

# Invisible No More: The Chiara Project's US-Mexico geospatial analysis of violence and service access for women

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**Abstract—** The [Chiara Project](#) is a binational data initiative developed by the [Metabolism of Cities Living Lab](#) at San Diego State University (SDSU) and Universidad Autónoma de Baja California (UABC) to expose and address the often-invisible violence faced by women in the U.S.-Mexico border regions, particularly between San Diego and Tijuana. Using community-driven, open-source geospatial dashboards, the project visualizes patterns of gender-based violence, health disparities, and institutional neglect. Comparative analyses reveal moderate associations between violence against women and service density in San Diego (healthcare, alcohol outlets, shelters), and much stronger associations between crime rates and service concentration in Tijuana. By integrating mapping and storytelling, the Chiara platform empowers communities, informs cross-border policy, and highlights the urgent need for safer, more equitable urban environments. This study illustrates how data justice and geospatial innovation can support advocacy, prevention, and collaborative governance in borderlands.

**Keywords:** US-Mexico border, women, violence, equity, geospatial

## I. INTRODUCTION

Women living along the U.S.–Mexico border, particularly in regions like San Diego and Tijuana, face heightened risks of gender-based violence, including sexual assault, trafficking, and institutional neglect. Despite the severity of these threats, this violence often

remains invisible in public datasets and policymaking, reinforcing cycles of marginalization. Digital transformation, particularly the use of geospatial tools and interactive dashboards, has emerged as a crucial strategy to improve transparency and enhance the visibility of gender-based violence [1]. The Chiara Project, a binational initiative developed by the Metabolism of Cities Living Lab, at SDSU and UABC seeks to disrupt this invisibility through community-based data collection and open-access geospatial dashboards. By centering the lived experiences of women, the project uses digital storytelling and spatial data to advocate for health equity, safety, and social justice across the borderlands. This paper explores and visualizes patterns of violence and inequality through a trauma-informed, ethical framework, and contributes to a growing body of research that emphasizes the importance of feminist urbanism, critical cartography, and community data sovereignty [2,3,4].

This project also exemplifies digital transformation within the social and urban landscape. By integrating emerging technologies such as geospatial dashboards, through digital storytelling, it redefines how data is accessed, interpreted, and mobilized for collective well-being. These digital tools not only modernize systems of monitoring and reporting but also democratize information, empowering communities through open-access platforms and intuitive visualizations that support informed decision-making and localized advocacy [5].

## II. LITERATURE REVIEW

Recent research explores gender-based violence in border regions and digital environments, underscoring its multidimensional nature and the structural inequalities that perpetuate it [6,7]. The COVID-19 pandemic has exacerbated preexisting vulnerabilities, shifting some forms of violence into virtual spaces, and highlighting the need for intersectional and decolonial frameworks that address the realities of Indigenous and marginalized women [8,9,10]. Scholars have emphasized that conventional data systems and urban planning mechanisms often fail to reflect the lived experiences of women, thereby perpetuating their invisibility in research and policy [11]. In response, feminist urbanism and critical cartography offer alternative models that center marginalized voices and challenge dominant spatial narratives [12].

Border regions like the U.S.–Mexico corridors are shaped by complex social, economic, and political forces that intensify vulnerabilities for women, particularly in the context of gender-based violence [13,14]. Scholars have noted that conventional data systems and urban planning mechanisms often fail to capture these lived realities, thereby perpetuating invisibility in both research and policy [15].

Feminist urbanism and critical cartography provide alternative frameworks for understanding spatial justice and power. These approaches challenge dominant narratives in geography and advocate for inclusive, participatory knowledge creation that centers marginalized voices [4]. At the heart of this work is the recognition that data and maps are not neutral, they reflect and reproduce power structures unless intentionally reimagined.

Recent work on data justice and community data sovereignty emphasizes the importance of local ownership and ethical governance of data, especially for vulnerable communities [15]. In this context, interactive geospatial dashboards are increasingly valued for their capacity to democratize data, support public engagement, and inform policy through accessible, real-time visualization [16,17]. The Chiara Project builds on these theoretical foundations to document and advocate for women’s rights across the San Diego–Tijuana borderlands.

### III. METHODS

The Chiara Project utilized a mixed-methods, binational approach that integrates spatial analysis, participatory research, and digital storytelling to expose patterns of violence against women in San Diego, California, and Tijuana, Mexico (see Figure 1). Data were gathered from open-source platforms, public records, community reports, and partnerships with

shelters and advocacy organizations. Geospatial tools such as ArcGIS Online and ESRI Dashboards were used to process, analyze, and visualize this data. A hotspot analysis identified areas with high concentrations of violence or limited access to services. To explore inter-city patterns and correlations, we compared variables such as incidence of gender-based violence, healthcare access, and proximity to shelters.

The interactive dashboards for Mexico and USA were developed bilingually (English and Spanish) and publicly shared to promote transparency, accessibility, and advocacy across borders. Additionally, statistical comparisons were performed between San Diego, California, and Tijuana, Baja California, to assess spatial disparities in urban infrastructure, healthcare access, and safety indicators (see Table 1). The study focused on variables such as reported violence, health outcomes, and proximity to services.

For the region of Tijuana, Mexico the study evaluated and visualized the relationships among key urban infrastructure indicators, including the availability of supermarkets and food stores, domestic violence shelters for women, maternal care centers, health care facilities, mental health service providers, and childcare centers within the border municipalities of Tijuana, Baja California in Mexico (*i.e.*, *Supermercados y Negocios de compra de Cerveza y Tabaco, Refugios Para Mujeres escapando de la Violencia Doméstica, Centros de Cuidado Materno, Centros de Cuidado Infantil, Centros de Salud, y Centros de Profesionales de Salud Mental*).

For the region of San Diego, California, USA the analysis was subsequently extended to adjacent cross-border regions in San Diego County, emphasizing variables such as mental health facilities, domestic violence shelters, food and liquor outlets, childcare centers, and health centers. Correlations were assessed with respect to reported violence, health outcomes, and the spatial proximity to essential social and healthcare services.

The methodological design emphasizes transparency, accessibility, and binational comparability to support data-driven advocacy and cross-border collaboration in addressing gender-based violence and urban inequality.



**Figure 1.** San Diego, CA and Tijuana, Mexico[18].

#### IV. RESULTS

The Chiara Project's geospatial analysis identified violence hotspots along the San Diego–Tijuana border, particularly in Tijuana's peripheral and rural areas with limited access to essential services. The study found a strong inverse correlation between the availability of service infrastructure and the incidence of gender-based violence, confirmed through Pearson correlation analysis of socioeconomic variables linked to women's support centers.

Table 1. Pearson correlation coefficients between Violence Against Women Index and selected community indicators in San Diego County

Variable	Pearson	Interpretation
Child care centers	0.213	Weak positive correlation
Domestic violence shelters	0.291	Weak-to-moderate positive correlation
Food and liquor businesses	0.346	Moderate positive correlation
Health care services	0.481	Moderate and statistically significant positive correlation
Mental health services	-0.048	No significant correlation

Pearson correlation analysis showed that the Violence Against Women Index had its strongest association with health care service density ( $r = 0.481$ ), likely reflecting higher detection and reporting rates in urban areas rather than a causal link. Moderate positive correlations were observed with alcohol-serving establishments ( $r = 0.346$ ) and domestic violence shelters ( $r = 0.291$ ), suggesting that both tend to cluster in areas with higher reported violence due to population density and institutional response. A weak positive correlation with child care centers ( $r = 0.213$ ) may indicate overlap with vulnerable families, while no significant relationship was found for mental health services ( $r = -0.048$ ), likely due to limited coverage or data integration.

The analysis of that though the set of indicators performed highlighted the presence of several inequalities and issues among the borders. The use of interactive dashboards supported the identification of patterns of violence and crimes as well of the exploitation of health centers.

**A. Chiara Us-Mexico Dashboards.** The Chiara dashboards visualize hidden cross-border patterns of gender-based violence and health disparities, empowering data-driven advocacy and policy reform.

**B. Chiara San Diego, Ca, Us Dashboards.** The San Diego, CA (USA) dashboards shown in Figure 2 reveal overlapping vulnerabilities affecting women. Many

border-area neighborhoods have higher percentages of women who often rely on community and free clinics for healthcare. Missing person data highlight the vulnerability of young Hispanic and Black women (ages 13–17), with cases concentrated in central San Diego neighborhoods, while SNAP participation and food access gaps reveal socioeconomic disparities, especially in border areas like Otay Mesa and San Ysidro.

Figure 2 maps SNAP participation and food retailers, revealing high SNAP rates in central and coastal San Diego and significant grocery access gaps in border areas like Otay Mesa and San Ysidro.

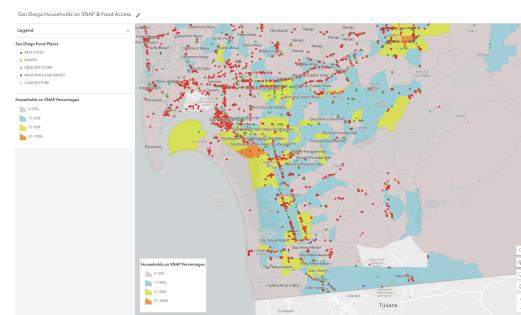


Figure 2. San Diego County household on SNAP and food access dashboard [21,22,23].

Figure 3 uses census data to show areas in San Diego County with higher percentages of women by census tract, alongside the distribution of healthcare facilities. It highlights that in neighborhoods near the border, where female populations are higher, residents rely more on community and free clinics for healthcare access.

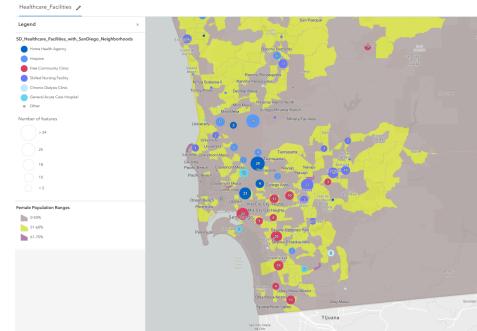


Figure 3. San Diego County healthcare facilities and women population dashboard [24,25,26].

Figure 4 shows San Diego County missing person data, showing that the most affected group is young women aged 13–17, primarily Hispanic and Black. Concentrations are seen in neighborhoods like Kearny Mesa, Downtown San Diego, Encanto, and Logan Heights.

Figure 5 shows the San Diego Domestic Violence the Dashboard reveals the City of San Diego accounts for the highest number of domestic violence (red) reports (39.86%), followed by Chula Vista, Oceanside, Escondido, and El Cajon. The top zip codes include downtown San Diego (92101) and areas in Chula Vista, City Heights/Oak Park, and El Cajon. Most incidents involve simple assault and are reported primarily by Hispanic (32.85%) and White women (34.49%). There is a noticeable concentration of reports near downtown San Diego and Chula Vista. While shelters exist in San Diego County, many do not publicly share their locations for safety reasons, though online resources are available.

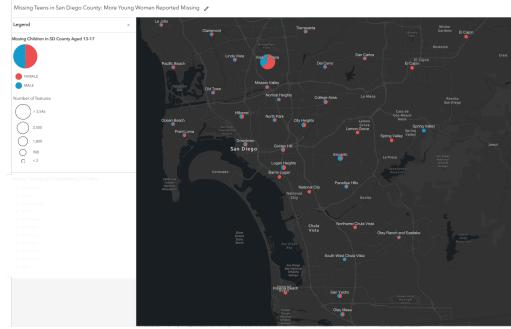


Figure 4. San Diego County missing young women [dashboard](#) [27].

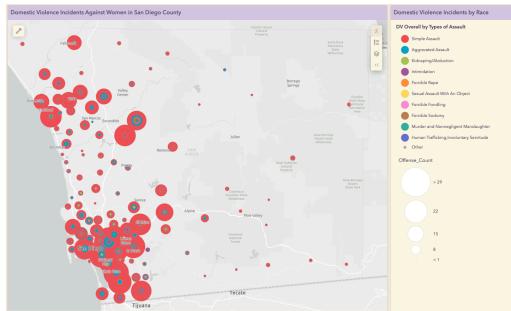


Figure 5. San Diego County domestic violence by incident [dashboard](#) [28,29,30,31].

Figure 6 shows the crime and safety dashboard shows that San Diego leads in reports of crimes against women (41.74%), followed by Chula Vista, Oceanside, Escondido, and El Cajon. The top zip codes for these reports include downtown San Diego (92101), Lincoln Acres (91950), Mid-City/Rollando Park (92115), Mira Mesa (92126), and Oceanside (92054). Excluding domestic violence, simple assault is the most commonly reported crime. The highest concentration of reports is found in the downtown San Diego area, indicating a geographic hotspot for crimes against women.

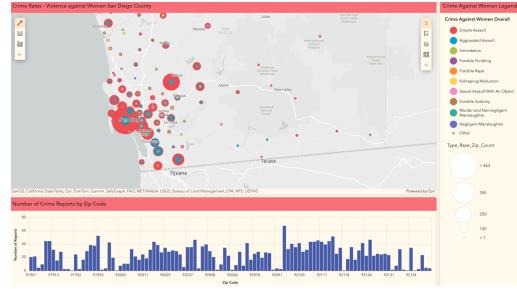


Figure 6. San Diego County crimes against women by incident [dashboard](#) [31].

Figure 7 the Mental Health Facilities Dashboard shows that most facilities are located in San Diego (37.14%), followed by Vista, La Mesa, Escondido, and El Cajon. In-person mental health services are more concentrated in the western part of the county, particularly between downtown San Diego and East County. However, facilities are limited further east, with few or none beyond Alpine. This highlights a geographic gap in access to mental health services in the eastern regions of the county.

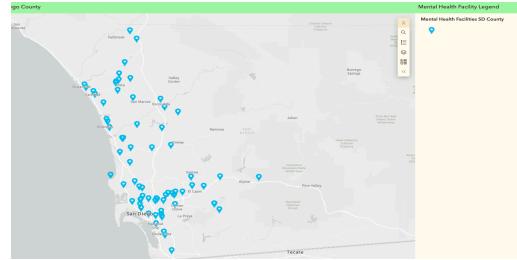


Figure 7. San Diego County mental health facility locations [dashboard](#) [32].

Figure 8 the Sanitation and Water Access Dashboard reveals that 58.67% of facilities are not at risk for unsafe drinking water, while 9.33% are potentially at risk and 14.67% are at risk. Julian has the highest number of at-risk facilities (3), followed by Campo and Encinitas (2 each). The dashboards highlight that most water testing occurs in mountainous regions, where results are largely safe. However, several facilities near the eastern county and U.S.–Mexico borders are flagged as at risk or potentially at risk, posing concerns as these sites provide drinking water to hundreds of residents.

**b. Chiara Tijuana, Mexico dashboards** The Tijuana, Mexico dashboards visualize the spatial distribution of the female population in peri-urban areas of Tijuana, particularly in the eastern, south-central, and west-coastal regions. These include neighborhoods such as Parajes del Valle, Ejido Morelos, El Refugio, Desarrollo Natura, Lomas Virreyes, Granjas del Sol, Real del Mar, and Punta Bandera.



Figure 8. San Diego County sanitation and water access dashboard [33].

A significant concentration of health resources is observed in areas with established urban infrastructure and proximity to major roadways. Central regions, including Zona Río, Libertad, and Mirador, appear to be better served due to their integration within the urban core and accessibility. In contrast, peripheral and semi-rural regions demonstrate lower service density. The data suggest that accessibility to services increases as proximity to central urban areas improves (Figure 10).

According to INEGI's ENDIREH data (Figure 9), gender-based violence remains a serious issue across Baja California, with Tijuana reporting the highest rates of physical, sexual, and psychological violence, including intimidation and human trafficking. Mexicali and Ensenada follow with significant figures, while Playas de Rosarito and Tecate register fewer but still notable cases. The overlap between high violence levels and underserved peripheral zones highlights the compounded vulnerability of women in semi-urban and isolated areas, emphasizing the need to address infrastructural inequities and gendered safety in regional planning [35].

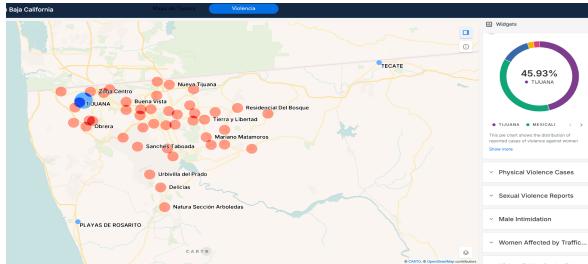


Figure 9. Women violence and crime in Baja California, Mexico region [dashboard](#) [34,35].

Figure 10 shows the spatial distribution of mental health and resource accessibility in Tijuana, highlighting that essential services—such as supermarkets, women's shelters, health clinics, daycare centers, and migrant shelters—are concentrated in specific central and coastal zones near the U.S. border, leaving peripheral neighborhoods underserved. Although these outlying areas often have higher proportions of women, they face

limited access to key resources. To promote equity and inclusion, the study recommends directing more resources toward these marginalized regions to achieve a more balanced territorial distribution of services.



Figure 10. Tijuana, Mexico mental health and resource accessibility [dashboard](#) [36,37].

**C. Comparative Quantitative Results: San Diego County and Tijuana.** The comparison between San Diego County and Tijuana shows that both cities face high levels of violence or crime in areas of extreme poverty, which coincide with high concentrations of population, services, and institutional accessibility. In San Diego, weak to moderate correlations link violence against women with the density of health services ( $\approx 0.48$ ), food and liquor outlets ( $\approx 0.35$ ), and shelters ( $\approx 0.29$ ), while mental health services show almost no association.

In Tijuana, the relationship between crime and services per 1,000 inhabitants is much stronger, with high Spearman (0.863), Kendall (0.701), partial Pearson ( $\approx 0.980$ ), and distance correlation (0.911) coefficients, and a linear model explaining 96% of variance ( $R^2 \approx 0.96$ ). Regression results indicate significant effects from child care centers ( $\beta \approx 11.65$ ), maternal care facilities ( $\beta \approx 3.01$ ), and supermarkets ( $\beta \approx 1.01$ ), revealing crime concentration around family and commercial zones. These findings call for cautious interpretation—correlation does not imply causation—and emphasize the need for refined models that consider population offsets, spatial dependence, and contextual factors like land use, mobility, lighting, and institutional presence, ensuring responsible communication to avoid stigmatization.

## V. CONCLUSION

The Chiara Project: This case study illustrates how interactive geospatial dashboards inspired by the principles of data justice/community data sovereignty can help increase gender-based violence (GBV) visibility and related service access in border regions like San Diego–Tijuana.

The findings suggest that the violence against women in San Diego County and general crime in Tijuana are spatially related to local services and urban activity centers. In San Diego, relationships are moderate in

strength—strongest with healthcare services and alcohol-related businesses, followed by domestic violence shelters—and decidedly stronger among general crime types in Tijuana. The Tijuana-based regression models highlight the role of childcare centers, maternal care facilities, and food outlets, as occurs in dense areas with family and commercial activity. These dashboards serve two purposes: they facilitate community-led geospatial analysis in order to render hidden forms of violence visible and supply comparative cross-border insights grounded in rigorous data. Unique engagement patterns indicate that the Tijuana platform had more reporting and continued use, implying the significance of this intervention in resource-constrained settings. The project provides methodological and practical resources for the prevention of violence in that it aids in capacity-building for communities through data-informed advocacy leading to sustained infrastructure at the border crossing a more secure and equitable global boundary.

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