Changes Occupation Specific in Non-COVID-19 Death Rates during the COVID-19 Pandemic in King County, WA

Technical Appendix

March 1 – December 31, 2020

We analyzed deaths among King County residents from 2017-2020 using death certificate data from the Washington State Department of Health Center for Health Statistics. We compared provisional death certificates for deaths occurring in 2020 to deaths that occurred during the same time period of 2017-2019.

All analyses excluded deaths that were biologically related to COVID-19. To provide the most current possible analysis, we defined causes of death using free text searches and the recorded manner of death rather than the International Classification of Disease (ICD)-10[1] codes because finalized ICD-10 codes were not available for the 2020 death data.

Substantial variation in death rates by cause of death and sub-population can make interpretation of death rate differences challenging. Using rate ratios to compare 2020 death rates to 2017-2019 death rates facilitates interpretation. For any causes of death and sub-population combination, a ratio of less than one shows a decreased death rate in 2020, a ratio greater than one shows an increased 2020 death rate, and a ratio equal to one shows a stable death rate. Furthermore, the proportion above or below one can be understood as a percent, e.g., a ratio of 0.90 is a 10% decrease in the death rates and ratio of 1.15 is a 15% increase in the death rate.

Age-adjustment

Age-adjustment is a statistical technique for standardizing the age distribution across different populations in order to facilitate comparison between groups. For example, almost 90% of Hispanic King County residents are under 50 years old, whereas less than 65% of white residents are under 50 years old. Since older persons are at greater risk of death, calculating standardized rates across groups allows us to more accurately assess if one group is at higher risk for death for reasons beyond the differences in age. This technique also allows for more accurate comparisons when age distributions of groups have changed over time. Note that age-specific estimates (e.g., death rates for youth 0 to 17 years of age) provided in the report are crude rates (i.e. not age-adjusted).

Cause of Death Definitions

Final encoding of cause of death on the death certificate into ICD-10 codes is a process that can take up to 12 to 18 months. In order to conduct rapid mortality surveillance with minimal delays, specific causes

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[1] https://www.cdc.gov/nchs/icd/icd10.htm, last accessed 12/8/2020

of death were classified by systematically searching the open text immediate causes of death fields (cause A-D) and the manner of death on the death certificates. Search terms were developed iteratively to improve sensitivity and specificity. The search terms could appear in any of the four cause fields; causes of death were not ascribed a hierarchy and are not mutually exclusive. For example, if a decedent had diabetic shock, which led to a fatal car accident, the individual would be classified as having a diabetes, traffic, and unintentional injury related death. To avoid introducing temporal biases from using ICD-10 codes with older data and open text for newer data, we applied the search string algorithm to entirety of our dataset.

We excluded both confirmed and suspected COVID-19 deaths from this analysis. Confirmed deaths are those where the deceased person tested positive for COVID-19 and had a death certificate noting that infection with the virus contributed to death. Suspected deaths are those where the deceased person tested positive for COVID-19 within 28 days of death, died of a natural disease, and did not have COVID-19 listed on their death certificate.

Below we present the search strings for the causes of death examined in this analysis. Unless otherwise specified, search terms use regular expressions and are applied to causes A-D.

Cancer

- "adenocarcinoma" OR "astrocytoma" OR "blastoma" OR "brain malignancy" OR "cancer" OR "carcinoma" OR "glioblastoma" OR "glioma" OR "hepatoma" OR "leukaemia" OR "leukemia" OR "lymphoma" OR "macroglobulinemia" OR "malignancy" OR "mass" OR "melanoma" OR "meningioma" OR "mesothelioma" OR "metastasis" OR "metastatic" OR "myelodysplasia" OR "myelodysplastic" OR "myelofibrosis" OR "myeloma" OR "myeloproliferative" OR "neoplasm" OR "oligodendroglioma" OR "pancreatic caner" OR "sarcoma" OR "tumor"

Cardiovascular Disease

- "aneurysm" OR "aorta" OR "aortic" OR "arrhythmi" OR "arteriosclerosis" OR "artery" OR "asystole" OR "atherosclerotic cerebral disease" OR "atrial fib" OR "card" OR "cerebrovascular" OR "chf" OR "congestive heart" OR "cor pulmonale" OR "coronary" OR "deep vein thromb" OR "deep vein thrombosis" OR "deep venous thromb" OR "heart attack" OR "heart block" OR "heart disease" OR "heart failure" OR "hypertension" OR "hypertensive disease" OR "infarct" OR "ischemia" OR "left ventri" OR "mitral regurgitation" OR "peripheral arterial disease" OR "pulmonary embol" OR "pulmonary embolism" OR "pulmonary thromboembol" OR "pulseless electrical activity" OR "recurrent venous thrombosis" OR "resuscitated arrest" OR "stemi" OR "stemi$" OR "[[:blank:]]stemi" OR "vascular disease" OR "vascular ischemic" OR "venous insufficiency" OR "ventricular fibrillation"
- "atherosclero" AND NOT "cereb"
- "vascular" AND NOT ("cereb" OR "dementia" OR "alz" OR "brain" OR "cerbro")
- "heart" AND "failure"

Dementia

- "alzheimer" OR "dementia" OR "pick's disease" OR "picks disease" OR "senile degeneration" OR "cerebellar degeneration" OR "delirium"

- "brain" AND "degeneration"

Diabetes

- ("diabet" OR "dm") AND NOT ("mdma" OR "admi")

Drowning

- "drown" OR "submers"

Firearms

- ("gun" OR "rifle" OR "shot" OR "bullet" OR "firearm" OR "fire arm" OR "gsw" OR "pistol" OR "revolver" OR "gsw") AND NOT ("pellet gun" OR "bebe gun" OR "bb gun" OR "pain" OR "bbgun" OR "bb pellet" OR "nerf" OR "nurf" OR "airgun" OR "air gun" OR "spring" OR "air soft" OR "nail gun" OR "remove gun" OR "no gun")

Homicide

- when the manner of death was **H – Homicide**

Overdose

- (injurydesc contains "toxic" OR "overdose") OR (injurydesc contains "intoxic" AND acute)
- among those identified above, search for the "intoxicat" among causes A-D and causeother. Otherwise, search for "intoxicat" among causes A-D.

Stroke

- "stroke" OR "lacunar" OR "cerebral vascular infarction" OR "cerebral vascular event" OR "cerebrovascular event" OR "cerebral venous thrombosis" OR "cerebral atherosclero" OR "ischemic stoke" OR "cerebral infarction" OR "pca thrombosis" OR "cva"
- "hemorr" AND ("cerebral" OR "arachnoid" OR "crani" OR "cereb" OR "brain" OR "subdural")
- "cerebr" AND "vasc" AND "accident"
- "infarct " AND ("cere" OR "brain")
- "ischemi " AND ("brain" OR "cerebr" OR "stroke")

Suicide

- when the manner of death was **S – Suicide**
- youth were defined as those 10 to 17 (rather than 0 to 17 for other causes of death)

Traffic

- when the manner of death variable was: **A – Accident** or **C – undetermined** and injurydesc contained one of the following
  - "vehicle" OR " motor vehicle" OR "car/" OR "car /" OR "[[:space:]]car[[:space:]]" OR "[[:space:]]car$" OR "automobile" OR "suv" OR "[[:space:]]van[[:space:]]" OR "van/" OR "van$" OR "pickup" OR "[[:space:]]truck[[:space:]]" OR "truck/" OR "[[:space:]]truck$" OR "motorcycle" OR "motor cycle" OR "scooter" OR "moped" OR "collision" OR "crash" OR "driver" OR "passenger" OR "bicy" OR "bike" OR "pedest"

Unintentional Injury

- When the manner of death was **A – Accident**

Occupations

Death certificates record the decedent's "usual occupation" and "kind of business/industry".[2] Anonymized death certificate occupation and industry open text fields for working age adults (ages 16 to 64) were processed using the National Institute for Occupational Safety and Health Industry and Occupation Computerized Coding System (NIOCCS)[3] version 4 application programming interface (API). The NIOCCS API returned standardized Bureau of Labor Statistics (BLS) 2010 Standardized Occupational Classification (SOC)[4] codes. The 22 major civilian groups were further aggregated into 13 occupation categories (Table 1). These categories were informed by American Communities Survey (ACS) Table S2401[5] ("Occupation by Sex for the Civilian Employed Population 16 Years and Over") and occupation categories that were hypothesized to have been at higher risk for negative impacts due to mitigation measures.

The NIOCCS API also categorized individuals into the following non-civilian occupation categories: Homemaker (unpaid), Did Not Work (unpaid), Student (unpaid), Military (Rank Not Specified), Military (Non-Commissioned Officer and Other Enlisted Personnel), Military (Commissioned Officers and Warrant Officers), Retired (unpaid), Volunteer (unpaid), and Insufficient Information. When possible, occupation text fields that were coded 'Insufficient Information' were further categorized using regular expressions into the 13 civilian occupation categories listed above. The categories "Student (unpaid)" and "Homemaker (unpaid)" were used to create the 'Student' and 'Homemaker' occupations, respectively. Similarly, decedents whose occupation was coded as 'Did Not Work (unpaid)' and who had the regular expression 'disab' in the original occupation field, were categorized as 'People who were unable to work due to a disability'. The remaining categories (military, retired, and volunteer) and decedents with insufficient occupation information were removed from the analysis because they lacked a relevant denominator or were not common enough to perform meaningful analyses. Corresponding King County population denominators for rate calculations were estimated using the SOCP indicator in the ACS Public Use Microdata Sample for 2015-2019. The sole exception was the denominator for those who did not work due a disability. This was defined when the SOCP was missing and the DIS indicator was equal to 1.

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[2] https://www.cdc.gov/nchs/data/misc/hb_occup.pdf
[3] https://csams.cdc.gov/nioccs/
[4] https://www.bls.gov/soc/2010/2010_major_groups.htm
[5] https://data.census.gov/cedsci/table?q=S2401&tid=ACSST1Y2019.S2401&hidePreview=false

Table 1. Occupation categories used in this analysis

Custom Occupation Category	BLS SOC Major Title
Arts, Design, Entertainment, Sports, and Media	Arts, Design, Entertainment, Sports, and Media
Building and Grounds Cleaning and Maintenance	Building and Grounds Cleaning and Maintenance
Computer, Engineering, and Science	Computer and Mathematical
	Architecture and Engineering
	Life, Physical, and Social Science
Education, Legal, and Community Service	Community and Social Service
	Legal
	Educational Instruction and Library
Food Preparation and Serving Related	Food Preparation and Serving Related
Healthcare Practitioners and Technical	Healthcare Practitioners and Technical
Healthcare Support	Healthcare Support
Management, Business, and Financial	Management
	Business and Financial Operations
Natural Resources, Construction, and Maintenance	Farming, Fishing, and Forestry
	Construction and Extraction
	Installation, Maintenance, and Repair
Personal Care and Service	Personal Care and Service
Production, Transportation, and Material Moving	Production
	Transportation and Material Moving
Protective Service	Protective Service
Sales and Office	Sales and Related
	Office and Administrative Support

Race and Ethnicity

In these analyses, Hispanic is categorized as a race. All race categories are mutually exclusive for a single race, e.g., American Indian / Alaskan Native (AI/AN) is comprised of non-Hispanic AI/AN alone. Race and ethnicity reporting on death certificates is known to be problematic, with high accuracy for white and Black populations, high misclassification for AI/AN populations, and moderate misclassification for others. Multi-racial was excluded as a category due to a high degree of misclassification. Race and ethnicity are usually recorded by the funeral director (or equivalent) after consulting with the family of the decedent to determine what the decedent considered himself or herself to be. However, in cases where no family member or responsible party can be found or they are unwilling to provide this information, the funeral director may complete it based on his or her observation. In contrast, the race and ethnicity population denominators are based on forecasts using self-reported census designations. The difference in the manner that race and ethnicity are determined for the numerators (decedents) and denominators (population) could potentially bias some of the results in an unknown direction.

Rate & Ratio Calculations

We modeled death rates using Poisson regression models with the natural log of the population as the offset. Age-adjusted models included age as a natural cubic spline with three degrees of freedom. We

then used the R `prediction` package to calculate the average predicted rates and the `multcomp` package to calculate death rate ratios. We calculated 95% confidence intervals (the range of values that includes the true value 95% of the time) for each rate and ratio. Determination of whether the death rate ratio was statistically significantly above or below one was based on a 2-sided p-value < 0.05.

Rates and ratios for March 1 through December 31 and three-month rolling averages were calculated for all causes of death and the following sub-populations:

- **King County residents** as a whole
- **Ages:** 0-17, 18-24, 25-44, 45-64, 65-74, and 75+ (crude rates only)
- **Regions:** East, North, Seattle, South
- **Gender:** Female, Male
- **Race/Ethnicity:** American Indian/Alaska Native (AI/AN), Asian, Black, Hispanic, Native Hawaiian/Pacific Islander (NH/PI), and White.
- **Occupation:** All those listed in Table 1 above
- **Not Employed:** Not employed due to disability, Homemaker, and Student