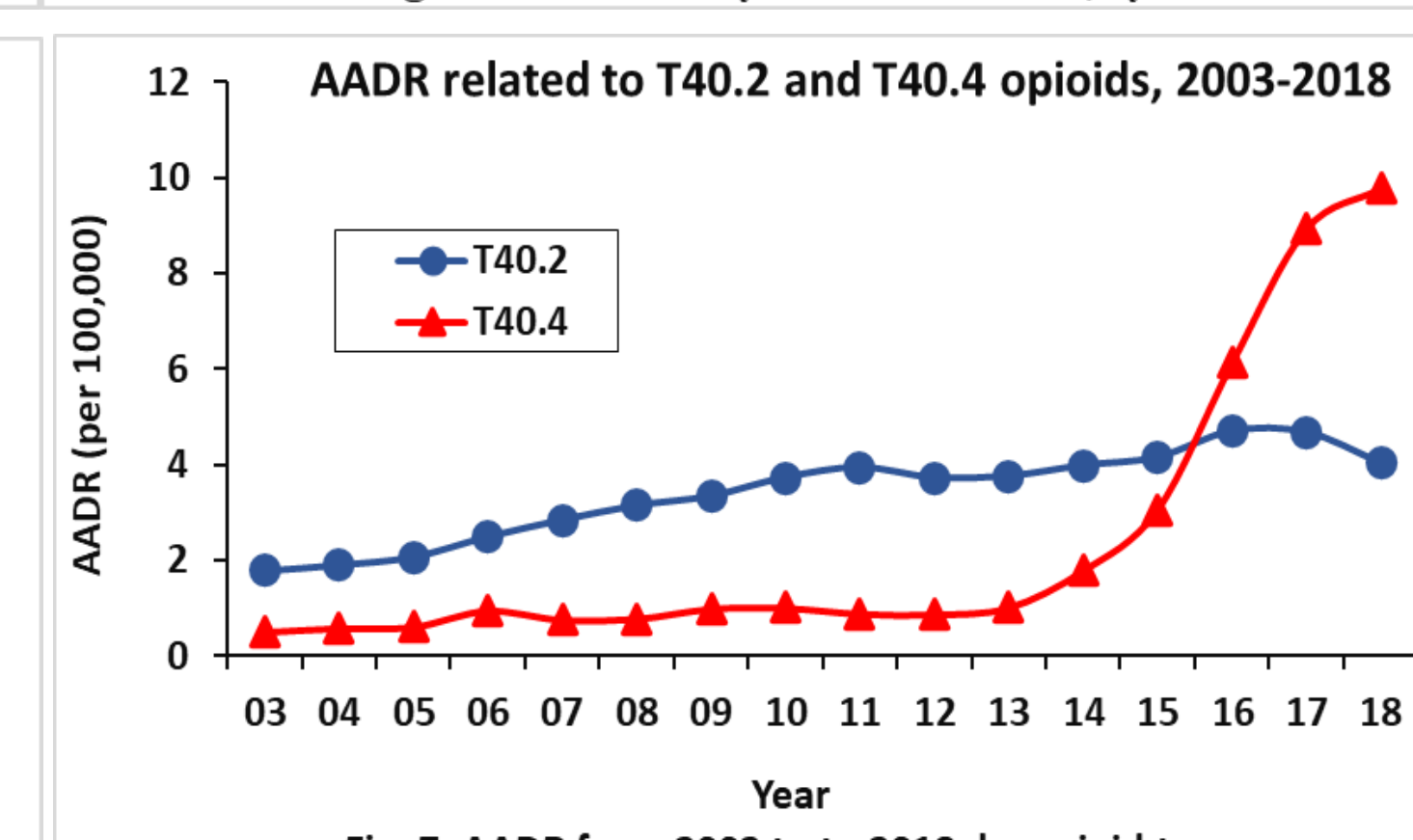


Fig. 7: AADR from 2003 to 2018, by opioid type

In Fig. 5, PVD for the male and female populations are plotted separately. It was observed that (1) weekend-to-weekday difference in opioid overdose deaths were higher for males than for females, (2) while PVD decreased from 2003 to 2018 for males, PVD for females changed little during the same period.

In Fig. 6, PVD values of opioid overdose deaths are plotted from 2003 to 2018 for T40.2 opioids (prescription opioids) and T40.4 opioids (synthetic opioids such as fentanyl). For both type of opioids, PVD was positive, indicates higher deaths in weekends than weekdays. However, for overdose deaths involving T40.4 opioid, the trend with time experienced an inversion in 2012. PVD related to T40.4 opioids decreased from 2003 to 2010, it increased significantly from 2012 to 2018. This trend is associated with the dramatic increase in T40.4-opioid-related overdose deaths from 2012 to 2018 (Fig. 7).

## Conclusions:

There is a consistent weekend-vs-weekday difference in opioid-overdose related death rate, with lower death rate near the middle of the week. The difference likely indicates that working or schooling environments in weekdays discourage substance abuse, rather than due to differences in the availability of emergency medical services. The weekend-to-weekday delta followed a decreasing trend, likely related to increasing adoption of work-from-home arrangements and flexible work schedules over time. The rapid increase in T40.4 opioid related overdose deaths since 2012 was driven in large part by increased deaths in weekends.