

# “Heat Mapping” of Pediatric and Adolescent Gun Violence in an Urban Center: Is Targeted Intervention One Possible Solution?

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Figure 1. Heat Mapping of Gun Violence in Philadelphia in 2016 (left; n=99) and 2022 (right; n=217)

**Introduction:** Firearm violence ranks among the leading causes of death and injury in children under the age of 18y in the United States<sup>1</sup>, with striking increases since the onset of the COVID-19 pandemic, especially in urban centers. The American Academy of Pediatrics, and others, have proposed numerous gun violence prevention strategies with no consensus on the optimal approach. While gun injuries are seen throughout urban areas, victims tend to cluster in specific geospatial locations or “hot spots”. Identification and analysis of these “hot spots” may direct targeted strategies to decrease gun violence amongst children and adolescents.

**Material and Methods:** Utilizing data from OpenDataPhilly ([opendataphilly.org](https://opendataphilly.org)), an online repository of geospatial datasets maintained by Philadelphia government agencies, gunshot wounds (GSWs) in victims younger than 18y were analyzed from 2016-2022. Data analysis included victim age, sex, and address where the GSW occurred. Using Maply ([maply.com](https://maply.com)), geographic mapping software that extracts data from Excel spreadsheets, latitude and longitude

points for each shooting site were mapped and converted to a heat map, in which progression from green to yellow to red indicates increasing frequency. Zip code maps were overlaid on the heat maps to further define these geospatial locations.

**Results:** From 2016-2022, a total of 1063 children (ages 0-12y) and adolescents (ages 13-17y) sustained GSWs in the city of Philadelphia, an average of 152 GSWs/year with an average age of 15y; children averaged 14 GSWs/per year while adolescents had 138 GSWs/year. Gun-related injuries in both children and adolescents increased dramatically over the study period, with child injuries increasing 64% and adolescent injuries increasing 126%. The largest one-year total increase occurred from 2019 to 2020 (correlated with the COVID-19 pandemic's arrival), a total change of 66%, with children and adolescents experiencing a 38% and 70% increase, respectively. The heat maps created from the yearly data show that the majority of pediatric GSWs in each year occurred in a cluster of zip codes and that these zip codes had the most increases in GSWs over the study period. During 2020, with pandemic restrictions in place, additional zip codes became "hot spots" and remained high density shooting zip codes for the subsequent years.

**Conclusion:** The incidence of pediatric gun violence has increased 120% in Philadelphia from 2016 to 2022, with increases seen in both age categories (child: 64% and adolescent: 126%). Heat map analysis indicates that overall GSWs occurred mostly in the same geospatial locations/zip codes ("hot spots"), and that, beginning in 2020, the frequency of GSWs in these "hot spots" increased dramatically and spread to other areas. Detailed study of these "hot spots" is needed to identify factors associated with gun violence, potentially making targeted intervention strategies more effective generalized programs of gun injury prevention.

## References:

1. Bailey, J. A., Jacovides, C. L., Butler, D., Bass, G. A., Seamon, M. J., Cannon, J., & Martin, N. D. (2023). Adolescent Gun Violence Shows an Age Group to Focus Trauma Prevention. *Journal of Surgical Research*, 283, 853–857. <https://doi.org/10.1016/j.jss.2022.10.011>