Final Report: Scenario 2 - MPX in the EU

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Problem Statement

As the world begins to recover from the effects of COVID, the threat of the so-called monkeypox virus (MPX) has public health officials preparing for the worst. Throughout Europe (EU), cases of MPX have begun to rise, and it is imperative to understand the groups at the highest risk for infection. This report aims to prepare data to analyze and assess the impact of MPX within each country of the EU, understand how case rates may differ by region, and find potential links to various demographic factors. These findings will aid local health departments' implementation and appropriate response to the epidemic. Our team hypothesizes that MPX will be prevalent among young (under 30 years old) and older populations (over 64 years old), as is typical for many infectious diseases.

Methods

To prepare this report, use data sets for the EU, explicitly including information on confirmed cases of MPX per country (euro_mpx_cases.csv) and census data (euro_census_stats.csv). The trajectory of this investigation incorporated four sets of data manipulation: (1) Grouping countries into regions; (2) Assessing necessary census information; (3) Compiling data sets with confirmed case demographics; (4) Creating tables and figures for visual analysis. Countries were grouped by region based on a region's data set (world_country_regions.csv) to enhance the representation of positive cases per region. Within the euro_mpx_cases data set, relevant fields include country, country code, and confirmed cases. A curated demographic data set included information on age, sex, and the number of people per strata. As an aside with the census data, we chose to initially assess any "missing" data as "NA" when paired with a country. However then decided to print information with omit-NA's to allow aggregate fields to be added together for "Table 2: Population Demographic (Population Density) per Region."

Results

Table 1: Monkeypox Cases Per Region

EU Region	Total Cases Per Region	Total Region Population	Countries Per Region
Eastern Europe	277	89171711	6
Northern Europe	619	37518701	9
Southern Europe	7958	133879004	7
Western Asia	4	904705	1
Western Europe	8214	191156200	6

In Table 1, we see that the regions in EU include various numbers of countries, thus having unequal populations. A useful metric to create a graph will be the calculation of cases per 100,000. This will allow us to use one categorical variable (EU Region) to a quantitative variable (number of confirmed cases). We compiled the relevant confirmed case information per region in the EU.

Table 2: Population Demographic (Population Density) per Region

Population Density	Eastern Europe	Northern Europe	Southern Europe	Western Asia	Western Europe
0-1000	21845414	4078765	10828744	100108	18275152
1000-9999	38482389	3291039	9540330	347223	40061110
10000-99999	36341910	4258214	13558594	658119	36737503
100000-199999	9206192	907953	2742384	151685	6971412
200000-499999	11991996	1446276	1187451	0	6165607
500000-999999	3920072	0	2808341	0	3137928
GE1000000	11722690	3419166	0	0	14834499

Table 2 illustrates the strata of individuals living within each region of the EU by the population density of that region.

Table 3: Age Groups (Age Density) per Region

Age Group	Eastern Europe	Northern Europe	Southern Europe	Western Asia	Western Europe
Y_GE85	1303120	204697	567517	10727	2129852
Y_LT15	13709721	2152921	4146606	134948	15420065
Y15-29	27810686	3530159	7538024	296079	25514710
Y30-49	47872417	6085532	15260777	465420	44271978
Y50-64	29165938	3770713	8305051	244311	25964808
Y65-84	13648781	1657391	4847869	105650	12881798

Table 3 summarizes the region demographics by age using data that provides information by region based on age in specific brackets.

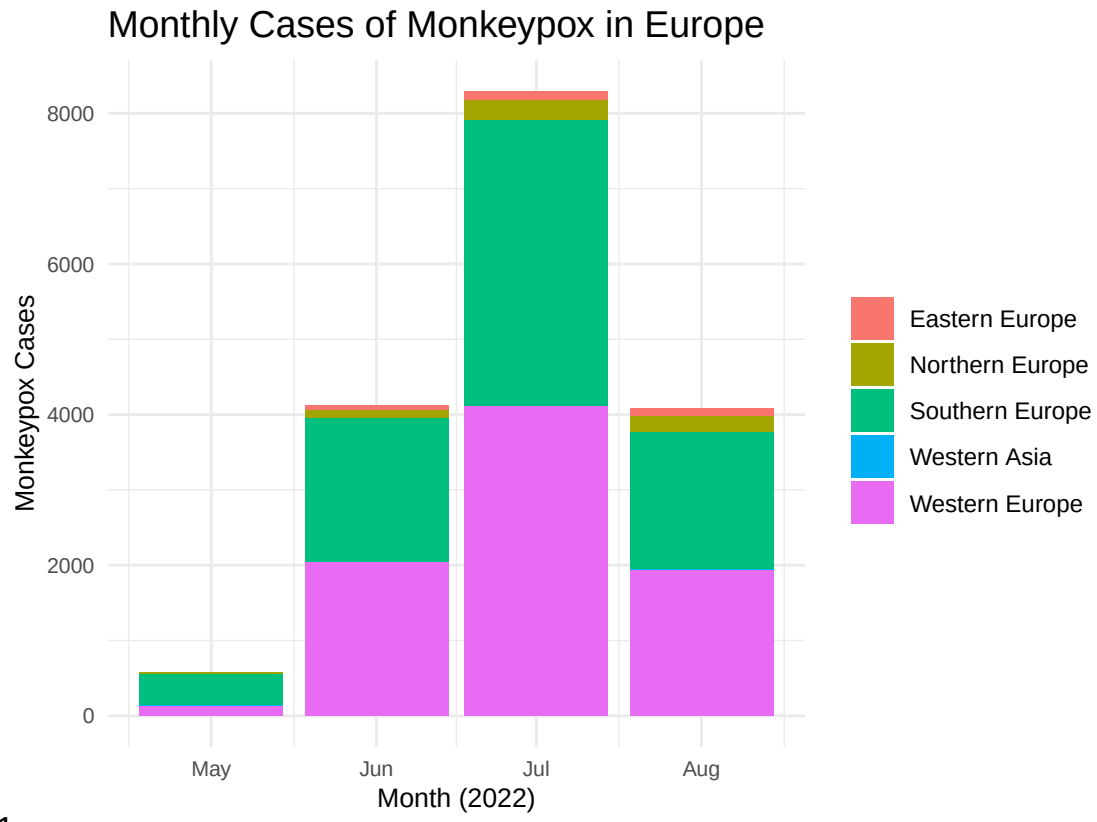

Figure 1

In the bar graph (Fig. 1) above we see the breakdown of monthly MPX infections in Europe between May and August of this year. The majority of cases occurred in Western Europe and Southern Europe as evidenced by the respectively colored purple and green regions in the bar graph. Over the course of 4 months, the total number of MPX cases by region were Western Asia = 4, Eastern Europe = 277, Northern Europe = 619, Southern Europe = 7958, and Western Europe = 8214

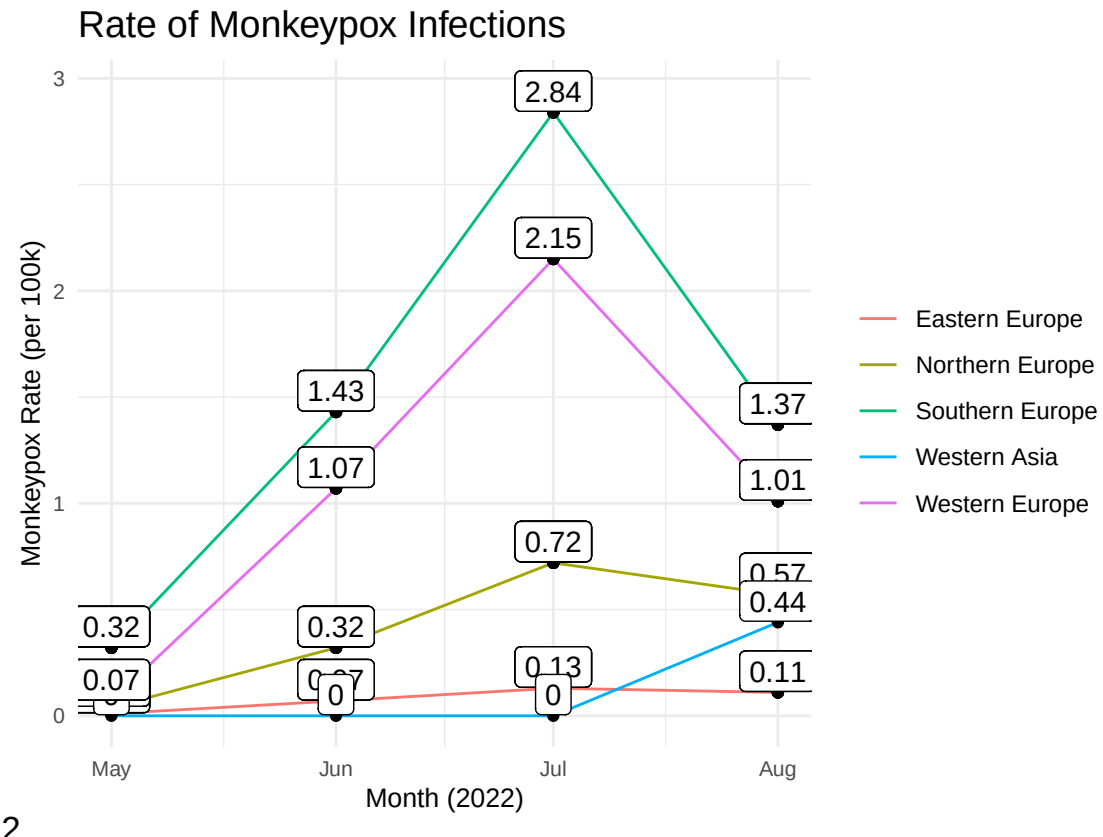

Figure 2

As a follow up to the bar graph (Fig. 1) above, we wanted to look at the rate of MPX infections per region. In the bar graph above, Western Europe had the greatest number of MPX infections however when we look at the rate of infections (Fig. 2), we see that over the course of the four months, Southern Europe had the greatest rate of infection with a peak of 2.84 MPX cases per 100,000 people in the month of July.

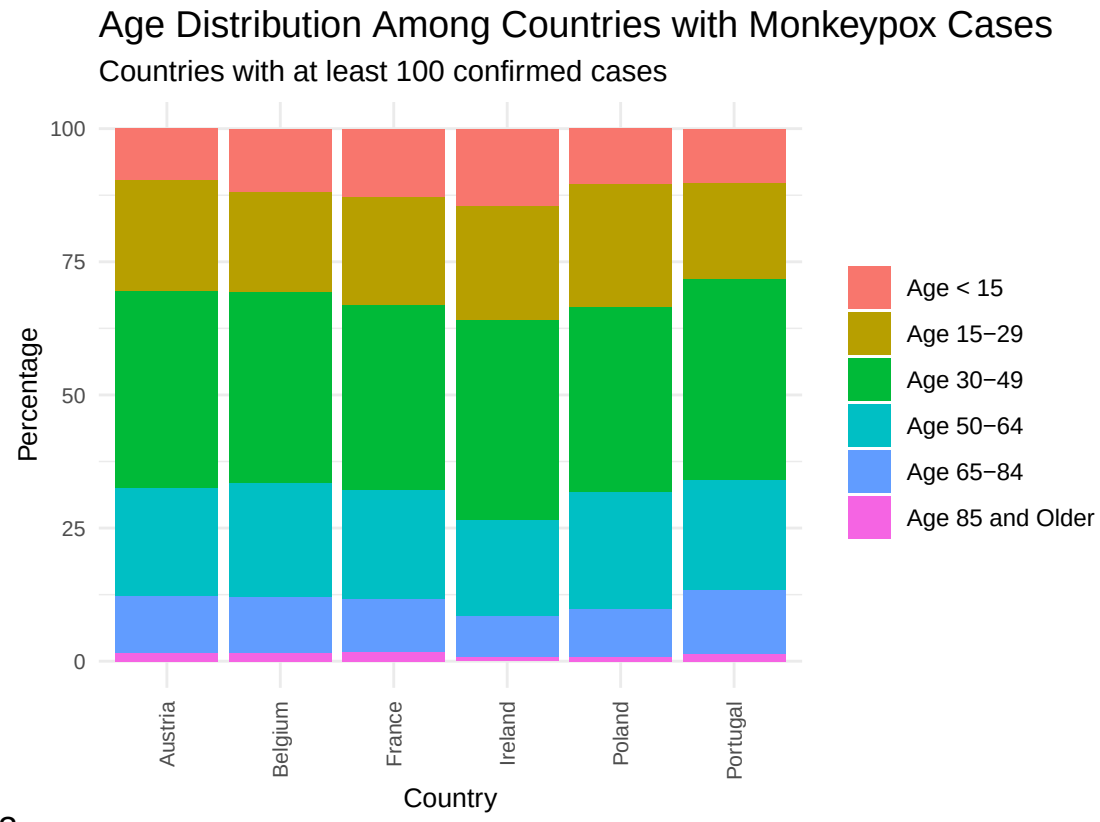

Figure 3

Figure 3 includes countries that experience at least 100 cases of MPX. The figure parameters include stacked bar graphs that visually represent the age brackets from which a positive case is observed. The 30-49 age range is observed to have more positive cases across each country than any of the other age brackets. Given the consistency within this observation, the investigators may find that countries with populations with thriving numbers of 30-49-year-old's are affected more by MPX than regions that do not. Moreover, the countries listed in this figure are predominantly within the Western Region of Europe; Western Europe includes six countries.

Discussion

Our analysis of Table 1 and Figure 1 reveal the impacted regions for MPX though the study period (May through August 2022) occurred in the Southern and Western Regions of Europe. Within the EU, these two regions comprise 13 of its 29 total countries, roughly 71.8% of the total EU population (extrapolated using Table 1).

Through empirical analysis in Figure 3, we are not confident of the initial hypothesis regarding younger (under 30 years old) and older (over 64 years old) populations having a higher risk of infection. We observe that the age group for 30-64-year-olds (broken into two categories of 30-49 and 50-64 years) contributes over 50% of MPX cases in countries with a minimum of 100 confirmed MPX cases (six countries from the 29 countries in the EU). Given that the 30-64 age group appears to burden more patients than those below 29 years old and above 64 years old for all six of the countries that have 100+ MPX cases, we believe that the expansion of this finding will be evident throughout the remaining 23 countries in the EU.

Given the analysis of this information, health department leadership should begin educational programs and outreach focusing on those 30-64 aged individuals.